TECHNICAL DATA
ELECTRON TUBES



PUBLISHED BY
TUNG-SOL
ELECTRIC INC.

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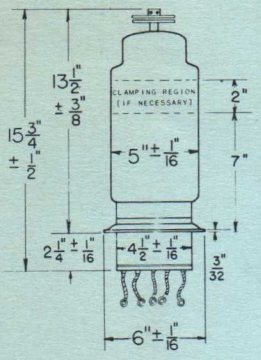
THYRATRON

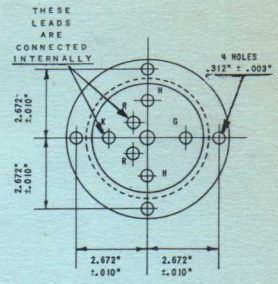


GLASS BULB

HEATER

AC OR DC

VERTICAL MOUNTING POSITION
(BASE DOWN)



BOTTOM VIEW

THE 5948 IS A THREE ELECTRODE, HYDROGEN FILLED, ZERO BIAS THYRATRON DESIGNED FOR THE GENERATION OF HIGH POWER PULSES. THE PRIMARY APPLICATION OF THE TUBE IS IN HIGH POWER, HIGH VOLTAGE RADAR MUDULATORS. THE 5948 IS CAPABLE OF SUPPLYING 12 MEGAWATT PULSES IN THIS SERVICE. AN INTERNAL HYDROGEN RESERVOIR PROMOTES LONG LIFE AND PERMITS OPTIMUM PRESSURE ADJUSTMENT FOR VARIOUS CONDITIONS OF OPERATION. THE CATHODE IS UNIPOTENTIAL AND IS CONNECTED TO THE ELECTRICAL CENTER OF THE CATHODE HEATER CIRCUIT IN ORDER TO MINIMIZE TIME JITTER.

FIRM ELECTRICAL CONNECTIONS ARE MADE TO THE CATHODE HEATERS, GRID AND RESERVOIR BY MEANS OF FLEXIBLE CABLES FITTED WITH LUGS. THE TUBE IS RIGIDLY SUPPORTED BY A BASE WITH A FLANGE CONTAINING BOLT HOLES.

ELECTRICAL DATA

	SYMBOL	MIN.	BOGEY	MAX.	
HEATER VOLTAGE	Ef	5.83	6.3	6.77	VOLTS
HEATER CURRENT (WITH BOGIE HEATER AND RESERVOIR VOLTAGE)	If	25	29	33	AMPS.
CATHODE HEATING TIME	tk	15			MINUTES
RESERVOIR VOLTAGE (SEE APPLICATION NOTES)	Eres	2.5	MARKED ON BASE	5.5	VOLTS
RESERVOIR CURRENT	Ires			11.0	AMPS.
RESERVOIR HEATING TIME	tres	15			MINUTES
ANODE VOLTAGE DROP	etd	100	200	400	VOLTS

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MECHANICAL DATA

TYPE OF COOLING	CONVECTION
(FORCED AIR COOLING ACROSS THE RADIATOR IS RECOMMENDED FOR MAXIMUM TUBE LIFE)	
MOUNTING POSITION	VERTICAL, BASE DOWN
MAXIMUM NET WEIGHT	4 LBS., 10 OZ.
DIMENSIONS:	SEE OUTLINE DRAWING

RATINGS

ABSOLUTE VALUES

	SYMBOL	MIN.	MAX.	
PEAK ANODE VOLTAGE				
INVERSE (NOTE 1)	epx	5% epy	25	KVOLTS
FORWARD (SEE APPLICATION NOTES FOR STARTING PROCEDURE)	epy	10	25	KVOLTS
CATHODE CURRENT				
PEAK	ib		1000	AMPS.
AVERAGE	ib		1	AMPS.
RMS (FOR SQUARE PULSE APPLICATIONS $I_p = \sqrt{I_b \times ib}$)	I_p		33	AMPS.
DC ANODE VOLTAGE	Ebb	5.0		KVOLTS
OPERATING FREQUENCY (THIS IS NOT NECESSARILY THE UPPER OPERATING FREQUENCY LIMIT OF THE 5948 BUT REPRESENTS THE HIGHEST REPETITION RATE EXTENSIVELY LIFE TESTED TO DATE.)	prr		1500	CPS
PEAK GRID VOLTAGE (NOTE 2)	egy	700	1800	VOLTS
PEAK INVERSE GRID VOLTAGE	egx		650	VOLTS
GRID PULSE RISE TIME (NOTE 5)	tr		0.35	μSEC.
GRID PULSE WIDTH AT 70.7% POINT		2.0		μSEC.
HEATING FACTOR (epy X ib X prr. SEE PAGE 3)	Pb		9×10^9	
CURRENT RATE OF RISE (NOTE 5)			5000	AMP/μSEC.
ANODE DELAY TIME (NOTE 3)	tad		1.0	μSEC.
TIME JITTER (NOTE 4)	tj		0.01	μSEC.
AMBIENT TEMPERATURE	TA	-55	+75	°C

NOTES

1: IN PULSED OPERATION, THE PEAK INVERSE VOLTAGE, EXCLUSIVE OF A SPIKE OF 0.05μSEC. MAXIMUM DURATION, SHALL NOT EXCEED 5.0 KILOVOLTS DURING THE FIRST 25μSEC. FOLLOWING THE ANODE PULSE.

2: THE GRID DRIVE REQUIREMENTS OF A 5948 CHANGE CONSIDERABLY DURING THE FIRST FEW MINUTES OF TUBE OPERATION. IN ORDER TO RELIABLY TRIGGER A COLD TUBE, THE GRID PULSE VOLTAGE AND DURATION AND THE GRID CIRCUIT IMPEDANCE SHOULD BE CHOSEN ACCORDING TO THE LIMITING CURVES.

3: ANODE DELAY TIME IS DEFINED AS THE TIME INTERVAL BETWEEN THE POINT ON THE RISING PORTION OF THE GRID VOLTAGE PULSE WHICH IS 26 PERCENT OF THE MAXIMUM UNLOADED PULSE AMPLITUDE AND THE POINT WHERE ANODE CONDUCTION TAKES PLACE.

4: TIME JITTER IS MEASURED AT 50 PERCENT OF THE PULSE AMPLITUDE AFTER THE TUBE HAS BEEN OPERATING FOR AT LEAST 60 SECONDS. THE LIMIT OF 0.01 μSEC. SHOWN IS THE MAXIMUM ALLOWABLE UNDER SPECIFIED UNFAVORABLE OPERATING CONDITIONS. WITH SUFFICIENT GRID DRIVE AND WITH ANODE VOLTAGES OF 15 KV AND ABOVE, JITTER NOT EXCEEDING 0.005 μSEC. CAN BE EASILY ACHIEVED.

5: MEASUREMENT MADE BETWEEN 26% AND 70.7% POINTS.

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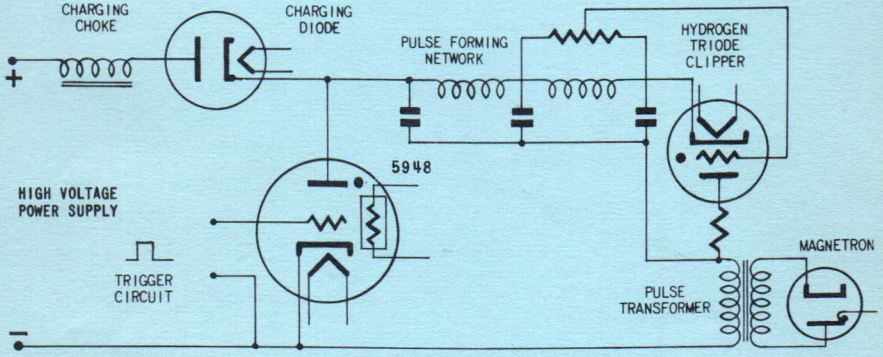
APPLICATION NOTES

THE 5948 HYDROGEN THYRATRON IS DESIGNED PRIMARILY FOR USE IN HIGH POWER RADAR MODULATOR SERVICE. A BASIC CIRCUIT FOR SUCH SERVICE IS ILLUSTRATED BELOW. IN SUCH A CIRCUIT, THE HYDROGEN THYRATRON SERVES AS A SWITCH TO RELEASE INTO THE MAGNATRON OR OTHER RADIO FREQUENCY GENERATOR, THE ENERGY STORED IN THE PULSE FORMING NETWORK. THE 5948 IS ADMIRABLY SUITED FOR SUCH SERVICE BY ITS ABILITY TO HOLD OFF HIGH VOLTAGE, AND TO PASS HIGH PEAK CURRENTS WITH RELATIVELY LOW TUBE VOLTAGE DROP. THE TUBE WILL OPERATE OVER A WIDE RANGE OF PULSE REPETITION RATES, PULSE WIDTHS AND PEAK CURRENTS, THUS PROVIDING A VERY FLEXIBLE CIRCUIT ELEMENT. TRIGGERING REQUIREMENTS ARE SIMPLIFIED SINCE THE TUBE OPERATES WITH ZERO BIAS.



THE 5948 CONTAINS A HYDROGEN RESERVOIR THAT MAINTAINS THE GAS PRESSURE WITHIN THE TUBE IN ACCORDANCE WITH THE VOLTAGE IMPRESSED ACROSS IT. SINCE THE RESERVOIR CAN HOLD MANY TUBE VOLUMES OF GAS, LONG TUBE LIFE IS INSURED. IN ADDITION IT IS POSSIBLE TO SET THE GAS PRESSURE AT THE OPTIMUM VALUE FOR ANY PARTICULAR SET OF OPERATING CONDITIONS. THE RESERVOIR HEATER VOLTAGE STAMPED ON THE TUBE BASE HAS BEEN DETERMINED FOR A PARTICULAR SET OF CONDITIONS SOMEWHAT BEYOND THE MAXIMUM TUBE RATINGS AND WILL BE SATISFACTORY FOR MOST APPLICATIONS. IN GENERAL, IT IS DESIRABLE TO OPERATE AT AS HIGH A RESERVOIR VOLTAGE AS POSSIBLE WITHOUT OBTAINING SPURIOUS DISCHARGES IN THE GRID–ANODE REGION. WHEN THE 5948 IS OPERATED AT OR NEAR MAXIMUM RATINGS, THE RESERVOIR VOLTAGE REGULATION SHOULD NOT EXCEED ±2.5%. IF THE 5948 IS OPERATED AT REDUCED DUTY A WIDER RESERVOIR OPERATING RANGE CAN BE EXPECTED. HOWEVER, CARE SHOULD BE TAKEN WHEN DETERMINING THE RESERVOIR VOLTAGE TO INSURE SATISFACTORY OPERATION WITH THE ANTICIPATED RESERVOIR VOLTAGE REGULATION. UNDER NO CIRCUMSTANCES SHOULD THE RESERVOIR VOLTAGE BE REDUCED TO SUCH AN EXTENT THAT THE ANODE SHOWS COLOR.

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APPLICATION NOTES —CONT'D.

THE INSTANTANEOUS APPLICATION OF ANODE VOLTAGE (INSTANTANEOUS STARTING OR "SLAP ON") IS NOT RECOMMENDED. WHEN IT IS ABSOLUTELY NECESSARY, THE MAXIMUM PERMISSIBLE EPY IS 18 KV AND THIS VALUE SHALL NOT BE ATTAINED IN LESS THAN 0.04 SEC. FOR INITIAL APPLICATION OF MAXIMUM RATED ANODE VOLTAGE, IT IS RECOMMENDED THAT THE FOLLOWING STARTING METHODE BE USED:

APPLY NO MORE THAN 18 KV EPY INITIALLY.
DO NOT INCREASE IN STEPS GREATER THAN 5 KV PER MINUTE.

TYPICAL OPERATION

VARIATIONS IN THE OPERATING PARAMETERS AFFECT THE LIFE EXPECTANCY OF HYDROGEN THYRATRONS; THEREFORE, A SIMPLE METHOD OF RATING FOR ALL CONDITIONS IS DIFFICULT. UNTIL SUCH TIME AS SUFFICIENT INFORMATION IS AVAILABLE TO PREPARE COMPLETE OPERATION RATING CHARTS, WE LIST THE FOLLOWING TYPICAL CONDITIONS OF OPERATION UNDER WHICH CONSIDERABLE TUBE LIFE HAS BEEN OBTAINED. IF THE 5948 IS TO BE EMPLOYED IN AN OPERATION DIFFERING WIDELY FROM THESE CONDITIONS (UNLESS THE REQUIREMENTS ARE OBVIOUSLY LESS SEVERE) IT IS SUGGESTED THAT THE CUSTOMER REQUEST A RECOMMENDATION FOR THE SPECIFIC APPLICATION.

	PEAK ANODE VOLTAGE		PEAK	PULSE WIDTH	di/dt
Prr	FORWARD	INVERSE	CURRENT	70% POINT	
pps	kv	kv	Amps	μs	AMPS/μs
360	25	3	1000	2.5	5000
1500	15	5	500	1.3	5000

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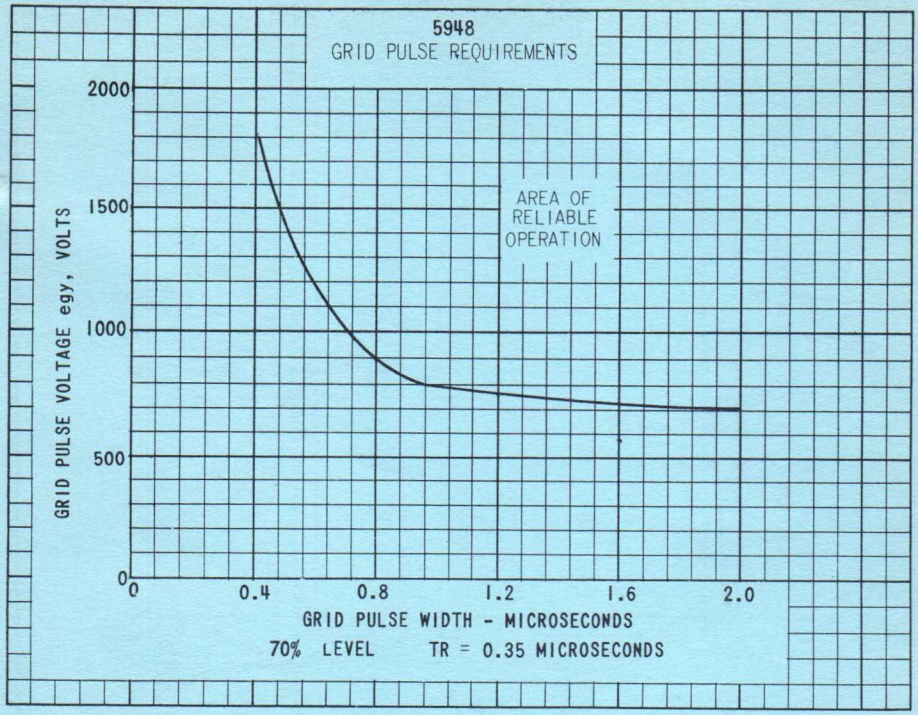

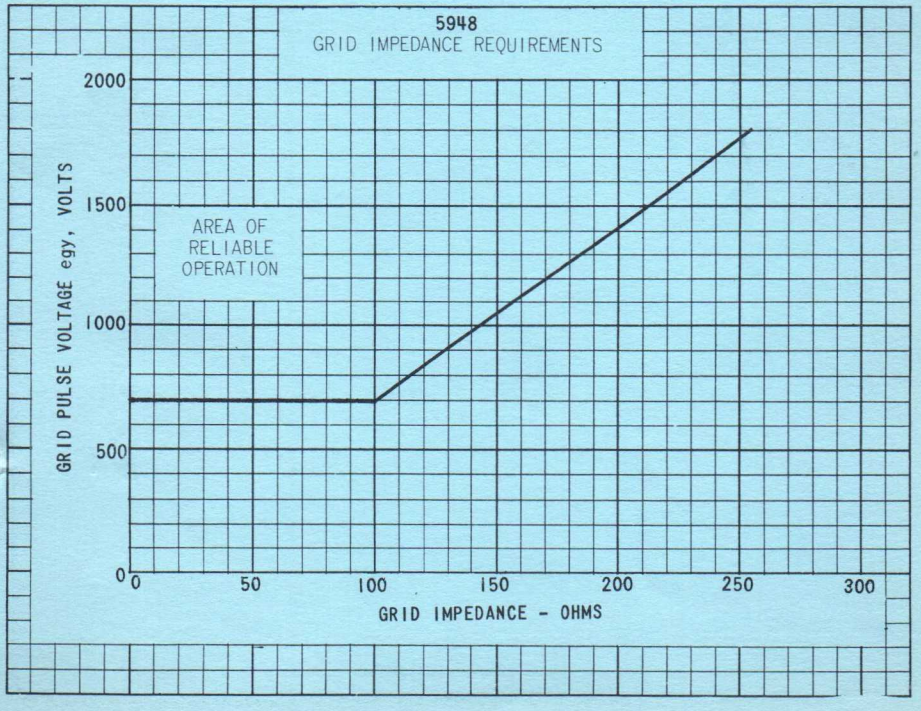

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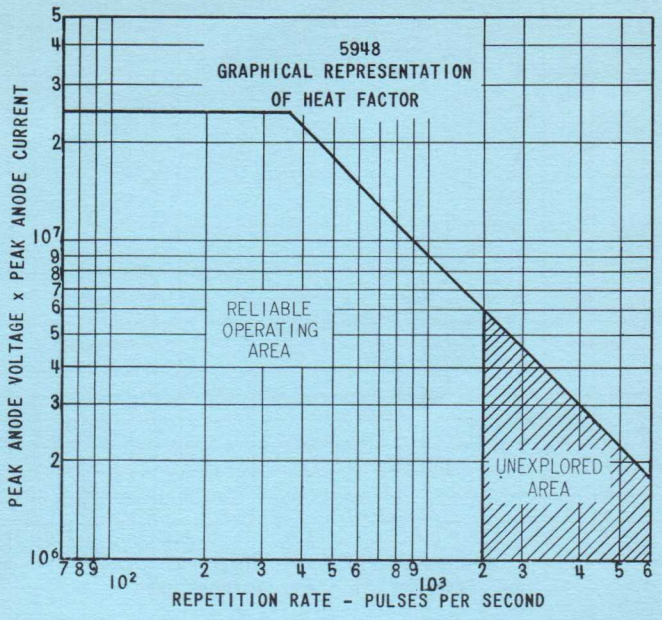
5948
GRAPHICAL REPRESENTATION
OF HEAT FACTOR
RELIABLE
OPERATING
AREA
UNEXPLORED
AREA
PEAK ANODE VOLTAGE x PEAK ANODE CURRENT
REPETITION RATE - PULSES PER SECOND
5
4
3
2
10⁷
9
8
7
6
5
4
3
2
10⁶
7 8 9
10²
2 3 4 5 6 8 9
10³
2 3 4 5 6

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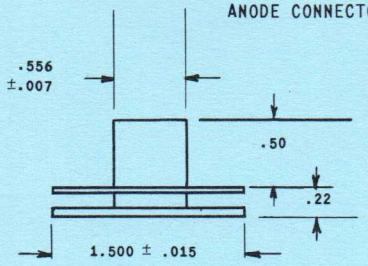
LEAD CONNECTIONS

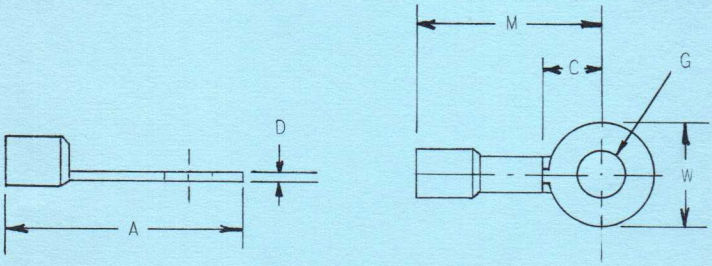
LEAD	FUNCTION	LEAD COLOR	LUG COLOR	LUG
1	GRID	GREEN	GREEN	S
2	CATHODE & HEATER C–T	BLACK	BLACK	L
3	HEATER	YELLOW	YELLOW	L
4	HEATER	YELLOW	BLACK	L
5	RESERVOIR	RED	YELLOW	S
6	RESERVOIR	RED	RED	S

LEADS ARE FLEXIBLE 5 1/2"±1/2" LONG FROM BOTTOM OF BASE TO CENTER OF LUG HOLE. COLOR CODING AS WELL AS BASE MARKING IDENTIFIES THE LEADS.

ANODE CONNECTOR



LUG DIMENSIONS



LUG	G STUD	A MAX.	W MAX.	C MIN.	D	M MAX.
L	1/4"	1.21"	.53"	.41"	.04"	.94"
S	#10	.90"	.31"	.30"	.03"	.74"

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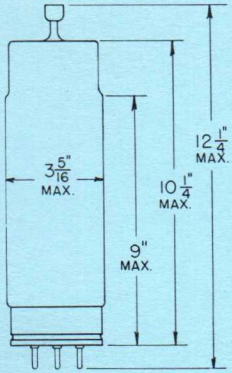


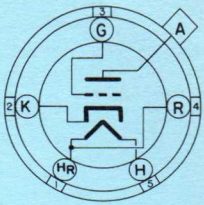
GLASS BULB

THYRATRON

HEATER

AC OR DC

VERTICAL MOUNTING POSITION
(BASE DOWN)



BOTTOM VIEW

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ELECTRICAL DATA

	SYMBOL	MIN.	BOGEY	MAX.	
HEATER VOLTAGE	Ef	6.0	6.3	6.6	VOLTS
HEATER CURRENT (WITH BOGIE HEATER AND RESERVOIR VOLTAGE)	If	15	18.5	22	AMPS.
CATHODE HEATING TIME	tk	15			MINUTES
RESERVOIR VOLTAGE (SEE APPLICATION NOTES)	Eres	3	MARKED ON BASE	5.5	VOLTS
RESERVOIR CURRENT	Ires	.2		5	AMPS.
RESERVOIR HEATING TIME	tres	15			MINUTES
ANODE VOLTAGE DROP	etd	75	125	250	VOLTS

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MECHANICAL DATA

MOUNTING POSITION	ANY
MAXIMUM NET WEIGHT	2 1/4 LBS.
DIMENSIONS:	SEE OUTLINE DRAWING
SOCKET	E.F. JOHNSON CO. NO. 122-275 OR EQUIVALENT
ANODE CONNECTOR	EITEL-McCULLOUGH, INC. NO. HR-8 OR EQUIVALENT

RATINGS

ABSOLUTE VALUES

	SYMBOL	MIN.	MAX.	
PEAK ANODE VOLTAGE				
INVERSE (NOTE 1)	epx	5% epy	25	KVOLTS
FORWARD (SEE APPLICATION NOTES FOR STARTING PROCEDURE)	epy	10	25	KVOLTS
CATHODE CURRENT				
PEAK	ib		500	AMPS.
AVERAGE	ib		0.5	AMPS.
RMS (FOR SQUARE PULSE APPLICATIONS $I_p = \sqrt{I_b \times ib}$)	I_p		16	AMPS.
DC ANODE VOLTAGE	Ebb	5		KVOLTS
OPERATING FREQUENCY (THIS IS NOT NECESSARILY THE UPPER OPERATING FREQUENCY LIMIT OF THE 5949 BUT REPRESENTS THE HIGHEST REPETITION RATE EXTENSIVELY LIFE TESTED TO DATE.)	prr		2000	CPS
PEAK GRID VOLTAGE (NOTE 2)	egy	550	1500	VOLTS
PEAK INVERSE GRID VOLTAGE	egx		450	VOLTS
GRID PULSE RISE TIME (NOTE 5)	tr		0.14	μSEC.
GRID PULSE WIDTH AT 70.7% POINT	tp	2		μSEC.
HEATING FACTOR (epy X ib X prr. SEE PAGE 3)	P_b		6.25×10^9	
CURRENT RATE OF RISE (NOTE 5)	dik/dt		2500	AMP/μSEC.
ANODE DELAY TIME (NOTE 3)	tad		1.0	μSEC.
TIME JITTER (NOTE 4)	tj		0.01	μSEC.
AMBIENT TEMPERATURE	TA	-55	+75	°C

NOTES

1: IN PULSED OPERATION, THE PEAK INVERSE VOLTAGE, EXCLUSIVE OF A SPIKE OF 0.05μSEC. MAXIMUM DURATION, SHALL NOT EXCEED 5.0 KILOVOLTS DURING THE FIRST 25μSEC. FOLLOWING THE ANODE PULSE.

2: THE GRID DRIVE REQUIREMENTS OF A 5949 CHANGE CONSIDERABLY DURING THE FIRST FEW MINUTES OF TUBE OPERATION. IN ORDER TO RELIABLY TRIGGER A COLD TUBE, THE GRID PULSE VOLTAGE AND DURATION AND THE GRID CIRCUIT IMPEDANCE SHOULD BE CHOSEN ACCORDING TO THE LIMITING CURVES.

3: ANODE DELAY TIME IS DEFINED AS THE TIME INTERVAL BETWEEN THE POINT ON THE RISING PORTION OF THE GRID VOLTAGE PULSE WHICH IS 26 PERCENT OF THE MAXIMUM UNLOADED PULSE AMPLITUDE AND THE POINT WHERE ANODE CONDUCTION TAKES PLACE.

4: TIME JITTER IS MEASURED AT 50 PERCENT OF THE PULSE AMPLITUDE AFTER THE TUBE HAS BEEN OPERATING FOR AT LEAST 60 SECONDS. THE LIMIT OF 0.01 μSEC. SHOWN IS THE MAXIMUM ALLOWABLE UNDER SPECIFIED UNFAVORABLE OPERATING CONDITIONS. WITH SUFFICIENT GRID DRIVE AND WITH ANODE VOLTAGES OF 15 KV AND ABOVE, JITTER NOT EXCEEDING 0.005 μSEC. CAN BE EASILY ACHIEVED.

5: MEASUREMENT MADE BETWEEN 26% AND 70.7% POINTS.

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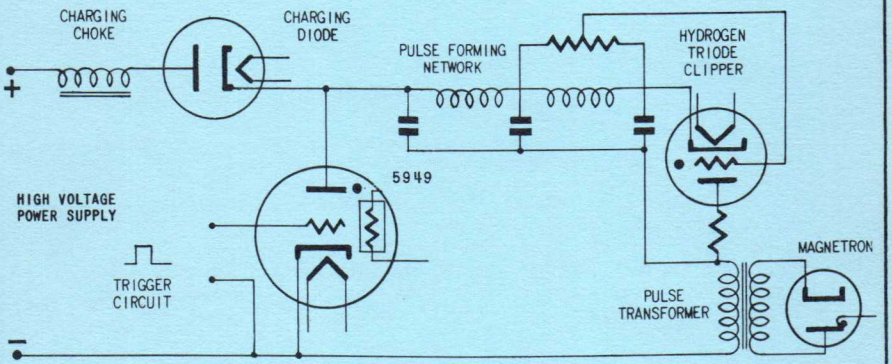

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DO NOT INCREASE IN STEPS GREATER THAN 5 KV PER MINUTE.

TYPICAL OPERATION

VARIATIONS IN THE OPERATING PARAMETERS AFFECT THE LIFE EXPECTANCY OF HYDROGEN THYRATRONS; THEREFORE, A SIMPLE METHOD OF RATING FOR ALL CONDITIONS IS DIFFICULT. UNTIL SUCH TIME AS SUFFICIENT INFORMATION IS AVAILABLE TO PREPARE COMPLETE OPERATION RATING CHARTS, WE LIST THE FOLLOWING TYPICAL CONDITIONS OF OPERATION UNDER WHICH CONSIDERABLE TUBE LIFE HAS BEEN OBTAINED. IF THE 5949 IS TO BE EMPLOYED IN AN OPERATION DIFFERING WIDELY FROM THESE CONDITIONS (UNLESS THE REQUIREMENTS ARE OBVIOUSLY LESS SEVERE) IT IS SUGGESTED THAT THE CUSTOMER REQUEST A RECOMMENDATION FOR THE SPECIFIC APPLICATION.

	PEAK ANODE VOLTAGE		PEAK	PULSE WIDTH	di/dt
Prr	FORWARD	INVERSE	CURRENT	70% POINT	
pps	kv	kv	Amps	μS	AMPS/μS
360	25	1.25	500	2	2500
1500	20	7.0	200	1	2500

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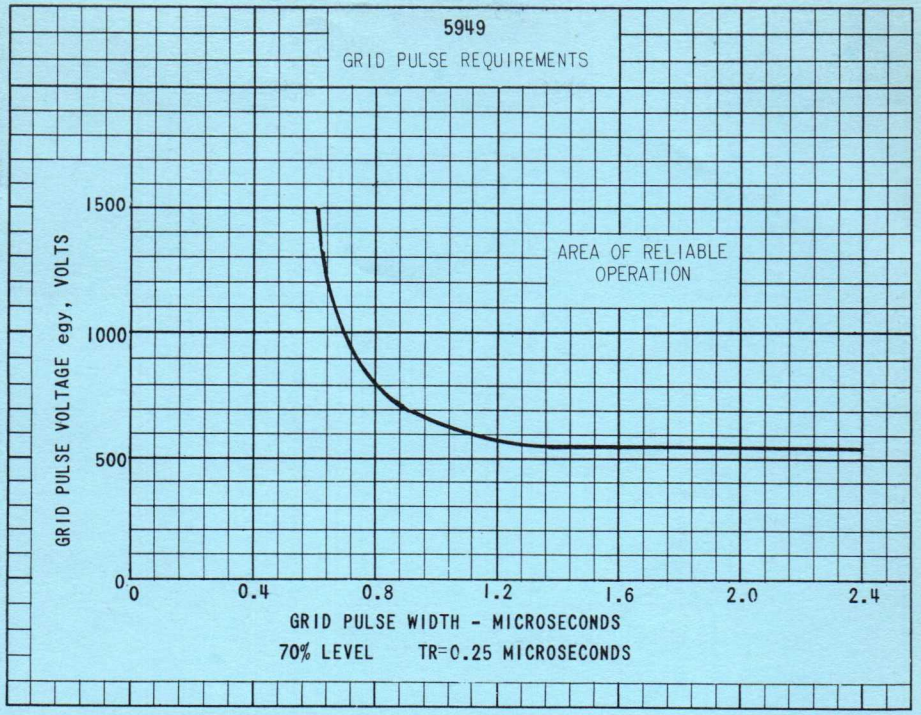

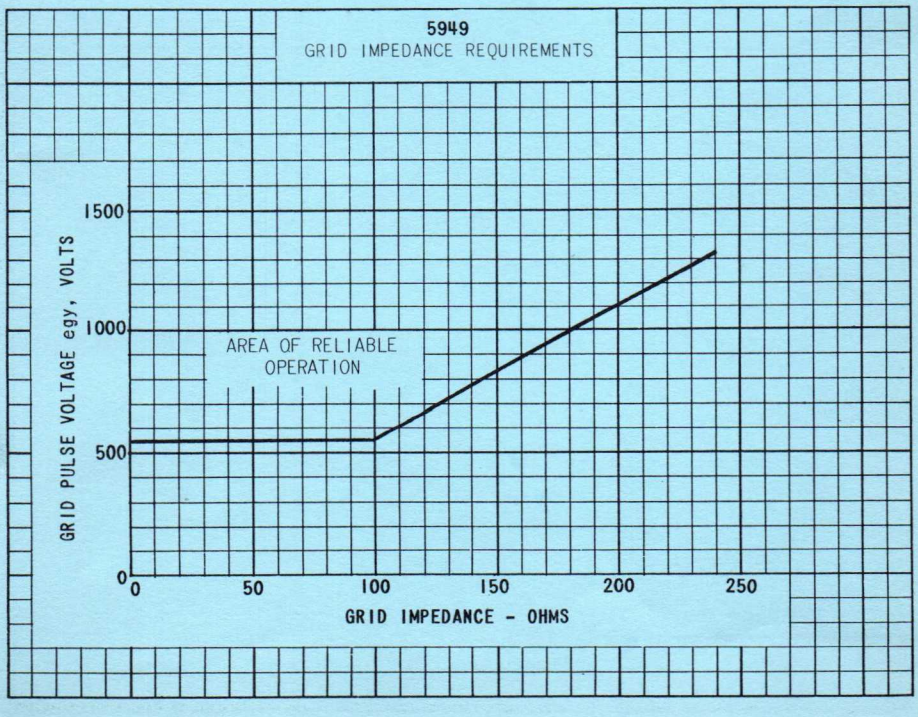

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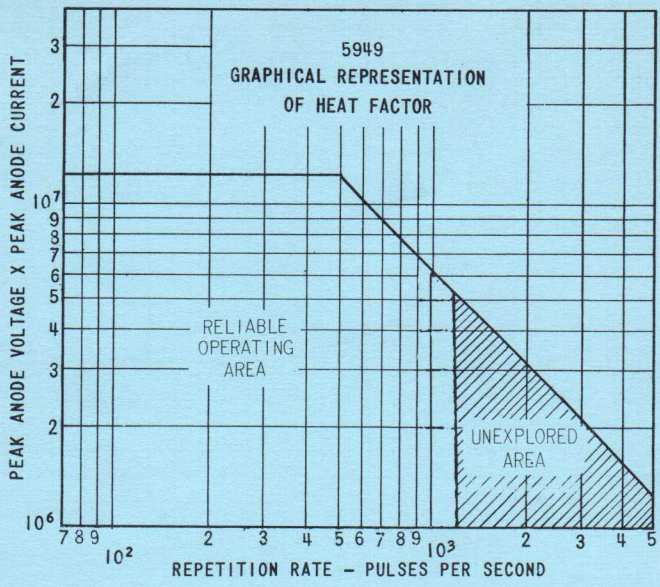
5949
GRAPHICAL REPRESENTATION
OF HEAT FACTOR
RELIABLE
OPERATING
AREA
UNEXPLORED
AREA
PEAK ANODE VOLTAGE X PEAK ANODE CURRENT
REPETITION RATE – PULSES PER SECOND

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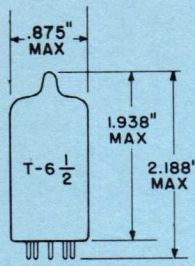
→ TWIN TRIODE

MINIATURE TYPE



GLASS BULB
SMALL-BUTTON NOVAL
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2

UNIPOTENTIAL CATHODE

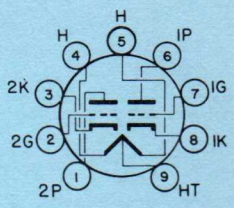
HEATER

SERIES	PARALLEL
12.6± 1.3 VOLTS	6.3± 0.6 VOLTS
0.15 AMP.	0.3 AMP.

AC OR DC

OPERATING POSITION•

ANY, BUT FOR UTMOST IN SERVICE, THE TUBE SHOULD BE OPERATED IN A VERTICAL POSITION WITH BASE UP OR DOWN, OR IN A HORIZONTAL POSITION WITH BASE PINS 6 & 9 IN A VERTICAL PLANE.



BOTTOM VIEW

BASING DIAGRAM
JEDEC 9A

THE 5963 IS A MEDIUM-MU TWIN TRIODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS ESPECIALLY DESIGNED FOR FREQUENCY-DIVIDER CIRCUITS IN ELECTRONIC COMPUTERS AND OTHER 'ON-OFF' CONTROL APPLICATIONS REQUIRING LONG PERIODS OF OPERATION UNDER CUT-OFF CONDITIONS.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE (EACH UNIT)	1.5	pf
GRID TO CATHODE & HEATER (EACH UNIT)	1.9	pf
PLATE TO CATHODE & HEATER (UNIT #1)	0.5	pf
PLATE TO CATHODE & HEATER (UNITS #2)	0.35	pf
GRID OF UNIT #1 TO GRID OF UNIT #2 (MAX.)	0.01	pf

RATINGS

ABSOLUTE MAXIMUM VALUES

EACH UNIT

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

MAXIMUM PLATE VOLTAGE	250	VOLTS
MAXIMUM GRID VOLTAGE:		
NEGATIVE BIAS VALUE	100	VOLTS
POSITIVE BIAS VALUE	0	VOLTS
PEAK NEGATIVE VALUE	200	VOLTS
MAXIMUM PLATE DISSIPATION	2.5	WATTS
MAXIMUM GRID INPUT	0.5	WATT
MAXIMUM DC CATHODE CURRENT	20	MA.
MAXIMUM PEAK CATHODE CURRENT	100	MA.
MAXIMUM PEAK HEATER CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	90	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	90	VOLTS
MAXIMUM BULB TEMPERATURE (AT HOTTEST POINT ON BULB SURFACE)	120	°C

→ INDICATES A CHANGE.

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A AMPLIFIER (EACH UNIT)

PLATE VOLTAGE	67.5	VOLTS
GRID VOLTAGE	0	VOLTS
AMPLIFICATION FACTOR	21	
PLATE RESISTANCE	6600	OHMS
TRANSCONDUCTANCE	3200	μMHOS
PLATE CURRENT	8.5	MA.

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

TYPICAL OPERATION AS FREQUENCY HALFER
EACH UNIT

	CUTOFF CONDITION	ZERO-BIAS CONDITION	
PLATE SUPPLY VOLTAGE	150	150	VOLTS
GRID VOLTAGE	−15	0	VOLTS
PLATE CIRCUIT RESISTANCE	20000	20000	OHMS
GRID-CIRCUIT RESISTANCE	47000	47000	OHMS
PLATE CURRENT	0	5.1	MA.

CIRCUIT VALUES

GRID-CIRCUIT RESISTANCE: (MAX.)		
FOR FIXED BIAS OPERATION	0.5	MEGOHM
FOR CATHODE-BIAS OPERATION	1.0	MEGOHM

RANGE VALUES FOR EQUIPMENT DESIGN

	NOTE	MIN	MAX	
CUTOFF CONDITION				
PLATE CURRENT	1	—	50	μAMP.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	—	—	50	μAMP.
ZERO-BIAS CONDITION				
PLATE CURRENT	2	4.6	5.4	MA.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	—	—	0.8	MA.

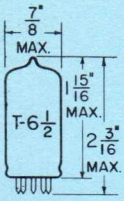
[1] FOR CONDITIONS WITH 12.6 VOLTS ON HEATER, PLATE-SUPPLY VOLTS = 150, PLATE-CIRCUIT RESISTANCE (OHMS) = 20000, GRID-SUPPLY VOLTS = −15, AND GRID-CIRCUIT RESISTANCE (OHMS) = 47000.

[2] CONDITIONS ARE SAME AS FOR NOTE 1 EXCEPT THAT GRID-SUPPLY VOLTS = 0.

TUNG-SOL

TRIODE

MINIATURE TYPE



GLASS BULB

UNIPOTENTIAL CATHODE

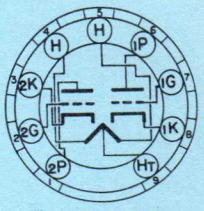
HEATER

SERIES	PARALLEL
12.6±10% VOLTS	6.3±10% VOLTS
0.15 AMP.	0.3 AMP.

AC OR DC

ANY MOUNTING POSITION

MICROPHONISM NOT TESTED



BOTTOM VIEW

SMALL-BUTTON NOVAL
9 PIN BASE

9A

THE 5963 IS A MEDIUM-MU TRIODE IN THE 9 PIN MINATURE CONSTRUCTION. IT IS ESPECIALLY DESIGNED FOR FREQUENCY-DIVIDER CIRCUITS IN ELECTRONIC COMPUTERS AND OTHER 'ON-OFF' CONTROL APPLICATIONS REQUIRING LONG PERIODS OF OPERATION UNDER CUT-OFF CONDITIONS.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE (EACH UNIT)	1.5	μμf
GRID TO CATHODE & HEATER (EACH UNIT)	1.9	μμf
PLATE TO CATHODE & HEATER (UNIT #1)	0.5	μμf
PLATE TO CATHODE & HEATER (UNITS #2)	0.35	μμf
GRID OF UNIT #1 TO GRID OF UNIT #2 (MAX.)	0.01	μμf

RATINGS

ABSOLUTE MAXIMUM VALUES

EACH UNIT

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

	SERIES	PARALLEL	
HEATER VOLTAGE	12.6±10%	6.3±10%	VOLTS
MAXIMUM PLATE VOLTAGE	250		VOLTS
MAXIMUM GRID VOLTAGE:			
NEGATIVE BIAS VALUE	100		VOLTS
POSITIVE BIAS VALUE	0		VOLTS
PEAK NEGATIVE VALUE	200		VOLTS
MAXIMUM PLATE DISSIPATION	2.5		WATTS
MAXIMUM GRID INPUT	0.5		WATT
MAXIMUM DC CATHODE CURRENT	20		MA.
MAXIMUM PEAK CATHODE CURRENT	100		MA.
MAXIMUM PEAK HEATER CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE	90		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	90		VOLTS
MAXIMUM BULB TEMPERATURE (AT HOTTEST POINT ON BULB SURFACE)	120		°C

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TUNG-SOL

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A AMPLIFIER (EACH UNIT)

HEATER VOLTAGE (SERIES)	12.6±10%	VOLTS
HEATER VOLTAGE (PARALLEL)	6.3±10%	VOLTS
HEATER CURRENT (SERIES)	0.15	AMP.
HEATER CURRENT (PARALLEL)	0.3	AMP.
PLATE VOLTAGE	67.5	VOLTS
GRID VOLTAGE	0	VOLTS
AMPLIFICATION FACTOR	21	
PLATE RESISTANCE	6600	OHMS
TRANSCONDUCTANCE	3200	μMHOS
PLATE CURRENT	8.5	MA.

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

TYPICAL OPERATION AS FREQUENCY HALFER
EACH UNIT

	CUTOFF CONDITION	ZERO-BIAS CONDITION	
PLATE SUPPLY VOLTAGE	150	150	VOLTS
GRID VOLTAGE	−15	0	VOLTS
PLATE CIRCUIT RESISTANCE	20000	20000	OHMS
GRID-CIRCUIT RESISTANCE	47000	47000	OHMS
PLATE CURRENT	0	5.1	MA.

CIRCUIT VALUES

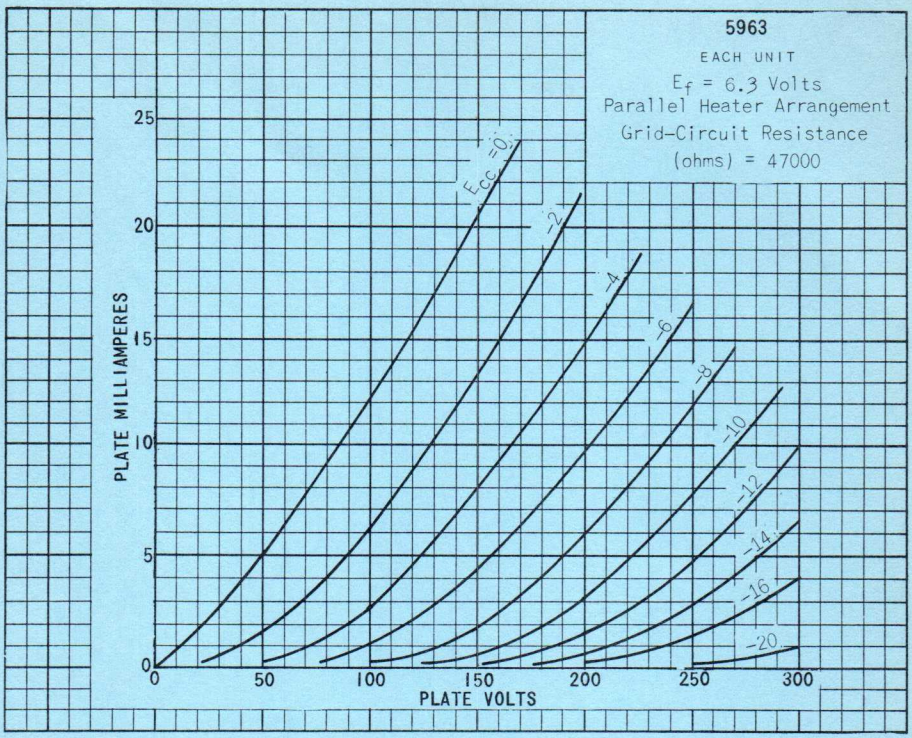
GRID-CIRCUIT RESISTANCE: (MAX.)		
FOR FIXED BIAS OPERATION	0.5	MEGOHM
FOR CATHODE-BIAS OPERATION	1.0	MEGOHM

RANGE VALUES FOR EQUIPMENT DESIGN

	NOTE	MIN	MAX	
CUTOFF CONDITION				
PLATE CURRENT	1	—	50	μAMP.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	—	—	50	μAMP.
ZERO-BIAS CONDITION				
PLATE CURRENT	2	4.6	5.4	MA.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	—	—	0.8	MA.

[1] FOR CONDITIONS WITH 12.6 VOLTS ON HEATER, PLATE-SUPPLY VOLTS = 150, PLATE-CIRCUIT RESISTANCE (OHMS) = 20000, GRID-SUPPLY VOLTS = −15, AND GRID-CIRCUIT RESISTANCE (OHMS) = 47000.

[2] CONDITIONS ARE SAME AS FOR NOTE 1 EXCEPT THAT GRID-SUPPLY VOLTS = 0.



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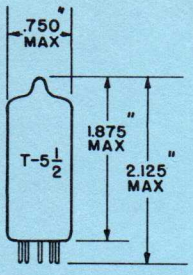
TUNG-SOL

→ TWIN TRIODE

MINIATURE TYPE



GLASS BULB
SMALL-BUTTON MINIATURE
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-2

UNIPOTENTIAL CATHODE

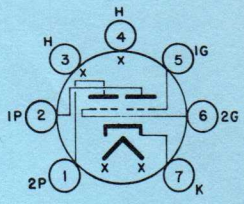
HEATER

6.3±10% VOLTS 0.45 AMP.

AC OR DC

OPERATING POSITION**:

**ANY, BUT FOR UTMOST IN SERVICE, THE TUBE SHOULD BE OPERATED IN A VERTICAL POSITION WITH BASE UP OR DOWN, OR IN A HORIZONTAL POSITION WITH BASE PINS 1 & 6 IN A VERTICAL PLANE.



BOTTOM VIEW
BASING DIAGRAM
JEDEC 7BF

THE 5964 IS A MEDIUM-MU TWIN TRIODE IN THE 7 PIN MINIATURE CONSTRUCTION. IT IS ESPECIALLY DESIGNED FOR FREQUENCY-DIVIDER CIRCUITS IN ELECTRONIC COMPUTERS AND OTHER 'ON-OFF' CONTROL APPLICATIONS REQUIRING LONG PERIODS OF OPERATION UNDER CUT-OFF CONDITIONS.

DIRECT INTERELECTRODE CAPACITANCES - APPROX.

WITHOUT EXTERNAL SHIELD

EACH UNIT

GRID TO PLATE	1.3	pf
GRID TO CATHODE AND HEATER	2.1	pf
PLATE TO CATHODE AND HEATER	0.4	pf
GRID OF UNIT #1 TO GRID OF UNIT #2 (MAX.)	0.5	pf

RATINGS

MAXIMUM ABSOLUTE VALUES

EACH UNIT

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

MAXIMUM PLATE VOLTAGE	250	VOLTS
MAXIMUM GRID VOLTAGE:		
NEGATIVE BIAS VALUE	100	VOLTS
POSITIVE BIAS VALUE	0	VOLTS
PEAK NEGATIVE VALUE	200	VOLTS
MAXIMUM PLATE DISSIPATION	1.5	WATTS
MAXIMUM GRID INPUT	0.1	WATT
MAXIMUM DC CATHODE CURRENT [A]	15	MA.
MAXIMUM PEAK CATHODE CURRENT [A]	75	MA.
MAXIMUM PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	90	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	90	VOLTS
MAXIMUM BULB TEMPERATURE (AT HOTTEST POINT ON BULB SURFACE)	150	°C

→ INDICATES A CHANGE.

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A AMPLIFIER - EACH UNIT
WITH BOTH UNITS OPERATING

PLATE VOLTAGE	100	VOLTS
CATHODE-BIAS RESISTOR	50	OHMS
AMPLIFICATION FACTOR	39	
PLATE RESISTANCE	6500	OHMS
TRANSCONDUCTANCE	6000	μMHOS
PLATE CURRENT	9.5	MA.

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

TYPICAL OPERATION AS FREQUENCY HALFER
EACH UNIT

	CUTOFF CONDITION	ZERO-BIAS CONDITION	
PLATE-SUPPLY VOLTAGE	150	150	VOLTS
PLATE-CIRCUIT RESISTANCE	20000	20000	OHMS
GRID-SUPPLY VOLTAGE	-10	0	VOLTS
GRID-CIRCUIT RESISTANCE	47000	47000	OHMS
PLATE CURRENT	0	5	MA.

CIRCUIT VALUES

GRID-CIRCUIT RESISTANCE: (MAX.)		
FOR FIXED-BIAS OPERATION	0.5	MEGOHM
FOR CATHODE-BIAS OPERATION	1.0	MEGOHM

RANGE VALUES FOR EQUIPMENT DESIGN

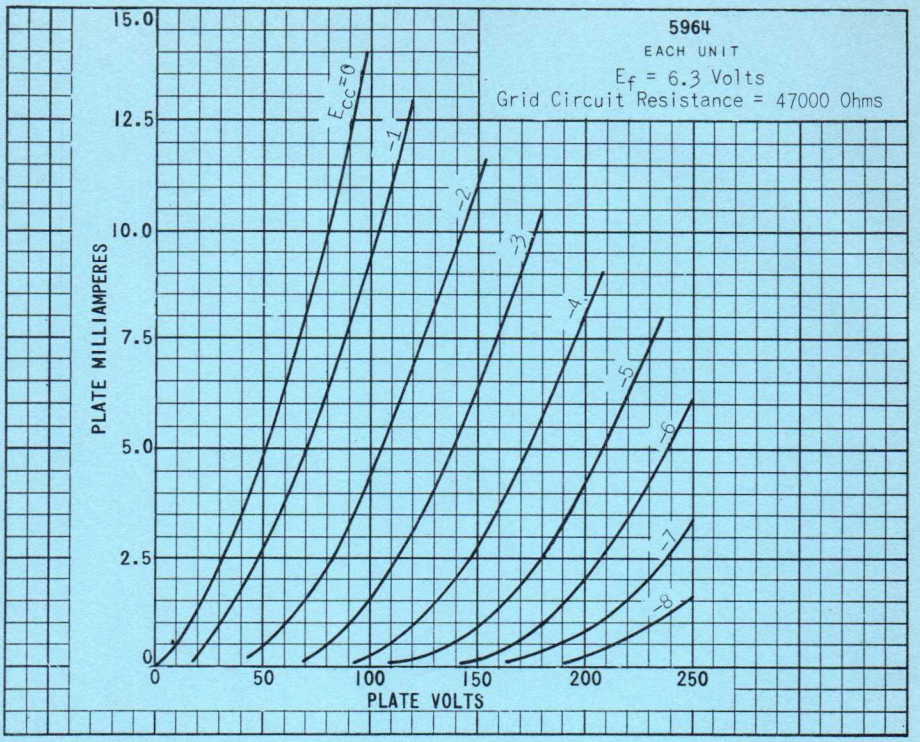
CUTOFF CONDITION	MIN.	MAX.	
PLATE CURRENT (EACH UNIT) [B]	---	0.075	MA.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	---	0.2	MA.
ZERO-BIAS CONDITION			
PLATE CURRENT (EACH UNIT) [C]	4.3	5.7	MA.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	---	1.4	MA.

[A] WITH BOTH UNITS OPERATING, THE DC CATHODE CURRENT SHOULD NOT EXCEED 30 MILLIAMPERES, AND THE PEAK CATHODE CURRENT SHOULD NOT EXCEED 150 MILLIAMPERES.

[B] FOR CONDITIONS WITH 6.3 VOLTS ON HEATER, PLATE-SUPPLY VOLTS = 150, PLATE-CIRCUIT RESISTANCE (OHMS) = 20000, GRID-SUPPLY VOLTS = -10, AND GRID-CIRCUIT RESISTANCE (OHMS) = 47000.

[C] CONDITIONS ARE SAME AS FOR NOTE 1 EXCEPT THAT GRID-SUPPLY VOLTS = 0.

• COMMON TO BOTH UNITS.



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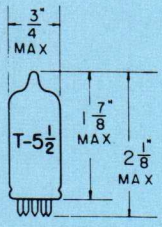
TUNG-SOL

TRIODE

MINIATURE TYPE



GLASS BULB

UNIPOTENTIAL CATHODE

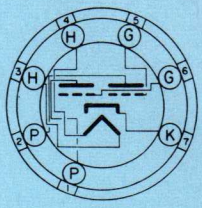
HEATER

6.3±10% VOLTS 0.45 AMP.

AC OR DC

OPERATING POSITION[1]

[1] ANY, BUT FOR UTMOST IN SERVICE, THE TUBE SHOULD BE OPERATED IN A VERTICAL POSITION WITH BASE UP OR DOWN, OR IN A HORIZONTAL POSITION WITH BASE PINS 1 & 6 IN A VERTICAL PLANE.



BOTTOM VIEW

SMALL-BUTTON MINIATURE

7 PIN BASE

7 BF

THE 5964 IS A MEDIUM-MU TRIODE IN THE 7 PIN MINATURE CONSTRUCTION. IT IS ESPECIALLY DESIGNED FOR FREQUENCY-DIVIDER CIRCUITS IN ELECTRONIC COMPUTERS, AND OTHER 'ON-OFF' CONTROL APPLICATIONS REQUIRING LONG PERIODS OF OPERATION UNDER CUT-OFF CONDITIONS.

DIRECT INTERELECTRODE CAPACITANCES - APPROX.

WITHOUT EXTERNAL SHIELD

EACH UNIT

GRID TO PLATE	1.3	μμf
GRID TO CATHODE AND HEATER	2.1	μμf
PLATE TO CATHODE AND HEATER	0.4	μμf
GRID OF UNIT #1 TO GRID OF UNIT #2 (MAX.)	0.5	μμf

RATINGS

MAXIMUM ABSOLUTE VALUES

EACH UNIT

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

HEATER VOLTAGE	6.3±10%	VOLTS
MAXIMUM PLATE VOLTAGE	250	VOLTS
MAXIMUM GRID VOLTAGE:		
NEGATIVE BIAS VALUE	100	VOLTS
POSITIVE BIAS VALUE	0	VOLTS
PEAK NEGATIVE VALUE	200	VOLTS
MAXIMUM PLATE DISSIPATION	1.5	WATTS
MAXIMUM GRID INPUT	0.1	WATT
MAXIMUM DC CATHODE CURRENT [A]	15	MA.
MAXIMUM PEAK CATHODE CURRENT [A]	75	MA.
MAXIMUM PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	90	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	90	VOLTS
MAXIMUM BULB TEMPERATURE (AT HOTTEST POINT ON BULB SURFACE)	150	°C

→ INDICATES A CHANGE.

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A AMPLIFIER - EACH UNIT
WITH BOTH UNITS OPERATING

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT	0.45	AMP.
PLATE VOLTAGE	100	VOLTS
CATHODE-BIAS RESISTOR	50	OHMS
AMPLIFICATION FACTOR	39	
PLATE RESISTANCE	6500	OHMS
TRANSCONDUCTANCE	6000	μMHOS
PLATE CURRENT	9.5	MA.

FREQUENCY DIVIDER IN COMPUTER SERVICE
AND
'ON-OFF' CONTROL SERVICE

TYPICAL OPERATION AS FREQUENCY HALFER
EACH UNIT

	CUTOFF CONDITION	ZERO-BIAS CONDITION	
PLATE-SUPPLY VOLTAGE	150	150	VOLTS
PLATE-CIRCUIT RESISTANCE	20000	20000	OHMS
GRID-SUPPLY VOLTAGE	-10	0	VOLTS
GRID-CIRCUIT RESISTANCE	47000	47000	OHMS
PLATE CURRENT	0	5	MA.

CIRCUIT VALUES

GRID-CIRCUIT RESISTANCE: (MAX.)		
FOR FIXED-BIAS OPERATION	0.5	MEGOHM
FOR CATHODE-BIAS OPERATION	1.0	MEGOHM

RANGE VALUES FOR EQUIPMENT DESIGN

CUTOFF CONDITION	MIN.	MAX.	
PLATE CURRENT (EACH UNIT) [B]	---	0.075	MA.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	---	0.2	MA.
ZERO-BIAS CONDITION			
PLATE CURRENT (EACH UNIT) [C]	4.3	5.7	MA.
DIFFERENCE IN PLATE CURRENT BETWEEN UNITS	---	1.4	MA.

[A] WITH BOTH UNITS OPERATING, THE DC CATHODE CURRENT SHOULD NOT EXCEED 30 MILLIAMPERES, AND THE PEAK CATHODE CURRENT SHOULD NOT EXCEED 150 MILLIAMPERES.

[B] FOR CONDITIONS WITH 6.3 VOLTS ON HEATER, PLATE-SUPPLY VOLTS = 150, PLATE-CIRCUIT RESISTANCE (OHMS) = 20000, GRID-SUPPLY VOLTS = -10, AND GRID-CIRCUIT RESISTANCE (OHMS) = 47000.

[C] CONDITIONS ARE SAME AS FOR NOTE 1 EXCEPT THAT GRID-SUPPLY VOLTS = 0.

• COMMON TO BOTH UNITS.

→ INDICATES A CHANGE

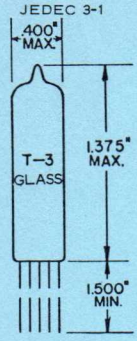
TUNG-SOL

TRIODE

SUBMINIATURE

OUTLINE DRAWING

JEDEC 3-1



SUBMINIATURE BASE 8 PIN BUTTON
JEDEC E8-10

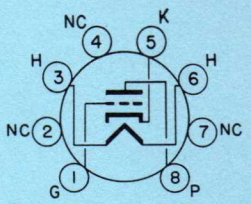
MEDIUM - MU TRIODE
FOR
OPERATION IN
CONTROL CIRCUITS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION

BASING DIAGRAM

JEDEC 8DK



BOTTOM VIEW

THE 5977 IS A MEDIUM-MU TRIODE IN THE T-3 SUBMINIATURE CONSTRUCTION. IT IS DESIGNED PRIMARILY FOR OPERATION IN CONTROL CIRCUITS WHERE LONG LIFE AND STABLE PERFORMENCE ARE ESSENTIAL. THE RUGGEDIZED CONSTRUCTION MAKE IT SUITABLE FOR SERVICE WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK AND VIBRATION ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

	UNSHIELDED	WITH 0.405" D. EXTERNAL SHIELD CONNECTED TO CATHODE	
GRID TO PLATE	1.3	1.3	pf
INPUT	2.0	2.0	pf
OUTPUT	0.8	2.2	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	150	MA
LIMITS OF APPLIED VOLTAGE		6.3 ± 0.3	VOLTS
HEATER CATHODE VOLTAGE:			
HEATER POSITIVE WITH RESPECT TO CATHODE		200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE		200	VOLTS

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RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	180	VOLTS
GRID VOLTAGE	-55	VOLTS
PLATE DISSIPATION	3.3	WATTS
PLATE CURRENT	22	MA
PEAK GRID CURRENT	4.4	MA
BULB TEMPERATURE	220	°C

CHARACTERISTICS

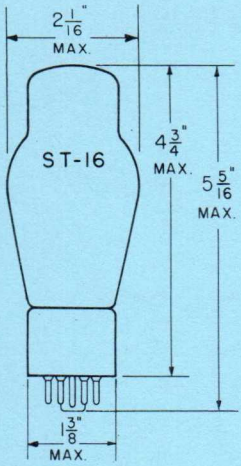
PLATE VOLTAGE - DC	100	VOLTS
CATHODE RESISTOR	270	OHMS
PLATE CURRENT	10.0	MA
AMPLIFICATION FACTOR	16	
TRANSCONDUCTANCE	4,500	μMHOS
GRID VOLTAGE FOR $I_b = 10\ \mu A$	-13.5	VOLTS

SPECIAL TESTS

LOW FREQUENCY VIBRATION TEST
LOW FREQUENCY VIBRATION FATIQUE
SHOCK TEST

TUNG-SOL

TWIN TRIODE

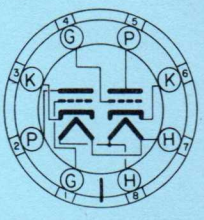


GLASS BULB

HEATER

6.3±10% VOLTS 2.4 AMP.

BASE DOWN MOUNTING POSITION



BOTTOM VIEW
MEDIUM SHELL
8 PIN OCTAL
8BD

THE 5998 IS A MEDIUM MU TWIN POWER TRIODE USED PRIMARILY AS A PASSING TUBE IN SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINISIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 5998 NOT ONLY MEETS THESE REQUIREMENTS BUT POSSESSES THE ADDITIONAL ADVANTAGE OF REQUIRING LITTLE GRID VOLTAGE SWING TO CONTROL THESE CURRENTS. THIS PERMITS THE USE OF SIMPLER CONTROL AMPLIFIER CIRCUITS IN THE REGULATED SUPPLY.

ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (E_f = 6.3 VOLTS)	2.4	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	14 000	μMHOS
AMPLIFICATION FACTOR	5.5	
INTER-ELECTRODE CAPACITIES PER TRIODE SECTION:		
GRID TO CATHODE	7.7	μμf
GRID TO PLATE	18.3	μμf
CATHODE TO PLATE	2.5	μμf
HEATER TO CATHODE	10.0	μμf
INTER-ELECTRODE CAPACITIES BETWEEN TRIODE SECTIONS:		
SECTION 1 PLATE TO SECTION 2 PLATE	1.7	μμf

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TUNG-SOL

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MECHANICAL DATA

MOUNTING POSITION	BASE DOWN	
BULB	ST-16	
BASE	MEDIUM SHELL-OCTAL-8 PIN JETEC #B8-11	
AVERAGE NET WEIGHT	2.4	OUNCES
MAXIMUM VIBRATION RATING (O TO 25 CPS)	2.5	G

RATINGS
ABSOLUTE VALUES

	MINIMUM	MAXIMUM	
POWER DISSIPATION PER PLATE	---	15	WATTS
PLATE CURRENT PER PLATE. DC	---	140	MA,DC
IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 50 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE.			
PLATE VOLTAGE DC	---	275	VOLTS
HEATER-CATHODE VOLTAGE DC	-100	+100	VOLTS
GRID VOLTAGE	---	0	VOLTS
HEATER VOLTAGE	5.7	6.9	VOLTS
ENVELOPE TEMPERATURE	---	*	°C
ALTITUDE FOR FULL RATINGS	---	10 000	FEET
CIRCUIT VALUES:			
TOTAL GRID CIRCUIT RESISTANCE	500	500 000	OHMS
RESISTANCE PER GRID LEG WHEN TRIODE SECTIONS ARE PARALLELED	500	---	OHMS

CATHODE RESISTANCE:

MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 15 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.

*FOR OPTIMUM TUBE LIFE BULB TEMPERATURE SHOULD NOT ESCEED 150° C. AT FULL DISSIPATION ON BOTH TRIODE SECTIONS IT WILL BE NECESSARY TO PROVIDE FORCED AIR COOLING TO KEEP THE BULB TEMPERATURE WITHIN THIS RATING.

RANGE OF VALUES

	MINIMUM	MAXIMUM	
CONDITIONS: E_f=6.3V, E_b=120V, E_c=-14V.			
PLATE CURRENT PER SECTION DC	50	125	MA.
AMPLIFICATION FACTOR	4.8	6.2	
TRANSCONDUCTANCE	11 000	17 000	μMHOS
HEATER CURRENT PER TUBE	2.20	2.60	AMP.
CONDITIONS: E_f=6.3V, E_b=200V, E_c=-55V, R_k=O			
PLATE CURRENT PER SECTION DC	0	10	MA.
CONDITIONS: E_f=6.3V, E_b=60V, E_c=OV.			
PLATE CURRENT PER SECTION DC	135	---	MA.

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APPLICATION NOTES

THE 5998 IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS. RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED, USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE RESISTANCE BECAUSE IT PROVIDES MORE BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE SIXTH THE VALUE $(\frac{R}{\mu + 1})$ OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE SIXTH THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (LESS THAN ONE WATT) AND THE ADDITIONAL VOLTAGE (LESS THAN 10 VOLTS) NECESSARY FROM THE UNREGULATED SUPPLY. A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE PASSING TUBE TO WORK WITH HIGHER BIAS AND HENCE WITH GREATER TUBE DROP.

A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASSING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATED OUTPUT IS LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A TUBE DROP AS POSSIBLE. A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES. SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE DUE TO TUBE AGING.

A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 6.3 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.

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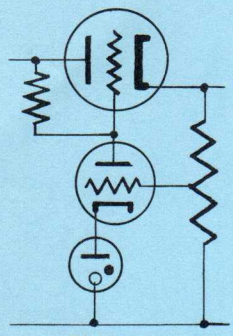


Figure 1

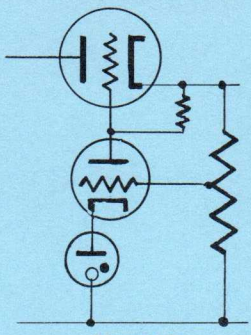


Figure 2

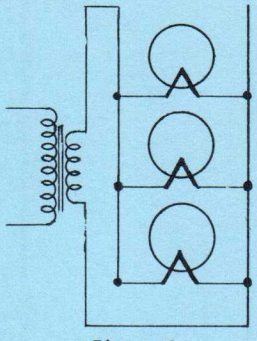
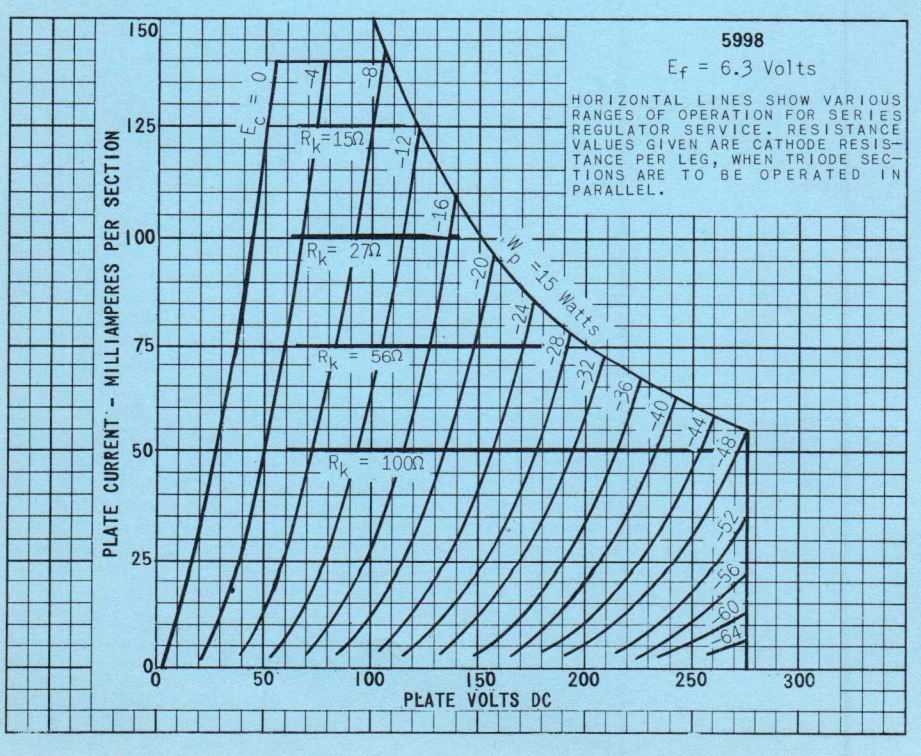
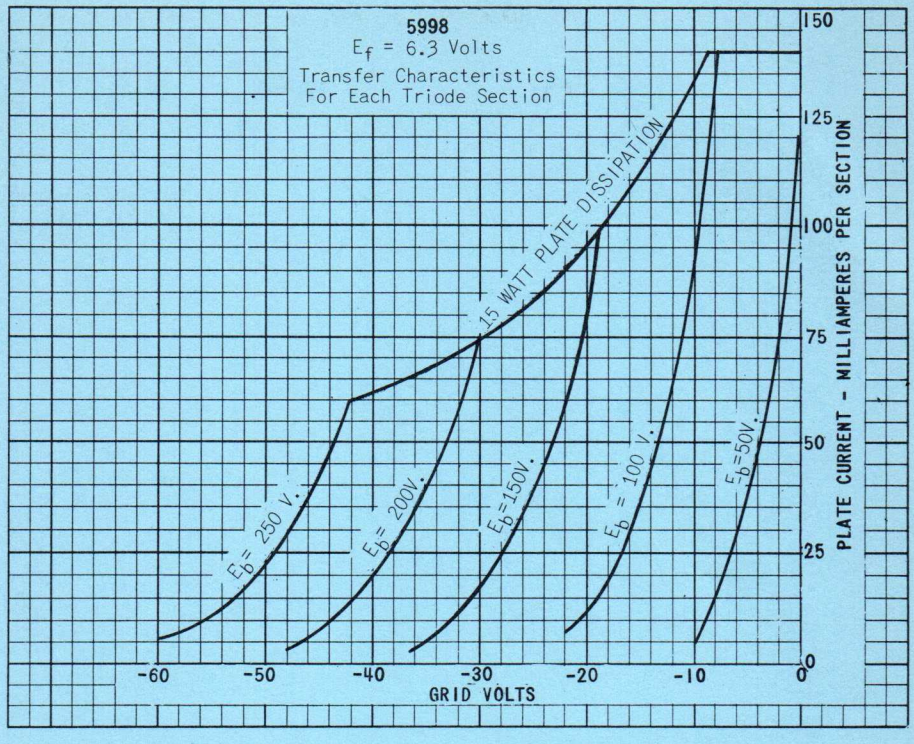
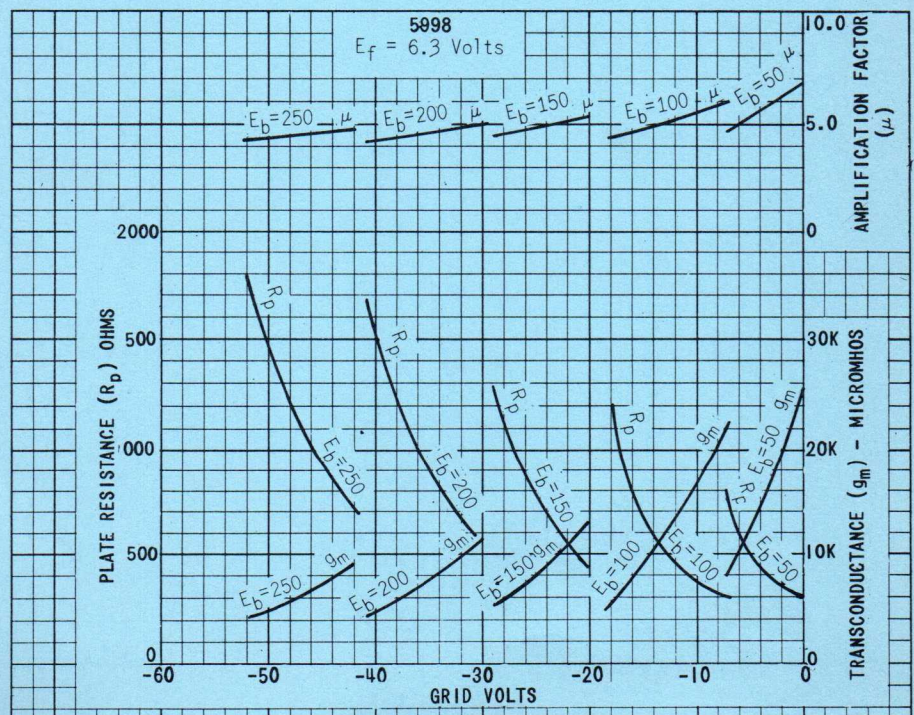


Figure 3







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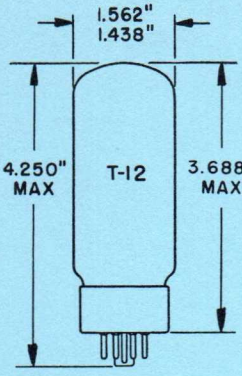
TWIN TRIODE



GLASS BULB
SHORT MEDIUM SHELL
8 PIN OCTAL B8-110
OUTLINE DRAWING
JEDEC 12-15

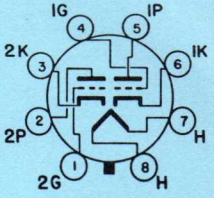
FOR

SERIES REGULATOR

APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 8BD

THE 5998A IS A LOW-MU TWIN TRIODE DESIGNED FOR SERVICE AS A SERIES REGULATOR IN DC POWER SUPPLIES. EXCEPT FOR THE USE OF T-12 ENVELOPE AND A DIFFERENT BASE, THE 5998A IS IDENTICAL TO THE 5998.

DIRECT INTERELECTRODE CAPACITANCES - APPROX.

WITHOUT EXTERNAL SHIELD

GRID TO PLATE, EACH SECTION: (G TO P)	14.5	pf
INPUT, EACH SECTION: G TO (H + K)	6.5	pf
OUTPUT, EACH SECTION: P TO (H + K)	2.0	pf
HEATER TO CATHODE, EACH SECTION: (H TO K)	11	pf
PLATE, SECTION 1 TO PLATE, SECTION 2: (1P TO 2P)	2.0	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

EACH SECTION

AVERAGE CHARACTERISTICS	6.3	VOLTS	2.4	AMP.
CATHODE HEATING TIME (MINIMUM)			30	SECONDS
HEATER SUPPLY LIMITS:				
VOLTAGE OPERATION			6.3 ± 0.6	VOLTS
MAXIMUM HEATER CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			100	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

EACH SECTION

PLATE VOLTAGE	275	VOLTS
PLATE DISSIPATION	15	WATTS
DC PLATE CURRENT	140	MA.
GRID CIRCUIT RESISTANCE	0.25	MEGOHMS
BULB TEMPERATURE AT HOTTEST POINT [A]	200	°C

AVERAGE CHARACTERISTICS

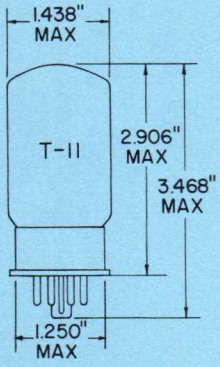
EACH SECTION

PLATE SUPPLY VOLTAGE	110	VOLTS
CATHODE-BIAS RESISTOR	105	OHMS
AMPLIFICATION FACTOR	5.4	
PLATE RESISTANCE, APPROX.	350	OHMS
TRANSCONDUCTANCE	15,500	μMHOS
PLATE CURRENT	100	MA.

[A] FOR OPTIMUM TUBE LIFE, THE BULB TEMPERATURE SHOULD BE MAINTAINED BELOW 150 °C BY FORCED AIR COOLING.

TUNG-SOL

BEAM POWER PENTODE



GLASS BULB
METAL SHELL
SMALL WAFER OCTAL
6 PIN BASE B6-23

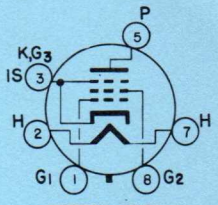
COATED UNIPOTENTIAL CATHODE

HEATER

26.5±2.7 VOLTS 0.28[A] AMP.

[A] AT 26.5 V.

ANY MOUNTING POSITION



BOTTOM VIEW [B]

BASING DIAGRAM
JEDEC 6CK

THE 6000 IS A SINGLE ENDED BEAM POWER PENTODE AMPLIFIER FOR RADIO FREQUENCY APPLICATIONS TO 100 MEGACYCLES. ITS 26.5 VOLT HEATER MAKES IT SUITABLE FOR VEHICULAR OR AIRCRAFT USE. THE RUGGED BUTTON-STEM CONSTRUCTION FEATURES SHORT INTERNAL LEADS AND A LOW-LOSS 6 PIN OCTAL BASE.

DIRECT INTERELECTRODE CAPACITANCES
WITHOUT EXTERNAL SHIELD

GRID TO PLATE: G1 TO P (MAX.)	0.18	pf
INPUT: G1 TO (H+K+G2+BASE SHELL)	15.0	pf
OUTPUT: P TO (H+K+G2+BASE SHELL)	7.0	pf

RATINGS[C]
INTERPRETED ACCORDING TO ABSOLUTE MAXIMUM SYSTEM

CLASS C AMPLIFIER OR OSCILLATOR

HEATER VOLTAGE	26.5±2.7	VOLTS
DC PLATE VOLTAGE	600	VOLTS
DC #2 GRID VOLTAGE	300	VOLTS
DC #1 GRID VOLTAGE-NEGATIVE	-200	VOLTS
DC PLATE CURRENT	125	MA.
DC GRID CURRENT	7	MA.
PLATE INPUT	60	WATTS
PLATE DISSIPATION	25	WATTS
GRID #2 DISSIPATION	4.0	WATTS
HEATER-CATHODE VOLTAGE, POSITIVE OR NEGATIVE	100	VOLTS

[B] AT THE HIGHER FREQUENCIES IT MAY BE DESIRABLE TO GROUND THE METAL BASE SHELL THROUGH A CLAMPING DEVICE.

[C] TO 100 MC.

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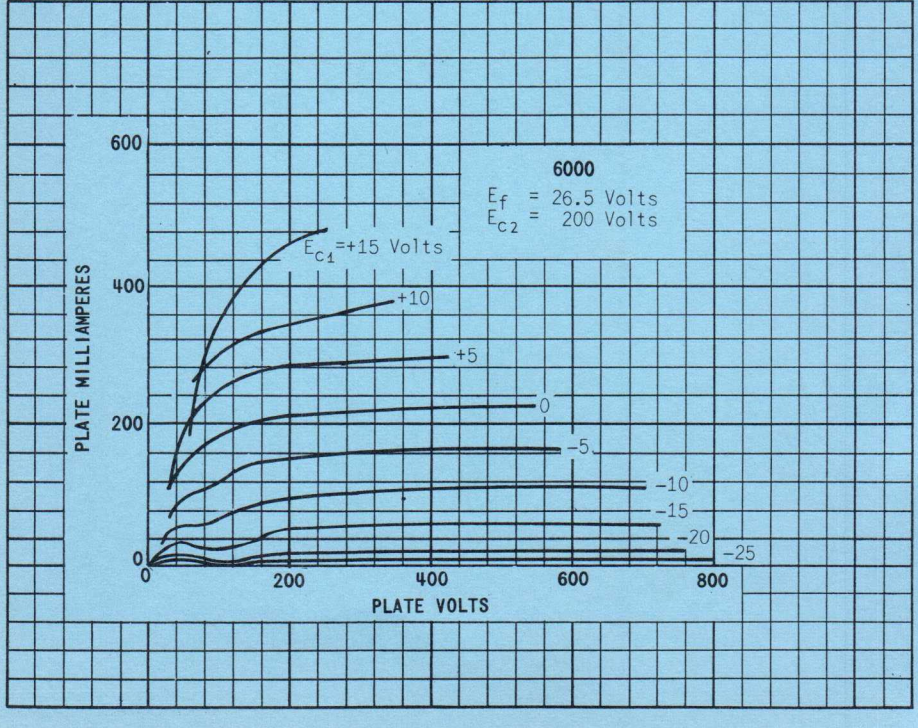
TYPICAL OPERATION

70 MC

PLATE VOLTAGE	400	600	VOLTS
GRID #2 VOLTAGE	200	225	VOLTS
GRID #1 VOLTAGE—DEVELOPED	−60	−60	VOLTS
GRID #1 RESISTOR	12,000	20,000	OHMS
PEAK RF GRID VOLTAGE	75	75	VOLTS
DC PLATE CURRENT	125	100	MA.
DC GRID #2 CURRENT	16	18	MA.
DC GRID #1 CURRENT	5.0	3.0	MA.
DRIVING POWER—MAX.	0.40	0.23	WATTS
POWER OUTPUT	28	35	WATTS

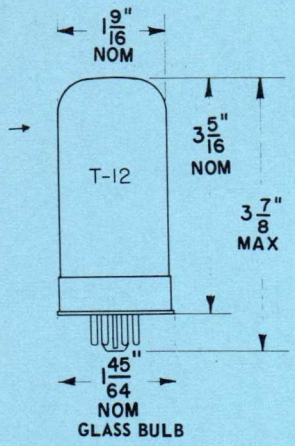
AVERAGE CHARACTERISTICS

TRANSCONDUCTANCE—FOR PLATE CURRENT OF 70 MA.	8000	μMHOS
AMPLIFICATION FACTOR, GRID #2 TO GRID #1	8	



TUNG-SOL

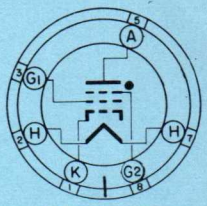
THYRATRON



HEATER

6.3±10% VOLTS 2.6 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW

LARGE WAFER
WITH EXTERNAL BARRIER
6 PIN OCTAL

THE 6012 IS A NEGATIVE CONTROL, XENON FILLED, FOUR ELECTRODE THYRATRON DESIGNED FOR USE IN RELAY AND GRID CONTROLLED RECTIFIER APPLICATIONS. ONE TYPE 6012 WILL CARRY 0.5 AMPERE IN MOTOR-CONTROL AND IN INVERTER SERVICE. USE OF THE SHIELD-GRID TYPE OF CONSTRUCTION PERMITS A VERY LOW PRE-CONDUCTION CONTROL GRID CURRENT TO FLOW. THIS PERMITS THE USE OF A HIGH RESISTANCE IN THE CONTROL GRID CIRCUIT. THE GRID CONTROL CHARACTERISTIC IS INDEPENDENT OF AMBIENT TEMPERATURE OVER THE RANGE FROM -75 TO +90 DEGREES CENTIGRADE DUE TO THE TUBE'S INERT GAS FILLING. THE 6012 MOUNTS IN A STANDARD OCTAL SOCKET.

ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (Ef=6.3 VOLTS)	2.6	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
INTERELECTRODE CAPACITANCES -APPROX.		
ANODE TO CONTROL GRID	0.65	μμf
CONTROL GRID TO CATHODE (AND SHIELD GRID)	6.5	μμf
ANODE TO CATHODE (AND SHIELD GRID)	4.5	μμf
ANODE VOLTAGE DROP - APPROX.	12	VOLTS
MAXIMUM CRITICAL GRID CURRENT (AT Epp=460 VOLTS RMS AND Ib=0.5 AMP.)	3	μAMPS.
IONIZATION TIME - APPROX. ANODE VOLTS = 100, ANODE CURRENT = 5 AMPS., SHIELD GRID VOLTS=0, CONTROL GRID =+50 VOLT SQUARE WAVE PULSE	0.5	μSEC.
DEIONIZATION TIME - APPROX. - NOTE 1 ANODE VOLTS = 125, ANODE CURRENT = 0.5 AMP., SHIELD GRID RESISTOR = 1000 OHMS, CONTROL GRID VOLTS =-13, CONTROL GRID RESISTOR = 1000 OHMS	175	μSEC.
ANODE VOLTS = 125, ANODE CURRENT = 0.5 AMP., SHIELD GRID RESISTOR = 1000 OHMS, CONTROL GRID VOLTS = -100, CONTROL GRID RESISTOR = 1000 OHMS	100	μSEC.

(NOTE 1. CONNECT SHIELD GRID TO CATHODE THROUGH SERIES RESISTOR.)

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MECHANICAL DATA

MOUNTING POSITION	ANY	
BULB	T12	
BASE	LARGE WAFER OCTAL 6 PIN WITH EXTERNAL BARRIER	
MAXIMUM NET WEIGHT	2.5	OUNCES

RATINGS

ABSOLUTE VALUES

FOR ANODE-SUPPLY FREQUENCY OF 60 CPS

MAXIMUM PEAK ANODE VOLTAGE		
FORWARD	650	VOLTS
INVERSE	1300	VOLTS
MAXIMUM CATHODE CURRENT		
PEAK	5	AMP.
AVERAGE -- NOTE 1	0.5	AMP.
SURGE - MAXIMUM DURATION 0.1 SECOND - NOTE 2	20	AMP.
MAXIMUM NEGATIVE CONTROL GRID VOLTAGE		
BEFORE CONDUCTION	200	VOLTS
DURING CONDUCTION -- NOTE 1	10	VOLTS
MAXIMUM POSITIVE CONTROL GRID CURRENT		
AVERAGE -- NOTE 1	0.05	AMP.
MAXIMUM NEGATIVE SHIELD GRID VOLTAGE		
BEFORE CONDUCTION	100	VOLTS
DURING CONDUCTION - NOTE 1	10	VOLTS
MAXIMUM POSITIVE SHIELD GRID CURRENT -- NOTE 1	0.05	AMP.
MAXIMUM HEATER - CATHODE VOLTAGE		
HEATER NEGATIVE	100	VOLTS
HEATER POSITIVE	25	VOLTS
MAXIMUM CONTROL GRID CIRCUIT RESISTANCE	2	MEGOHMS

1. AVERAGED OVER ANY INTERVAL OF 30 SECONDS MAXIMUM.

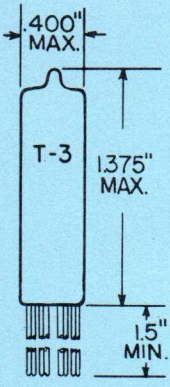
2. THE EQUIPMENT DESIGNER SHOULD LIMIT THE SHORT CIRCUIT CURRENT TO 20 AMPERES CIRCUITWISE. IT SHOULD BE UNDERSTOOD THAT WHILE THE TUBE MAY STAND SEVERAL FAULTS AT THIS MAGNITUDE OF CURRENT, EACH FAULT WILL ADVERSELY AFFECT TUBE LIFE.

→ INDICATES A CHANGE.

TUNG-SOL

TWIN TRIODE

SUBMINIATURE TYPE

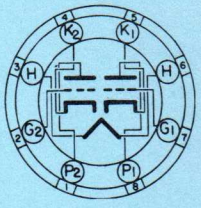


GLASS BULB

COATED UNIPOTENTIAL CATHODE

HEATER
6.3 VOLTS 0.3 AMP.
AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
SUBMINIATURE – 8
FLEXIBLE LEADS
8DG

THE 6021 IS A RUGGEDIZED MEDIUM MU TWIN TRIODE OF THE LIGHT LEAD, BUTTON, ← SUBMINIATURE CONSTRUCTION. THE TUBE MAY BE USED AT FREQUENCIES IN THE UHF REGION, PERMITTING APPLICATIONS SUCH AS UHF AND VHF OSCILLATORS AND MIXERS. CONTROLS ON THE PRODUCT AVERAGE FOR SUCH CHARACTERISTICS AS HEATER CURRENT, PLATE CURRENT, AND TRANSCONDUCTANCE ASSURE THAT THESE CRITICAL CHARACTERISTICS WILL REMAIN WELL CENTERED. SINCE IT MUST BE ABLE TO WITHSTAND SEVERE MECHANICAL TESTS TO MEET THE TEST SEPCIFICATION, THE 6021 IS ESPECIALLY SUITED FOR USE IN INDUSTRIAL AND MILITARY AIR-BORNE EQUIPMENT WHICH MAY BE SUBJECTED TO SEVERE SHOCK AND VIBRATION.

DIRECT INTERELECTRODE CAPACITANCES – EACH SECTION

	WITH SHIELD*	WITHOUT SHIELD	
GRID TO PLATE (RATED)	1.4	1.5	μμf
MAXIMUM	---	1.7	μμf
MINIMUM	---	1.3	μμf
INPUT (RATED)	2.1	2.4	μμf
MAXIMUM	---	2.8	μμf
MINIMUM	---	2.0	μμf
OUTPUT (SECTION #1) (RATED)	1.3	0.28	μμf
MAXIMUM	---	0.33	μμf
MINIMUM	---	0.23	μμf
OUTPUT (SECTION #2) (RATED)	1.4	0.32	μμf
MAXIMUM	---	0.39	μμf
MINIMUM	---	0.25	μμf
MAXIMUM GRID TO GRID (RATED)	0.011	0.013	μμf
MAXIMUM PLATE TO PLATE (RATED)	0.33	0.52	μμf

RATINGS
ABSOLUTE MAXIMUM VALUES

HEATER VOLTAGE	6.3±5%	VOLTS
MAXIMUM DC PLATE VOLTAGE	165	VOLTS
MAXIMUM DC GRID VOLTAGE	0	VOLTS
MAXIMUM HEATER–CATHODE VOLTAGE	±200	VOLTS
MAXIMUM GRID RESISTANCE (EACH SECTION)	1.1	MEGOHM
MAXIMUM DC PLATE CURRENT (EACH SECTION)	22	mA

CONTINUED ON FOLLOWING PAGE

→ INDICATES A CHANGE.

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RATINGS — CONT'D.
ABSOLUTE MAXIMUM VALUES

MAXIMUM DC GRID CURRENT (EACH SECTION)	5.5	mA
MAXIMUM PLATE DISSIPATION (EACH SECTION)	0.7	WATT
MAXIMUM BULB TEMPERATURE	220	°C
MAXIMUM ALTITUDE [A]	60 000	FEET
LIFE EXPECTANCY:		
30°C AMBIENT TEMPERATURE	5 000	HOURS
175°C AMBIENT TEMPERATURE	1 000	HOURS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.3	AMP.
DC PLATE VOLTAGE	100	VOLTS
CATHODE BIAS RESISTOR	150	OHMS
PLATE CURRENT [J]	6.5	Ma
TRANSCONDUCTANCE	5 400	μMHOS
AMPLIFICATION FACTOR	35	
GRID VOLTAGE FOR 10μa PLATE CURRENT	-6.5	VOLTS

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

E_f = 6.3v, E_b = 100Vdc, E_c = 0 Vdc, Rk/k = 150 OHMS
EXCEPT AS MODIFIED BELOW

	INITIAL				500 HOUR LIFE TEST		
	INDIVIDUAL MIN.	INDIVIDUAL MAX.	PROD. MIN.	AVG. MAX.	INDIVIDUAL MIN.	INDIVIDUAL MAX.	
HEATER CURRENT	280	320	288	312	276	328	mA
HEATER-CATHODE LEAKAGE [B] (E_{hk}=±100Vdc)	---	±5.0	---	---	---	±10	μAdc
GRID CURRENT (E_b= 150Vdc, R_k=300, R_{g1}=1.0 MEG.)	0	-0.3	---	---	0	-0.9	μAdc
PLATE CURRENT (1)	4.5	8.5	5.6	7.3	---	---	mAdc
PLATE CURRENT (1) DIFFERENCE BETWEEN SECTIONS	---	1.6	---	---	---	---	mAdc
PLATE CURRENT (2) (E_c=6.5Vdc, R_k=0)	---	100	---	---	---	---	μAdc
TRANSCONDUCTANCE (1)	4450	6350	5000	5800	---	---	μMHOS
CHANGE IN INDIVIDUAL TUBES	---	---	---	---	---	25	PERCENT
AVERAGE CHANGE	---	---	---	---	---	15	PERCENT
INSULATION OF ELECTRODES [C] g-ALL	100	---	---	---	50	---	MEGOHMS
p-ALL	100	---	---	---	50	---	MEGOHMS
Δ TRANSCONDUCTANCE (E_f = 5.7V)	---	15	---	---	---	15	PERCENT
GRID EMISSION [D] (E_f=7.5V, E_c=-7.5Vdc E_b=150Vdc, R_k=0, R_p=1.0MEG)	---	-0.5	---	---	---	---	μAdc
PULSE EMISSION [E] (E_f=6.0V, e PULSE=50V, tp=25 usec, prr=200pps)	300	---	---	---	---	---	ma
AMPLIFICATION FACTOR [F]	30	40	---	---	---	---	

SPECIAL REQUIREMENTS

	MIN.	MAX.	
AF NOISE [GH] (E_{sig}=65mVac, R_g=0.1 meg., R_p=.01 meg., R_k=75, C_k=1000μf)	---	17	VU
LOW PRESSURE VOLTAGE BREAKDOWN [J] (PRESSURE =55±5mm Hg., VOLTAGE =300Vac)	---	---	

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SPECIAL REQUIREMENTS – CONT'D.

	MIN.	MAX.	
VARIABLE FREQUENCY VIBRATION [K] (NO VOLTAGES, POST SHOCK AND VIBRATIONAL FATIGUE TEST END POINTS APPLY)	---	---	
LOW FREQUENCY VIBRATION [MG] (R_p = 10,000, C_k=1,000 μf, F=40cps, G=15)	---	50	mVac
SUBMINIATURE LEAD FATIGUE [N]	4	---	ARCS
SHOCK [P] (HAMMER ANGLE =30°, E_{hk}=+100Vdc, R_g=0.1meg.)	---	---	
VIBRATIONAL FATIGUE [R] (G =2.5; FIXED FREQUENCY; F=25min. 60 max.)			
POST SHOCK AND VIBRATIONAL FATIGUE TEST END POINTS			
LOW FREQUENCY VIBRATION	---	200	mVac
HEATER CATHODE LEAKAGE (E_{hk}=±100Vdc)	---	20	μAdc
Δ TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES	---	20	PERCENT
GLASS STRAIN [S]	---	---	
1 HOUR STABILITY LIFE TEST [G] (E_{hlc}=+200Vdc, R_{g1g}=1.0 meg., TA=ROOM)	---	---	
STABILITY LIFE TEST END POINTS Δ TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES	---	15	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST (STABILITY LIFE TEST CONDITIONS OR EQUIVALENT TA=ROOM)	---	---	
SURVIVAL RATE LIFE TEST END POINTS CONTINUITY AND SHORTS (INOPERATIVES)	---	---	
TRANSCONDUCTANCE (1)	---	4 000	μMHOS
HEATER CYCLING LIFE TEST [U] (E_f=7.0V, 1 min. on, 4 min. off, E_{hk}=140Vac, E_c= E_b=0)	---	---	
INTERMITTENT LIFE TEST (STABILITY LIFE TEST CONDITIONS, BULB TEMP = 220°C)	---	---	

NOTES

[A] IF ALTITUDE RATING IS EXCEEDED, REDUCTION OF INSTANTANEOUS VOLTAGES (Ef EXCLUDED) MAYBE REQUIRED.

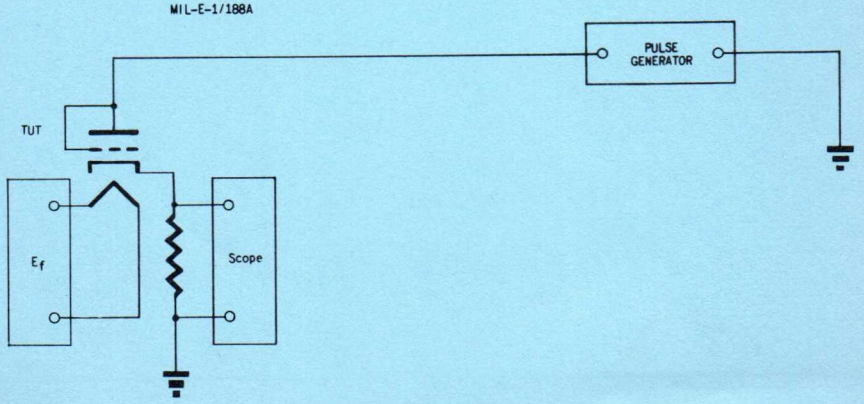
[B] SEE MIL-E-1C 4.10.15

[C] SEE MIL-E-1C 4.8.2

[D] PRIOR TO THIS TEST PRE-HEAT TUBES FOR 5 MINUTES WITH BOTH SECTIONS OPERATING SEPARATELY AT CONDITIONS LISTED BELOW. TEST IMMEDIATELY AFTER PRE-HEATING. (E_f=7.5V, E_c=0Vdc, E_b=150 Vdc, Rk=300 OHMS, R_g=1.0 MEG).

[E] THE PULSE IS ESSENTIALLY A SQUARE WAVE WITH 1.0 USEC RISE TIME AND 0.8 USEC FALL. THE PULSE SHALL BE APPLIED TO PLATE AND GRID TIED TOGETHER. PULSE EMISSION SHALL BE MEASURED IN TERMS OF VOLTAGE DEVELOPED ACROSS A 1.0 OHM RESISTOR IN THE CATHODE CIRCUIT. TEST LIMIT AS MEASURED BY THE LEADING EDGE OF A CALIBRATED TRACE. THE AMPLITUDE OF THE TRAILING EDGE OF WHICH SHALL NOT VARY BY MORE THAN 20% FROM THE VALUE OF THE LEADING EDGE. TEST EACH UNIT SEPARATELY.

MIL-E-1/188A



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NOTES - CONT'D.

F SEE MIL-E-1C 4.10.11.1

G TIE 1K TO 2K, 1g TO 2g, AND 1p TO 2p.

H SEE MIL-E-1C 4.10.3.2

J THERE SHALL BE NO EVIDENCE OF ARCING OR CORONA BETWEEN ANODE PINS AND ADJACENT PINS WITH NO OTHER VOLTAGES APPLIED.

K SEE MIL-E-1C 4.9.20.3

M SEE MIL-E-1C 4.9.19.1

N SEE MIL-E-1C 4.9.5.3

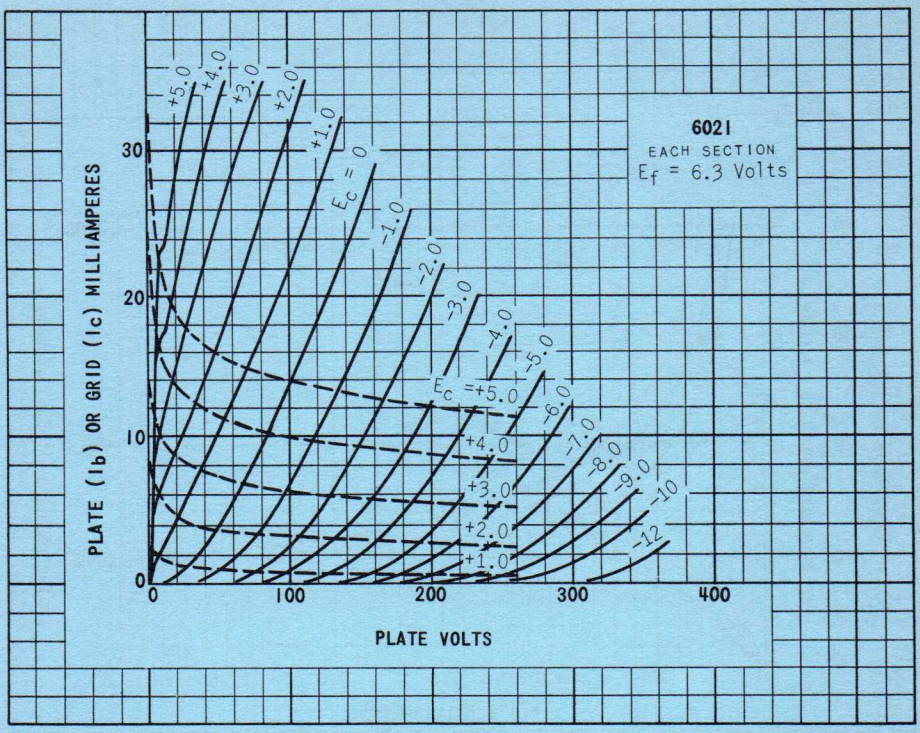
P SEE MIL-E-1C 4.9.20.5

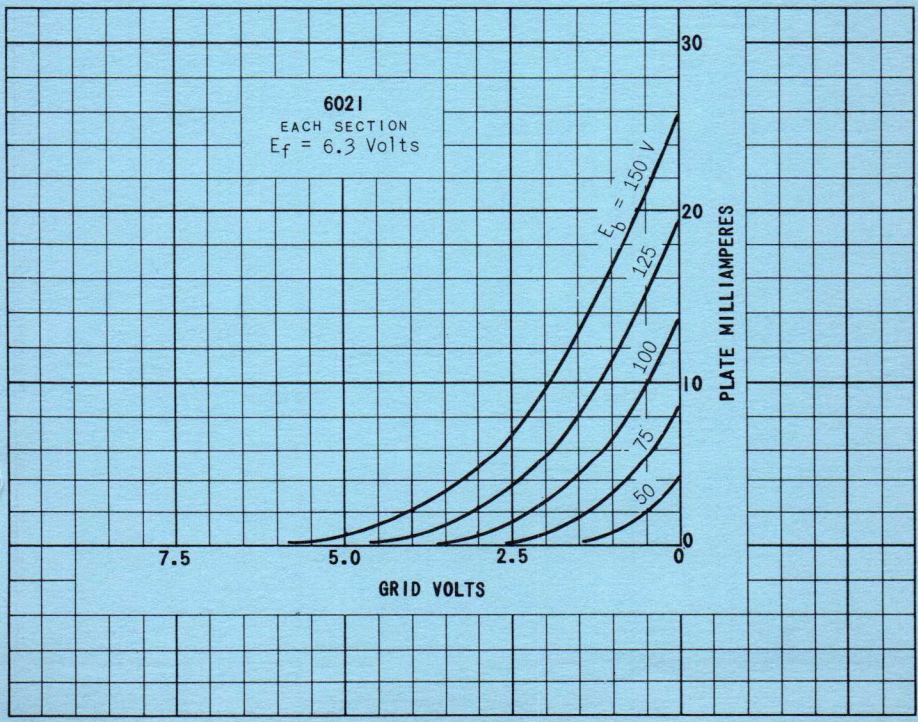
R SEE MIL-E-1C 4.9.20.6

S ALL TUBES SHALL HAVE BEEN SEALED A MINIMUM OF 48 HOURS PRIOR TO CONDUCTING THIS TEST. TUBES SHALL BE AT ROOM TEMPERATURE. ENTIRE TUBE SHALL BE IMMERSED IN WATER NOT LESS THAN 85° C FOR 15 SECONDS AND IMMEDIATELY THEREAFTER IMMERSED IN ICE WATER NOT MORE THAN 50° C FOR 5 SECONDS. TUBES SHALL BE PLACED IN WATER SO THAT NO CONTACT IS MADE WITH THE CONTAINING VESSEL NOR EACH OTHER. TUBES SHALL THEN BE REMOVED AND ALLOWED TO COOL AT ROOM TEMPERATURE ON A WOODEN SURFACE. THE TUBES SHALL BE ALLOWED TO COOL FOR 48 HOURS AND THEN BE INSPECTED FOR EVIDENCE OF AIR LEAKS.

U THE REGULATION OF THE HEATER VOLTAGE SHALL NOT BE MORE THAN 3.0 PERCENT.

* WITH SHIELD OF 0.405" INSIDE DIAMETER CONNECTED TO CATHODE OF SECTION UNDER TEST.





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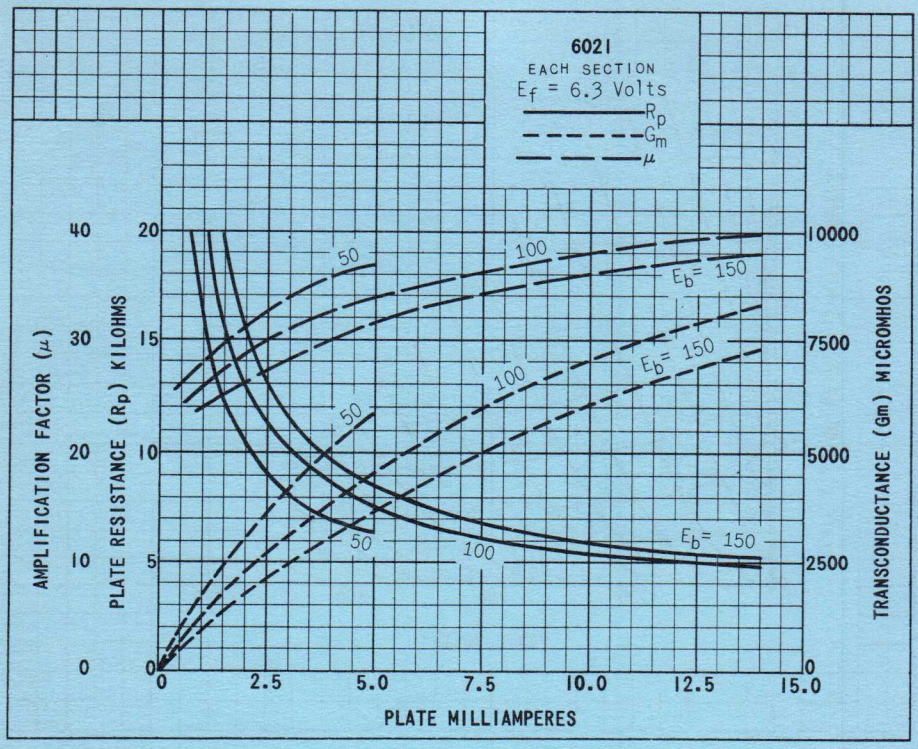
6021
EACH SECTION
E_f = 6.3 Volts
R_p
G_m
μ
AMPLIFICATION FACTOR (μ)
PLATE RESISTANCE (R_p) KILOHMS
TRANSCONDUCTANCE (Gm) MICROMHOS
PLATE MILLIAMPERES
0
2.5
5.0
7.5
10.0
12.5
15.0
40
30
20
10
0
20
15
10
5
0
10000
7500
5000
2500
0
50
100
E_b= 150
50
100
E_b= 150
50
100
E_b= 150

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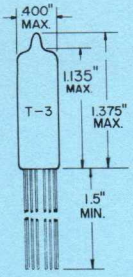
DOUBLE TRIODE

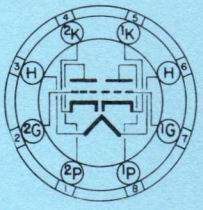
SUBMINIATURE TYPE



GLASS BULB

HEATER

ANY MOUNTING POSITION



BOTTOM VIEW
SUBMINIATURE BUTTON
8PIN
0.017" TINNED
FLEXIBLE LEADS

8DG

THE 6021WA IS A HEATER-CATHODE TYPE MEDIUM-MU DOUBLE TRIODE OF SUBMINIATURE CONSTRUCTION CAPABLE OF OPERATION IN THE UHF REGION. IT IS DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED. THE FLEXIBLE LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO THE TERMINALS OF CIRCUIT COMPONENTS WITHOUT THE USE OF SOCKETS. STANDARD 8 PIN SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE LEADS TO A SUITABLE LENGTH.

RATINGS
MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST-NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HR. FATIGUE TEST-NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS
AND NORMAL OPERATION

	MIL-E-1 SYMBOL	DES. MIN.	NORM. TEST CONDITIONS NOTE 7	NORM. OPERATION NOTE 6	DES. MAX.	MIL-E-1 UNITS
HEATER VOLTAGE (NOTE 8)	Ef:	6.0	6.3	6.3	6.6	V
PLATE VOLTAGE	Eb:	---	100	100	250	Vdc
PEAK PLATE VOLTAGE	eb:	---	---	---	360	v
GRID VOLTAGE	Ec1:	-55	0	0	---	Vdc
PLATE DISSIPATION (PER PLATE)	Pp/p:	---	---	0.65	0.7	W
GRID #1 CIRCUIT RESISTANCE	Rg/g:	---	---	1.0	1.1	MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200	---	100	+200	Vdc
PLATE CURRENT (PER PLATE)	Ib/p:	0.5	---	6.5	22	mAdc
GRID CURRENT (PER GRID)	Ic/c:	---	---	---	5.5	mAdc
CATHODE RESISTANCE (PER UNIT)	Rk:	---	150	150	---	OHMS
TRANSCONDUCTANCE (PER PLATE)	Sm/p:	---	---	5400	---	μMHOS
AMPLIFICATION FACTOR	Mu/p:	---	---	35	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOG	UAL	MAX.	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1	COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES								
HEATER CURRENT:	0.4	If:	285	---	---	---	315	---	mA.
HEATER-CATHODE LEAKAGE (1):									
Ehk=+100 Vdc	0.4	Ihk(1):	---	---	---	---	3.5	---	μAdc
Ehk=−100 Vdc		Ihk(1):	---	---	---	---	3.5	---	μAdc
GRID CURRENT:									
Eb=150 Vdc; Rk/k=300 OHMS; Rg=1.0 MEG.	0.4	Ic(1):	---	---	---	---	−0.3	---	μAdc
PLATE CURRENT (1):	0.4	Ib(1):	4.5	5.6	6.5	7.3	8.5	2.3	mAdc
PLATE CURRENT (2):									
Ec1=−6.5 Vdc	0.4	Ib(2):	---	---	---	---	100	---	μAdc
TRANSCONDUCTANCE (1):	0.4	Sm(1):	4450	5000	5400	5800	6350	1100	μMHOS
CONTINUITY TO SHORTS (NOTE 11) (INOPERATIVES):	0.4	---	---	---	---	---	---	---	---
MECHANICAL:									
ENVELOPE (8-1)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS PART 2									
INSULATION OF ELECTRODES:									
Ef=6.3 V									
Eg-all=−100 Vdc	2.5	Rg1-all:	250	---	---	---	---	---	MEG.
Ep-all=−300 Vdc		Rp-all:	250	---	---	---	---	---	MEG.
PLATE CURRENT (1) DIFFERENCE BETWEEN SECTIONS:	2.5	Ib:	---	---	---	---	1.5	---	mAdc
TRANSCONDUCTANCE (2):									
Ef=5.7 V; (NOTE 9)	2.5	Δ_{Ef}Sm(2):	---	---	---	---	10	---	PERCENT
GRID EMISSION:									
Eb=250 Vdc; Rg/g=1.0 MEG; Rk/k=2200 OHMS; Ef=7.5 V; PREHEAT 5 MINUTES AT Ec=0; TEST AT Ec=−9.0 Vdc	6.5	Isc1:	---	---	---	---	−0.5	---	μAdc
AF NOISE:									
Esig=65 mVac; Rg=0.1 MEG.; Rp=0.01 MEG., Rk=75 OHMS: Ck=1000 μf; UNITS CONNECTED IN PARALLEL	2.5	EB:	---	---	---	---	17	---	VU
PULSE EMISSION (1):									
Eb=150 Vdc; Ec1=−25 Vdc; Egk=+30 V; Rk/k=1.0 OHM; DUTY CYCLE = 1%; tp= 10 μsec (NOTE 12)	2.5	ik:	320	---	---	---	---	---	ma.
		Δ_{tp}ik:	---	---	---	---	10	---	PERCENT

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]-cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2 (CONT'D.)									
			COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES						
PULSE EMISSION (2): Ef=5.9V; Eb=150 Vdc; Ec1=-25 Vdc; tp=10μsec, DUTY CYCLE =1%; egk=+30 V; Rk/k=1.0 OHMS; (NOTE 12)	6.5	ik:	300	---	---	---	---	---	ma.
HEATER-CATHODE LEAKAGE (2): Ef=-6.7 V (PIN 6 NEGATIVE); Ehk=+100 Vdc (CATHODE NEG.) t=16 SECONDS (NOTE 13)	6.5	Ihk(2):	---	---	---	---	1.0	---	μAdc
AMPLIFICATION FACTOR:	6.5	mu:	30	---	35	---	40	---	---
CAPACITANCE		Cgp:	1.2	---	1.5	---	1.8	---	μμf
CAPACITANCE:		Cin:	1.8	---	2.4	---	3.0	---	μμf
CAPACITANCE (NOTE 2)	6.5	Cout: (UNIT #1):	0.20	---	0.28	---	0.36	---	μμf
CAPACITANCE:		Cout (UNIT #2):	0.22	---	0.32	---	0.42	---	μμf
CAPACITANCE:		Cgg:	---	---	---	---	0.013	---	μμf
CAPACITANCE:		Cpp:	---	---	---	---	0.52	---	μμf
OPERATION TIME: (NOTE 10)	4.0	t:	---	---	---	---	20	---	SEC.
LOW PRESSURE VOLTAGE BREAKDOWN: PRESSURE =21 ±3 mmHg; VOLTAGE = 300 Vac.	6.5	---	---	---	---	---	---	---	---
VIBRATION (2): F=40 cps; G=15; Rp=10,000 OHMS	2.5	Ep:	---	---	---	---	20	---	mVac
VIBRATION (3): F=70-2000; t=3 MINUTES; G=15; Rp=10,000 OHMS. POSITIONS X_1 AND X_2 ONLY.	6.5	ep:	---	---	---	---	125 (PEAK TO PEAK)	---	mv.
DEGRADATION RATE ACCEPTANCE TESTS									
SUBMINIATURE LEAD FATIGUE:	2.5	---	4.0	---	---	---	---	---	arcs
SHOCK (1): Ehk=+100 Vdc; Rg=0.1 MEG.; HAMMER ANGLE = 30°; (NOTE 3)	20	---	---	---	---	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOWABLE DEF. PER CHARACT. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
DEGRADATION RATE ACCEPTANCE TESTS (CONT'D.							
FATIGUE (1): 96 HOURS; G=2.5; FIXED FREQUENCY; F=25 MIN., 60 MAX. (NOTE 5)			6.5	---	---	---	---
SHOCK (2): Ehk=100 Vdc; Rg=0.1 MEG.; HAMMER ANGLE=120°+RUBBER PAD; t=10 MILLISECONDS; G=75; (NOTE 15)			20	---	---	---	---
FATIGUE (2): 6 HOURS; G=10; F=130-2000-130 cps (NOTE 14)			6.5	---	---	---	---
POST SHOCK (1) & (2) AND FATIGUE (1) & (2) TEST END POINTS:							
VIBRATION (2): F=40cps; G=15; Rp=10,000 OHMS			---	Ep:	---	80	mVac
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc			---	Ihk(1):	---	7.0	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	7.0	μAdc
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:							
Ef=6.3 V			---	Δ_tSm(1):	---	15	PERCENT
GRID CURRENT (1):			---	Ic1:	---	-1.0	μAdc
GLASS STRAIN (THERMAL SHOCK):			6.5	---	---	---	---
ACCEPTANCE LIFE TEST							
HEATER CYCLING LIFE TEST: Ef=7.0 V; Eb=Ec1=0V; Ehk=140 Vac; 1 MIN ON, 4 MIN OFF			1.0	---	2000	---	CYCLES
HEATER CYCLE LIFE TEST END POINT:							
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc			---	Ihk(1):	---	7.0	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	7.0	μAdc
2 & 20 HOUR STABILITY LIFE TEST: TA=ROOM; Ehk=+200 Vdc; Rg/g=1.0 MEG.			---	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]- cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOWABLE DEF. PER CHARACTER. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (CONT'D.)							
2 & 20 HOUR STABILITY LIFE TEST END POINTS:							
CHANGE IN TRANS-CONDUCTANCE (1) OF INDIVIDUAL TUBES: (TYPICAL SAMPLE SIZE = 50 TUBES)			1.0	Δ_tSm(1):	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST:							
TA=ROOM; Ehk=+200 Vdc; Rg/g=1.0 MEG.			---	---	---	---	---
100 HOUR SURVIVAL RATE LIFE TEST END POINTS:							
(TYPICAL SAMPLE SIZE=200 TUBES)							
INOPERATIVES:			0.65	---	---	---	---
TRANSCONDUCTANCE (1):			1.0	Sm(1):	4000	---	μMHOS
200 HOUR INTERMITTENT LIFE TEST (1):							
Eb=250 Vdc; Ehk=+200 Vdc; Rg/g=1.0 MEG; Rk/k=2200 OHMS; TA=ROOM	---	---	---	---	---	---	---
200 HOUR INTERMITTENT LIFE TEST (1) END POINTS:							
(TYPICAL SAMPLE SIZE =20 TUBES 1st SAMPLE, 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-0.9	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
CHANGE IN TRANS-CONDUCTANCE (1) OF INDIVIDUAL TUBES:	1	3	---	Δ_tSm(1):	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	Δ_{Ef}Sm(2):	---	20	PERCENT
HEATER=CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
ELECTRODE INSULATION:							
g-all:	1	3	---	Rg1-all:	100	---	MEG.
p-all:			---	Rp-all:	100	---	MEG.
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
500 HOUR INTERMITTENT PULSE LIFE TEST:							
Eb=250 Vdc; Ec1=-25 Vdc; Rk/k=0; RL/p=330 OHMS; tp=10μsec.; DUTY CYCLE= 1.0%; egk=+30±1v; TA=ROOM.	---	---	---	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]-cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHAR.		AQL	MIL-E-1			MIL-E-1
ACCEPTANCE LIFE TESTS (CONT'D.)	1st SAMP.	COMB. SAMP.	%	SYMBOL	MIN.	MAX.	UNITS
500 HOUR INTERMITTENT PULSE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
PULSE EMISSION (1):	1	3	---	ik:	300	---	ma.
CHANGE IN PULSE EMISSION (1) OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δ_{ik}:	---	-35	PERCENT
			---	Δ_{ik}:	---	+50	PERCENT
TOTAL DEFECTIVES:	2	5	---	---	---	---	---
INTERMITTENT HIGH TEMPERATURE LIFE TEST (2): T BULB=220°C; Ehk=+200 Vdc; Rg/g=1.0 MEG.	---	---	---	---	---	---	---
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST (2) END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-0.7	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δ_tSm(1):	---	20	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	Δ_{Ef}Sm(2):	---	15	PERCENT
HEATER-CATHODE LEAKAGE (1): Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES: g-all	1	3	---	Rg1-all:	50	---	MEG.
p-all			---	Rp-all:	50	---	MEG.
TRANSCONDUCTANCE (1) AVERAGE CHANGE:	---	---	---	Avg Δ_tSm:	---	15	PERCENT
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
1000 HOUR HIGH TEMPERATURE LIFE TEST (2) END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS [1] - cont'd.

IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC. 1st SAMP.	2nd. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (CONT'D.)							
GRID CURRENT (1):	1	3	---	Ic(1):	---	-1.0	μAdc
HEATER-CURRENT	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES:	1	3	---	$\Delta_t Sm(1)$:	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef} Sm(2)$:	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
ELECTRODE INSULATION:							
g-all:	2	5	---	Rg1-all:	25	---	MEG.
p-all:			---	Rp-all:	25	---	MEG.
TOTAL DEFECTIVES:	4	8	---	---	---	---	---

NOTES

1. CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1, AND MIL-STD-105A.
2. WITHOUT SHIELD
3. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.
4. CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.
5. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.
6. THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.
7. THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.
8. FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY ±5% HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.

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NOTES - CONT'D.

9. CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef=6.3 V TO THAT VALUE MEASURED AT Ef=5.7 V.

10. OPERATION TIME IS THE TIME IN SECONDS REQUIRED FOR THE PLATE CURRENT TO ATTAIN A VALUE WITHIN ±10% OF THE THREE (3) MINUTE PLATE CURRENT (1) VALUE MEASURED AT PLATE CURRENT (1) TEST CONDITIONS. NO PREHEATING BEFORE THIS TEST IS ALLOWED. A COLD TUBE MUST BE USED.

11. DURING BOTH CONTINUITY AND SHORT TESTING, THE TUBE UNDER TEST SHALL BE TAPPED AT LEAST THREE TIMES IN EACH OF TWO PLANES 90° APART WITH A TAPPER WHICH SHALL BE ADJUSTED TO GIVE AN IMPULSE OF APPROXIMATELY ONE HALF SINE WAVE OF 300±50 MICRO SECONDS DURATION AND HAVING A MINIMUM AVERAGE AMPLITUDE OF 80 G's PEAK ACCELERATION AS MEASURED WITH A GULTON A-305 ACCELEROMETER AND KA-1 KIT. THE SHORTS DETECTING EQUIPMENT SHALL BE A DEVICE CAPABLE OF DETECTING AS SHORTS, THE FOLLOWING INTERELEMENT RESISTANCES OF THE GIVEN TIME DURATION.

DURATION	SENSITIVITY
PERMANENT SHORT	600,000 OHMS
500 MICROSECONDS	500,000 OHMS
100 MICROSECONDS	100,000 OHMS
60 MICROSECONDS	1 000 OHMS

TUBES WHICH GIVE AN INDICATION OF ONE OR MORE OF THE FOLLOWING SHALL BE REJECTED AS INOPERABLE:

A) EITHER A PERMANENT OR TAP SHORT AT ANY TIME DURING THE TAPPING PROCEDURE.
B) ANY OPEN CIRCUIT
C) AIR LEAKS

12. PEAK CATHODE CURRENT SHALL BE MEASURED BY MEANS OF A HIGH IMPEDANCE OSCILLOSCOPE OR EQUIVALENT DEVICE CONNECTED ACROSS A 1.0±1% CATHODE RESISTOR. THE SPECIFIED LIMIT REFERS TO THE MAXIMUM OF THE PULSE AMPLITUDE. THE VARIATION OF THE OUTPUT PULSE AMPLITUDE BETWEEN 20% AND 80% TP SHALL NOT EXCEED THE SPECIFIED LIMIT.

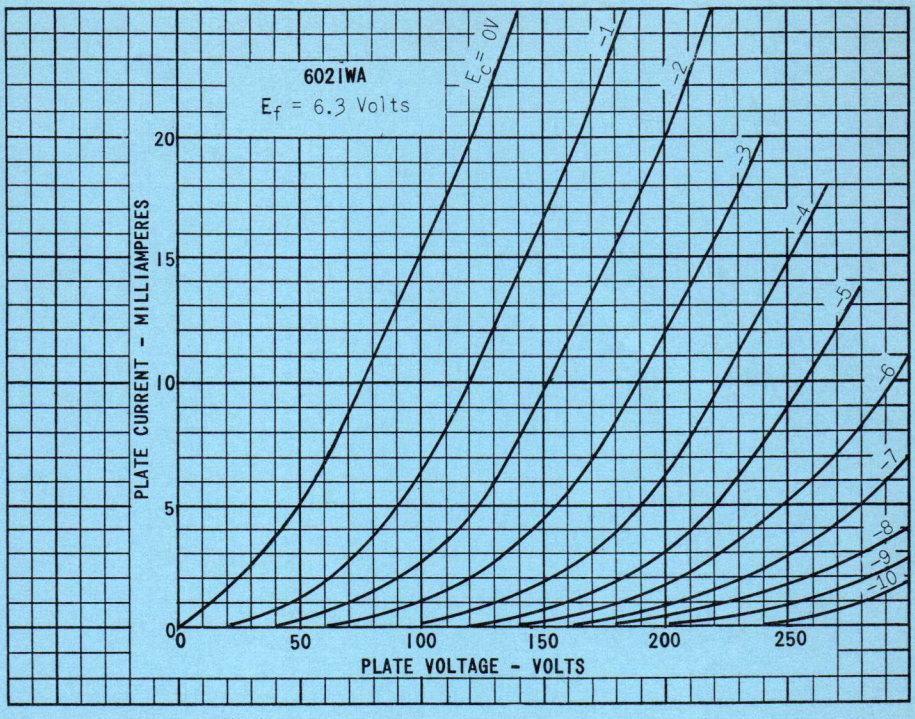
13. HEATER-CATHODE LEAKAGE (2) IS PERFORMED AS FOLLOWS:

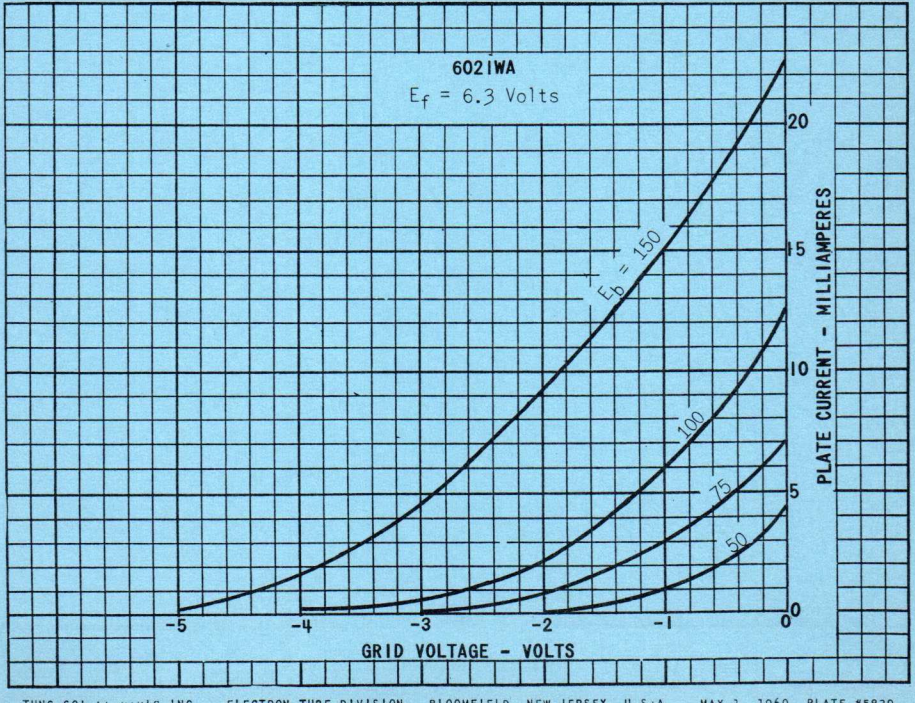
A) PREHEAT TUBES FOR 10 SECONDS WITH Ef=10.5 V.
B) TEST IMMEDIATELY BY THE APPLICATION OF THE SPECIFIED TEST CONDITIONS OF THIS TEST.
C) AFTER 16 SECONDS READ HEATER-CATHODE LEAKAGE OF EACH SECTIONS.

14. THE TUBES SHALL BE RIGIDLY MOUNTED ON A TABLE VIBRATING WITH SIMPLE HARMONIC MOTION. THE TUBES SHALL BE VIBRATED FOR A TOTAL OF 6 HOURS, 2 HOURS IN EACH OF THREE POSITIONS, X1, X2, AND Y1. ONLY RATED HEATED VOLTAGE SHALL BE APPLIED. TUBES WHICH SHOW ONE OR MORE OF THE FOLLOWING DEFECTS SHALL BE CONSIDERED FAILURES.

A) TUBES WHICH SHOW PERMANENT OR TAP SHORTS OR OPEN CIRCUITS FOLLOWING FATIGUE TEST, WHEN TESTED AS SPECIFIED IN 4.7.2 AND 4.7.3.
B) TUBES WHICH DO NOT COMPLY WITH POST FATIGUE LIMITS. THIS IS A DESTRUCTIVE TEST.

15. THE PROVISIONS OF PARAGRAPH 4.9.20.5 OF SPECIFICATION MIL-E-1 SHALL APPLY, EXCEPT FOR TEST CONDITIONS LISTED FOR SHOCK TEST (2).





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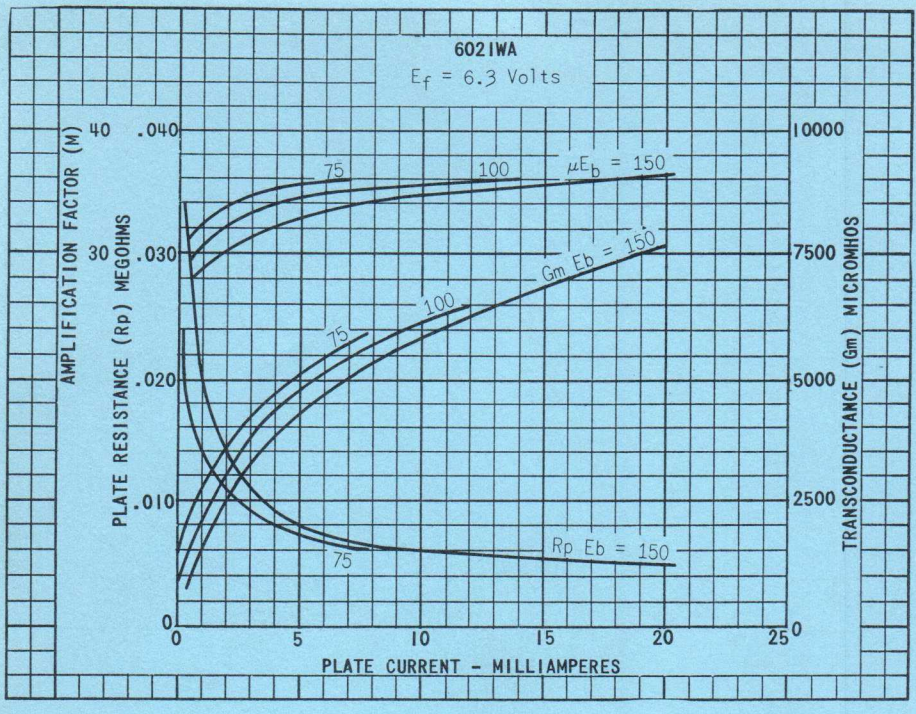
6021WA
Ef = 6.3 Volts
AMPLIFICATION FACTOR (M)
PLATE RESISTANCE (Rp) MEGOHMS
TRANSCONDUCTANCE (Gm) MICROMHOS
PLATE CURRENT - MILLIAMPERES
μEb = 150
Gm Eb = 150
Rp Eb = 150
75
100
75
100
75
40
30
.040
.030
.020
.010
0
10000
7500
5000
2500
0
0
5
10
15
20
25

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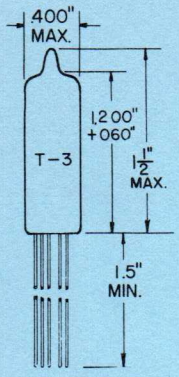
TRIODE

SUBMINIATURE



GLASS BULB

BASE - SAME AS E8-10 EXCEPT LEADS 1, 2, & 6 REMOVED

OUTLINE DRAWING

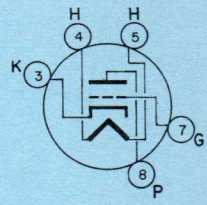
JEDEC 3-2

COATED UNIPOTENTIAL CATHODE

FOR RADIOSONDE SERVICE

OSCILLATOR AT 400 MC

ANY MOUNTING POSITION



BOTTOM VIEW

THE 6026 IS A HIGH-EFFICIENCY OSCILLATOR TRIODE IN A ROUND SUBMINIATURE CONSTRUCTION WITH 5 FLEXIBLE LEADS. IT IS INTENDED PARTICULARLY FOR TRANSMITTING SERVICE IN RADIOSONDE AND SIMILAR APPLICATIONS. AS A CLASS C OSCILLATOR IN SUCH SERVICE, THE TUBE CAN DELIVER A USEFUL POWER OUTPUT OF 1.25 WATTS.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE	1.3	pf
INPUT	2.0	pf
OUTPUT	0.42	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	200	MA.
HEATER SUPPLY LIMITS:			
VOLTAGE OPERATION		5.2 TO 6.6	VOLTS
MAXIMUM PEAK HEATER-CATHODE VOLTAGE		0	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

OSCILLATOR - CLASS C TELEGRAPHY

DC PLATE VOLTAGE	150	VOLTS
DC GRID VOLTAGE	-50	VOLTS
TOTAL CATHODE CURRENT	40	MA.
DC GRID CURRENT	10	MA.
PLATE INPUT	3.3	WATTS
PLATE DISSIPATION	3.0	WATTS

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TYPICAL OPERATING CHARACTERISTICS

AS OSCILLATOR AT 400 MC

DC PLATE VOLTAGE	135	VOLTS
GRID RESISTOR	1300	OHMS
DC PLATE CURRENT	20	MA.
DC GRID CURRENT (APPROX.)	9.5	MA.
USEFUL POWER OUTPUT	1.25	WATTS

CLASS A_1 AMPLIFIER

PLATE VOLTAGE	120	VOLTS
CATHODE RESISTOR	220	OHMS
AMPLIFICATION FACTOR	24	
PLATE RESISTANCE	4000	OHMS
TRANSCONDUCTANCE	5900	μMHOS
PLATE CURRENT	12	MA.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	NOTE	MIN.	MAX.	
HEATER CURRENT:				
WITH 5.2 VOLTS AC ON HEATER	---	0.176	---	AMP.
WITH 6.6 VOLTS AC ON HEATER	---	---	0.225	AMP.
AMPLIFICATION FACTOR	1	17	31	
GRID-TO-PLATE CAPACITANCE	---	1.05	1.55	pf
GRID-TO-CATHODE CAPACITANCE	---	1.55	2.45	pf
PLATE-TO-CATHODE CAPACITANCE	---	0.345	0.495	pf
PLATE CURRENT	2	8	16	MA.
PLATE CURRENT	3	9.5	18.5	MA.
PLATE CURRENT	4	---	300	μAMP.
TRANSCONDUCTANCE	2	4200	7600	μMHOS
TRANSCONDUCTANCE	3	4600	8000	μMHOS

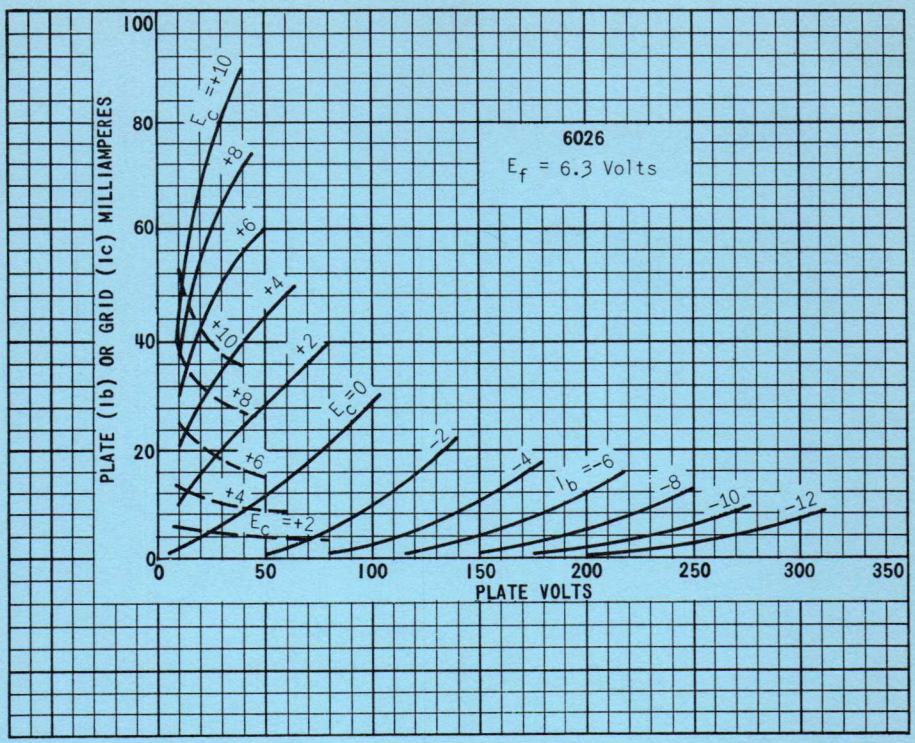
1. WITH 5.2 OR 6.3 VOLTS AC ON HEATER, 120 VOLTS DC ON PLATE, AND CATHODE RESISTOR OF 220 OHMS.

2. WITH 5.2 VOLTS AC ON HEATER, 120 VOLTS DC ON PLATE, AND CATHODE RESISTOR OF 220 OHMS.

3. WITH 6.3 VOLTS AC ON HEATER, 120 VOLTS DC ON PLATE, AND CATHODE RESISTOR OF 220 OHMS.

4. WITH 5.2 VOLTS AC ON HEATER, 120 VOLTS DC ON PLATE, -12 VOLTS DC ON GRID, AND CATHODE RESISTOR OF 220 OHMS.

A HEATER VOLTAGE RANGE AND MAXIMUM RATINGS ARE ESTABLISHED ON BASIS THAT TUBE HEATER WILL BE SUPPLIED FROM BATTERIES IN RADIOSONDE AND SIMILAR APPLICATIONS UTILIZING EQUIPMENT DESIGNED FOR EXTREME COMPACTNESS AND LIGHT WEIGHT AND REQUIRING TUBE LIFE OF ONLY A FEW HOURS.



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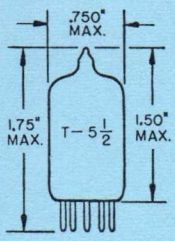
OUTLINE DRAWING
JEDEC 5-1



GLASS BULB
MINIATURE BUTTON
7 PIN E7-1

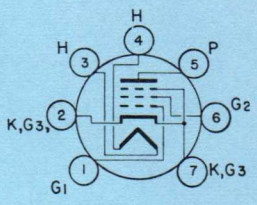
PENTODE

MINIATURE TYPE
FOR
COMMERCIAL AND INDUSTRIAL
RF APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION

BASING DIAGRAM
JEDEC 7BD



BOTTOM VIEW

THE 6028 IS A SHARP-CUTOFF PENTODE IN THE 7 PIN MINIATURE CONSTRUCTION. IT IS INTENDED FOR RF APPLICATIONS WHERE A HIGH DEGREE OF RELIABILITY IS REQUIRED. THE TUBE IS CHARACTERIZED BY LONG LIFE AND STABLE PERFORMANCE.

DIRECT INTERELECTRODE CAPACITANCES

WITH SHIELD #316 CONNECTED TO CATHODE

GRID 1 TO PLATE	MAX.	0.02	pf
INPUT		3.9	pf
OUTPUT		2.85	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	20.0	VOLTS	50	mA
LIMITS OF APPLIED VOLTAGE			20.0±1.0	VOLTS
HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			75	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			75	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM RATINGS – SEE EIA STANDARD RS-239

PLATE VOLTAGE	200	VOLTS
GRID 2 SUPPLY VOLTAGE	155	VOLTS
GRID 2 VOLTAGE	SEE RATING CHART	
CATHODE CURRENT	20	mA
PLATE DISSIPATION	1.85	WATTS
GRID 2 DISSIPATION FOR GRID 2 VOLTAGES UP TO 77.5 VOLTS	0.55	WATT

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CHARACTERISTICS

CLASS A1 AMPLIFIER

PLATE SUPPLY VOLTAGE	120	VOLTS
GRID 2 SUPPLY VOLTAGE	120	VOLTS
CATHODE RESISTOR (FIXED BIAS NOT RECOMMENDED)	200	OHMS
GRID 1 VOLTAGE	0	VOLTS
PLATE CURRENT	7	mA
GRID 2 CURRENT	2.25	mA
TRANSCONDUCTANCE	4,950	μMHOS
PLATE RESISTANCE (APPROX.)	0.34	MEGOHM
GRID 1 VOLTAGE FOR I_b = 200 μA MAX.	-10	VOLTS



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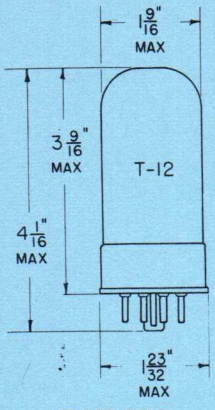
TWIN TRIODE



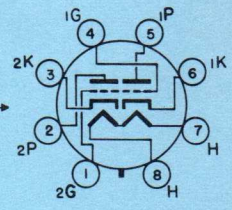
GLASS BULB
LARGE WAFER OCTAL
WITH METAL SLEEVE 88-86

HEATER

6.3±5% VOLTS 2.5 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 8BD

THE 6080WA IS A RUGGED VERSION OF THE POPULAR 6080, MANUFACTURED UNDER THE RELIABLE TUBE PROGRAM. IN THIS PROGRAM, TUBES ARE HANDLED IN LOTS WITH MANY DESTRUCTIVE TESTS PERFORMED ON RANDOMLY SELECTED SAMPLES. THUS A TUBE MAY PASS ALL REQUIRED TESTS AND STILL BE REJECTED IF IT IS FROM AN UNSATISFACTORY LOT.

WITH THE MOUNT SHOCK ISOLATED FROM THE BULB BY NINE METAL SPRING CLIPS. AND BY THE USE OF HEAVY DUTY PARTS, THE TUBE WILL WITHSTAND A SHOCK IMPULSE OF 450G AND A VIBRATION AT 50CPS (D=.08"). OTHER FEATURES ARE HIGH ALTITUDE RATING, HIGH BULB TEMPERATURE LIMITS, AND LONG LIFE TESTS WITH MANY LIFE TEST END POINTS. PLATE CURRENT AND TRANSCONDUCTANCE ARE HELD TO CLOSE LIMITS TO PROVIDE GREATER BALANCE BETWEEN TUBE SECTIONS. THIS IS ESPECIALLY ADVANTAGEOUS WHEN MANY TUBES ARE TO BE PARALLELED IN REGULATED POWER SUPPLY SERVICE.

THIS TUBE CAN BE USED FOR ANY APPLICATION REQUIRING HIGH PLATE CURRENT AT LOW PLATE VOLTAGES. IT HAS FOUND WIDE USE IN ELECTRONICALLY REGULATED POWER SUPPLIES.

→ INDICATES A CHANGE.

ELECTRICAL DATA

HEATER VOLTAGE	6.3±5%	VOLTS
HEATER CURRENT (E_f=6.3VOLTS)	2.5	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	7 000	μMHOS
AMPLIFICATION FACTOR	2.0	
INTER ELECTRODE CAPACITIES PER TRIODE SECTION		
GRID TO CATHODE	6.2	μμf
GRID TO PLATE	8.4	μμf
CATHODE TO PLATE	2.2	μμf
HEATER TO CATHODE	6.3	μμf
INTER ELECTRODE CAPACITIES BETWEEN TRIODE SECTIONS		
SECTION 1 GRID TO SECTION 2 GRID	0.5	μμf
SECTION 1 PLATE TO SECTION 2 PLATE	2.2	μμf

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MECHANICAL DATA

MOUNTING POSITION	ANY	
(IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)		
BULB	T-12	
BASE	LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JEDEC #88-86	
MAXIMUM NET WEIGHT	3	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	450	G
MAXIMUM VIBRATION RATING (D =.08" @ 50 CPS)	10	G

RATINGS

ABSOLUTE VALUES

	MIN.	MAX.	
HEATER VOLTAGE	6.0	6.6	VOLTS
PLATE VOLTAGE (DC)	---	250	VOLTS
GRID VOLTAGE (DC)	---	0	VOLTS
HEATER-CATHODE VOLTAGE (DC)	-300	+300	VOLTS
GRID CURRENT PER GRID	---	5.	MA.
PLATE CURRENT PER PLATE (DC)	---	125.	MA.
(IF SEVERAL TUBE SECTIONS ARE TO BE USED IN PARALLEL WITH EACH OTHER, IT IS RECOMMENDED NOT TO EXCEED 100 MA PER PLATE.)			
POWER DISSIPATION PER PLATE	---	13	WATTS
ENVELOPE TEMPERATURE	---	230	°C
ALTITUDE FOR FULL RATINGS	---	60 000	FEET
CIRCUIT VALUES:			
GRID CIRCUIT RESISTANCE FOR CATHODE BIAS OPERATION	---	1.0	MEGOHM
GRID CIRCUIT RESISTANCE FOR FIXED BIAS OR COMBINATION FIXED AND CATHODE BIAS OPERATION	---	0.1	MEGOHM

ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450 G/MSEC)

FATIGUE; 25 CPS, 0.08" TOTAL DISPLACEMENT, FOR 32 HOURS IN EACH OF THREE MUTUALLY PERPENDICULAR PLANES (2.5G)

POST SHOCK AND FATIGUE LIMITS:

VIBRATION (R_p=2000 Ω, E_c=- 7VDC, TIE 1K TO 2K, 1G TO 2G, 1P TO 2P), GENERATED PLATE VOLTAGE (MAX.)		100	MVAC
HEATER-CATHODE LEAKAGE (E_{hk} =±100 VDC) (MAX.)		50	μADC
CHANGE IN TRANSCONDUCTANCE FROM INITIAL VALUE (MAX.)		10	PERCENT
GRID CURRENT (MAX.)		-3	μA
HEATER CYCLING LIFE TEST (E_f=7.5V, E_{hk}=300VDC. DURATIOI OF 2000 CYCLES OF 1 MIN. ON AND 1 MIN. OFF) END POINT (E_{hk}=±100V.) (MAX.)		50	μADC
STABILITY LIFE TEST (1 HR.) END POINT:			
CHANGE IN TRANSCONDUCTANCE FROM INITIAL VALUE (MAX.)		10	PERCENT
SURVIVAL RATE LIFE TEST (100 HRS.) END POINT:			
TRANSCONDUCTANCE (MIN.)		5800	μMHOS
INTERMITTENT LIFE TEST (1000 HRS.) END POINTS:			
GRID CURRENT	MIN. 0 MAX. -10		μADC
TRANSCONDUCTANCE (MIN.)		5500	μMHOS
CHANGE IN TRANSCONDUCTANCE BY REDUCING E_f TO 5.7V.(MAX.)		10	PERCENT
HEATER-CATHODE LEAKAGE E_{hk}=±100VDC.(MAX.)		25	μADC
HEATER CURRENT	MIN.2.35 MAX.2.75		AMPS
INSULATION OF ELECTRODES: GRID TO ALL OTHERS AND PLATE TO ALL OTHERS (MIN.)		100	MEGOHM

TUNG-SOL

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RANGE OF VALUES

CONDITIONS: E_f = 6.3V, E_b = 135V, E_c = 0, $R_{k/k}$ = 250 Ω

BOTH SECTIONS OPERATING. EACH SECTION READ SEPARATELY.

INDIVIDUAL PLATE CURRENT (DC)	100	150	MA.
LOT AVERAGE PLATE CURRENT (SAME CONDTIONS)(DC)	115	135	MA.
PLATE CURRENT, DIFFERENCE BETWEEN SECTIONS (DC)	---	25	MA.
INDIVIDUAL SECTION TRANSCONDUCTANCE	6000	8200	μMHOS
LOT AVERAGE TRANSCONDUCTANCE	6600	7400	μMHOS
AMPLIFICATION FACTOR	1.5	2.5	
HEATER CURRENT @ 6.3V.	2.35	2.65	AMP.

SIMILAR TYPE REFERENCE : 7105.

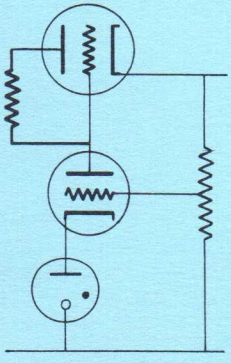

FIGURE 1

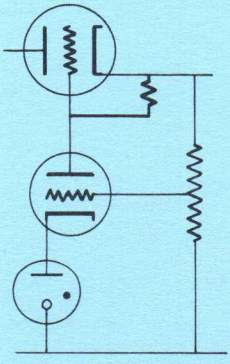

FIGURE 2

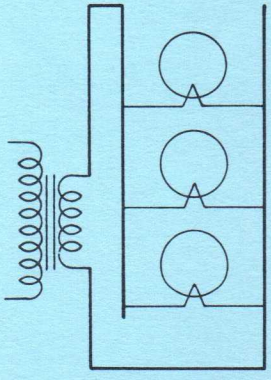

FIGURE 3

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

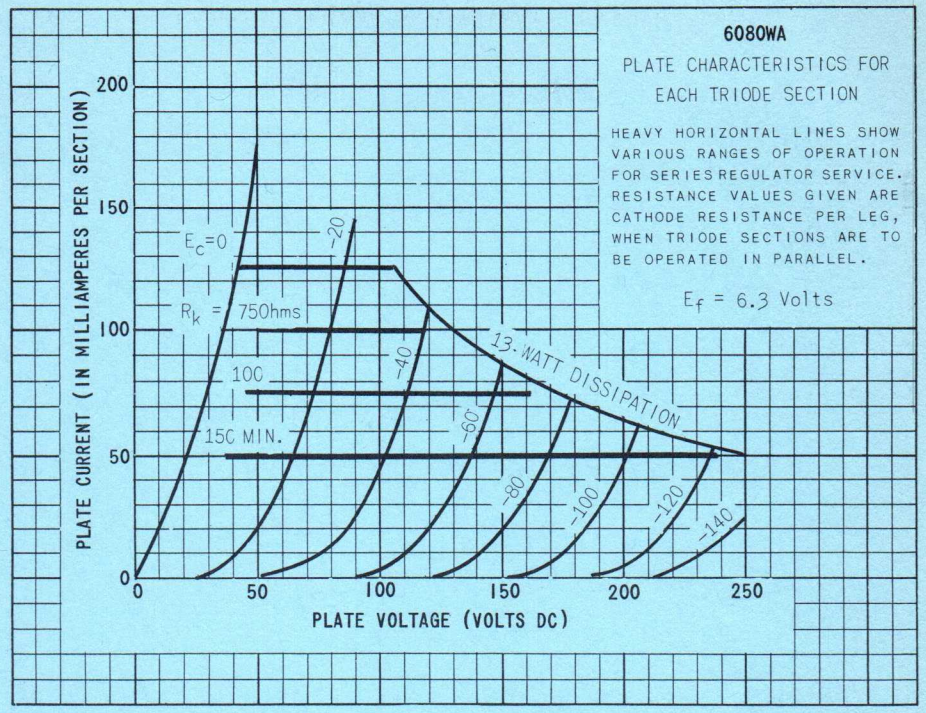
APPLICATION NOTES

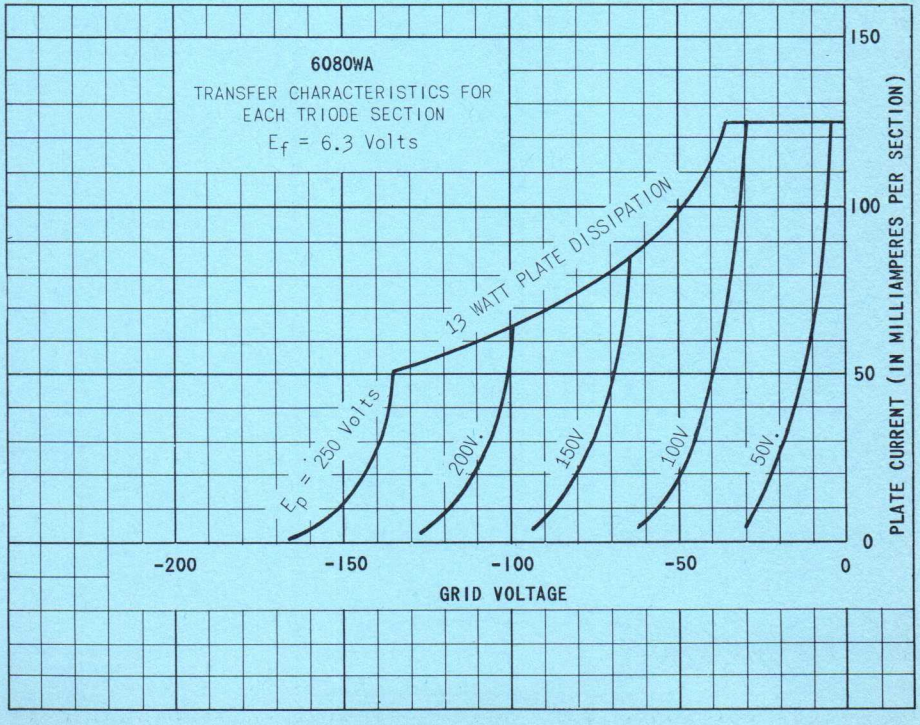
THE 6080WA IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS. RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED, USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE RESISTANCE BECAUSE IT PROVIDES MORE BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE THIRD THE VALUE $(\frac{R}{u+1})$ OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE THIRD THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (ABOUT ONE WATTS) AND THE ADDITIONAL VOLTAGE (LESS THAN 10 VOLTS) NECESSARY FROM THE UNREGULATED SUPPLY. A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE PASSING TUBE TO WORK WITH HIGHER BIAS AND HENCE WITH GREATER TUBE DROP.

A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASSING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATOR OUTPUT IS LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A TUBE DROP AS POSSIBLE. A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES. SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE DUE TO TUBE AGING.

A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 6.3 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.





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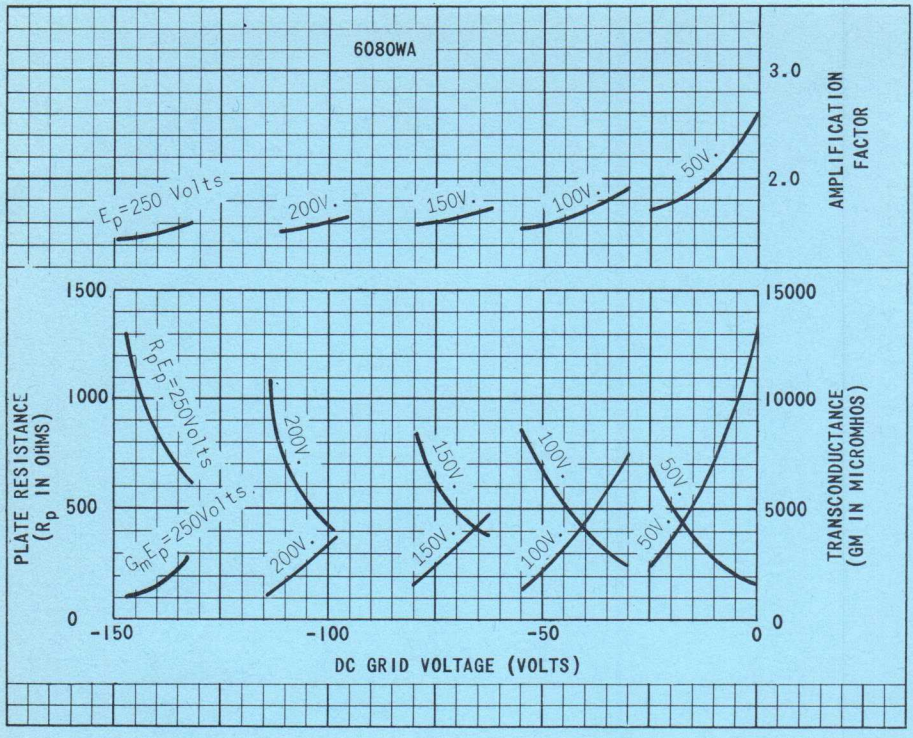
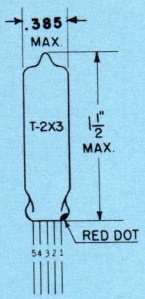

6080WA
3.0
2.0
AMPLIFICATION FACTOR
E_p=250 Volts
200V.
150V.
100V.
50V.
1500
1000
500
0
15000
10000
5000
0
PLATE RESISTANCE (R_p IN OHMS)
TRANSCONDUCTANCE (GM IN MICROMHOS)
R_pE_p=250Volts
G_mE_p=250Volts
-150
-100
-50
0
DC GRID VOLTAGE (VOLTS)

TUNG-SOL

PENTODE

SUBMINIATURE TYPE



GLASS BULB

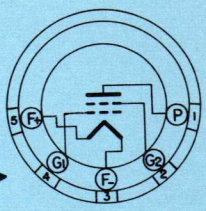
DOT IS ADJACENT TO LEAD 1

FILAMENT

1.25±20% VOLTS 0.02 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

0.016" TINNED FLEXIBLE LEADS 0.048" CENTER-TO-CENTER

THE 6088 IS A SUBMINIATURE POWER AMPLIFIER PENTODE OF LOW CURRENT DESIGNED FOR USE IN PORTABLE AND WEARABLE EQUIPMENT. THE FLEXIBLE LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO THE TERMINALS OF CIRCUIT COMPONENTS WITHOUT THE USE OF SOCKETS. STANDARD SUBMINIATURE SOCKETS MAY BE USED BY CUTING THE LEADS TO A SUITABLE LENGTH.

RATINGS

ABSOLUTE MAXIMUM VALUES

FILAMENT VOLTAGE	1.25±20%	VOLTS
MAXIMUM PLATE VOLTAGE	67.5	VOLTS
MAXIMUM SCREEN GRID VOLTAGE	67.5	VOLTS
MAXIMUM CATHODE CURRENT	1.5	MA.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

FILAMENT VOLTAGE	1.25	VOLTS
FILAMENT CURRENT	0.02	AMP.
PLATE VOLTAGE	45	VOLTS
SCREEN GRID VOLTAGE	45	VOLTS
CONTROL GRID VOLTAGE	-1.25	VOLTS
ZERO-SIGNAL PLATE CURRENT	650	μA.
ZERO-SIGNAL SCREEN GRID CURRENT	150	μA.
TRANSCONDUCTANCE	625	μMHOS
PLATE RESISTANCE (APPROX.)	0.7	MEGOHMS
LOAD RESISTANCE	0.08	MEGOHMS
POWER OUTPUT	10.5	MW.
DISTORTION (APPROX.)	10	PERCENT

→ INDICATES A CHANGE.

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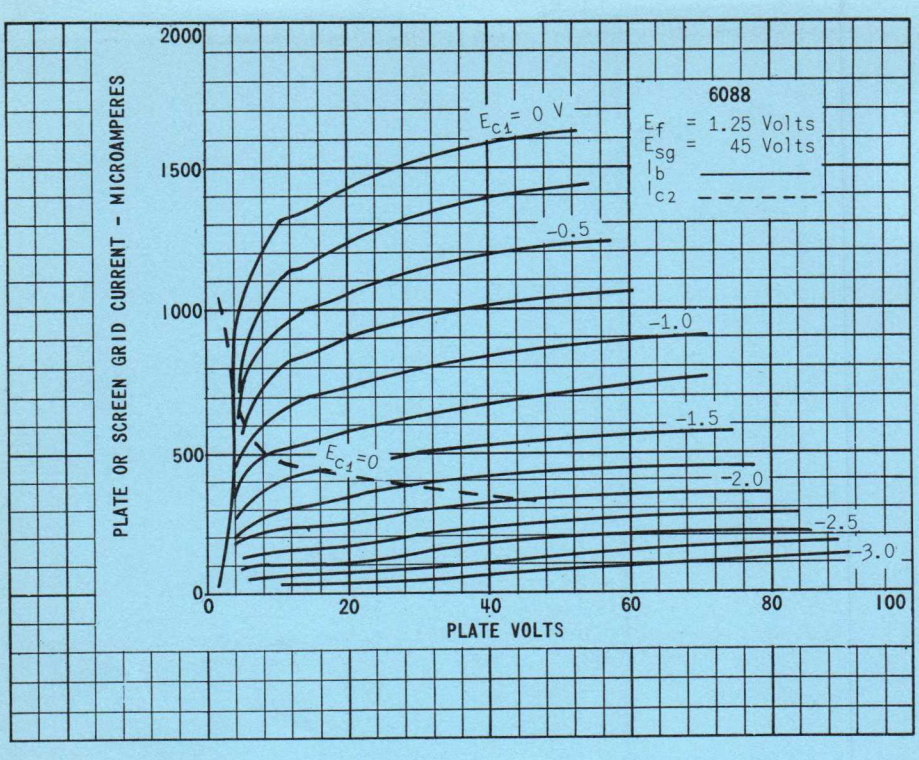
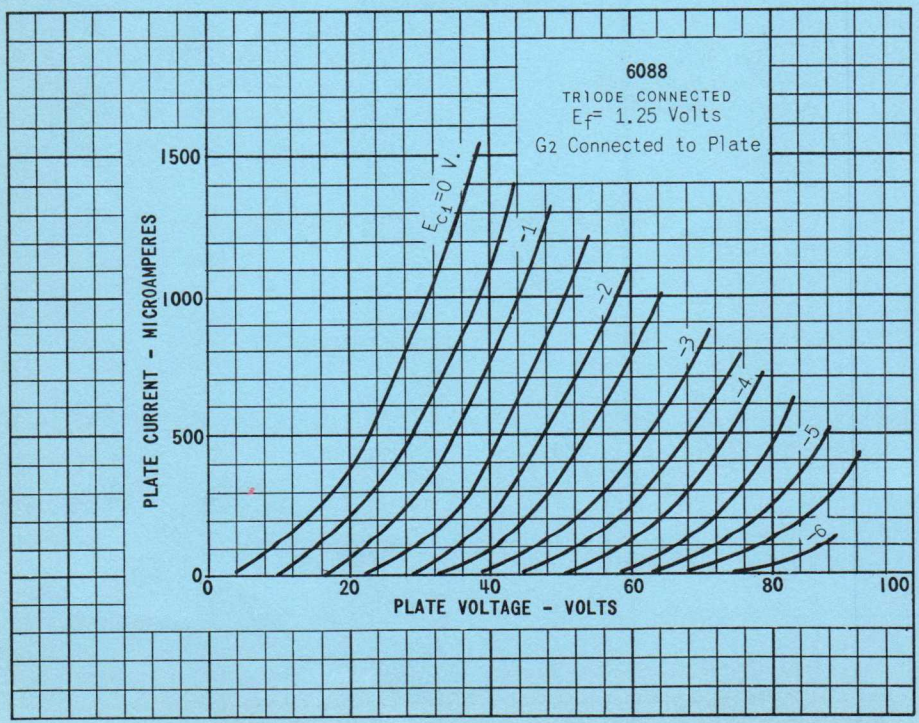
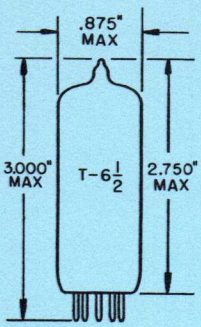

6088
Ef = 1.25 Volts
Esg = 45 Volts
Ib
Ic2
Ec1 = 0 V
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
Ec1=0
PLATE OR SCREEN GRID CURRENT - MICROAMPERES
PLATE VOLTS
0
500
1000
1500
2000
0
20
40
60
80
100


6088
TRIODE CONNECTED
Ef= 1.25 Volts
G2 Connected to Plate
Ec1=0 V.
-1
-2
-3
-4
-5
-6
PLATE CURRENT - MICROAMPERES
PLATE VOLTAGE - VOLTS
0
500
1000
1500
0
20
40
60
80
100

TUNG-SOL

BEAM PENTODE

MINIATURE TYPE

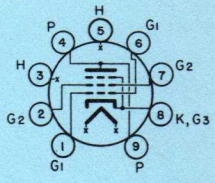


HARD GLASS ENVELOPE
MINIATURE BASE E9-1
9PINS-GOLD PLATED TUNGSTEN

FOR
MOBILE EQUIPMENT
APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9DH

THE 6094 IS A BEAM POWER PENTODE IN A T-6 1/2 HARD GLASS ENVELOPE. IT IS DESIGNED FOR SERVICE IN EQUIPMENT WITH HIGH AMBIENT TEMPERATURES AND WHERE HIGH LEVELS OF VIBRATION, SHOCK AND OTHER ACCELERATIONS ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID 1 TO PLATE	1.45	pf
INPUT	8.5	pf
OUTPUT	5.3	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM RATING SYSTEM - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	600	MA
LIMITS OF APPLIED VOLTAGE			6.3±0.3	VOLTS
LIMITS OF HEATER-CATHODE VOLTAGE			450	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM RATING SYSTEM - SEE EIA STANDARD RS-239

PLATE VOLTAGE	275	VOLTS
POSITIVE GRID 1 VOLTAGE	5	VOLTS
GRID 2 VOLTAGE	275	VOLTS
PLATE DISSIPATION	12.5	WATTS
GRID 2 DISSIPATION	2.0	WATTS
CATHODE CURRENT	75	MA
ALTITUDE	60,000	FT
ENVELOPE TEMPERATURE	+300°	C

AVERAGE CHARACTERISTICS

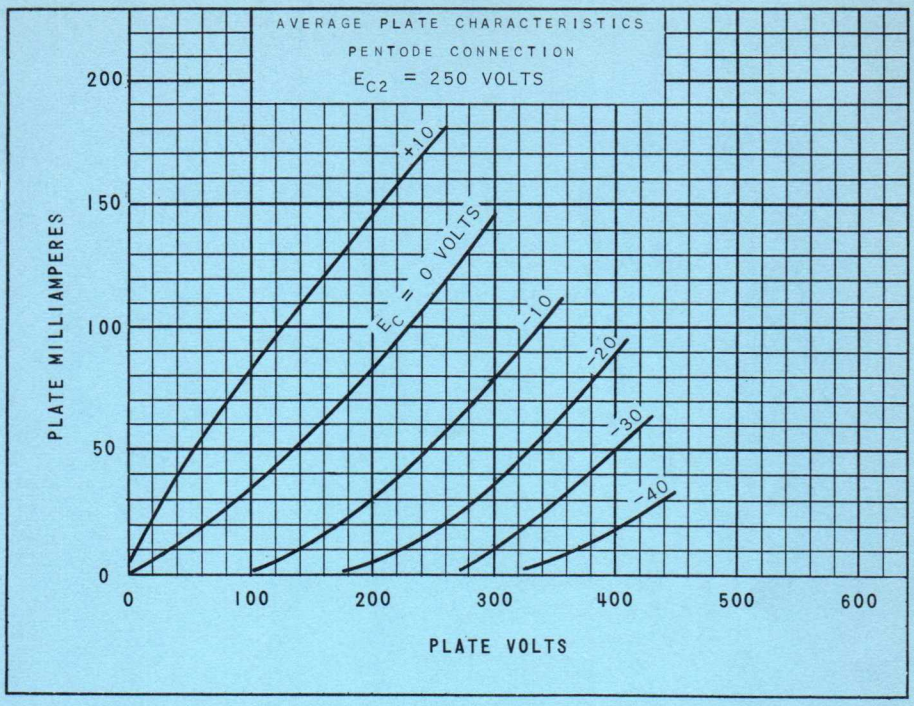
PLATE VOLTAGE	250	VOLTS
GRID 2 VOLTAGE	250	VOLTS
GRID 1 VOLTAGE	-12.5	VOLTS
PLATE CURRENT	45	MA
GRID 2 CURRENT	3.5	MA
TRANSCONDUCTANCE	4,100	μMHOS

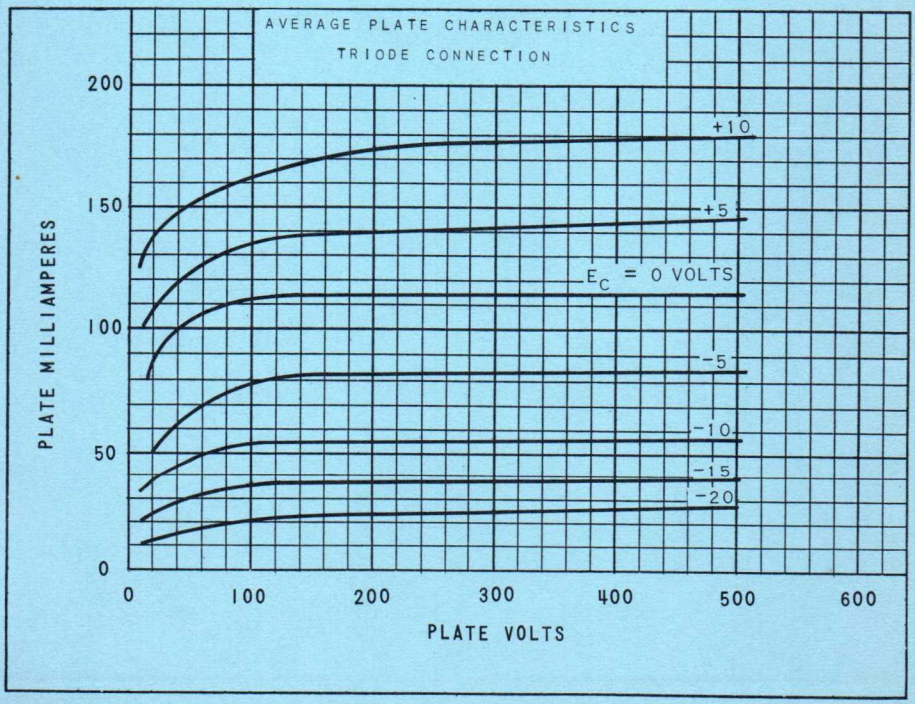
TYPICAL OPERATION

PLATE VOLTAGE	250	VOLTS
GRID 2 VOLTAGE	250	VOLTS
GRID 1 VOLTAGE	-12.5	VOLTS
GRID 1 SIGNAL VOLTAGE	8.8	VOLTS RMS
LOAD RESISTANCE	5,000	OHMS
POWER OUTPUT	4.5	WATTS

ADDITIONAL TESTS

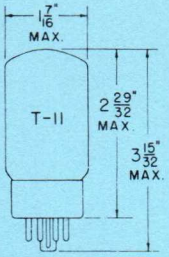
HEATER CYCLING
HIGH TEMPERATURE LIFE
HIGH LEVEL FATIGUE
SHOCK


AVERAGE PLATE CHARACTERISTICS
PENTODE CONNECTION
E_{C2} = 250 VOLTS
PLATE MILLIAMPERES
PLATE VOLTS
0
50
100
150
200
0
100
200
300
400
500
600
+10
E_C = 0 VOLTS
-10
-20
-30
-40


AVERAGE PLATE CHARACTERISTICS
TRIODE CONNECTION
PLATE MILLIAMPERES
PLATE VOLTS
0
50
100
150
200
0
100
200
300
400
500
600
+10
+5
E_C = 0 VOLTS
-5
-10
-15
-20

TUNG-SOL

BEAM PENTODE

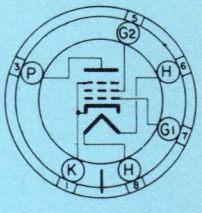


GLASS BULB

COATED UNIPOTENTIAL CATHODE

HEATER
6.3 VOLTS 1.2 AMP.
AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
INTERMEDIATE SHORT
SHELL 6 PIN OCTAL
LOW LOSS PHENOLIC

6BQ

THE 6098/6AR6WA IS A RUGGEDIZED SINGLE-ENDED BEAM PENTODE WHICH MAY BE USED IN APPLICATIONS REQUIRING RELATIVELY HIGH PEAK PLATE CURRENTS AT NEGATIVE GRID POTENTIALS. IT IS ELECTRICALLY EQUIVALENT TO THE 6AR6, BUT CONTROLS ON THE PRODUCT AVERAGE FOR SUCH CHARACTERISTICS AS PLATE CURRENT, SCREEN CURRENT, AND TRANSCONDUCTANCE ASSURE THAT THESE CRITICAL CHARACTERISTICS WILL REMAIN WELL CENTERED. SINCE IT MUST BE ABLE TO WITHSTAND SEVERE MECHANICAL TESTS TO MEET TEST SPECIFICATIONS, THE 6098/6AR6WA IS ESPECIALLY SUITED FOR USE IN INDUSTRIAL AND MILITARY AIRBORNE COMMUNICATIONS EQUIPMENT WHICH MAY BE SUBJECTED TO SEVERE SHOCK AND VIBRATIONS.

DIRECT INTERELECTRODE CAPACITANCES

	WITHOUT SHIELD	
GRID #1 TO PLATE (RATED)	0.55	μμf
MAXIMUM	9.9	μμf
MINUMUM	0.4	μμf
INPUT (RATED)	11.0	μμf
MAXIMUM	13.5	μμf
MINIMUM	8.5	μμf
OUTPUT (RATED)	7.0	μμf
MAXIMUM	9.2	μμf
MINIMUM	5.0	μμf

RATINGS
ABSOLUTE MAXIMUM VALUES

	CLASS A AMPLIFIER	CLASS B AMPLIFIER	
HEATER VOLTAGE	6.3±10%	6.3±10%	VOLTS
MAXIMUM DC PLATE VOLTAGE	400	600	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	315	315	VOLTS
MAXIMUM DC GRID #1 CURRENT	0	---	mA
MAXIMUM PLATE DISSIPATION	21	21	WATTS
MAXIMUM GRID #2 DISSIPATION	3.5	3.5	WATTS
MAXIMUM HEATER-CATHODE VOLTAGE	±200	±200	VOLTS
MAXIMUM DC CATHODE CURRENT [A]	125	60	mA
MAXIMUM BULB TEMPERATURE	225	225	°C
MAXIMUM PEAK FORWARD PLATE VOLTAGE	---	1250	VOLTS

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A_1 AMPLIFIER

	TRIODE CONNECTION	PENTODE CONNECTION	
HEATER VOLTAGE	6.3	6.3	VOLTS
HEATER CURRENT	1.2	1.2	AMP.
DC PLATE VOLTAGE	200	250	VOLTS
DC GRID #2 VOLTAGE	TIED TO PLATE	250	VOLTS
DC GRID #1 VOLTAGE	−12.5	−22.5	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	100 000	100 000	OHMS
DC PLATE CURRENT	90	77	mA
GRID #2 CURRENT	TIED TO PLATE	5	mA
PLATE RESISTANCE (APPROX.)	1 000	21 000	OHMS
DC GRID #1 VOLTAGE FOR PLATE CURRENT CUTOFF	---	−65	VOLTS
TRANSCONDUCTANCE	6 000	5400	μMHOS

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

E_f = 6.3V, E_b = 250Vdc, E_{c2} = 250Vdc, E_{c1} = −22.5Vdc

EXCEPT AS MODIFIED BELOW

	INITIAL				500 HOUR LIFE TEST		
	INDIVIDUAL MIN.	INDIVIDUAL MAX.	PROD. MIN.	AVG. MAX.	INDIVIDUAL MIN.	INDIVIDUAL MAX.	
HEATER CURRENT	1.08	1.32	---	---	1.08	1.32	AMP.
HEATER CATHODE LEAKAGE (E_{hk}=±100Vdc)	---	75	---	---	---	75	μAdc
#1 GRID CURRENT	0	−1.0	---	---	0	−2.0	μAdc
PLATE CURRENT	55	100	68	86	---	---	mAdc
SCREEN GRID CURRENT	---	8.0	---	6.2	---	---	mAdc
GRID #1 TRANSCONDUCTANCE	4300	6500	4975	5825	4000	6500	μMHOS
INSULATION OF ELECTRODES[B] (E_f=6.3V, E(g1-all)=30Vdc, g1 neg; E(p-all)=500Vdc, p neg. R(g1-all)	25	---	---	---	10	---	MEGOHM
R(p-all)	25				10		MEGOHM
CUTOFF PLATE CURRENT (E_{c1} = 65Vdc)	---	1.0	---	---	---	---	mAdc
GRID #2 CURRENT[C] (E_f = 7.0V)	0	−3.0	---	---	---	---	μAdc
Δ TRANSCONDUCTANCE[D] (E_f = 5.7V)	---	15	---	---	---	15	PERCENT

SPECIAL REQUIREMENTS

	MIN.	MAX.	
VIBRATIONAL FATIGUE[E]	---	---	
SHOCK[F] (HAMMER ANGLE 30°, E_{hk}=100Vdc, HEATER POSITIVE, R_{g1} =0.1 MEG)	---	---	
POST SHOCK AND VIBRATIONAL FATIGUE TEST END POINTS			
VIBRATION	---	1500	mVac
HEATER CATHODE LEAKAGE	---	±150	μAdc
GRID #1 CURRENT	0	−2.0	μAdc
GRID #1 TRANSCONDUCTANCE	3500	---	μMHOS
HIGH VOLTAGE TEST[G] (E_{c1}=−150Vdc, E_{c2}=300Vdc, E_{bb}=1250Vdc, I_{c1}=0.2 mAdc, R_1=5000)	1150	---	VOLTS
AF NOISE[H] (E_{c1}=−35Vdc, R_p=2000, E_{ca1}=245mVac)	---	17	VU
LOW FREQUENCY VIBRATION (E_{c1} = 35Vdc, R_p=2000)	---	1000	mVac

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TUNG-SOL

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SPECIAL REQUIREMENTS - CONT'D.

	MIN.	MAX.	
RIPPLE TEST[J] (E_b=325Vdc, E_{c2}=300Vdc, R_p=1000, R_k=500, E_f=6.3Vac, 400CYCLES)	---	100	mVac
LOW PRESSURE VOLTAGE BREAKDOWN [K] (VOLTAGE=800Vac, PRESSURE=55±5mm. Hg)	---	---	
STABILITY LIFE TEST (E_{hk}=200Vdc, HEATER POSITIVE, R_{g1}=47,000, MIN. BULB TEMP.=225°C) [L]			
STABILITY LIFE TEST END POINTS Δ GRID #1 TRANSCONDUCTANCE	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST (INTERMITTENT LIFE TEST CONDITIONS OR EQUIVALENT)	---	---	
INTERMITTENT LIFE TEST (E_{hk}=200Vdc, HEATER POS., R_{g1}=47,000, MIN. BULB TEMP. =+225°C)	---	---	

NOTES

[A] DIFFICULTY MAY BE ENCOUNTERED IF THIS TUBE IS OPERATED FOR LONG PERIODS OF TIME WITH VERY SMALL VALUES OF CATHODE CURRENT.

[B] SEE MIL-E-1C 4.8.2

[C] PRIOR TO THIS TEST TUBES TO BE PREHEATED 5 MINUTES AT CONDITIONS INDICATED BELOW. TEST IMMEDIATELY AFTER PREHEATING. E_f=7.0Vac, E_{c1}=-22Vdc, R_k=0 OHMS, R_{g1}=0.1 MEG, E_b=250Vdc, E_{c2}=250 Vdc.

[D] THE VALUE OF #2 TRANSCONDUCTANCE SHALL APPLY TO INDIVIDUAL TUBES AND IS EXPRESSED:

$$\frac{(\text{SM AT } 6.3)-(\text{SM AT } 5.7)}{(\text{SM AT } 6.3)} \times 100$$

[E] SEE MIL-E-1C 4.9.20.6

[F] SEE MIL-E-1C 4.9.20.5

[G] THIS TEST WILL BE MADE BEFORE THE TRANSCONDUCTANCE #1 AND TRANSCONDUCTANCE #2 TEST. WITH A 60 CYCLE SINUSOIDAL DRIVING VOLTAGE APPLIED TO THE CONTROL GRID, MEASURE THE PEAK TO PEAK VOLTAGE ACROSS THE LOAD.

[H] SEE MIL-E-1C 4.10.3.2

[J] ADJUST E_{c1} SO THAT I_b=55 mAdc. MEASURE RIPPLE BETWEEN PLATE AND GROUND WITH METER HAVING AN IMPEDANCE OF 100,000 OHMS OR GREATER. THE HEATER SHALL BE TIED TO NEGATIVE END OF CATHODE RESISTOR.

[K] THERE SHALL BE NO EVIDENCE OF ARCING OR CORONA BETWEEN ANODE PIN AND ADJACENT PINS WITH NO OTHER VOLTAGES APPLIED.

[L] BULB TEMPERATURE SHALL BE DEFINED AS THE HIGHEST TEMPERATURE INDICATED WHEN USING A THERMOCOUPLE OF .003 INCH MAXIMUM DIAMETER ELEMENTS WELDED TO A RING OF .025 INCH DIAMETER PHOSPHOR BRONZE PLACED AROUND THE BULB.

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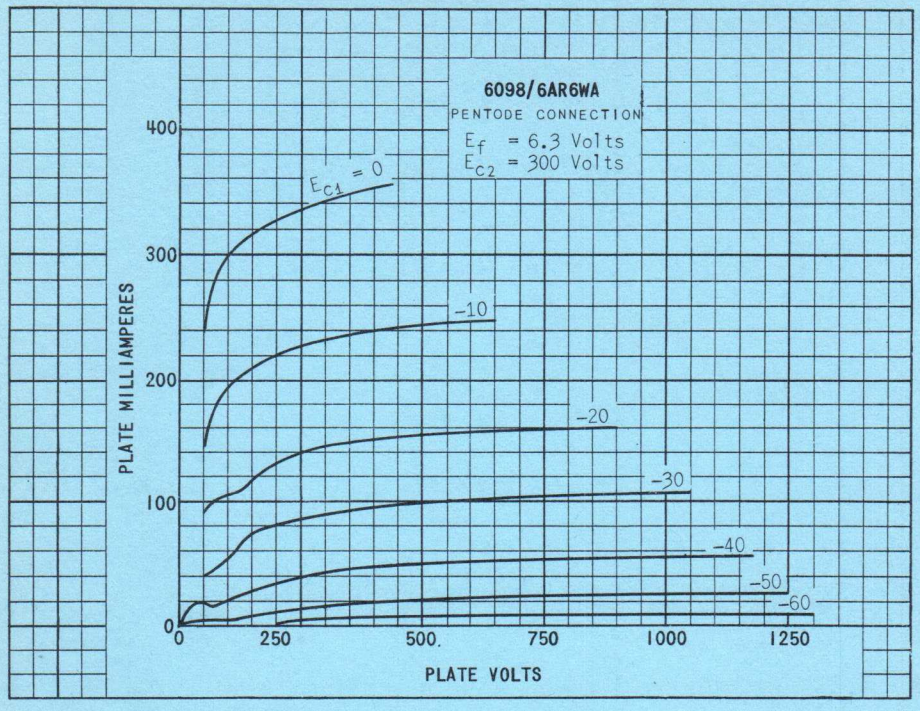
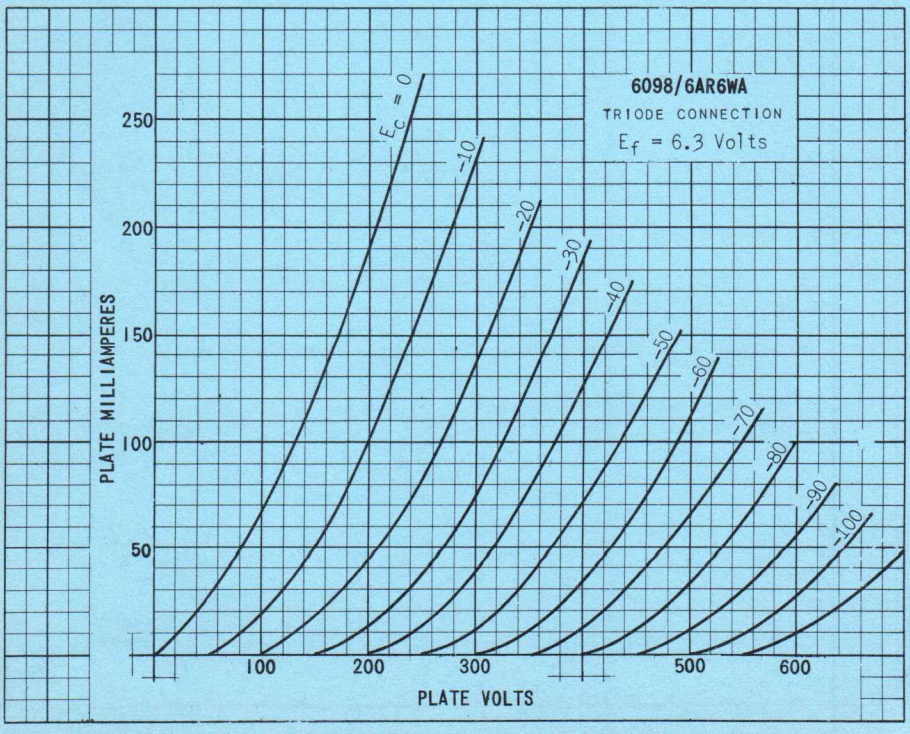
6098/6AR6WA

PREMIUM TUBE

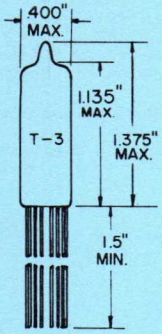




TUNG-SOL

TWIN DIODE

SUBMINIATURE



GLASS BULB

SUBMINIATURE BUTTON

FLEXIBLE LEADS

BASE - E8-10

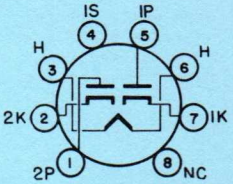
OUTLINE DRAWING

JEDEC 3-1

COATED UNIPOTENTIAL CATHODE

RUGGEDIZED LOW CURRENT POWER SUPPLY RECTIFIER

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM

JEDEC 8DJ

THE 6110 IS A TWIN DIODE RECTIFIER IN THE 8 PIN SUBMINIATURE CONSTRUCTION. THIS TYPE IS CHARACTERIZED BY LONG LIFE AND STABLE PERFORMANCE. IT IS SUITABLE FOR HIGH OPERATING TEMPERATURES AND WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK AND VIBRATION ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

	WITHOUT SHIELD	WITH[A] SHIELD	
PLATE TO PLATE, (MAX.)	0.15	0.026	pf
INPUT (EACH UNIT) (P TO K+H+i.s.(e.s.))	1.5	2.2	pf
CATHODE TO ALL OTHER ELECTRODES (EACH UNIT)	2.6	2.6	pf

[A] WITH EXTERNAL SHIELD OF 0.405 INCH DIAMETER CONNECTED TO HEATER.

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE VALUES

AVERAGE CHARACTERISTICS	6.3 VOLTS	150	MA.
HEATER SUPPLY LIMITS: VOLTAGE OPERATION		6.3±.315	VOLTS
MAXIMUM HEATER CATHODE VOLTAGE		±360	VOLTS

MAXIMUM RATINGS

MECHANICAL

MAXIMUM IMPACT ACCELERATION[D]	450	G
MAXIMUM UNIFORM ACCELERATION[E]	1000	G
MAXIMUM VIBRATIONAL ACCELERATION FOR EXTENDED PERIODS[F]	2.5	G
MAXIMUM BULB TEMPERATURE	250	°C

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MAXIMUM RATINGS[A]

ABSOLUTE VALUES

PLATE SUPPLY VOLTAGE (AC)(EACH UNIT)	165	VOLTS
PEAK INVERSE PLATE VOLTAGE	460	VOLTS
PEAK PLATE CURRENT:		
STEADY STATE (EACH UNIT)	26.5	MA.
TRANSIENT (EACH UNIT)	160	MA.
OUTPUT CURRENT (DC) (EACH UNIT)	4.4	MA.

TYPICAL OPERATING CHARACTERISTICS

FULL-WAVE RECTIFIER
(CAPACITOR INPUT TO FILTER)

PLATE VOLTAGE (AC)(EACH UNIT)	150	VOLTS
FILTER INPUT CAPACITANCE	8	μf
EFFECTIVE PLATE SUPPLY IMPEDANCE	1 500	OHMS
OUTPUT CURRENT (DC)	8	MA.
LIFE EXPECTANCY:		
30°C AMBIENT TEMPERATURE	5 000	HOURS
175°C AMBIENT TEMPERATURE	1 000	HOURS
AVG. DIODE CURRENT (EACH UNIT) AT 10 VOLTS DC	15	MA.

[D]FORCES IN ANY DIRECTION AS APPLIED BY THE NAVY TYPE HIGH IMPACT (FLYWEIGHT) SHOCK MACHINE FOR ELECTRONIC DEVICES, OR EQUIVALENT.

[E]FORCES IN ANY DIRECTION APPLIED GRADUALLY, AS IN CENTRIFUGE.

[F]VIBRATIONAL FORCES IN ANY DIRECTION AT 60 CYCLES PER SECOND FOR A PERIOD EXCEEDING 100 HOURS.

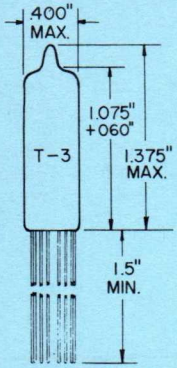
[G]LIMITATIONS BEYOND WHICH NORMAL TUBE PERFORMANCE AND TUBE LIFE MAY BE IMPARIED.

[H]TUBE LIFE AND RELIABILITY OF PERFORMANCE ARE DIRECTLY RELATED TO THE DEGREE OF REGULATION OF THE HEATER VOLTAGE TO ITS CENTER-RATED VALUE OF 6.3 VOLTS.

TUNG-SOL

TWIN TRIODE

SUBMINIATURE TYPE



GLASS BULB
SUBMINIATURE BUTTON
8 LEAD E8-10
OUTLINE DRAWING
JEDEC 3-1

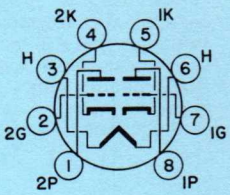
COATED UNIPOTENTIAL CATHODE

HEATER

6.3±0.3 VOLTS 0.3 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 8DG

8DG

THE 6111 IS A SUBMINIATURE MEDIUM-MU TWIN TRIODE DESIGNED FOR USE IN GENERAL-PURPOSE AMPLIFIER APPLICATIONS. EACH SECTION HAS AN INDIVIDUAL CATHODE AND IS ELECTRICALLY INDEPENDENT. THE TUBE MAY ALSO BE USED AS A COMBINED OSCILLATOR AND MIXER IN HIGH-FREQUENCY CIRCUITS.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID TO PLATE, EACH SECTION	1.4	1.5	pf
INPUT, EACH SECTION	2.1	1.9	pf
OUTPUT, SECTION 1	1.3	0.28	pf
OUTPUT, SECTION 2	1.4	0.32	pf
GRID TO GRID, MAX.	0.010	0.011	pf
PLATE TO PLATE, MAX.	0.3	0.5	pf

[A] WITH EXTERNAL SHIELD OF 0.405" INSIDE DIAMETER CONNECTED TO CATHODE OF SECTION UNDER TEST.

RATINGS

ABSOLUTE MAXIMUM VALUES

EACH SECTION

MAXIMUM PLATE VOLTAGE	165	VOLTS
MAXIMUM NEGATIVE DC GRID VOLTAGE	55	VOLTS
MAXIMUM PLATE DISSIPATION	0.95	WATTS
MAXIMUM DC PLATE CURRENT	22	MA.
MAXIMUM DC GRID CURRENT	5.5	MA.
MAXIMUM HEATER-CATHODE VOLTAGE:		
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID CIRCUIT RESISTANCE	1.1	MEGOHMS
MAXIMUM BULB TEMPERATURE AT HOTTEST POINT	220	C

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A_1 AMPLIFIER - EACH SECTION

PLATE VOLTAGE	100	VOLTS
CATHODE-BIAS RESISTOR	220	OHMS
AMPLIFICATION FACTOR	20	
PLATE RESISTANCE, APPROX.	4000	OHMS
TRANSCONDUCTANCE	5000	μMHOS
PLATE CURRENT	8.5	MA.
GRID VOLTAGE, APPROX. Ib = 10 μAMPERES	−9.0	VOLTS

CLASS A RESISTANCE-COUPLED AMPLIFIER

EACH SECTION

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)										
R_L	R_{gf}	Ebb = 90 Volts			Ebb = 150 Volts			Ebb = 225 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	2400	8.4	13	2100	16	14	1900	25	15
0.10	0.24	3100	12	14	2800	22	15	2600	34	16
0.24	0.24	6200	10	14	5600	19	15	5200	30	16
0.24	0.51	7800	13	14	7200	25	15	7000	38	15
0.51	0.51	14000	11	13	13000	21	14	12000	32	15
0.51	1.0	19000	14	13	17000	26	14	16000	40	15
HIGH IMPEDANCE DRIVE (APPROXIMATELY 100K OHMS)										
R_L	R_{gf}	Ebb = 90 Volts			Ebb = 150 Volts			Ebb = 225 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	3200	11	13	2500	21	14	2100	32	15
0.10	0.24	4200	15	14	3400	28	15	3000	43	15
0.24	0.24	8400	13	13	6800	24	14	6000	36	15
0.24	0.51	10000	16	13	8700	29	15	7800	45	15
0.51	0.51	17000	13	13	15000	25	14	13000	38	15
0.51	1.0	21000	17	13	19000	30	14	17000	47	15

NOTES:

1. E_o IS MAXIMUM RMS VOLTAGE OUTPUT FOR APPROXIMATELY FIVE PERCENT TOTAL HARMONIC DISTORTION.
2. GAIN IS MEASURED FOR AN OUTPUT VOLTAGE OF TWO VOLTS RMS.
3. R_k IS IN OHMS; R_l AND R_{gf} ARE IN MEGOHMS.
4. COUPLING CAPACITORS (C) SHOULD BE SELECTED TO GIVE DESIRED FREQUENCY RESPONSE. R_k SHOULD BE ADEQUATELY BY-PASSED.

TUNG-SOL

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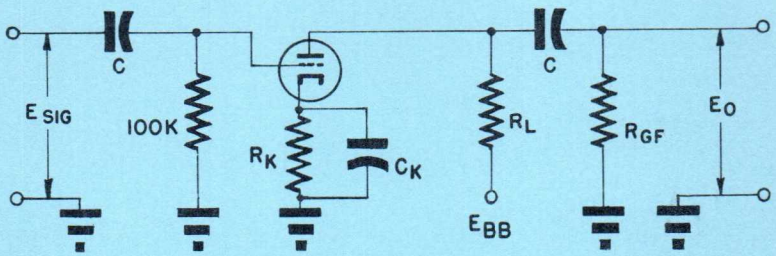

CHARACTERISTICS LIMITS

		MIN	MAX	
HEATER CURRENT: Ef = 6.3 V	INITIAL	280	320	MA.
	500 HR.	276	328	MA.
PLATE CURRENT, EACH SECTION Ef =6.3 V., Eb =100 V., Rk =220 OHMS (BY PASSED)	INITIAL	6.0	11	MA.
PLATE CURRENT DIFFERENCE BETWEEN SECTIONS: DIFFERENCE BETWEEN PLATE CURRENTS FOR EACH SECTION AT Ef =6.3 V., Eb =100 V., Rk =220 OHMS (BY-PASSED)	INITIAL	---	2.0	MA.
TRANSCONDUCTANCE (1), EACH SECTION Ef =6.3 V., Eb =100 V., Rk =220 OHMS (BY-PASSED)	INITIAL	4100	5900	μMHOS
TRANSCONDUCTANCE CHANGE WITH HEATER VOLTAGE, EACH SECTION: DIFFERENCE BETWEEN TRANSCONDUCTANCE (1) AND TRANSCONDUCTANCE AT Ef =5.7 VOLTS (OTHER CONDITIONS THE SAME) EXPRESSED AS A PERCENTAGE OF TRANSCONDUCTANCE (1)	INITIAL	---	15	PERCENT
	500 HR.	---	15	PERCENT
'TRANSCONDUCTANCE CHANGE WITH OPERATION, EACH SECTION DIFFERENCE BETWEEN TRANSCONDUCTANCE (1) INITIALLY AND AFTER OPERATION EXPRESSED AS A PERCENTAGE OF INITIAL VALUE	500 HR.	---	20	PERCENT
AVERAGE TRANSCONDUCTANCE CHANGE WITH OPERATION, EACH SECTION: AVERAGE OF VALUES FOR "TRANSCONDUCTANCE CHANGE WITH OPERATION"	500 HR	---	15	PERCENT
AMPLIFICATION FACTOR, EACH SECTION: Ef =6.3 V., Eb = 100 V., Rk = 220 OHMS (BY-PASSED)	INITIAL	17	23	
PLATE CURRENT CUTOFF, EACH SECTION: Ef = 6.3 V., Eb = 100 V., Ec =-9.0 V.	INITIAL	---	100	μAMPS.
INTERELECTRODE CAPACITANCES:				
GRID TO PLATE (G TO P), EACH SECTION	INITIAL	1.2	1.8	μμf
INPUT (G TO K+H), EACH SECTION	INITIAL	1.4	2.4	μμf
OUTPUT (P TO K+H), SECTION 1	INITIAL	0.20	0.36	μμf
OUTPUT (P TO K+H), SECTION 2	INITIAL	0.22	0.42	μμf
GRID TO GRID (G TO G)	INITIAL	---	0.011	μμf
PLATE TO PLATE (P TO P)	INITIAL	---	.0.50	μμf

MEASURED WITHOUT EXTERNAL SHIELD.

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TUNG-SOL

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CHARACTERISTICS LIMITS - cont'd.

NEGATIVE GRID CURRENT, EACH SECTION				
Ef = 6.3 V., Eb = 100 V., Rk = 220 OHMS				
(BY-PASSED) Rg = 1.0 MEG.	INITIAL	---	0.3	μAMPS.
	500 HR.	---	0.9	μAMPS.
HEATER-CATHODE LEAKAGE CURRENT:				
Ef = 6.3 V., Ehk = 100 V.,				
HEATER POSITIVE WITH RESPECT				
TO CATHODE	INITIAL	---	5.0	μAMPS.
	500 HR.	---	10	μAMPS.
HEATER NEGATIVE WITH RESPECT				
TO CATHODE	INITIAL	---	5.0	μAMPS.
	500 HR.	---	10	μAMPS.
INTERELECTRODE LEAKAGE RESISTANCE:				
Ef = 6.3 V., POLARITY OF APPLIED DC				
INTERELECTRODE VOLTAGE IS SUCH				
THAT NO CATHODE EMISSION RESULTS.				
GRID (EACH SECTION) TO ALL AT 100V.DC	INITIAL	100	---	MEGOHMS
	500 HR.	50	---	MEGOHMS
PLATE (EACH SECTION) TO ALL AT 300V.DC	INITIAL	100	---	MEGOHMS
	500 HR.	50	---	MEGOHMS
VIBRATIONAL NOISE OUTPUT VOLTAGE, RMS:				
Ef = 6.3 V., Ebb = 100 V., Rk = 220 OHMS				
(BY-PASSED), R_L = 10,000 OHMS, VIBRATIONAL				
ACCELERATION = 15 G AT 40 cps.	INITIAL	---	50	MV.
GRID EMISSION CURRENT, EACH SECTION:				
Ef = 7.5 V., Eb = 100 V., Ecc = -9.0 V.,				
Rg = 1.0 MEG.	INITIAL	---	0.5	μAMPS.
PULSE CATHODE CURRENT:				
Ef = 6.0 V., PULSE OF 25 μSECONDS DURATION,				
200-CYCLE REPETITION RATE, AND 50 VOLT				
AMPLITUDE IS APPLIED TO PLATE AND GRID				
TIED TOGETHER. PULSE CATHODE CURRENT				
IS MEASURED FOR EACH SECTION WITH OP-				
POSITE SECTION FLOATING	INITIAL	300	---	MA.

SPECIAL TESTS AND RATINGS

STABILITY LIFE TEST
STATISTICAL SAMPLE OPERATED FOR ONE HOUR TO EVALUATE AND CONTROL INITIAL VARIATIONS IN TRANSCONDUCTANCE.

SURVIVAL RATE LIFE TEST
STATISTICAL SAMPLE OPERATED FOR ONE HUNDRED HOURS TO EVALUATE AND CONTROL EARLY-LIFE ELECTRICAL AND MECHANICAL IN-OPERATIVES.

HEATER-CYCLING LIFE TEST
STATISTICAL SAMPLE OPERATED FOR 2000 CYCLES TO EVALUATE AND CONTROL HEATER-CATHODE DEFECTS. CONDITIONS OF TEST INCLUDE Ef = 7.0 VOLTS CYCLED FOR ONE MINUTE ON AND FOUR MINUTES OFF, Eb = Ec = 0 VOLTS, AND Ehk = 140 VOLTS RMS.

SHOCK RATING--450 G
STATISTICAL SAMPLE SUBJECTED TO FIVE IMPACT ACCELERATIONS OF 450 G IN EACH OF FOUR DIFFERENT POSITIONS. THE ACCELERATING FORCES ARE APPLIED BY THE NAVY-TYPE, HIGH IMPACT (FLYWEIGHT) SHOCK MACHINE FOR ELECTRONIC DEVICES OR ITS EQUIVALENT.

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TUNG-SOL

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SPECIAL TESTS AND RATINGS - cont'd.

FATIGUE RATING-2.5 G

STATISTICAL SAMPLE SUBJECTED TO VIBRATIONAL ACCELERATION OF 2,5 G FOR 32 HOURS IN EACH OF THREE DIFFERENT POSITIONS. THE SINUSOIDAL VIBRATION IS APPLIED AT A FIXED FREQUENCY BETWEEN 25 AND 60 CYCLES PER SECOND.

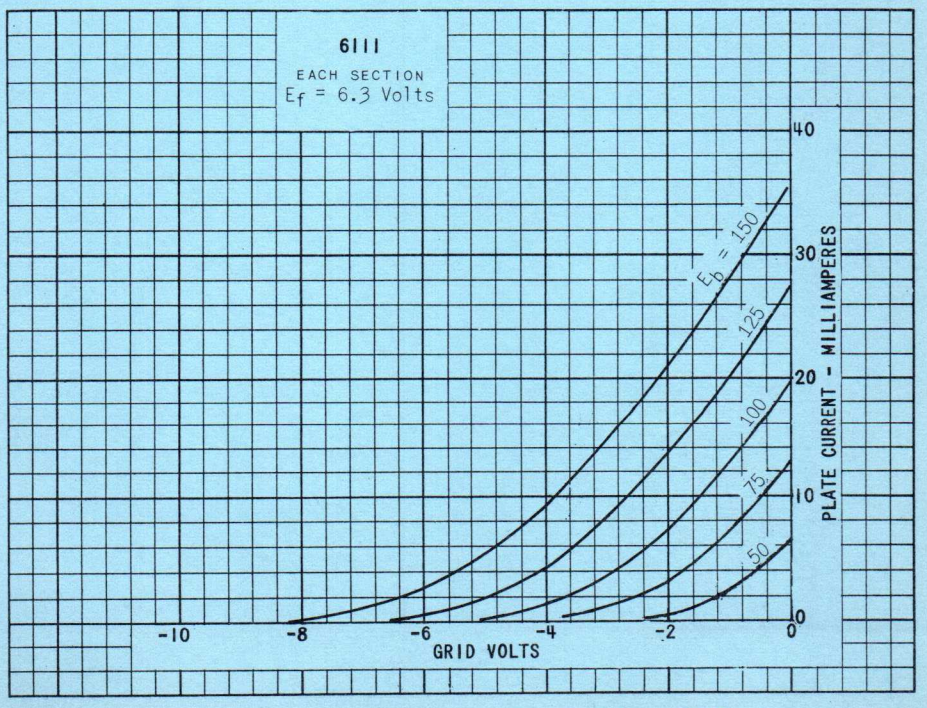
ALTITUDE RATING--60,000 FEET

STATISTICAL SAMPLE SUBJECTED TO PRESSURE OF 55 MILLIMETERS OF MERCURY TO EVALUATE AND CONTROL ARCING AND CORONA.

NOTE:

THE CONDITIONS FOR SOME OF THE INDICATED TESTS HAVE DELIBERATELY BEEN SELECTED TO AGGRAVATE TUBE FAILURES FOR TEST AND EVALUATION PURPOSES. IN NO SENSE SHOULD THESE CONDITIONS BE INTERPRETED AS SUITABLE CIRCUIT OPERATING CONDITIONS.

IN THE DESIGN OF MILITARY EQUIPMENT EMPLOYING THIS TUBE, REFERENCE SHOULD BE MADE TO THE APPROPRIATE MIL-E-1 SPECIFICATION.



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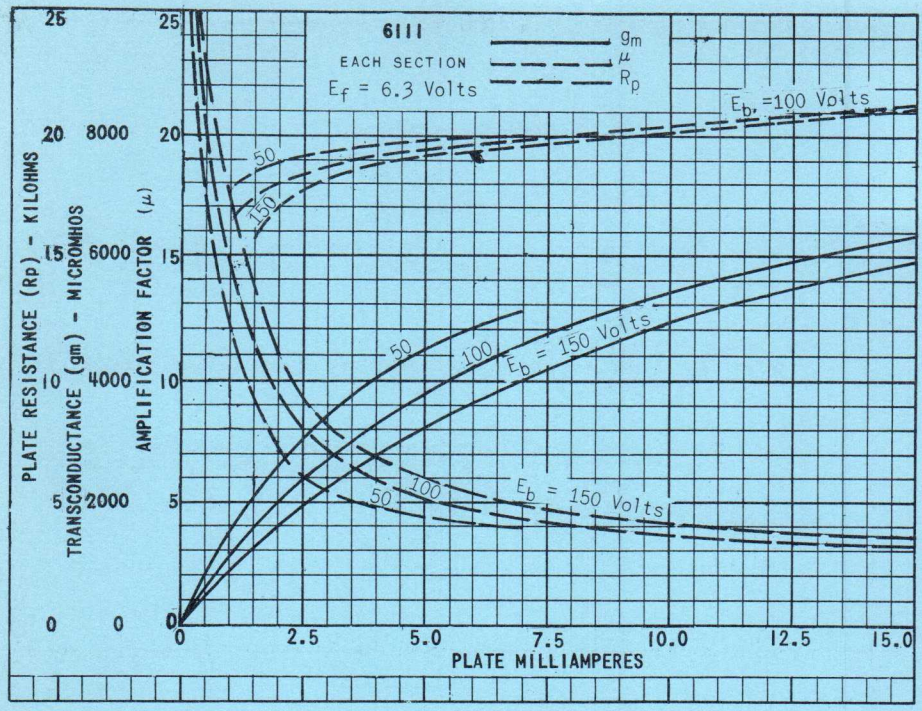
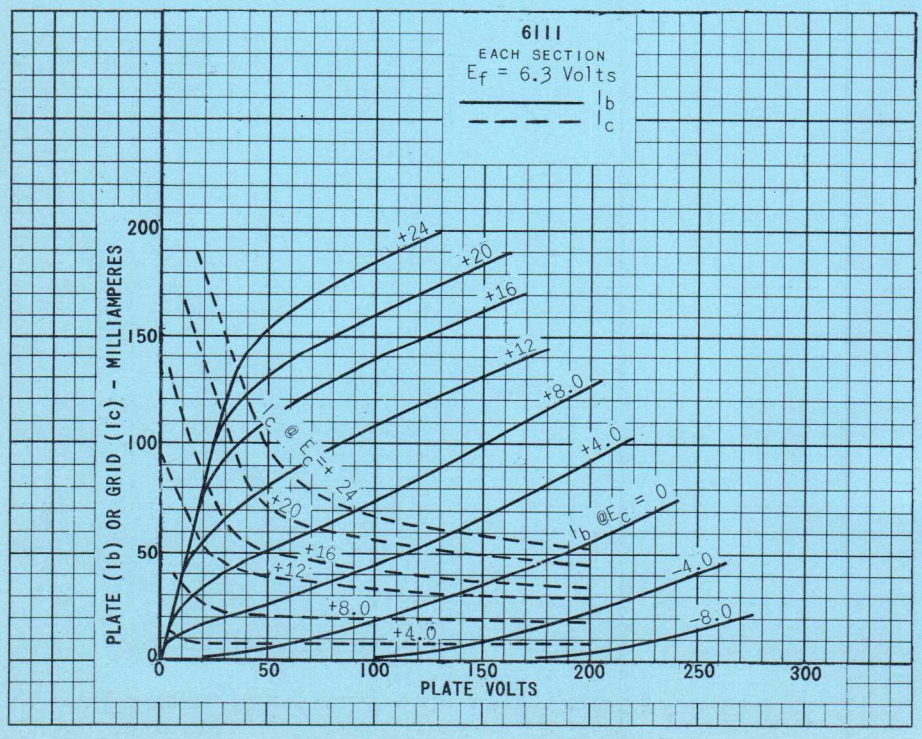
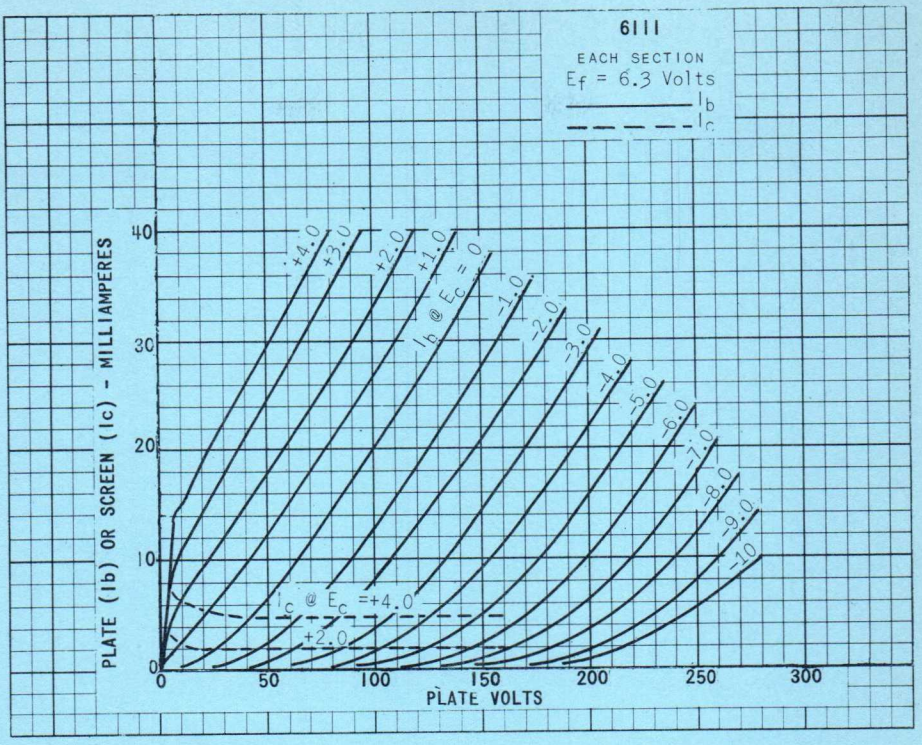
TENTATIVE DATA







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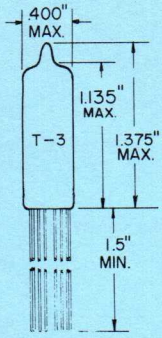
TWIN TRIODE

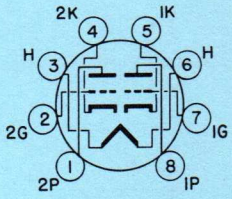
SUBMINIATURE TYPE



GLASS BULB
SUBMINIATURE BUTTON
8 PIN BASE E8-10
0.17" TINNED
FLEXIBLE LEADS
OUTLINE DRAWING
JEDEC 3-1

HEATER

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 8DG

THE 6111WA IS A HEATER-CATHODE TYPE MEDIUM-MU TWIN TRIODE CAPABLE OF OPERATION IN THE UHF REGION. IT IS OF SUBMINIATURE CONSTRUCTION AND DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED.

RATINGS

MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST-NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HR. FATIGUE TEST NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS

AND NORMAL OPERATION

	MIL-E-1 SYMBOL	DES. MIN.	NORM. TEST CONDITIONS NOTE 7	NORM. OPERATION NOTE 6	DES. MAX.	MIL-E-1 UNITS
HEATER VOLTAGE (NOTE 8)	Ef:	6.0	6.3	6.3	6.6	V
PLATE VOLTAGE	Eb:	---	100	100	250	Vdc
PEAK PLATE VOLTAGE	eb:	---	---	---	360	v
GRID #1 VOLTAGE	Ec1:	-55	0	0	---	Vdc
PLATE DISSIPATION (PER PL.)	Pp/p:	---	---	0.85	0.95	W
GRID #1 CIRCUIT RESISTANCE	Rg/g:	---	---	1.0	1.1	MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200	---	100	+200	v
PLATE CURRENT (PER PLATE)	Ib/p:	0.5	---	8.5	22	mAdc
GRID CURRENT (PER GRID)	Ic/c:	---	---	---	5.5	mAdc
CATHODE RESISTANCE (PER UNIT)	Rk:	---	220	220	---	OHMS
TRANSCONDUCTANCE (PER PLATE)	Sm/p:	---	---	5000	---	μMHOS
AMPLIFICATION FACTOR	Mu/p:	---	---	20	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1			COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES.						
HEATER CURRENT:	0.4	If:	285	---	---	---	315	---	mA
HEATER-CATHODE LEAKAGE (1):									
Ehk=+100 Vdc	0.4	Ihk(1):	---	---	---	---	3.5	---	μAdc
Ehk=-100 Vdc		Ihk(1):	---	---	---	---	3.5	---	μAdc
GRID CURRENT:									
Rg=1.0 MEG.	0.4	Ic(1):	---	---	---	---	-0.3	---	μAdc
PLATE CURRENT (1):	0.4	Ib(1):	6.0	7.5	8.5	9.5	11.0	2.8	mAdc
PLATE CURRENT (2):									
Ec1=-9.0 Vdc	0.4	Ib(2):	---	---	---	---	100	---	μAdc
TRANSCONDUCTANCE (1):	0.4	Sm(1):	4100	4650	→5000	5350	5900	1000	μMHOS
CONTINUITY AND SHORTS (INOPERATIVES):									
(NOTE 11)	0.4	---	---	---	---	---	---	---	---
MECHANICAL:									
ENVELOPE (8-1)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS, PART 2									
INSULATION OF ELECTRODES:									
Ef=6.3V									
Eg-all=-100 Vdc	2.5	Rg1-all:	250	---	---	---	---	---	MEG.
Ep-all=-300Vdc		Rp-all:	250	---	---	---	---	---	MEG.
PLATE CURRENT (1) DIFFERENCE BETWEEN SECTIONS:	2.5	Δlb:	---	---	---	---	1.5	---	mAdc
TRANSCONDUCTANCE (2):									
Ef=5.7 V (NOTE 9)	2.5	Δ_{Ef}Sm(2):	---	---	---	---	10	---	PERCENT
GRID EMISSION: Ef=7.5 V; Rg/g=1.0 MEG.; Eb=250 Vdc; Rk/k=2900 OHMS PREHEAT 5 MIN. AT Ec1=0, TEST AT									
Ec1=-20 Vdc	6.5	Isc1:	---	---	---	---	-0.5	---	μAdc
AF NOISE: Esig=65 mVac; Rg1= 0.1 MEG.; Rp=0.01 MEG.; Rk=100 OHMS; Ck=1000μf UNITS CONNECTED IN PARALLEL	2.5	EB:	---	---	---	---	17	---	VU
AMPLIFICATION FACTOR:	6.5	Mu:	17	---	20	---	23	---	---
PULSE EMISSION (1): Eb=150 Vdc; Ec1 =-25 Vdc; tp=10 μsec; DUTY CYCLE= 1%; egk=+30 V; Rk/k=1.0 OHM; (NOTE 12)	2.5	ik:	320	---	---	---	---	---	ma
		Δ_{tp}ik:	---	---	---	---	10	---	PERCENT
PULSE EMISSION (2): Ef=5.9 V; Eb=150 Vdc; Ec1=-25 Vdc; tp=10μsec DUTY CYCLE =1%; egk=+30 V; Rk/k =1.0 OHM; (NOTE 12)	6.5	ik:	300	---	---	---	---	---	ma

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→INDICATES A CHANGE.

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] cont'd.

IN THE FOLLOWING TEST EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2 - CONT'D.									
HEATER-CATHODE LEAKAGE (2): Ef=-6.7 V(PIN 6 NEG.); Ehk=+100 Vdc;(CATHODE NEGATIVE); t=16 SEC. (NOTE 13)	6.5	Ihk(2):	---	---	---	---	1.0	---	μAdc
CAPACITANCE:		Cgp:	1.2	---	1.5	---	1.8	---	μμf
CAPACITANCE:		Cin:	1.4	---	1.9	---	2.4	---	μμf
CAPACITANCE (NOTE2)	6.5	Cout (UNIT #1)	0.20	---	0.28	---	0.36	---	μμf
CAPACITANCE		Cout (UNIT #2)	0.22	---	0.32	---	0.42	---	μμf
CAPACITANCE		Cgg:	---	---	---	---	0.011	---	μμf
CAPACITANCE:		Cpp:	---	---	---	---	0.50	---	μμf

MEASUREMENTS ACCEPTANCE TESTS, PART 2 cont'd.	ALLOWABLE DEF. PER CHARAC. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
OPERATION TIME: (NOTE 10)	---	---	4.0	t:	---	20	SEC.
LOW PRESSURE VOLTAGE BREAKDOWN: PRESSURE =21 ±3 mmHg; VOLTAGE = 300 Vac.	---	---	6.5	---	---	---	---
VIBRATION (2): F=40 cps; G=15; Rp= 10,000 OHMS	---	---	2.5	Ep:	---	20	mVac
VIBRATION (3): F=70-2000cps G=10; Rp=10,000 OHMS. POSITIONS X_1 AND X_2 ONLY.	---	---	6.5	ep:	---	125 PEAK TO PEAK	mv.
DEGRADATION RATE ACCEPTANCE TESTS							
SUBMINIATURE LEAD FATIGUE:	---	---	2.5	---	4.0	---	arcs
SHOCK (1): Ehk=+100 Vdc; Rg=0.1 MEG.; HAMMER ANGLE = 30°; (NOTE 3)	---	---	20	---	---	---	---
FATIGUE (1): 96 HOURS; G=2.5; FIXED FREQUENCY; F=25 MIN., 60 MAX. (NOTE 5)	---	---	6.5	---	---	---	---
SHOCK (2): Ehk=100 Vdc; Rg=0.1 MEG.; HAMMER ANGLE=120°+RUBBER PAD; t=10 MILLISECONDS; G=75; (NOTE 15)	---	---	20	---	---	---	---
FATIGUE (2): 6 HOURS; G=10; F=130-2000-130 cps (NOTE 14)	---	---	6.5	---	---	---	---
POST SHOCK TESTS (1) & (2) AND FATIGUE TESTS (1) & (2) END POINTS: VIBRATION (2): F=40cps; G=15; Rp= 10,000 OHMS			---	Ep:	---	80	mVac

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC. 1st SAMP.	ALLOW. DEF. PER CHARAC. COMB. SAMP.	AQL %	MIL-E-1	MIN	MAX	MIL-E-1
DEGRADATION RATE ACCEPTANCE TESTS (CONT'D.							
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	7	μAdc
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:							
Ef=6.3 V	---	---	---	Δ_tSm(1).	---	15	PERCENT
GRID CURRENT (1):	---	---	---	Ic(1):	---	-1.0	μAdc
GLASS STRAIN (THERMAL SHOCK).	---	---	6.5	---	---	---	---
ACCEPTANCE LIFE TEST							
HEATER CYCLING LIFE TEST: Ef=7.0V; Eb=Ec=0V; Ehk=140 Vac; 1 MIN. ON, 4 MIN. OFF	---	---	1.0	---	2000	---	CYCLES
HEATER CYCLING LIFE TEST END POINTS:							
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
Ehk=-100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
2 & 20 HOUR STABILITY LIFE TEST: TA=ROOM; Ehk=+200 Vdc; Rg/g= 1.0 MEG.	---	---	---	---	---	---	---
2 & 20 HOUR STABILITY LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE= 50 TUBES)	---	---	---	---	---	---	---
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:	---	---	1.0	Δ_tSm(1):	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST: TA = ROOM; Ehk=+200 Vdc; Rg/g =1.0 MEG.	---	---	---	---	---	---	---
100 HOUR SURVIVAL RATE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE= 200 TUBES)	---	---	---	---	---	---	---
CONTINUITY AND SHORTS (INOPERATIVES:	---	---	0.65	---	---	---	---
TRANSCONDUCTANCE (1):	---	---	1.0	Sm(1):	3750	---	μMHOS
200 HOUR INTERMITTENT LIFE TEST (1): Eb=250 Vdc Ec1=0 Vdc; Ehk=+200 Vdc; Rg/g=1.0 MEG.; Rk/k= 2900 OHMS; TA = ROOM							
200 INTERMITTENT LIFE TEST (1) END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic1:	---	-0.9	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:	1	3	---	Δ_t Sm(1):	---	25	PERCENT

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CHARACTERISTICS AND QUALITY CONTROL TESTS cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST ACCEPTANCE LIFE TESTS (cont'd.)	ALLOW. DEF. PER CHARAC. 1st COMB.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef}Sm(2)$:	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES:							
g-all	1	3	---	Rg-all:	100	---	MEG.
p-all			---	Rp-all:	100	---	MEG.
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
500 HOUR INTERMITTENT PULSE LIFE TEST: Eb=250 Vdc; Ec1=-25 Vdc; Rk/k=0; R1/p=330 OHMS; tp=10 μsec; DUTY CYCLE = 1.0 %; egk=+ 30±1 VOLTS; TA = ROOM							
500 HOUR INTERMITTENT PULSE LIFE TEST END POINTS: (TYPICAL SAMPLSE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
PULSE EMISSION:	1	3	---	ik:	300	---	mA
CHANGE IN PULSE EMISSION OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δik:	---	-35	PERCENT
			---	Δik:	---	+50	PERCENT
TOTAL DEFECTIVES:	2	5	---	---	---	---	---
INTERMITTENT HIGH TEMPERATURE LIFE TEST (2): T BULB =220° C; Ehk=+200 Vdc; Rg/g=1.0 MEG.	---	---	---	---	---	---	---
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST (2) END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-0.7	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE IN INDIVIDUAL TUBES FROM INITIAL:	1	3	---	$\Delta_t Sm(1)$:	---	20	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef}Sm(2)$:	---	15	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc

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CHARACTERISTICS AND QUALITY CONTROL TEST cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (cont'd.)							
INSULATION OF ELECTRODES:							
g-all:	1	3	---	Rg-all:	50	---	MEG.
p-all:			---	Rp-all:	50	---	MEG.
TRANSCONDUCTANCE (1) AVERAGE CHANGE:	---	---	---	Avg $\Delta_t Sm$:	---	15	PERCENT
TOTAL DEFECTIVES	3	6	---	---	---	---	---
1000 HOUR HIGH TEMPERATURE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-1.0	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	$\Delta_t Sm(1)$:	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef} Sm(2)$:	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES:							
g-all:	2	5	---	Rg-all:	25	---	MEG.
p-all:			---	Rp-all:	25	---	MEG.
TOTAL DEFECTIVES:	4	8	---	---	---	---	---

NOTES

1. CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1, "INSPECTION INSTRUCTIONS FOR ELECTRON TUBES," AND MIL-STD-105A.
2. WITHOUT SHIELD.
3. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.
4. CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.
5. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

CONTINUED ON FOLLOWING PAGE

NOTES CONT'D.

6. THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.

7. THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.

8. FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY ± 5% HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.

9. CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef=6.3 V TO THAT VALUE MEASURED AT Ef=5.7V.

10. OPERATION TIME IS THE TIME IN SECONDS REQUIRED FOR THE PLATE CURRENT TO ATTAIN A VALUE WITHIN ± 10% OF THE THREE (3) MINUTE PLATE CURRENT (1) VALUE MEASURED AT PLATE CURRENT (1) TEST CONDITIONS. NO PREHEATING BEFORE THIS TEST IS ALLOWED. A COLD TUBE MUST BE USED.

11. DURING BOTH CONTINUITY AND SHORT TESTING, THE TUBE UNDER TEST SHALL BE TAPPED AT LEAST THREE TIMES IN EACH OF TWO PLANES 90° APART WITH A TAPPER WHICH SHALL BE ADJUSTED TO GIVE AN IMPULSE OF APPROXIMATELY ONE HALF SINE WAVE OF 300 ± 50 MICROSECONDS DURATION AND HAVING A MINIMUM AVERAGE AMPLITUDE OF 80 G'S PEAK ACCELERATION AS MEASURED WITH A GULTON A-305 ACCELEROMETER AND KA-1 KIT. THE SHORTS DETECTING EQUIPMENT SHALL BE A DEVICE CAPABLE OF DETECTING AS SHORTS, THE FOLLOWING INTERELEMENT RESISTANCES OF THE GIVEN TIME DURATION.

DURATION	SENSITIVITY
PERMANENT	600,000 OHMS
500 MICRO SECONDS	500,000 OHMS
100 MICRO SECONDS	100,000 OHMS
60 MICRO SECONDS	1,000 OHMS

TUBES WHICH GIVE AN INDICATION OF ONE OR MORE OF THE FOLLOWING SHALL BE REJECTED AS INOPERABLE:

A. EITHER A PERMANENT OR TAP SHORT AT ANY TIME DURING THE TAPPING PROCEDURE

B. ANY OPEN CIRCUIT

C. ANY LEAKS

12. PEAK CATHODE CURRENT SHALL BE MEASURED BY MEANS OF A HIGH IMPEDANCE OSCILLOSCOPE OR EQUIPMENT DEVICE CONNECTED ACROSS A 1.0 ± 1% CATHODE RESISTOR. THE SPECIFIED LIMIT REFERS TO THE MAXIMUMS OF THE PULSE COMPLITUDE. THE VARIATION OF THE OUTPUT PULSE AMPLITUDE BETWEEN 20% t_p AND 80% t_p SHALL NOT EXCEED THE SPECIFIED LIMIT.

13. HEATER-CATHODE LEAKAGE (2) IS PERFORMED AS FOLLOWS:

A. PREHEAT TUBES FOR 10 SECONDS WITH Ef = 10.5V

B. TEST IMMEDIATELY BY THE APPLICATIONS OF THE SPECIFIED TEST CONDITIONS OF THIS TEST

C. AFTER 16 SECONDS READ HEATER-CATHODE LEAKAGE OF EACH SECTION.

14 THE TUBES SHALL BE RIGIDLY MOUNTED ON A TABLE VIBRATING WITH SIMPLE HARMONIC MOTION. THE TUBES SHALL BE VIBRATED FOR A TOTAL OF 6 HOURS, 2 HOURS IN EACH OF THREE POSITIONS, X1, X2 AND Y1. ONLY RATED HEATED VOLTAGE SHALL BE APPLIED. TUBES WHICH SHOW ONE OR MORE OF THE FOLLOWING DEFECTS SHALL BE CONSIDERED FAILURES.

A. TUBES WHICH SHOW PERMANENT OR TAP SHORTS OR OPEN CIRCUITS FOLLOWING FATIGUE TEST, WHEN TESTED AS SPECIFIED IN 4.7.2 AND 4.7.3

B. TUBES WHICH DO NOT COMPLY WITH POST FATIGUE LIMITS, THIS IS A DESTRUCTIVE TEST

15 THE PROVISIONS OF PARAGRAPH 4.9.20.5 OF SPECIFICATION MIL-E-1 SHALL APPLY, EXCEPT FOR TEST CONDITIONS LISTED FOR SHOCK TEST (2).

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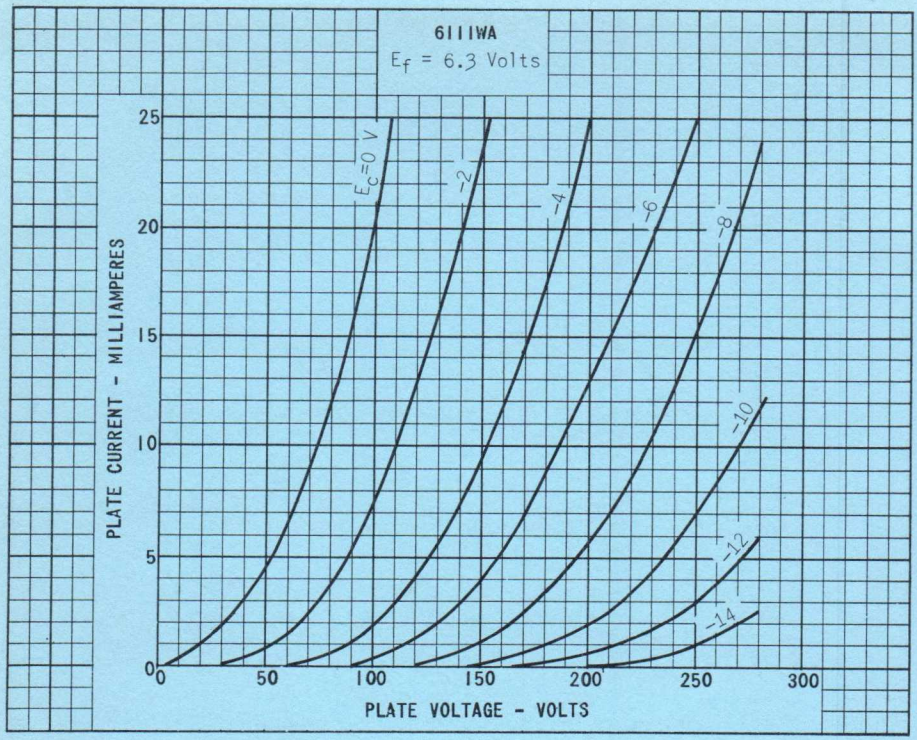
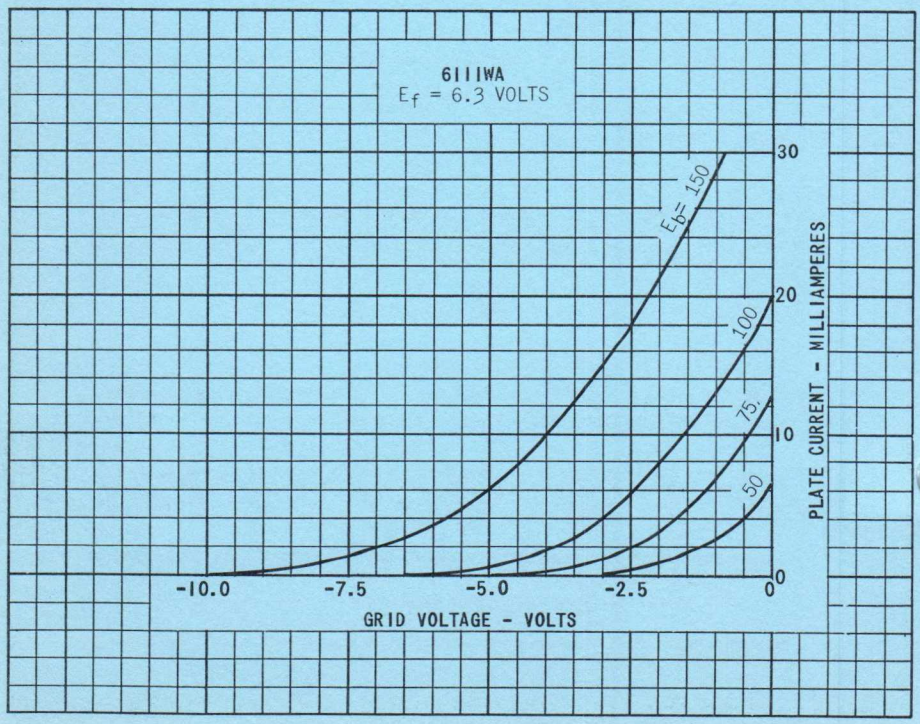
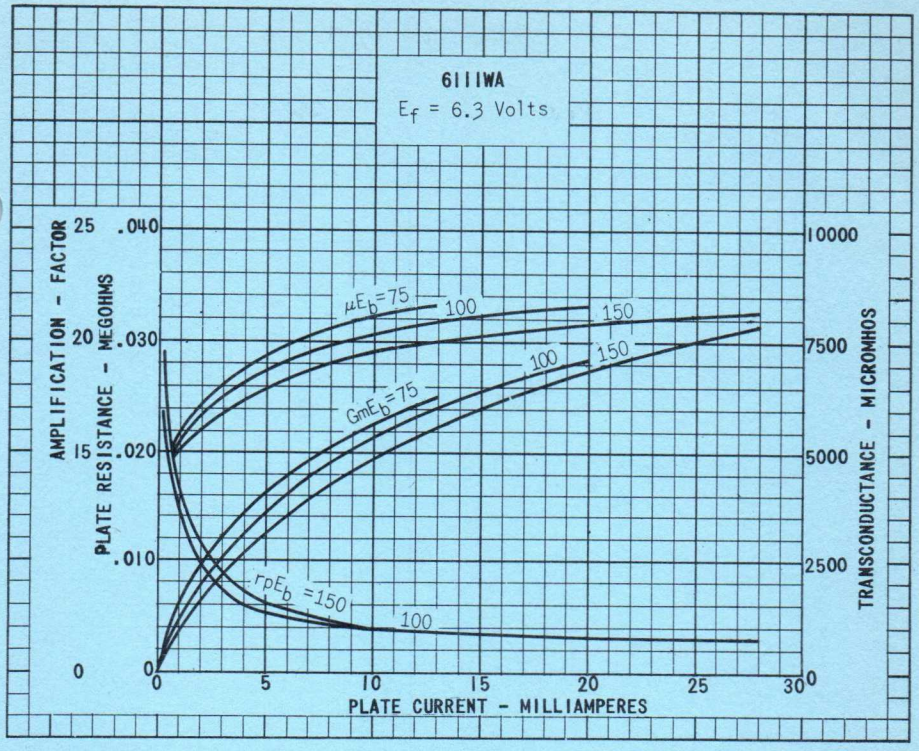
TENTATIVE DATA







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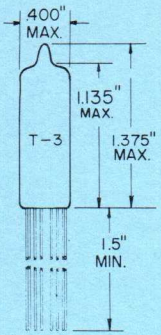
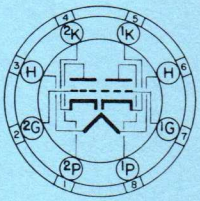
DOUBLE TRIODE

SUBMINIATURE TYPE



GLASS BULB

ANY MOUNTING POSITION



BOTTOM VIEW

SUBMINIATURE BUTTON
8 PIN
0.017" TINNED
FLEXIBLE LEADS

THE 6112 IS A HEATER-CATHODE TYPE HIGH-MU DOUBLE TRIODE OF SUBMINIATURE CONSTRUCTION, CAPABLE OF OPERATION IN THE UHF REGION. IT IS DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED. THE FLEXIBLE LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO THE TERMINALS OF CIRCUIT COMPONENTS WITHOUT THE USE OF SOCKETS. STANDARD SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE LEADS TO A SUITABLE LENGTH.

RATINGS

MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST - NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (100 HOUR FATIGUE TEST-NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS

AND NORMAL OPERATION

	MIL-E-1B SYMBOL	ABS. MIN.	NORM. TEST CONDITIONS (NOTE 7)	NORM. OPERATION (NOTE 6)	ABS. MAX.	MIL-E-1B UNITS
HEATER VOLTAGE (NOTE 8)	Ef:	6.0	6.3	6.3	6.6	V
PLATE VOLTAGE	Eb:	---	100	100	165	Vdc
GRID #1 VOLTAGE	Ec1:	-55	0	0	0	Vdc
PLATE DISSIPATION (PER PLATE)	Pp/p:	---	---	0.08	0.10	W
GRID #1 CIRCUIT RESISTANCE	Rg/g:	---	---	1.0	1.1	MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200	---	100	+200	Vdc
PLATE CURRENT (PER PLATE)	Ib/p:	---	---	---	3.3	mAdc
GRID CURRENT	Ic/c:	---	---	---	---	mAdc
CATHODE RESISTANCE (PER UNIT)	Rk:	---	1500	1500	---	OHMS

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

(IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY)

TEST	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOG.	UAL.	MAX.	ALD	MIL-E-1B UNITS
MEASUREMENTS ACCEPTANCE TESTS - PART 1									
	COMBINED AQL=1.0% EXCLUDING MECHANICAL AND INOPERATIVES								
HEATER CURRENT:	0.65	If:	280	288	300	312	320	24	mA.
HEATER-CATHODE LEAKAGE: Ehk=- 100 Vdc	0.65	Ihk:	---	---	---	---	5.0	---	μAdc
Ehk=+100 Vdc			---	---	---	---	5.0	---	μAdc
GRID CURRENT: Eb=150 Vdc: Ec=0; Rk=820 OHMS; Rg= 1.0 MEG.	0.65	Ic(1):	---	---	---	---	-0.3	---	μAdc
PLATE CURRENT (1):	0.65	Ib(1):	0.50	---	0.8	---	1.10	---	mAdc
PLATE CURRENT (2): Ec1 =-2.8 Vdc	0.65	Ib(2):	---	---	---	---	50	---	μAdc
TRANSCONDUCTANCE (1):	0.65	Sm(1):	1500	1650	1800	1950	2100	350	μMHOS
CONTINUITY AND SHORTS (INOPERATIVES):	0.4	---	---	---	---	---	---	---	---
MECHANICAL: (ENVELOPE (8-1)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS - PART 2									
INSULATION OF ELECTRODES: Ef =6.3 V									
Eg-all=-100 Vdc	2.5	Rg-all:	100	---	---	---	---	---	MEG.
Ep-all=-300 Vdc		Rp-all:	100	---	---	---	---	---	MEG.
TRANSCONDUCTANCE (2): Ef =5.7 V (NOTE 9)	2.5	ΔSm(2): Ef:		---	---	---	15	---	PERCENT
GRID EMISSION: Eb=150 Vdc: Rg=1.0 MEG; Rk=820 OHMS; Ef=7.5 V: PREHEAT AT Ec =0; TEST AT Ec=-4.0 Vdc:	2.5	Ic(2):	---	---	---	---	-0.5	---	μAdc
AF NOISE: Esig=45 mVac; Rg=0.5 MEG: Rp=0.02 MEG; Rk= 750 OHMS: CK = 1000 μf; UNITS CONNECTED IN PARALLEL	2.5	EB:	---	---	---	---	17	---	VU
AMPLIFICATION FACTOR;	6.5	Mu:	60	---	70	---	80	---	---
A.C. AMPLIFICATION: Esig=0.2 Vac; Ebb =100 Vdc: Ecc=0; Rk=0;	6.5	Ep:	8.0	---	---	---	---	---	Vac
CAPACITANCE:		Cgp:	0.8	---	1.00	---	1.20	---	μμf
CAPACITANCE:		Cin:	1.30	---	1.70	---	2.10	---	μμf
CAPACITANCE: (NOTE 2)	6.5	Cout (Unit #1)	0.16	---	0.23	---	0.30	---	μμf
CAPACITANCE:		Cout (Unit #2)	0.21	---	0.28	---	0.35	---	μμf
CAPACITANCE:		Cgg:	---	---	---	---	0.014	---	μμf
CAPACITANCE:		Cpp:	---	---	---	---	0.80	---	μμf

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOG.	UAL.	MAX.	ALD	MIL-E-1B UNITS
MEASUREMENTS ACCEPTANCE TESTS - PART 2 (cont'd.)									
LOW PRESSURE VOLTAGE BREAKDOWN: PRESSURE = 55±5mmHG; VOLTAGE = 300 Vac.	6.5								
VIBRATION (1): NO VOLTAGES; F VARIABLE FROM 10 - 50 cps; G MAX. = 10; FIXED AMPLITUDE 0.040''; POST SHOCK AND FATIGUE TEST END POINTS APPLY	10.0	---	---	---	---	---	---	---	---
VIBRATION (2): F= 40cps; G=15; Rp= 10,000 OHMS	2.5	Ep:	---	---	---	---	25	---	mVac
DEGRADATION RATE ACCEPTANCE TESTS									
SUBMINIATURE LEAD FATIGUE:	2.5	---	4.0	---	---	---	---	---	arcs
SHOCK: Ehk =+100 Vdc; Rg =0.1 MEG HAMMER ANGLE =30°. (NOTE 3)	20	---	---	---	---	---	---	---	---
FATIGUE: 96 HOURS; G = 2.5 ; FIXED FREQUENCY; F=25 min; 60 max. (NOTE 5)	6.5	---	---	---	---	---	---	---	---
POST SHOCK AND FATIGUE TEST END POINTS:									
VIBRATION (2): F=40 cps; G=15; Rp= 10,000 OHMS	---	Ep:	---	---	---	---	100	---	mVac
HEATER-CATHODE LEAKAGE: Ehk=± 100 Vdc Ehk=-100 Vdc		Ihk:	---	---	---	---	20	---	μAdc
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES: Ef=6.3 V		ΔtSm(1):	---	---	---	---	20	---	PERCENT
GLASS STRAIN (THERMAL SHOCK):	6.5	---	---	---	---	---	---	---	---

ACCEPTANCE LIFE TESTS

	MAX. DEFECTS PER CHARACTERISTIC 1st SAMPLE	MAX. DEFECTS PER CHARACTERISTIC COMB. SAMPLE	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
HEATER CYCLING: Ef = 7.0 V; Eb=Ec= 0V; Ehk =140 Vac; 1 min. on, 4 min. off.	---	---	2.5	---	2000	---	CYCLES

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST	MAX. DEFECTS PER CHARACT. 1st SAMPLE	MAX. DEFECTS PER CHARACT. COMB. SAMPLE	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
ACCEPTANCE LIFE TESTS (cont'd.)							
1 HOUR STABILITY LIFE TEST: TA = ROOM; Ehk=+200 Vdc; Rg/g =1.0 MEG.	---	---	---	---	---	---	---
1 HOUR STABILITY LIFE TEST END POINTS: CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES: (TYPICALSAMPLE SIZE = 50 TUBES.	---	---	1.0	ΔtSm(1):	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST: TA = ROOM; Ehk =+200 Vdc; Rg/g =1.0 MEG.							
100 HOUR SURVIVAL RATE LIFE TEST, END POINTS: (TYPICAL SAMPLE SIZE = 200 TUBES)	---	---	---	---	---	---	---
CONTINUITY AND SHORTS (INOPERATIVES):	---	---	0.65	---	---	---	---
TRANSCONDUCTANCE (1):	---	---	1.0	Sm(1):	1200	---	μMHOS
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST: T BULB = 220 °C; Ehk =+200 Vdc; Rg/g =1.0 MEG.	---	---	---	---	---	---	---
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES	1	3	---	---	---	---	---
HEATER CURRENT	2	5	---	If:	276	328	mA
HEATER-CATHODE LEAKAGE: Ehk =±100 Vdc Ehk=-100 Vdc	2	5	---	Ihk:	---	10	μAdc
GRID CURRENT (1)	1	3	---	Ic(1):	---	-0.9	μAdc
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	ΔtSm(1):	---	25	PERCENT
TRANSCONDUCTANCE (1) AVERAGE CHANGE:	---	---	---	AveΔtSm(1):	---	15	PERCENT
INSULATION OF ELECTRODES; g1-all	2	5	---	Rg1-all:	50	---	MEG.
p-all	2	5	---	Rp-all:	50	---	MEG.
TRANSCONDUCTANCE (2):(NOTE 9)	2	5	---	ΔtSm(2):	---	15	PERCENT
TOTAL DEFECTIVES	4	8	---	---	---	---	---
1000 HOUR HIGH TEMPERATURE INFORMATION LIFE TEST: T BULB=220°C; Ehk =+200 Vdc: Rg/g = 1.0 MEG.							
1000 HOUR HIGH TEMPERATURE INFORMATION LIFE TEST END POINTS: READ FOR SAME CHARACTERISTICS AS FOR 500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST. LIMITS NOT ESTABLISHED.							

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NOTES

NOTE 1: CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1B, 'INSPECTION INSTRUCTIONS FOR ELECTRON TUBES,' AND MIL-STD-105A.

NOTE 2: WITHOUT SHIELD.

NOTE 3: TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1B BASIC SPECIFICATION.

NOTE 4: CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.

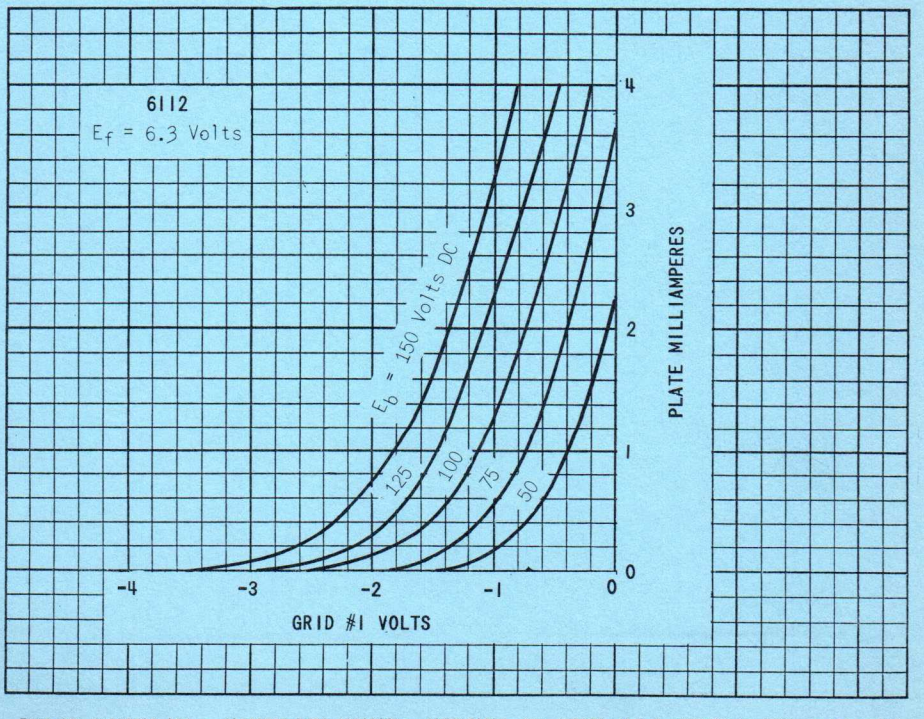
NOTE 5: TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1B BASIC SPECIFICATION.

NOTE 6: THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.

NOTE 7: THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHER WISE STATED UNDER THE INDIVIDUAL TEST ITEM.

NOTE 8: FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY ±5% HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.

NOTE 9: CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef=6.3 V TO THAT VALUE MEASURED AT Ef=5.7 V.



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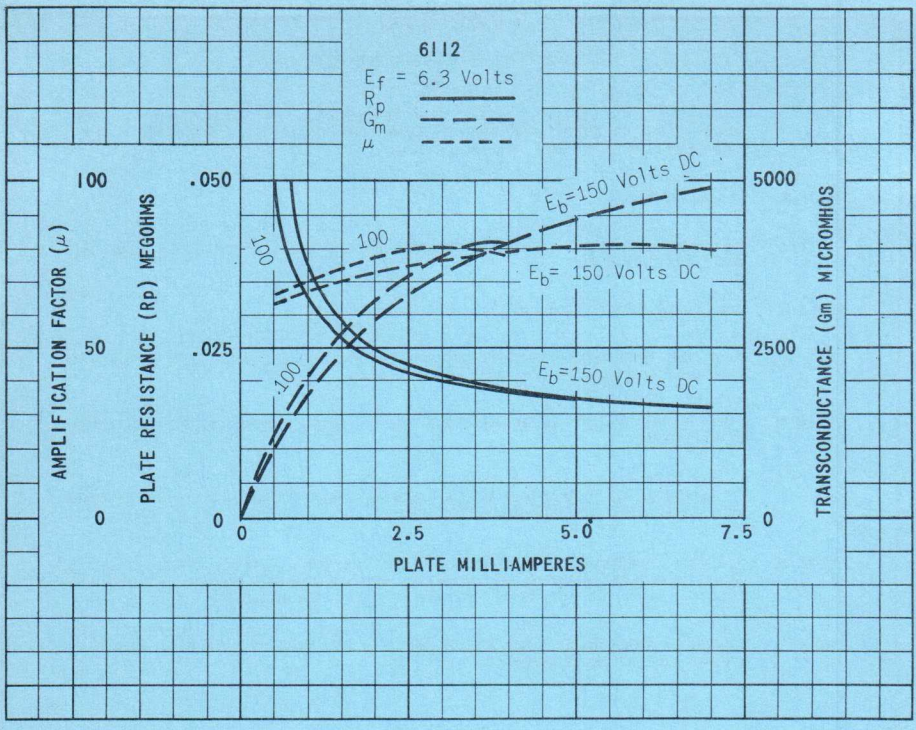
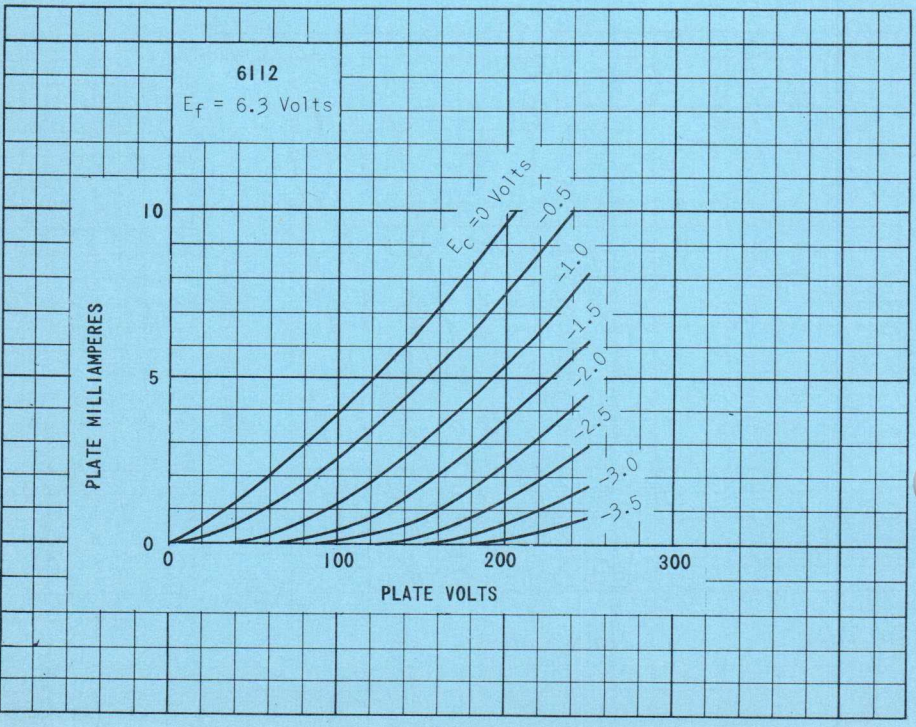

6112
E_f = 6.3 Volts
R_p
G_m
μ
AMPLIFICATION FACTOR (μ)
PLATE RESISTANCE (Rp) MEGOHMS
TRANSCONDUCTANCE (Gm) MICROMHOS
PLATE MILLIAMPERES
100
50
0
.050
.025
0
5000
2500
0
2.5
5.0
7.5
E_b=150 Volts DC
E_b= 150 Volts DC
E_b=150 Volts DC
100
100
100


6112
E_f = 6.3 Volts
PLATE MILLIAMPERES
PLATE VOLTS
10
5
0
0
100
200
300
E_c =0 Volts
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5

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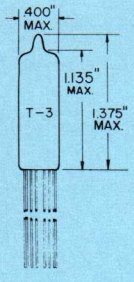
DOUBLE TRIODE

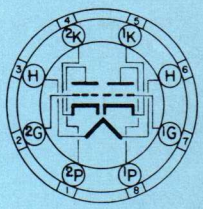
SUBMINIATURE TYPE



GLASS BULB

HEATER

ANY MOUNTING POSITION



BOTTOM VIEW

SUBMINIATURE BUTTON
8 PIN BASE
0.017" TINNED
FLEXIBLE LEADS

8DG

THE 6112WA IS A HEATER-CATHODE TYPE HIGH-MU DOUBLE TRIODE CAPABLE OF OPERATION IN THE UHF REGION. IT IS OF SUBMINIATURE CONSTRUCTION AND DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED. THE FLEXIBLE LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO THE TERMINALS OF CIRCUIT COMPONENTS WITHOUT THE USE OF SOCKETS. STANDARD SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE LEADS TO A SUITABLE LENGTH.

RATINGS
MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST-NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HR. FATIGE TEST-NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS
AND NORMAL OPERATION

	MIL-E-1 SYMBOL	DES. MIN.	NORM. TEST CONDITIONS NOTE 7	NORM. OPERATION NOTE 6	DES. MAX.	MIL-E-1 UNITS
HEATER VOLTAGE (NOTE 8)	Ef:	6.0	6.3	6.3	6.6	V
PLATE VOLTAGE	Eb:	---	100	100	250	Vdc
PEAK PLATE VOLTAGE	ep:	---	---	---	360	v
GRID #1 VOLTAGE	Ec1:	-55	0	0	---	Vdc
PLATE DISSIPATION (PER PLATE)	Pp/p:	---	---	0.08	0.3	W
GRID #1 CIRCUIT RESISTANCE	Rg/g:	---	---	1.0	1.1	MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200	---	100	+200	Vdc
PLATE CURRENT (PER PLATE)	Ib/p:	---	---	0.8	3.3	mAdc
GRID CURRENT	Ic/c:	---	---	---	---	mAdc
CATHODE RESISTANCE (PER UNIT)	Rk:	---	1500	1500	---	OHMS
TRANSCONDUCTANCE (PER PLATE)	Sm/p:	---	---	1800	---	μMHOS
AMPLIFICATION FACTOR	Mμ/p:	---	---	70	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

(IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY)

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS - PART 1	COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES.								
HEATER CURRENT:	0.4	If:	285	---	---	---	315	---	mA
HEATER-CATHODE LEAKAGE:									
Ehk=+100 Vdc	0.4	Ihk:	---	---	---	---	3.5	---	μAdc
Ehk=-100 Vdc		Ihk:	---	---	---	---	3.5	---	μAdc
GRID CURRENT: Eb=150 Vdc; Ec=0; Rk=820 OHMS; Rg= 1.0 MEG.	0.4	Ic(1):	---	---	---	---	-0.3	---	μAdc
PLATE CURRENT (1):	0.4	Ib(1):	0.50	---	0.8	---	1.10	---	mAdc
PLATE CURRENT (2): Ec1=-2.8 Vdc	0.4	Ib(2):	---	---	---	---	50	---	μAdc
TRANSCONDUCTANCE (1):	0.4	Sm(1):	1500	1650	1800	1950	2100	350	μMHOS
CONTINUITY AND SHORTS (INOPERATIVES): (NOTE 11)	0.4	---	---	---	---	---	---	---	---
MECHANICAL: ENVELOPE (8-1)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS - PART 2									
INSULATION OF ELECTRODES:									
Ef=6.3 V; Eg-all=-100Vdc;	2.5	Rg-all:	250	---	---	---	---	---	MEG.
Ep-all=-300 Vdc;		Rp-all:	250	---	---	---	---	---	MEG.
TRANSCONDUCTANCE (2): Ef=5.7 V; (NOTE 9)	2.5	Δ_{Ef}Sm(2):	---	---	---	---	15	---	PERCENT
GRID EMISSION: Eb=250 Vdc; Rg=1.0 MEG; Rk=2700 OHMS; Ef=7.5 V; PREHEAT AT Ec=0; TEST AT Ec=-9.0 Vdc	6.5	Ic(2):	---	---	---	---	-0.5	---	μAdc
AF NOISE: Esig=45mVac; Rg= 0.5 MEG.; Rp=0.2 MEG ; Rk=750 OHMS; Ck= 1000 μf; UNITS CONNECTED IN PARALLEL	2.5	EB:	---	---	---	---	17	---	VU
AMPLIFICATION FACTOR:	6.5	Mu:	60	---	70	---	80	---	---
AC AMPLIFICATION: Esig=0.2 Vac; Ebb=100 Vdc; Ecc=0; Rk=0; Rg1= 10 MEG.;	6.5	Ep:	8.0	---	---	---	---	---	Vac
HEATER-CATHODE LEAKAGE (2): Ef=-6.7V; PIN 6 NEGATIVE; Ehk=+100 Vdc; CATHODE NEGATIVE t= 16 SEC.; (NOTE 12)	6.5	Ihk(2):	---	---	---	---	1.0	---	μAdc

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

(IN THE FOLLOWING TESTS, EACH UNIT IS TESTED SEPARATELY)

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2 (CONT'D.)	COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES								
CAPACITANCE:		Cgp:	0.8	---	1.00	---	1.20	---	μμf
CAPACITANCE:		Cin:	1.30	---	1.70	---	2.10	---	μμf
CAPACITANCE: (NOTE 2)	6.5	Cout: UNIT #1	0.16	---	0.23	---	0.30	---	μμf
CAPACITANCE:		Cout UNIT #2:	0.21	---	0.28	---	0.35	---	μμf
CAPACITANCE:		Cgg:	---	---	---	---	0.014	---	μμf
CAPACITANCE:		Cpp:	---	---	---	---	0.80	---	μμf
LOW PRESSURE BREAKDOWN: PRESSURE=21±3mmHG; VOLTAGE=300 Vac	6.5								
VIBRATION (2): F=40cps; G=15; Rp= 10,000 OHMS	2.5	Ep:	---	---	---	---	20	---	mVac
VIBRATION (3): F=70-2000; t=3 MINUTES; G=15; Rp=10,000 OHMS; POSITIONS X AND X2 ONLY.	6.5	ep:	---	---	---	---	75 peak to peak	---	mv
OPERATION TIME: (NOTE 10)	4.0	t:	---	---	---	---	20	---	sec.

TEST	ALLOWABLE DEF. PER CHARACTER. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
DEGRADATION RATE ACCEPTANCE TESTS							
SUBMINIATURE LEAD FATIGUE:	---	---	2.5	---	4.0	---	arcs
SHOCK (1): Ehk=+100 Vdc; Rg= 0.1 MEG.; HAMMER ANGLE = 30°; (NOTE 3)	---	---	20	---	---	---	---
FATIGUE (1): 96 HOURS; G=2.5; FIXED FREQUENCY; F=25 MIN; 60 MAX.; (NOTE 5)	---	---	6.5	---	---	---	---
SHOCK (2): Ehk=+100 Vdc; Rg= 0.1 MEG.; HAMMER ANGLE = 120 °+ RUBBER PAD; t=10 MILLISECONDS; G= 75 (NOTE 14)	---	---	20	---	---	---	---
FATIGUE (2): 6 HOURS; G=10; F=130-2000-130 cps (NOTE 13)	---	---	6.5	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] cont'd.

TEST	ALLOWABLE DEF. PER CHARACT. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN	MAX.	MIL-E-1 UNITS
DEGRADATION RATE ACCEPTANCE TESTS -CONT'D.							
POST SHOCK AND FATIGUE (1) AND (2) TEST END POINTS:							
VIBRATION (2): F=40 cps; G=15; Rp= 10,000 OHMS.	---	---	---	Ep:	80	---	mVac
HEATER-CATHODE LEAKAGE:							
Ehk=+100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
Ehk=+100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
CHANGE IN TRANS-CONDUCTANCE (1) OF INDIVIDUAL TUBES:							
Ef=6.3 V	---	---	---	Δ_tSm(1):	---	15	PERCENT
GRID CURRENT (1):	---	---	---	Ic(1):	---	-1.0	μAdc
GLASS STRAIN (THERMAL SHOCK):	---	---	6.5	---	---	---	---
ACCEPTANCE LIFE TESTS							
HEATER CYCLING: Ef=7.0V; Eb=Ec=0V; Ehk=140 Vac; 1 MIN. ON, 4 MIN. OFF	---	---	1.0	---	2000	---	CYCLES
HEATER CYCLING LIFE TEST END POINTS:							
HEATER-CATHODE LEAKAGE:							
Ehk=+100 Vdc	---	---	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc	---	---	---	Ihk(1):	---	10	μAdc
2 & 20 HOUR STABILITY LIFE TEST: TA=ROOM; Ehk=+200 Vdc; Rg/g=1.0 MEG.: Eb=150 Vdc; Rk/k=820 OHMS	---	---	---	---	---	---	---
2 & 20 HOUR STABILITY LIFE TEST END POINTS: CHANGE IN TRANSCON-DUCTANCE (1) OF IN-DIVIDUAL TUBES: (TYPICAL SAMPLE SIZE= 50 TUBES)	---	---	1.0	Δ_tSm(1):	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST: TA=ROOM; Ehk=+200 Vdc; Rg/g=1.0 MEG.; Eb=150 Vdc; Rk/k=820 OHMS							
100 HOUR SURVIVAL RATE LIFE TEST END POINTS: TYPICAL SAMPLE SIZE= 200 TUBES)	---	---	---	---	---	---	---
CONTINUITY AND SHORTS (INOPERATIVES):	---	---	0.65	---	---	---	---
TRANSCONDUCTANCE (1):	---	---	1.0	Sm(1):	1200	---	μMHOS

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] cont'd.

TEST	ALLOWABLE DEF. PER CHARACTER. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (CONT'D.)							
200 HOUR INTERMITTENT LIFE TEST (1): TA=ROOM; Eb=250 Vdc; Ehk=+200 Vdc; Rg/g= 1.0 MEG.; Rk/k=2700 OHMS							
200 HOUR INTERMITTENT LIFE TEST (1) END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic1:	---	-0.9	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
CHANGE IN TRANSCONDUCTANCE OF INDIVIDUAL TUBES:	1	3	---	Δ_tSm(1):	---	25	PERCENT
TRANSCONDUCTANCE (2):	1	3	---	Δ_{Ef}Sm(2):	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES:							
g-all:	1	3	---	Rg-all:	100	---	MEG.
p-all:			---	Rp-all:	100	---	MEG.
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST(2): T BULB=220°C; Ehk=200 Vdc; Rg/g=1.0 MEG.; Eb=150 Vdc; Rk/k=820 OHMS	---	---	---	---	---	---	---
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST (2) END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE, 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-0.7	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δ_tSm(1):	---	20	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	Δ_{Ef}Sm(2):	---	15	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST	ALLOWABLE DEF. PER CHARACTER. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (CONT'D.)							
INSULATION OF ELECTRODES:							
g-all:	1	3	---	Rg-all:	50	---	MEG.
p-all:			---	Rp-all:	50	---	MEG.
TRANSCONDUCTANCE (1) AVERAGE CHANGE:	1	3	---	Avg. $\Delta_t Sm(1)$:	---	15	PERCENT
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
1000 HOUR HIGH TEMPERATURE LIFE TEST (2) END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic1:	---	-1.0	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	$\Delta_t Sm(1)$:	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef} Sm(2)$:	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk(1) =+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk(1) =+100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES:							
g1-all:	2	5	---	Rg-all:	25	---	MEG.
p-all:			---	Rp-all:	25	---	MEG.
TOTAL DEFECTIVES:	4	8	---	---	---	---	---

NOTES:

1 CHARACTERISTICS, QUALITY CONTROL TEST PRECEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPH OF MIL-E-1, "INSPECTION INSTRUCTIONS FOR ELECTRON TUBES", AND MIL-STD-105A.

2 WITHOUT SHIELD.

3 TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

4 CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.

5 TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

6 THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.

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NOTES - CONT'D.

7 THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.

8 FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY ± 5% HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.

9 CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef = 6.3 V TO THAT VALUE MEASURED AT Ef = 5.7 V.

10. OPERATION TIME IS THE TIME IN SECONDS REQUIRED FOR THE PLATE CURRENT TO ATTAIN A VALUE WITHIN ± 10% OF THE THREE (3) MINUTE PLATE CURRENT (1) VALUE MEASURED AT PLATE CURRENT (1) TEST CONDITIONS. NO PREHEATING BEFORE THIS TEST IS ALLOWED, A COLD TUBE MUST BE USED.

11. DURING BOTH CONTINUITY AND SHORT TESTING, THE TUBE UNDER TEST SHALL BE TAPPED AT LEAST THREE TIMES IN EACH OF TWO PLANES 90° APART WITH A TAPPER WHICH SHALL BE ADJUSTED TO GIVE AN IMPULSE OF APPROXIMATELY ONE HALF SINE WAVE OF 300 ± 50 MICRO SECONDS DURATION AND HAVING A MINIMUM AVERAGE AMPLITUDE OF 80 G'S PEAK ACCELERATION AS MEASURED WITH A GULTON A-305 ACCELEROMETER AND KA-1 KIT. THE SHORTS DETECTING EQUIPMENT SHALL BE A DEVICE CAPABLE OF DETECTING AS SHORTS, THE FOLLOWING INTERELEMENT RESISTANCES OF THE GIVEN TIME DURATION.

DURATION	SENSITIVITY
PERMANENT SHORT	600,000 OHMS
500 MICRO SECONDS	500,000 OHMS
100 MICRO SECONDS	100,000 OHMS
60 MICRO SECONDS	1,000 OHMS

TUBES WHICH GIVE AN INDICATION OF ONE OR MORE OF THE FOLLOWING SHALL BE REJECTED AS INOPERABLE:

A. EITHER A PERMANENT OR TAP SHORT AT ANY TIME DURING THE TAPPING PROCEDURE

B. ANY OPEN CIRCUIT

C. AIR LEAKS

12. HEATER-CATHODE LEAKAGE (2) SHALL BE PERFORMED AS FOLLOWS:

A. PREHEAT TUBES FOR 10 SECONDS WITH E_f = 10.5 V

B. TEST IMMEDIATELY BY THE APPLICATION OF THE SPECIFIED TEST CONDITIONS FOR THIS TEST

C. AFTER 16 SECONDS READ HEATER-CATHODE LEAKAGE OF EACH SECTION.

13. THE TUBES SHALL BE RIGIDLY MOUNTED ON A TABLE VIBRATING WITH SIMPLE HARMONIC MOTION. THE TUBES SHALL BE VIBRATED FOR A TOTAL OF 6 HOURS, 2 HOURS IN EACH OF THREE POSITIONS, X1, X2, AND Y1. ONLY RATED HEATER VOLTAGE SHALL BE APPLIED. TUBES WHICH SHOW ONE OR MORE OF THE FOLLOWING DEFECTS SHALL BE CONSIDERED FAILURES.

A. TUBES WHICH SHOW PERMANENT OR TAP SHORTS OR OPEN CIRCUITS FOLLOWING FATIGUE TEST, WHEN TESTED AS SPECIFIED IN 4.7.2 AND 4.7.3

B. TUBES WHICH DO NOT COMPLY WITH POST FATIGUE LIMITS, THIS IS A DESTRUCTIVE TEST

14. THE PROVISIONS OF PARAGRAPH 4.9.20.5 OF SPECIFICATION MIL-E-1 SHALL APPLY, EXCEPT FOR EXCEPT FOR TEST CONDITIONS LISTED FOR SHOCK TEST (2).

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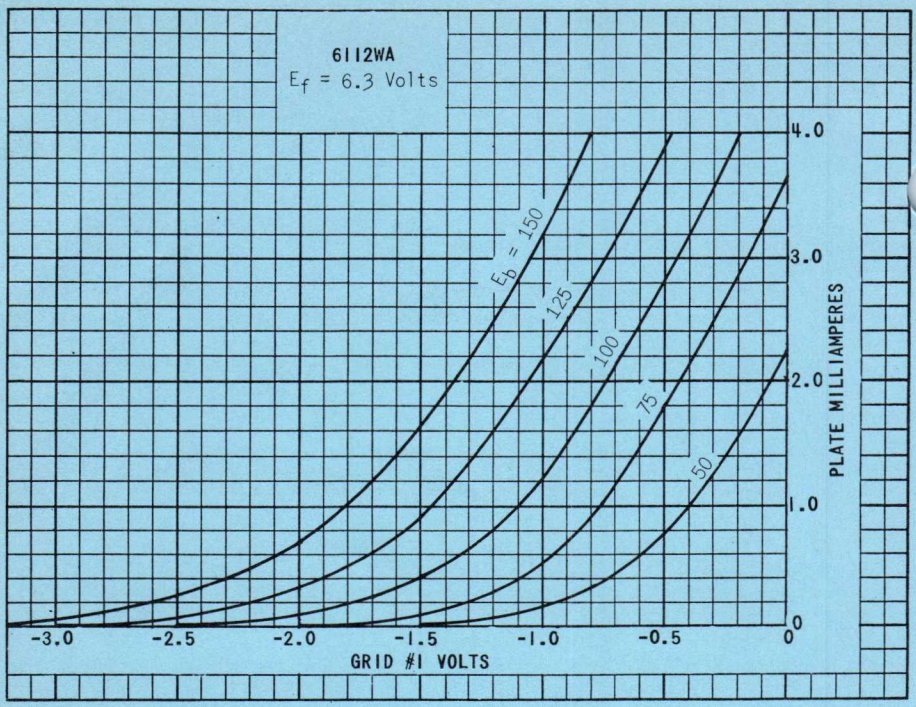

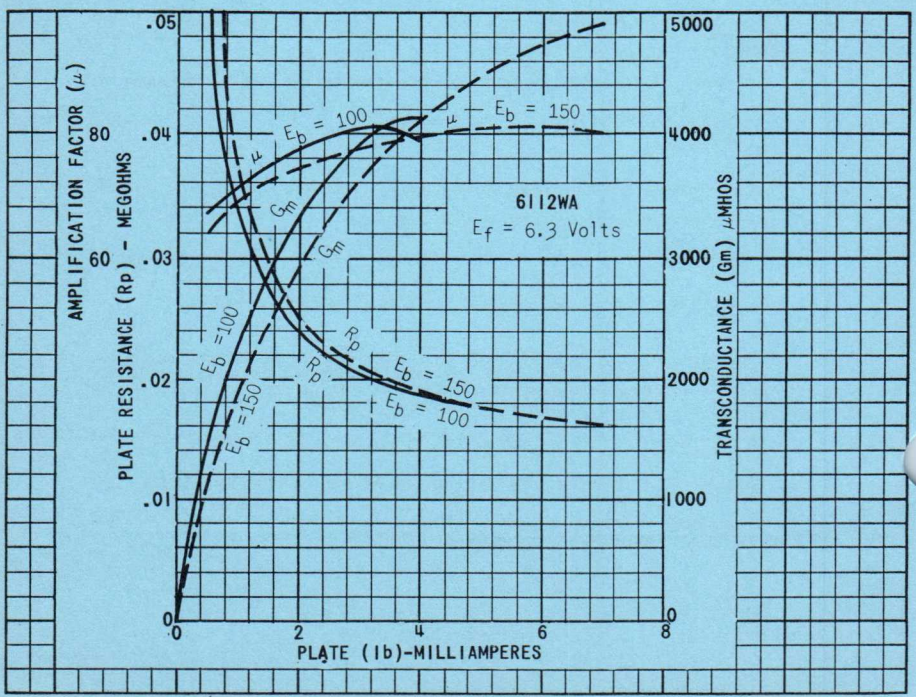

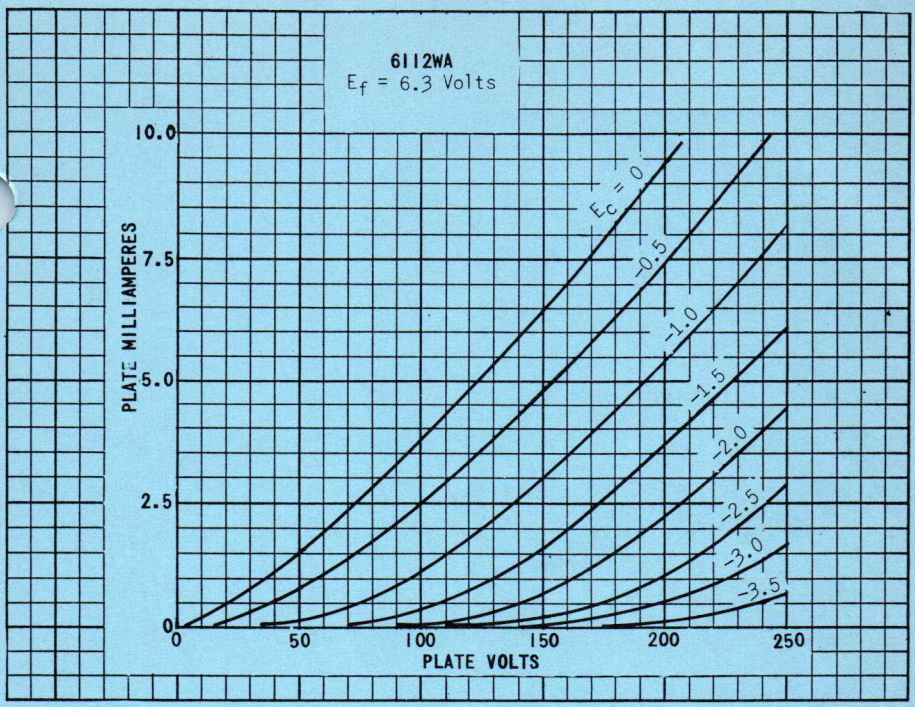

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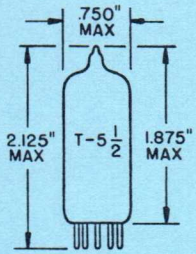
PENTODE

MINIATURE TYPE



GLASS BULB
MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-2

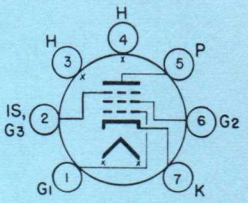
FOR

MOBILE AND AIRCRAFT

APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 7BK

THE 6136 IS A SHARP-CUTOFF PENTODE IN THE 7 PIN MINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE AS A HIGH-GAIN RF OR IF AMPLIFIER. FEATURES INCLUDE A HIGH DREGEE OF MECHANICAL STRENGTH AND A HEATER-CATHODE CONSTRUCTION DESIGNED TO WITHSTAND MANY THOUSAND CYCLES OF INTERMITTENT OPERATION.

DIRECT INTERELECTRODE CAPACITANCES

	WITH [A] SHIELD	WITHOUT SHIELD	
GRID 1 TO PLATE (MAX.)	0.0035	0.0035	pf
INPUT	6.5	6.0	pf
OUTPUT	5.5	5.0	pf

[A] WITH EXTERNAL SHIELD 316 CONNECTED TO PIN 7.

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	300	MA.
LIMITS OF APPLIED VOLTAGE			6.3±0.6	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE			100	VOLTS

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TUNG-SOL

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

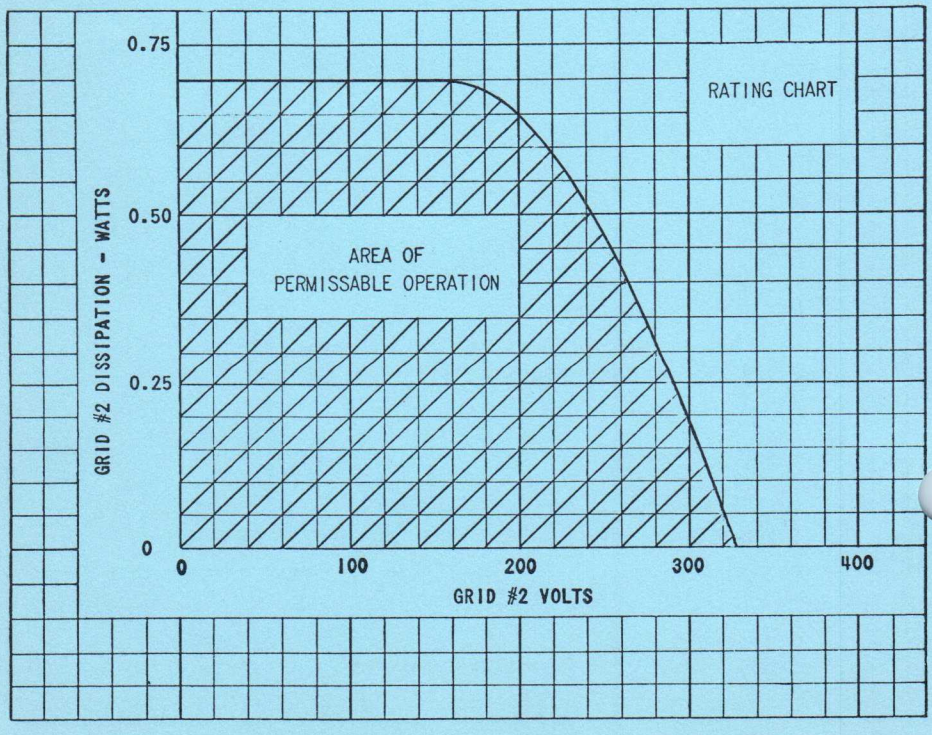
PLATE VOLTAGE	330	VOLTS
GRID 2 SUPPLY VOLTAGE	330	VOLTS
GRID 2 VOLTAGE - SEE RATING CHART		
POSITIVE DC GRID 1 VOLTAGE	0	VOLTS
NEGATIVE DC GRID 1 VOLTAGE	50	VOLTS
DC GRID 1 CURRENT	1.0	MA.
PLATE DISSIPATION	→ 3.3	WATTS
GRID 2 DISSIPATION	0.7	WATTS
GRID 1 CIRCUIT RESISTANCE	0.5	MEGOHMS
BULB TEMPERATURE AT HOTTEST POINT	165°	C

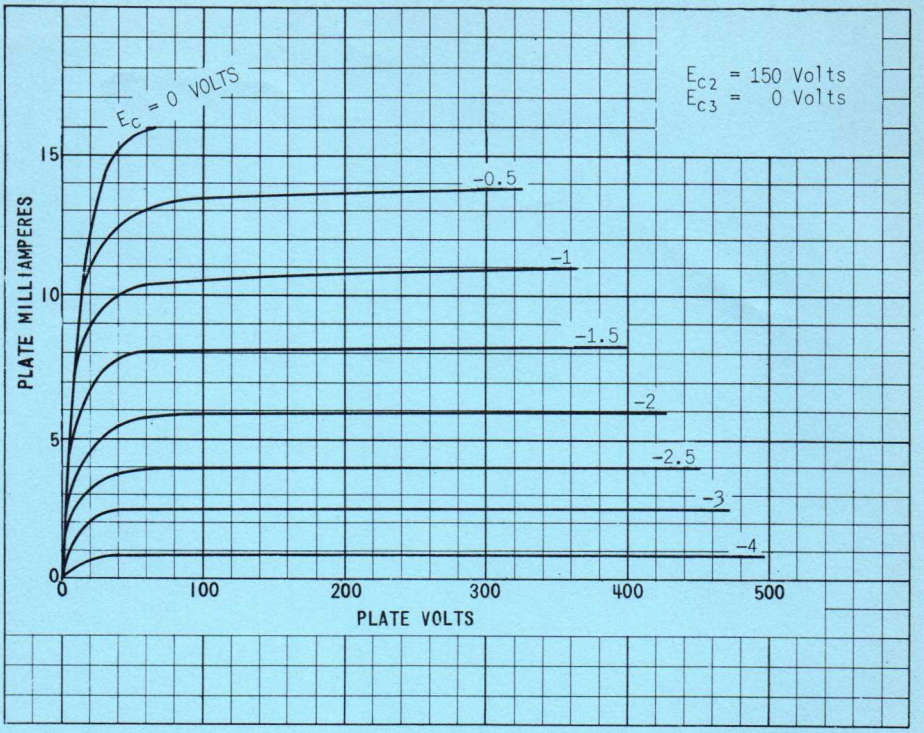
TYPICAL OPERATING CHARACTERISTICS

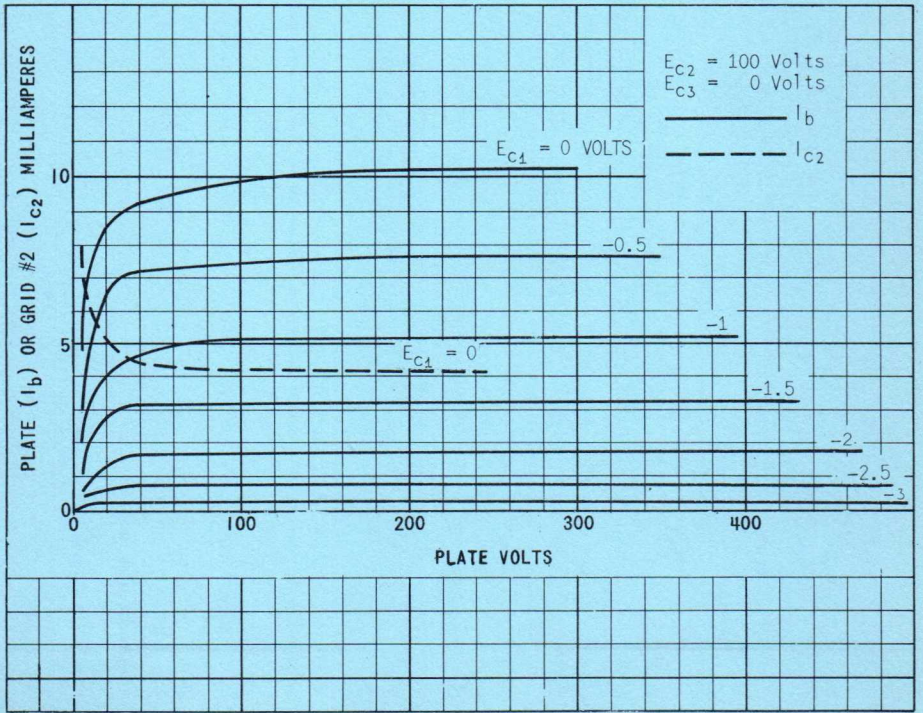
CLASS A1 AMPLIFIER

PLATE VOLTAGE	100	250	VOLTS
GRID 3 CONNECTED TO CATHODE AT SOCKET			
GRID 2 VOLTAGE	100	150	VOLTS
PLATE CURRENT	5.0	10.6	MA.
GRID 2 CURRENT	2.1	4.3	MA.
CATHODE BIAS RESISTOR	150	68	OHMS
TRANSCONDUCTANCE	3,900	5,200	μMHOS
PLATE RESISTANCE (APPROX.)	0.5	1.0	MEGOHM
GRID 1 VOLTAGE (APPROX.) FOR Ib = 10 μAMPS	-4.2	-6.5	VOLTS

→ INDICATES A CHANGE.







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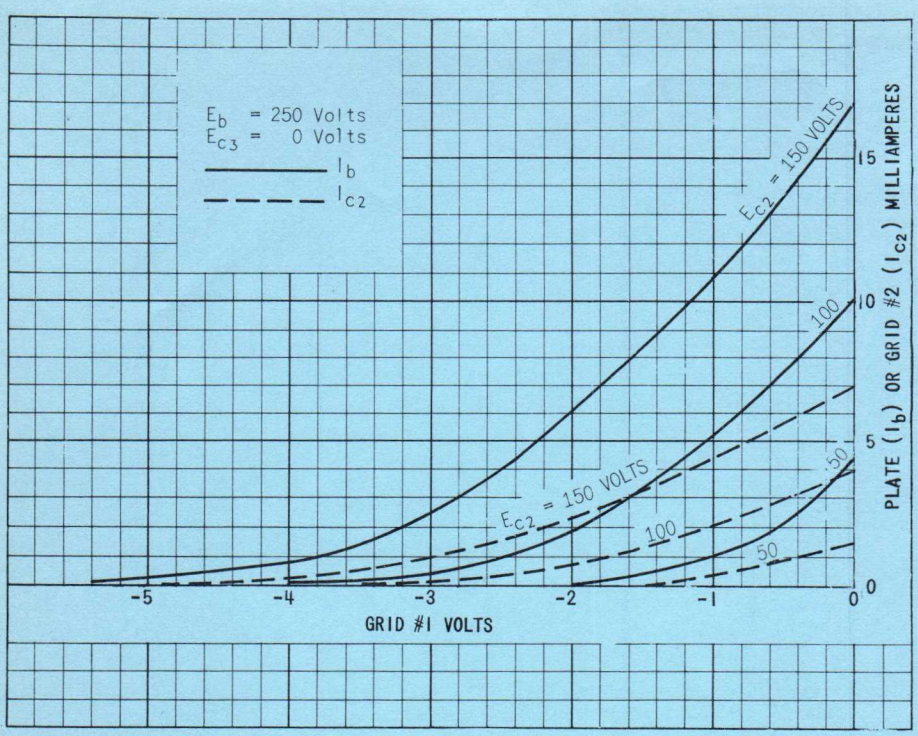
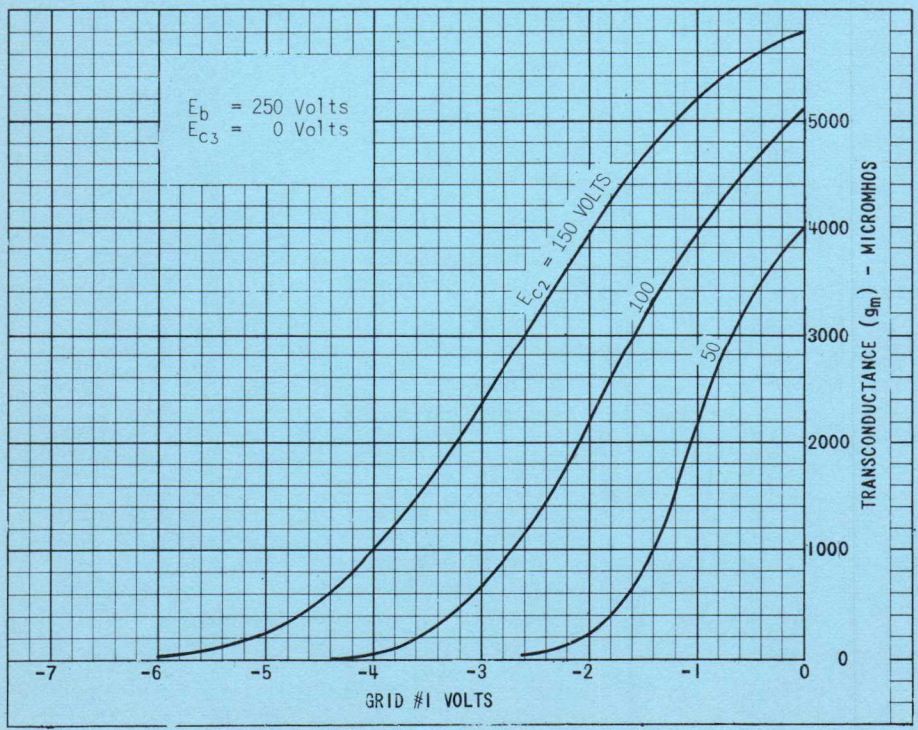

E_b = 250 Volts
E_{c3} = 0 Volts
I_b
I_{c2}
E_{c2} = 150 VOLTS
100
50
E_{c2} = 150 VOLTS
100
50
0
5
10
15
-5
-4
-3
-2
-1
0
GRID #1 VOLTS
PLATE (I_b) OR GRID #2 (I_{c2}) MILLIAMPERES


E_b = 250 Volts
E_{c3} = 0 Volts
E_{c2} = 150 VOLTS
100
50
0
1000
2000
3000
4000
5000
-7
-6
-5
-4
-3
-2
-1
0
GRID #1 VOLTS
TRANSCONDUCTANCE (g_m) - MICROMHOS

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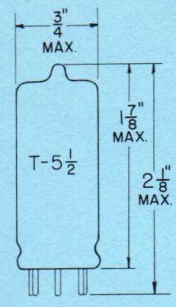
PENTODE
MINIATURE TYPE

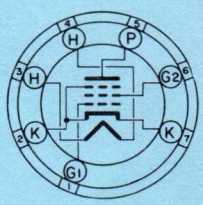


GLASS BULB
6-2

COATED UNIPOTENTIAL CATHODE

HEATER

6.3±10% VOLTS 0.30 AMP.



BOTTOM VIEW
MINIATURE BUTTON
7 PIN BASE

THE 6186/6AG5WA IS A SHARP CUTOFF PENTODE IN THE 7 PIN MINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE AS AN INTERMEDIATE FREQUENCY OR RF AMPLIFIER. THROUGH THE USE OF TWO CATHODE LEADS, ISOLATION OF INPUT AND OUTPUT CIRCUITS IS MADE FEASIBLE

RATINGS
AND NORMAL OPERATION

	MIL-E-1 SYMBOL	TEST CONDITIONS	ABS. MAX.	MIL-E-1 UNITS
HEATER VOLTAGE	Ef	6.3	6.3±10%	V
PLATE VOLTAGE	Eb	250	330	Vdc
GRID #1 VOLTAGE	Ec1	0		Vdc
GRID #2 VOLTAGE	Ec2	150	250	Vdc
CATHODE RESISTANCE	Rk	200		OHMS
GRID #2 DISSIPATION	Pg2		0.55	W
PLATE DISSIPATION	Pp		2.5	W
HEATER-CATHODE VOLTAGE	Ehk		100	V
BUBB TEMPERATURE			+165	°c
ALTITUDE		NOTE 11		

CHARACTERISTICS AND QUALITY CONTROL TESTS

TEST QUALIFICATION APPROVAL TESTS	AQL %	MIL-E-1 SYMBOL	MAX.	MIL-E-1 UNITS
QUALIFICATION APPROVAL:				
CARTON DROP:				
(d) PACKAGE GROUP 1; CARTON SIZE B;				
VIBRATION (1):				
Rp = 2000	---	Ep:	100	mVac

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CHARACTERISTICS AND QUALITY CONTROL TESTS - cont'd.

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	BOG.	MAX.	MIL-E-1 UNITS
ACCEPTANCE TESTS- GROUP A						
FATIGUE:						
NOTE 3	6.5					
SHOCK:						
HAMMER ANGLE=30°						
Ehk=100 Vdc, HEATER						
POSITIVE; Rg1=0.1Meg.	---					
POST SHOCK AND &						
FATIGUE TEST END						
POINTS						
VIBRATION (2):	---	Ep:	---	---	450	mVac
HEATER-CATHODE LEAKAGE:						
HEATER POSITIVE	---	Ihk	---	---	30	μAdc
HEATER NEGATIVE	---	Ihk:	---	---	30	μAdc
TRANSCONDUCTANCE (1):	---	Sm:	3500	---	---	μMHOS
GRID CURRENT (1):	---	Ic1:	0	---	-0.2	μAdc
ACCEPTANCE TESTS- GROUP B						
GLASS STRAIN:	2.5	---	---	---	---	---
ACCEPTANCE TESTS- GROUP C						
CONTINUITY & SHORT:	0.4	---	---	---	---	---
ACCEPTANCE TESTS GROUP D - NOTE 6						
HEATER CURRENT	0.65	If:	275	300	375	mA
HEATER-CATHODE LEAKAGE:						
Ehk=100 Vdc, HEATER POS.	0.65	Ihk:	---	---	10	μAdc
Ehk=100 Vdc, HEATER NEG.			---	---	10	μAdc
GRID CURRENT (1):	0.65	Ic1:	0	---	-0.1	μAdc
PLATE CURRENT (1):	0.65	Ib:	5.2	---	8.8	mAdc
SCREEN GRID CURRENT:	0.65	Ic2:	1.3	---	2.7	mAdc
TRANSCONDUCTANCE (1):	0.65	Sm:	4000	---	6000	μMHOS
ACCEPTANCE TESTS- GROUP E						
INSULATION OF						
ELECTRODES:						
Ef = 6.3 V						
E(g1-all)=100Vdc, g1 Neg.	2.5	Rg1-all:	100	---	---	MEG
E(p-all)=300Vdc, p Neg.		Rp-all:	100	---	---	MEG.
PLATE CURRENT (2):						
Rk=0; Ec1=-4.5 Vdc	2.5	Ib:	5	---	---	μAdc
PLATE CURRENT (3):						
Rk=0; Ec1=-10Vdc	2.5	Ib:	---	---	100	μAdc
TRANSCONDUCTANCE (2):						
Ef = 5.7 V.	2.5	ΔSm:	---	---	15	PERCENT

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CHARACTERISTICS AND QUALITY CONTROL TESTS - cont'd.

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	BOG.	MAX.	MIL-E-1 UNITS
ACCEPTANCE TESTS- GROUP E- cont'd.						
GRID CURRENT (2): Ef =7.0 V; Rg1= 0.1 Meg.	2.5	Ic1:	0	---	-0.2	μAdc
RF NOISE: Ec1=-2Vdc; Eca1=15.0 mVac	2.5	---	---	---	3	mW
NOISE & MICROPHONICS: Ef=6.3Vac; Ehk=0; Ebb= Ecc2=300Vdc; Rg2=0.06 Meg; Rp=0.01 Meg; Rk= 200	2.5	---	---	---	50	mVac
ACCEPTANCE TESTS- GROUP F						
VIBRATION (2): Rp = 2000	6.5	Ep:	---	---	100	mVac
CAPACITANCE: NO SHIELD		Cgp:	---	---	0.03	pf
NO SHIELD	6.5	Cin:	5.2	---	7.8	pf
NO SHIELD		Cout:	1.3	---	2.3	pf
LOW PRESSURE VOLTAGE BREAKDOWN: NOTE 10	6.5		500	---	---	Vac

	AQL %	ALLOWABLE DEF. PER CHARACTER. 1st SAMP.	COMB. SAMP.	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS:							
STABILITY LIFE TEST: INTERMITTENT LIFE TEST CONDITIONS:NOTE 7	---	---	---		---	---	
STABILITY LIFE TEST END POINTS: TRANSCONDUCTANCE (1):	1.0	---	---	ΔSm:	---	10	PERCENT
SURVIVAL RATE LIFE TEST: INTERMITTENT LIFE TEST CONDITIONS OR EQUIVALENT: NOTE 7	0.65	---	---		---	---	
INTERMITTENT LIFE TEST: Ehk=100Vdc; HEATER POS.; Rg1=1.0 Meg; MIN. BULB TEMP.=+165°C	---	---	---		---	---	

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CHARACTERISTICS AND QUALITY CONTROL TESTS - cont'd.

TEST	AQL %	ALLOWABLE DEF. PER CHARACTER. 1st. SAMP.	COMB. SAMP.	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS:- cont'd.							
INTERMITTENT LIFE TEST END POINTS (500 HOURS):							
INOPERATIVES	---	1	3		---	---	
HEATER CURRENT	---	1	3	If:	275	325	mA
HEATER CATHODE LEAKAGE:							
HEATER POSITIVE	---	1	3	Ihk:	---	10	μAdc
HEATER NEGATIVE				Ihk	---	10	μAdc
GRID CURRENT (1)	---	1	3	Ic1:	0	-0.1	μAdc
TRANSCONDUCTANCE (1)	---	1	3	Sm:	3750	6000	μMHOS
TRANSCONDUCTANCE (1) AVG. CHANGE:	---	---	---	AVG.ΔSm:	---	15	PERCENT
TRANSCONDUCTANCE (2)	---	2	5	ΔSm:	---	15	PERCENT
INSULATION OF ELECTRODES:							
(g1-all)	---	2	5	Rg1-all:	50	---	MEG.
(p-all)				Rp-all)	50	---	MEG.
INTERMITTENT LIFE TEST END POINTS (1000 HRS.)							
INOPERATIVES	---	2	5		---	---	
HEATER CURRENT:	---	2	5	If:	275	325	mA
HEATER CATHODE LEAKAGE:							
HEATER POSITIVE	---	2	5	Ihk:	---	10	μAdc
HEATER NEGATIVE				Ihk:	---	10	μAdc
GRID CURRENT (1)	---	2	5	Ic1:	0	-0.1	μAdc
TRANSCONDUCTANCE (1)	---	2	5	Sm:	3500	6000	μMHOS

GENERAL NOTE:

GENERAL TUBE MARKING REQUIREMENTS AS CONTAINED IN SPECIFICATION MIL-E-1 AND INSPECTION INSTRUCTIONS FOR ELECTRON TUBES SHALL APPLY TO TUBES MANUFACTURED IN ACCORDANCE WITH THIS TEST SPECIFICATION SHEET EXCEPT THAT THE LAST 2 DIGITS OF THE YEAR OF MANUFACTURE SHALL BE SHOWN RATHER THAN THE SINGLE LAST DIGIT. ALSO EACH TUBE SHALL BE MARKED WITH A LOT IDENTIFICATION SYMBOL, LETTER OR FIGURE, SO THAT TUBES OF A GIVEN LOT MAY BE IDENTIFIED.

A LOT AS REFERENCED IN THIS SPECIFICATION SHALL BE AS SPECIFIED IN PARAGRAPH 5.3.1.3 INSPECTION INSTRUCTIONS FOR ELECTRON TUBES.

NOTES:

1, DIFFICULTY MAY BE ENCOUNTERED IF THIS TUBE IS OPERATED FOR LONG PERIODS OF TIME WITH VERY SMALL VALUES OF CATHODE CURRENT.

2, IF IT IS DESIRED TO CHECK QUALITY SUBSEQUENT TO LOT ACCEPTANCE, THE CONDITIONS AND ACCEPTANCE LIMITS SET FORTH IN THIS SPECIFICATION SHALL APPLY. WHEN 100% TESTING IS PERFORMED AND THE RESULTS INDICATE THAT THE PERCENTAGE OF DEFECTIVES IS EQUAL TO OR LESS THAN THE SPECIFIED AQL VALUES, THE LOT IS DEEMED AS COMPLYING WITH THE INTENT OF THE SPECIFICATION.

3, THIS TEST SHOULD BE CONDUCTED ON THE INITIAL PRODUCTION LOT AND THEREAFTER ON A LOT EVERY 30 DAYS APPROXIMATE. IN THE EVENT OF LOT FAILURE, THE LOT IS REJECTED AND SUCCEEDING LOT IS SUBJECTED TO THIS TEST. ONCE A LOT HAS PASSED, THE 30 DAY RULE SHALL APPLY. MIL-STD-105, SAMPLE SIZE CODE LETTER F, NORMAL AND TIGHTENED INSPECTION TABLES TO APPLY.

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NOTES- cont'd.

4, REFERENCE MIL-STD-105, SAMPLE SIZE CODE LETTER E. NORMAL AND TIGHTENED INSPECTION TABLES TO APPLY.

5, REFERENCE MIL-STD-105, SAMPLE SIZE CODE LETTER I, NORMAL AND TIGHTENED INSPECTION TABLES TO APPLY.

6, THE AQL FOR THE COMBINED DEFECTIVES FOR ATTRIBUTES IN GROUP D SHALL BE ONE (1) PERCENT. A TUBE HAVING ONE (1) OR MORE DEFECTS SHALL BE COUNTED AS ONE (1) DEFECTIVE. MIL-STD-105, INSPECTION LEVEL 2 SHALL APPLY.

7, TUBES TO BE LIFE TESTED AT ROOM TEMPERATURE AMBIENT.

8, APPROVED ALTERNATE TEST - THE INSERTION OF A 1.0 MEG RESISTOR IN THE GRID CIRCUIT SHALL NOT CHANGE THE PLATE CURRENT MORE THAN 0.5 MADC.

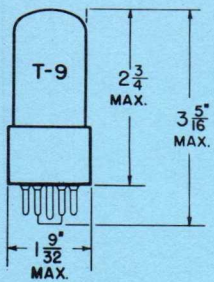
9, THE CATHODE RESISTOR SHALL BE SHUNTED WITH A CAPACITIVE REACTANCE NOT EXCEEDING THREE (3) OHMS AT 60 CYCLES.

10, BREAKDOWN SHALL BE DEFINED AS THE VOLTAGE AT WHICH ARCING OCCURS BETWEEN ANODE BASE PIN AND ADJACENT PINS. PRESSURE = 55±5M/M MERCURY; TEMPERATURE =25±5°C; HUMIDITY =0; VOLTAGE =500VAC, 60 CYCLES, SINUSOIDAL WAVE FORM.

11, REFERENCE SPECIFICATION SHALL BE OF THE ISSUE IN EFFECT ON THE DATE OF INVITATION FOR BID.

TUNG-SOL

TWIN TRIODE



GLASS BULB
INTERMEDIATE SHELL
8 PIN OCTAL
LOW LOSS B8-6

OUTLINE DRAWING
JEDEC 9-11

COATED UNIPOTENTIAL CATHODE

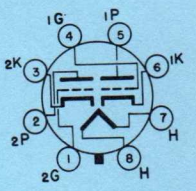
HEATER

6.3±0.6 VOLTS 0.30 AMP.[A]

AC OR DC

ANY MOUNTING POSITION

[A] AT 6.3 VOLTS



BOTTOM VIEW

BASING DIAGRAM
JEDEC 8BD

THE 6188 IS A RUGGEDIZED, HIGH-MU, TWIN TRIODE INTENDED ESPECIALLY FOR BALANCED HIGH GAIN DC AMPLIFIER SERVICE, WHERE GOOD STABILITY, LOW GRID CURRENT AND BALANCED PLATE CURRENT ARE REQUIRED. EACH TRIODE SECTION IS ELECTRICALLY INDEPENDENT EXCEPT FOR A COMMON HEATER, WHOSE SECTIONS ARE SERIES CONNECTED INTERNALLY.

RATINGS
ABSOLUTE MAXIMUM SYSTEM

HEATER VOLTAGE	6.3±0.6	VOLTS
MAXIMUM PLATE VOLTAGE	275	VOLTS
MAXIMUM PLATE DISSIPATION – EACH PLATE	1.1	WATTS
BULB TEMPERATURE	165	°C
MAXIMUM HEATER–CATHODE VOLTAGE, POSIT. OR NEGAT.	100	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A_1 AMPLIFIER

EACH SECTION

PLATE VOLTAGE	250	VOLTS
GRID VOLTAGE	−2.0	VOLTS
PLATE CURRENT	2.3	MA.
TRANSCONDUCTANCE	1600	μMHOS
AMPLIFICATION FACTOR	70	
PLATE RESISTANCE	44,000	OHMS

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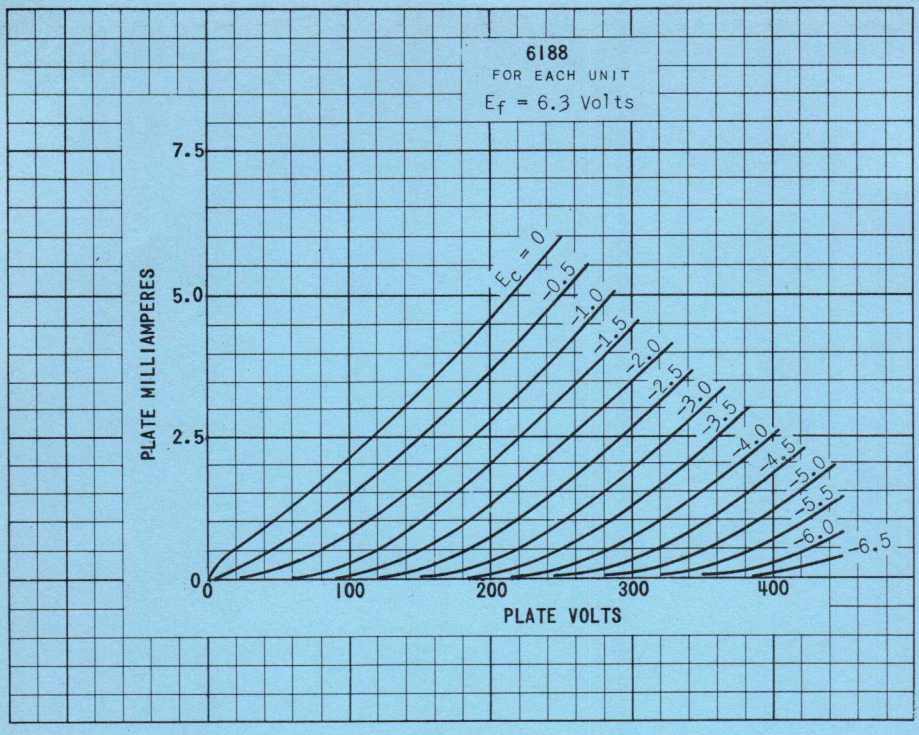
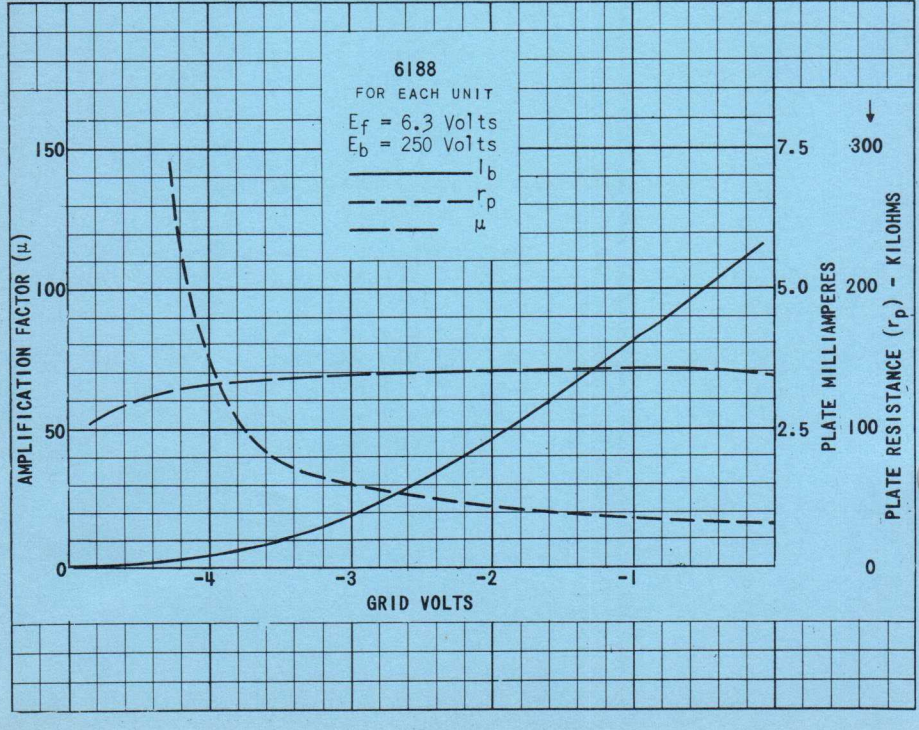
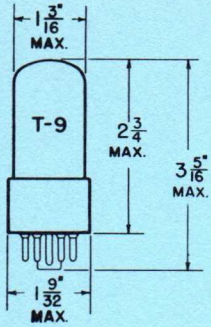

6188
FOR EACH UNIT
E_f = 6.3 Volts
PLATE MILLIAMPERES
7.5
5.0
2.5
0
E_c = 0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
0
100
200
300
400
PLATE VOLTS


6188
FOR EACH UNIT
E_f = 6.3 Volts
E_b = 250 Volts
I_b
r_p
μ
AMPLIFICATION FACTOR (μ)
150
100
50
0
-4
-3
-2
-1
GRID VOLTS
7.5
5.0
2.5
PLATE MILLIAMPERES
300
200
100
0
PLATE RESISTANCE (r_p) - KILOHMS

TUNG-SOL

TWIN TRIODE

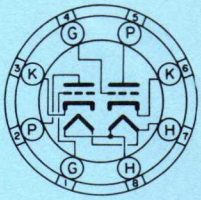


GLASS BULB

COATED UNIPOTENTIAL CATHODE

HEATER
6.3 VOLTS 0.3 AMP.
AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
INTERMEDIATE SHELL
8 PIN OCTAL
LOW LOSS PHENOLIC
8BD

THE 6188/6SU7WGT IS A RUGGEDIZED, HIGH MU, TWIN TRIODE IN THE OCTAL BASE, BANTAM CONSTRUCTION. THE TWO TRIODES ARE ELECTRICALLY INDEPENDENT, ALLOWING SIMULTANEOUS USE OF THE TWO IN COMPLETELY DIFFERENT APPLICATIONS. TIGHT GAS AND LEAKAGE CONTROLS ON THE TUBE INCREASE STABILITY AND A SPECIAL PLATE CURRENT BALANCE TEST BETWEEN SECTIONS IS SPECIFIED. THEREFORE, IN ADDITION TO GENERAL PURPOSE APPLICATIONS SUCH AS VOLTAGE AMPLIFIERS, OSCILLATORS AND MULTIVIBRATORS, THE 6188/6SU7WGT MAY BE USED IN APPLICATIONS REQUIRING EXTREME STABILITY SUCH AS BALANCED AMPLIFIERS, AND WHERE LARGE GRID RESISTORS MAY BE NECESSARY. CONTROLS ON THE PRODUCT AVERAGE FOR SUCH CHARACTERISTICS AS PLATE CURRENT, TRANSCONDUCTANCE AND AMPLIFICATION FACTOR ASSURE THAT THESE CRITICAL CHARACTERISTICS WILL REMAIN WELL CENTERED. SINCE IT MUST BE ABLE TO WITHSTAND SEVERE MECHANICAL TESTS TO MEET TEST SPECIFICATION, THE 6188/6SU7WGT IS ESPECIALLY SUITED FOR USE IN MILITARY AND INDUSTRIAL AIRBORNE EQUIPMENT WHICH MAY BE SUBJECTED TO SEVERE SHOCK AND VIBRATION.

RATINGS
ABSOLUTE MAXIMUM VALUES

HEATER VOLTAGE	6.3±0.6	VOLTS
MAXIMUM DC PLATE VOLTAGE	275	VOLTS
MAXIMUM HEATER–CATHODE VOLTAGE	±100	VOLTS
MAXIMUM PLATE DISSIPATION (EACH SECTION)	1.1	WATTS
MAXIMUM BULB TEMPERATURE	+165	°C

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS
CLASS A_1 AMPLIFIER (EACH SECTION)

PLATE VOLTAGE	250	VOLTS
GRID VOLTAGE	−2	VOLTS
PLATE CURRENT	2.3	mA
PLATE RESISTANCE	44 000	OHMS
TRANSCONDUCTANCE	1 600	μMHOS
AMPLIFICATION FACTOR	70	

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TUNG-SOL

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CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

E_f = 6.3V, E_b = 250 Vdc, E_c = −2.0Vdc
EXCEPT AS MODIFIED BELOW

	INITIAL				500 HOUR LIFE TEST		
	INDIVIDUAL MIN.	INDIVIDUAL MAX.	PROD. MIN.	AVG. MAX.	INDIVIDUAL MIN.	INDIVIDUAL MAX.	
HEATER CURRENT	275	325	---	---	275	325	mA
HEATER CATHODE LEAKAGE (E_{hk}=±100Vdc)	---	5.0	---	---	---	5.0	μAdc
GRID CURRENT (1) [A]	0	−0.5	---	---	0	−0.5	μAdc
PLATE CURRENT (1)	1.55	3.05	2.00	2.60	---	---	mAdc
AC AMPLIFICATION [BP] (E_{bb}=200Vdc, E_c=0, E_{sig}=0.2Vac, R_g 2000)	8.6	---	---	---	---	---	Vac
PLATE CURRENT (2) (E_c =4.50Vdc)	---	200	---	---	---	---	μAdc
PLATE CURRENT (3) (E_c =4.25 dc)	5	---	---	---	---	---	μAdc
INSULATION OF ELECTRODES [C]							
R(g-all)	100	---	---	---	---	50	MEGOHM
R(p-all)	100	---	---	---	---	50	MEGOHM
TRANSCONDUCTANCE (1)	1325	1875	1500	1700	---	---	μMHOS
Δ TRANSCONDUCTANCE [D] (E_f = 5.7V)	---	15	---	---	---	---	PERCENT
AMPLIFICATION FACTOR [E]	55	85	62	78	---	---	
PLATE CURRENT DIFFERENCE [F]	---	±0.1	---	---	---	---	Vdc
GRID CURRENT DIFFERENCE [F]	---	±1.5	---	---	---	---	Vdc

SPECIAL REQUIREMENTS

	MIN.	MAX.	
NOISE AND MICROPHONICS [AG] (E_f=6.3Vac, E_{hk}=0, E_b=200Vdc, E_c=0, R_L=0.1 meg.)	---	50	mVac
LOW PRESSURE VOLTAGE BREAKDOWN [H] (PRESSURE = 55±5mm Hg., voltage=500Vac)	---	---	
LOW FREQUENCY VIBRATION [JA] (R_p = 10,000)	---	50	mVac
SHOCK [K] (HAMMER ANGLE = 30°C, E_{hk}=+100Vdc	---	---	
VIBRATIONAL FATIGUE [L]	---	---	
POST SHOCK AND VIBRATIONAL FATIGUE TEST END POINTS			
VIBRATION	---	200	mVac
HEATER CATHODE LEAKAGE (E_{hk}=±100 Vdc)	---	±10	μAdc
GRID CURRENT (1)	0	−0.5	μAdc
AC AMPLIFICATION	8.0	---	Vac
1 HOUR STABILITY LIFE TEST (E_b=250Vdc, E_c=1.0Vdc, E_{hk}=±100Vdc, R_g=1.0meg; TA=Room)	---	---	
STABILITY LIFE TEST END POINTS Δ TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES	---	10	PERCENT
INTERMITTENT LIFE TEST [N] (STABILITY LIFE TEST CONDITIONS OR EQUIVALENT ENVELOPE TEMPERATURE =+165°C)			

NOTES

[A] TIE 1p TO 2p, 1g TO 2g, 1k TO 2k. (PARASITIC SUPPRESSOR OF 50 OHM MAXIMUM PERMITTED).

[B] SEE MIL-E-1C 4.10.11.2

[C] SEE MIL-E-1C 4.8.2

[D] THE VALUE OF Δ TRANSCONDUCTANCE SHALL APPLY TO INDIVIDUAL TUBES AND IS EXPRESSED:

$$\frac{(\text{SM AT } 6.3)-(\text{SM AT } 5.7)}{(\text{SM AT } 6.3)} \times 100$$

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TUNG-SOL

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NOTES – CONT'D.

E SEE MIL-E-1C 4.10.11.1

F THE TEST CIRCUIT TO BE USED IS SHOWN SCHEMATICALLY IN FIGURE 1. WITH SWITCH S1 IN POSITION (1) ADJUST Ec ON SECTION 2 TO GIVE E = 0 ON METER M1. MEASURE Ec AT METER M2.

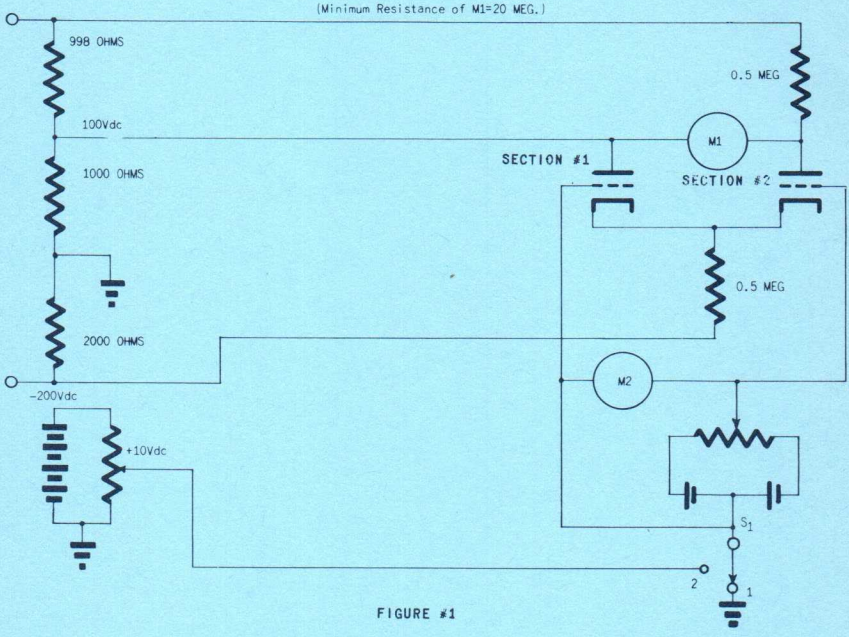

FIGURE #1

G SEE MIL-E-1C 4.10.3.5

H BREAKDOWN IS DEFINED AS THE VOLTAGE AT WHICH ARCING OCCURS BETWEEN ANODE BASE PIN AND ADJACENT PINS. TEMP.= 25±5° C, HUMIDITY=0; VOLTAGE SHALL BE OF SINUSOIDAL WAVEFORM AT F=60 CPS. PRESSURE =55±5mm Hg.

J SEE MIL-E-1C 4.9.19.1

K SEE MIL-E-1C 4.9.20.5

L SEE MIL-E-1C 4.9.20.6

N ENVELOPE TEMPERATURE IS DEFINED AS THE HIGHEST TEMPERATURE INDICATED WHEN USING A THERMOCOUPLE OF .003 IN. MAX. DIAMETER ELEMENTS WELDED TO A RING OF .025 IN. DIAMETER PHOSPHOR BRONZE PLACED AROUND THE BULB.

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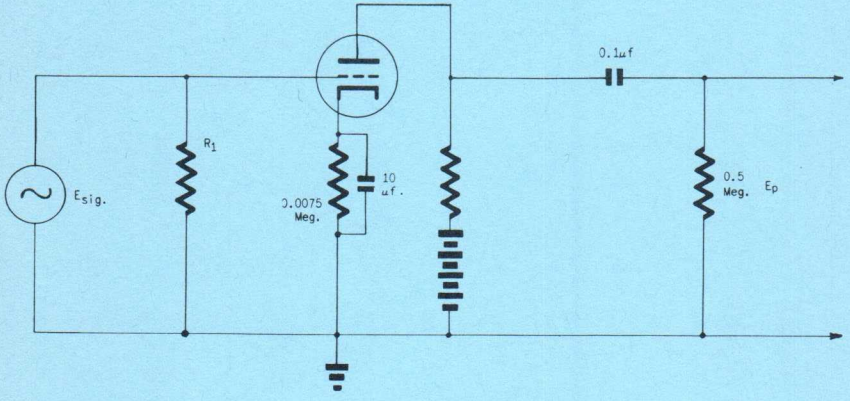
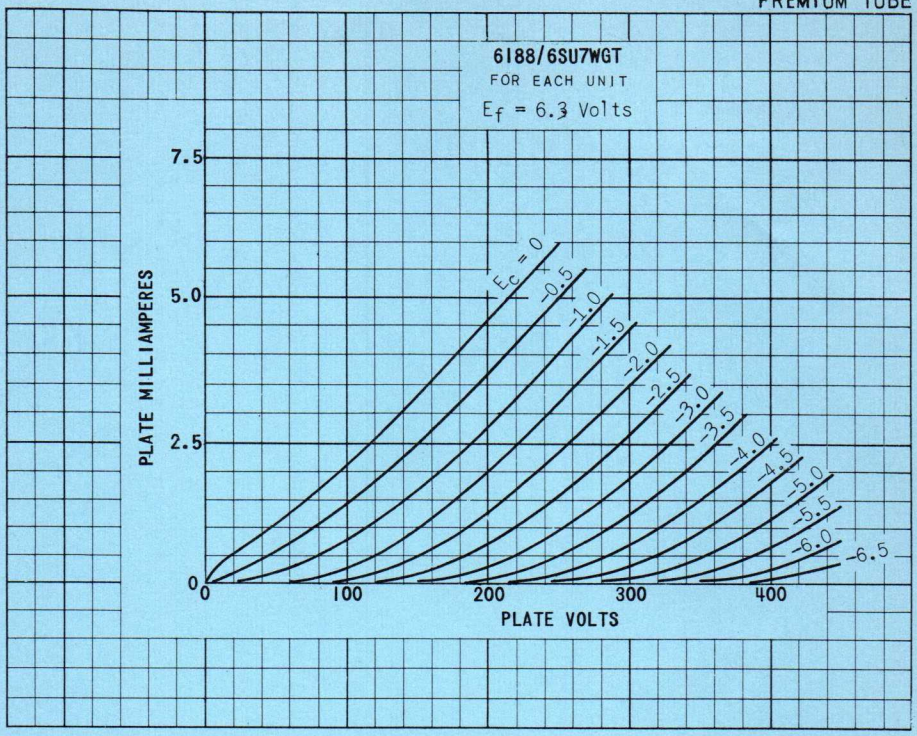
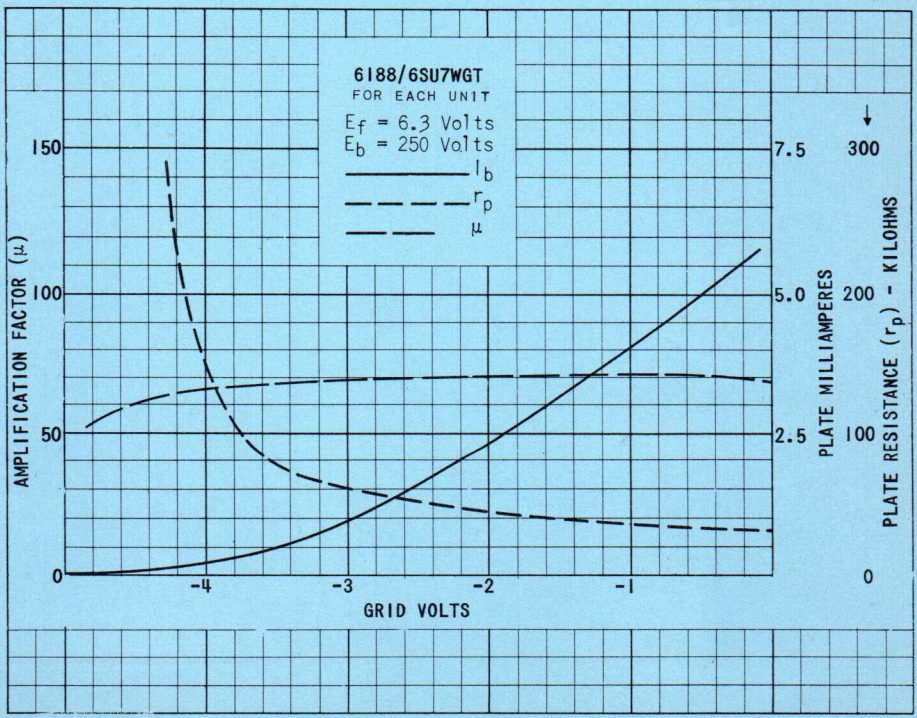
NOTES – CONT'D.

P Esig = SIGNAL GENERATOR WITH INTERNAL RESISTANCE SUCH THAT IN COMBINATION WITH R_1 GIVES 2000 OHMS RESISTANCE BETWEEN #1 GRID AND GROUND.





→ INDICATES A CHANGE.



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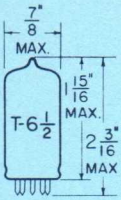
TWIN TRIODE

MINIATURE BUTTON



GLASS BULB

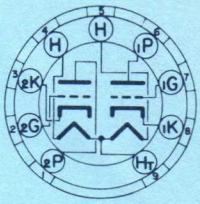
COATED UNIPOTENTIAL CATHODE

HEATER

SERIES	PARALLEL
12.6 VOLTS	6.3 VOLTS
0.15 AMP.	0.3 AMP.

AC OR DC

FOR 12.6 VOLT OPERATION APPLY HEATER VOLTAGE BETWEEN PINS #4 AND #5. FOR 6.3 VOLT OPERATION APPLY HEATER VOLTAGE BETWEEN PIN #9 AND PINS #4 AND #5 CONNECTED TOGETHER.



BOTTOM VIEW
MINIATURE BUTTON
9 PIN BASE
9A

ANY MOUNTING POSITION

THE 6189/12AU7WA IS A RUGGEDIZED, MEDIUM MU, TWIN TRIODE OF THE NINE PIN MINIATURE CONSTRUCTION. THE TWO TRIODE SECTIONS ARE ELECTRICALLY INDEPENDENT ALLOWING SIMULTANEOUS USE OF THE TWO IN WIDELY DIFFERENT APPLICATIONS. IN ADDITION TO GENERAL PURPOSE AUDIO FREQUENCY VOLTAGE AMPLIFIER AND PHASE INVERTER CIRCUITS, THE 6189/12AU7WA IS WELL SUITED TO USE AS OSCILLATOR, MULTIVIBRATOR, COMBINED OSCILLATOR-MIXER, AND RESISTANCE COUPLED AMPLIFIER SERVICE. THE HEATER CENTER TAP PERMITS OPERATION FROM EITHER A 6.3 OR 12.6 VOLT SUPPLY. CONTROLS ON THE PRODUCT AVERAGE FOR SUCH CHARACTERISTICS AS PLATE CURRENT TRANSCONDUCTANCE, AND AMPLIFICATION FACTOR ASSURE THAT THESE CRITICAL CHARACTERISTICS WILL REMAIN WELL CENTERED. SINCE IT MUST BE ABLE TO WITHSTAND SEVERE MECHANICAL TESTS TO MEET THE TEST SPECIFICATION, THE 6189/12AU7WA IS ESPECIALLY SUITED FOR USE IN INDUSTRIAL AND MILITARY AIRBORNE EQUIPMENT WHICH MAY BE SUBJECTED TO SEVERE SHOCK AND VIBRATION.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD	WITHOUT SHIELD	
TRIODE UNIT #1			
GRID TO PLATE (RATED)	1.5	1.5	μμf
INPUT (RATED)	1.8	1.6	μμf
OUTPUT (RATED)	2.0	0.40	μμf
TRIODE UNIT #2			
GRID TO PLATE (RATED)	1.5	1.5	μμf
INPUT (RATED)	1.8	1.6	μμf
OUTPUT (RATED)	2.0	0.32	μμf

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RATINGS

ABSOLUTE MAXIMUM VALUES

HEATER VOLTAGE	6.3±10%	12.6±10%	VOLTS
MAXIMUM DC PLATE VOLTAGE	330		VOLTS
MAXIMUM PLATE DISSIPATION (PER PLATE)	3.0		WATTS
MAXIMUM HEATER CATHODE VOLTAGE	±200		VOLTS
MAXIMUM PEAK DC CATHODE CURRENT (EACH SECTION)	22		mA.
MAXIMUM BULB TEMPERATURE	165		°C

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A_1 AMPLIFIER – EACH TRIODE UNIT

HEATER VOLTAGE	12.6	6.3	12.6	6.3	VOLTS
HEATER CURRENT	0.15	0.3	0.15	0.3	AMP.
PLATE VOLTAGE	100		250		VOLTS
GRID VOLTAGE	0		-8.5		VOLTS
PLATE CURRENT	11.8		10.5		mA.
PLATE RESISTANCE (APPROX.)	6500		7700		OHMS
TRANSCONDUCTANCE	3100		2200		μMHOS
AMPLIFICATION FACTOR	20		17		
GRID VOLTAGE FOR Ib=10μA (APPROX.)	---		-24		VOLTS

RESISTANCE COUPLED AMPLIFIER

EACH SECTION

R_p MEG.	R_s MEG.	R_{g1} MEG.	E_{bb} = 90 VOLTS			E_{bb} = 180 VOLTS			E_{bb} = 300 VOLTS		
			R_k	GAIN	E_o	R_k	GAIN	E_o	R_k	GAIN	E_o
0.10	0.10	0.10	3300	14	13	2200	14	26	1800	14	40
0.10	0.24	0.10	3600	14	16	2700	15	33	2200	15	51
0.24	0.24	0.10	7500	14	16	5100	15	30	4300	15	44
0.24	0.51	0.10	9100	14	19	6800	15	39	5100	15	54
0.51	0.51	0.10	13000	14	16	9100	15	30	6800	16	40
0.51	1.0	0.10	15000	14	19	10000	16	32	7500	16	45
0.24	0.24	10	0	15	13	0	16	33	0	17	46
0.24	0.51	10	0	16	17	0	17	38	0	18	62
0.51	0.51	10	0	16	14	0	18	32	0	18	53
0.51	1.0	10	0	17	18	0	18	41	0	19	68

NOTES: 1. E_o IS MAXIMUM RMS VOLTAGE OUTPUT FOR FIVE PERCENT (5%) TOTAL HARMONIC DISTORTION.

2. GAIN MEASURED AT 2.0 VOLTS RMS OUTPUT.

3. FOR ZERO-BIAS DATA, GENERATOR IMPEDANCE IS NEGLIGIBLE.

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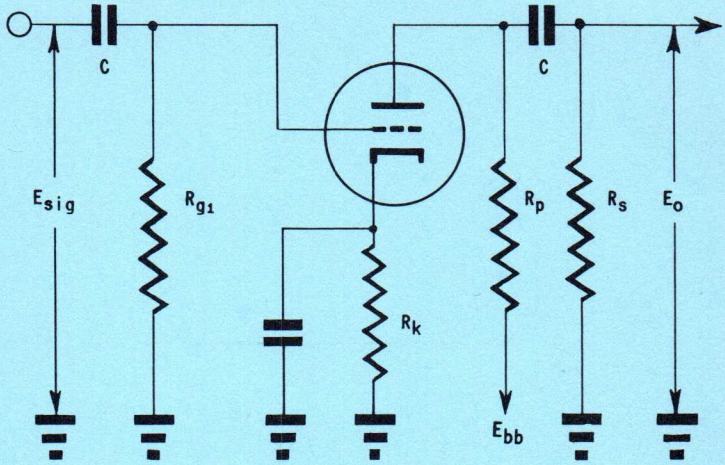

NOTES: COUPLING CAPACITORS (C) SHOULD BE SELECTED TO GIVE DESIRED FREQUENCY RESPONSE.
R_k SHOULD BE ADEQUATELY BY-PASSED.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Ef=12.6V, Eb=250Vdc, Ec=-8.5Vdc

EXCEPT AS MODIFIED BELOW

	INITIAL				500 HOUR LIFE TEST		
	INDIVIDUAL MIN.	INDIVIDUAL MAX.	PROD. MIN.	AVG. MAX.	INDIVIDUAL MIN.	INDIVIDUAL MAX.	
HEATER CURRENT	138	162	---	---	138	162	mA.
HEATER CATHODE LEAKAGE[A] (Ehk=±100Vdc)	---	±10	---	---	---	±10	μAdc
GRID CURRENT (1) (Rg=0.5 MEG.)	0	-0.5	---	---	0	-0.5	μAdc
PLATE CURRENT (1)	6.5	14.5	9.0	12.0	---	---	mAdc
TRANSCONDUCTANCE (1)	1750	2650	2000	2400	1600	2650	μMHOS
ΔAVERAGE TRANSCONDUCTANCE (1)	---	---	---	---	---	15	PERCENT
INSULATION OF ELECTRODES[B] (Ef=12.6V, E(g-all)=100Vdc, g NEG.:E(p.all)=300 Vdc, p NEG.)							
R(g-all)	500	---	---	---	250	---	MEGOHMS
R(p-all)	500	---	---	---	250	---	MEGOHMS
PLATE CURRENT (2) (Ec=-25Vdc)	---	20	---	---	---	---	μAdc
PLATE CURRENT (3) (Ec=-18Vdc)	5	---	---	---	---	---	μAdc
ΔTRANSCONDUCTANCE (2)[C]	---	15	---	---	---	15	PERCENT
GRID CURRENT (2)[D]	0	-1.5	---	---	---	---	μAdc
PLATE CURRENT (1) (DIFFERENCE BETWEEN SEC.)	---	3.5	---	---	---	---	mAdc
TRANSCONDUCTANCE (3) (Eb=100Vdc, Ec=0)	2500	4000	2850	3650	---	---	μMHOS
AMPLIFICATION FACTOR	15.5	18.5	16.2	17.8	---	---	

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SPECIAL REQUIREMENTS

	MIN.	MAX.	
RF NOISE [AEF]			
(Ec=-9Vdc, Ecal=7.0mVac)	---	3.0	mW.
NOISE AND MICROPHONICS [AGH]			
(Ef=12.6Vac, Ehk=0, Ebb=300Vdc, Ec=0, Rp=50,000)	---	50	mVac
LOW FREQUENCY VIBRATION [JA]			
(Rp=2000)	---	100	mVac
LOW PRESSURE VOLTAGE BREAKDOWN [K]	500	---	Vac
STABILIZATION			
INTERMITTENT LIFE TEST CONDITIONS OR EQUIVALENT	---	---	
VARIABLE FREQUENCY VIBRATION [LA]			
(Rp=2000)	---	100	mVac
VIBRATIONAL FATIGUE [M]	---	---	
SHOCK [N]			
(HAMMER ANGLE=30°; Ehk=100Vdc, HEATER POSITIVE; Rg=0.1MEG.)	---	---	
POST SHOCK AND FATIGUE TEST END POINTS			
LOW FREQUENCY VIBRATION	---	150	mVac
HEATER-CATHODE LEAKAGE	---	±30	μAdc
TRANSCONDUCTANCE (3)	2000	---	μMHOS
GRID CURRENT (1)	0	-1.5	μAdc
SHORT AND CONTINUITY [P]	---	---	
GLASS STRAIN [R]	---	---	

NOTES

[A] TIE 1p TO 2p, 1g TO 2g, 1k TO 2k. (PARASITIC SUPPRESSORS OF 50 OHMS MAXIMUM ARE PERMITTED).

[B] SEE MIL-E-1C 4.8

[C] THE VALUE OF TRANSCONDUCTANCE (2) SHALL APPLY TO INDIVIDUAL TUBES AND IS EXPRESSED:--

$$\frac{(Sm \text{ AT } 12.6) - (Sm \text{ AT } 11.4)}{(Sm \text{ AT } 12.6)} \times 100$$

[E] SEE MIL-E-1C 4.10.3.1

[F] THE OUTPUT INDICATOR SHALL BE A "VU" METER. THE THREE (3) MILLIWATT POINT SHALL BE DETERMINED AS A METER DEFLECTION OF 25 PERCENT THE CALIBRATION POINT.

[G] THE CATHODE RESISTOR SHALL BE SHUNTED WITH A CAPACITIVE REACTANCE NOT EXCEDING THREE (3) OHMS AT 60 CYCLES.

[H] TIE CATHODES TOGETHER AND GROUND THROUGH A 1500 OHM RESISTOR. GRIDS ARE GROUNDED.

[J] SEE MIL-E-1C 4.9.20.4

[K] BREAKDOWN SHALL BE DEFINED AS THE VOLTAGE AT WHICH ARCING OCCURS BETWEEN ANODE BASE PIN AND ADJACENT PINS. PRESSURE=55±5mmHg.; TEMPERATURE=25±5°C; HUMIDITY =0; VOLTAGE=500Vac, 60 CYCLES, SINUSOIDAL WAVE FORM.

[L] SEE MIL-E-1C 4.9.20.3

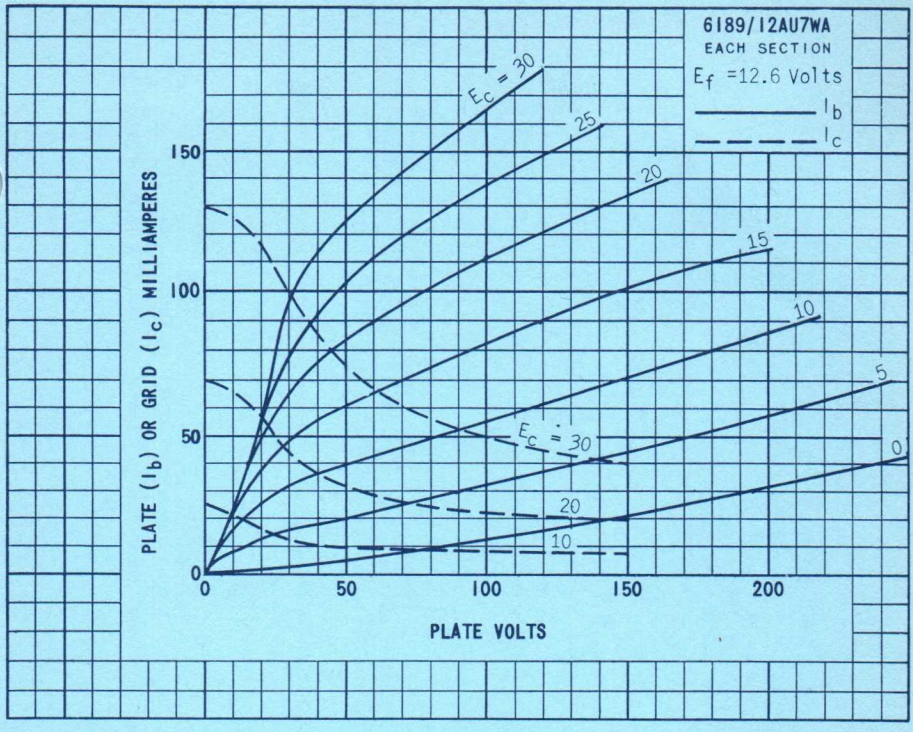
[M] SEE MIL-E-1C 4.9.20.6

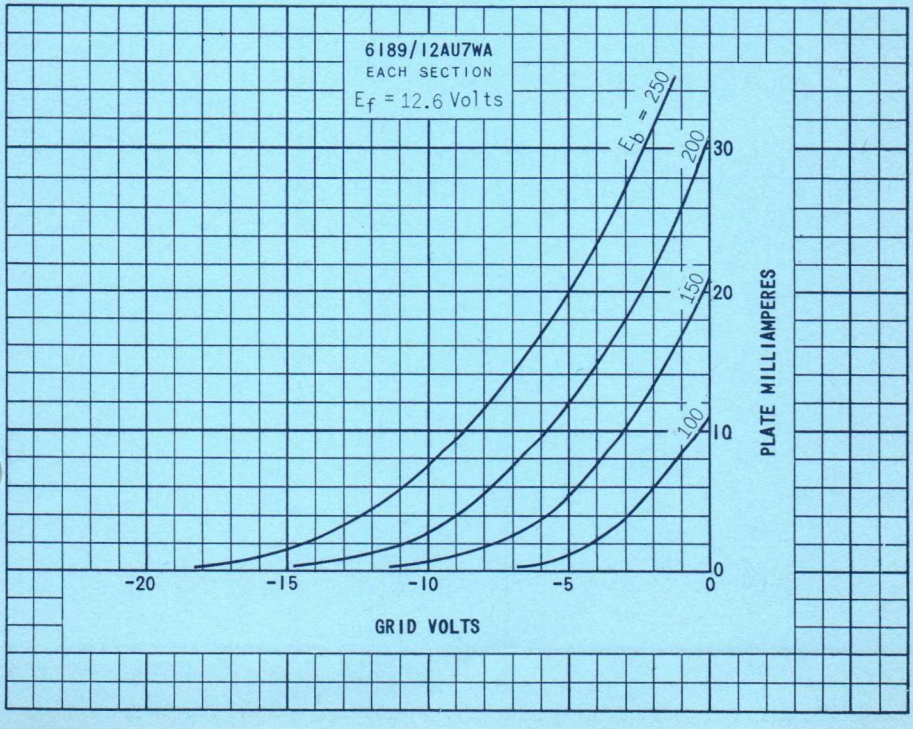
[N] SEE MIL-E-1C 4.9.20.5

[P] SEE MIL-E-1C 4.7.5

[R] GLASS STRAIN TEST CONSISTS OF COMPLETELY SUBMERGING THE TUBE INTO BOILING WATER (97°C-100°C) FOR A PERIOD OF 15 SECONDS, THEN IMMEDIATELY PLUNGING INTO COLD WATER (0±3°C). THE AMOUNT OF WATER SHALL BE AT LEAST TWO (2) LITERS PER FIFTEEN TUBES. TUBES FOR THIS TEST SHALL HAVE BEEN EXHAUSTED A MINIMUM OF 48 HOURS PRIOR TO PERFORMANCE OF THIS TEST.

[D] PRIOR TO THIS TEST TUBES TO BE PREHEATED FIVE (5) MINUTES AT CONDITIONS INDICATED BELOW. TEST IMMEDIATELY AFTER PREHEATING Ef=14.0V, Ec=-8.5Vdc, Rk=0 OHMS, Eb=250Vdc, Rg=0.5 MEG.





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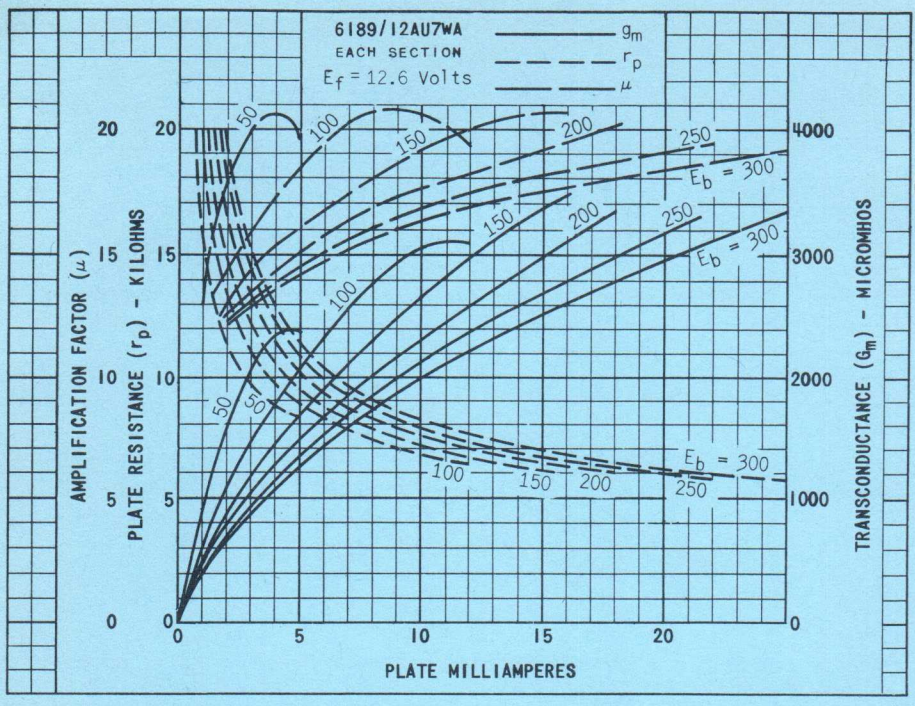
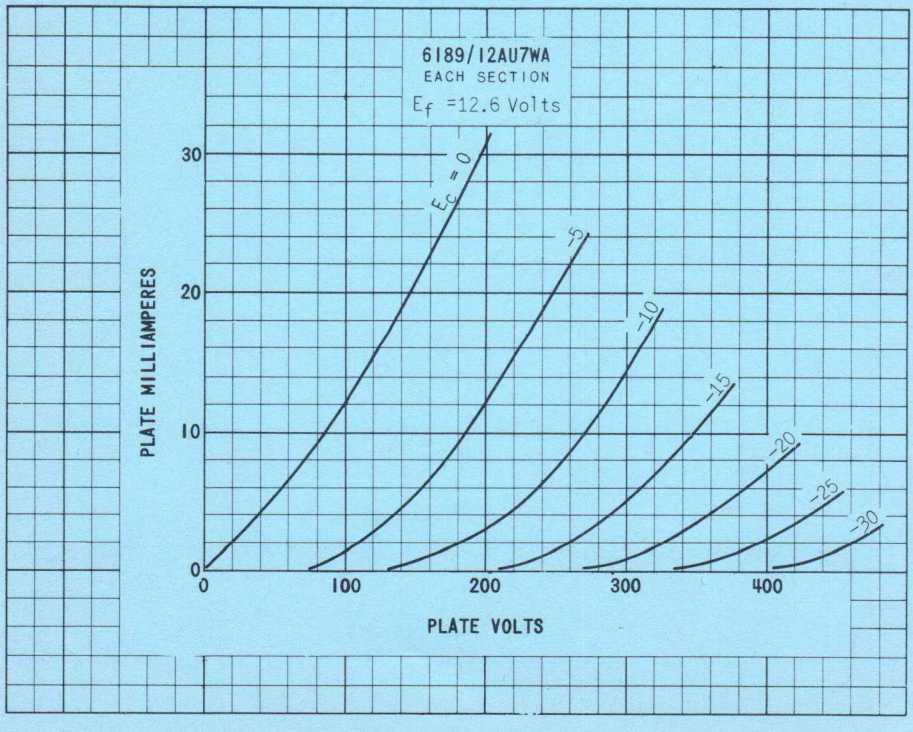
TENTATIVE DATA

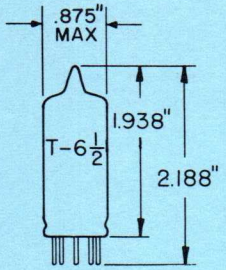




TUNG-SOL

TWIN TRIODE

MINIATURE TYPE

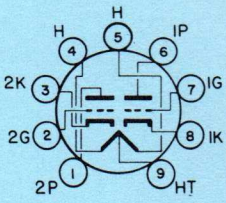


GLASS BULB
SMALL BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2

COATED UNIPOTENTIAL CATHODE

FOR MOBILE AND
AIRCRAFT APPLICATIONS

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9A

THE 6201 IS A TWIN TRIODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE AS A GROUNDED-GRID AMPLIFIER OR AS A FREQUENCY CONVERTER IN VHF APPLICATIONS. THE TUBE IS DESIGNED TO ASSURE DEPENDABLE LIFE AND RELIABLE SERVICE UNDER CONDITIONS ENCOUNTERED IN MOBILE AND AIRCRAFT APPLICATIONS.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID TO PLATE (EACH SECTION)	1.6	1.6	pf
INPUT (EACH SECTION)	2.5	2.5	pf
OUTPUT (SECTION 1)	1.2	0.45	pf
OUTPUT (SECTION 2)	1.3	0.38	pf
HEATER TO CATHODE (EACH SECTION)	2.8	2.8	pf
PLATE TO PLATE		0.24	pf

	WITH SHIELD[B]	WITHOUT SHIELD	
GROUNDED-GRID OPERATION			
PLATE TO CATHODE (SECTION 1)	0.18	0.2	pf
PLATE TO CATHODE (SECTION 2)	0.2	0.24	pf
INPUT (EACH SECTION)	5.0	5.0	pf
OUTPUT (SECTION 1)	2.7	1.9	pf
OUTPUT (SECTION 2)	2.7	1.8	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	(PARALLEL)	6.3 VOLTS	300	MA.
	(SERIES)	12.6 VOLTS	150	MA.
HEATER SUPPLY LIMITS: VOLTAGE OPERATION			6.3±0.6	VOLTS
			12.6±1.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE			90	VOLTS

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TUNG-SOL

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MAXIMUM RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

EACH SECTION

PLATE VOLTAGE	300	VOLTS
NEGATIVE DC GRID VOLTAGE	50	VOLTS
PLATE DISSIPATION	2.5	WATTS
PEAK IMPACT ACCELERATION IN ANY DIRECTION	SEE BELOW	G
BULB TEMPERATURE AT HOTTEST POINT, ABS. MAX.	180	C

TYPICAL OPERATING CHARACTERISTICS

CLASS A_1 AMPLIFIER

EACH SECTION

PLATE VOLTAGE	100	250	VOLTS
CATHODE BIAS RESISTOR	270	200	OHMS
AMPLIFICATION FACTOR	57	60	
PLATE RESISTANCE, APPROXIMATE	14 300	10 900	OHMS
TRANSCONDUCTANCE	4 000	5 500	μMHOS
PLATE CURRENT	3.3	10	MA.
GRID VOLTAGE, APPROXIMATE FOR Ib = 10 μAMPS.	-5	-12	VOLTS

[A] WITH EXTERNAL SHIELD #315 CONNECTED TO CATHODE OF SECTION UNDER TEST.

[B] WITH EXTERNAL SHIELD #315 CONNECTED TO GRID OF SECTION UNDER TEST.

SPECIAL RATINGS AND PERFORMANCE DATA

HEATER-CYCLING RATING

CYCLES OF INTERMITTENT OPERATION, MINIMUM 2000 CYCLES

Ef = 7.5 VOLTS (PARALLEL-HEATER CONNECTION) CYCLED FOR ONE MINUTE ON AND ONE MINUTE OFF. Eb = Ec = 0 VOLTS. Ehk = 135 VOLTS WITH HEATER POSITIVE WITH RESPECT TO CATHODE.

SHOCK RATING

IMPACT ACCELERATION (MAX.) 600 G

THIS TEST IS PERFORMED ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN IN A NAVY-TYPE, HIGH-IMPACT (FLY-WEIGHT) SHOCK MACHINE. TUBES ARE HELD RIGID IN FOUR DIFFERENT POSITIONS AND ARE SUBJECTED TO 20 BLOWS AT THE SPECIFIED MAXIMUM IMPACT ACCELERATION. AT THE END OF THIS TEST, TUBES SHALL NOT SHOW PERMANENT OR TEMPORARY SHORTS OR OPEN CIRCUITS, AND ARE REQUIRED TO MEET ESTABLISHED LIMITS FOR VIBRATIONAL ACCELERATION, HEATER-CATHODE LEAKAGE CURRENT, AND TRANSCONDUCTANCE.

FATIGUE RATING

VIBRATIONAL ACCELERATION (MAX.) 2.5 G

THIS TEST IS PERFORMED ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN. TUBES ARE RIGIDLY MOUNTED AND SUBJECTED IN EACH OF THREE POSITIONS AT 2.5 G VIBRATIONAL ACCELERATION AT 25 CYCLES PER SECOND FOR 32 HOURS. AT THE END OF THIS TEST, TUBES SHALL NOT SHOW PERMANENT OR TEMPORARY SHORTS OR OPEN CIRCUITS, AND ARE REQUIRED TO MEET ESTABLISHED LIMITS FOR IMPACT ACCELERATION, HEATER-CATHODE LEAKAGE CURRENT, AND TRANSCONDUCTANCE.

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SPECIAL RATINGS AND PERFORMANCE DATA - CONT'D.

LOW-FREQUENCY VIBRATION PERFORMANCE:

RMS OUTPUT VOLTAGE (MAX.) 100 MV

THIS TEST IS PERFORMED ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN UNDER THE FOLLOWING CONDITIONS; PLATE OF UNIT #1 TIED TO PLATE OF UNIT #2, GRID OF UNIT #1 TIED TO GRID OF UNIT #2, HEATER VOLTS = 12.6, DC PLATE VOLTS = 250, DC GRID VOLTS =-3, PLATE LOAD RESISTANCE = 2000 OHMS, AND VIBRATIONAL ACCELERATION OF 2.5 G AT 25 CYCLES PER SECOND.

AUDIO-FREQUENCY NOISE AND MICROPHONIC PERFORMANCE:

RMS OUTPUT VOLTAGE (MAX.) 100 MV

THIS TEST IS PERFORMED ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN UNDER THE FOLLOWING CONDITIONS: PLATE OF UNIT #1 TIED TO PLATE OF UNIT #2, GRID OF UNIT #1 TIED TO GRID OF UNIT #2, DC HEATER VOLTS = 12.6, PLATE-SUPPLY VOLTS = 300, CATHODE RESISTOR (COMMON TO BOTH UNITS) = 200 OHMS, AND PLATE LOAD RESISTANCE =10000 OHMS.

SHORTS AND CONTINUITY TEST:

THIS TEST IS PERFORMED ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN. IN THIS TEST, A TUBE IS CONSIDERED INOPERATIVE IF IT SHOWS A PERMANENT OR TEMPORARY SHORT ON OPEN CURCUIT, OR A VALUE OF REVERSE GRID CURRENT IN EXCESS OF 1.4MICROAMPERES UNDER CONDITIONS SPECIFIED IN THE CHARACTERISTICS RANGE VALUES FOR REVERSE GRID CURRENT.

1-HOUR STABILITY LIFE PERFORMANCE:

THIS TEST IS PERFORMED ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN TO INSURE THAT THE TUBES HAVE BEEN PROPERLY STABILIZED. WITH BOTH UNITS OPERATING, EACH UNIT IS CHECKED FOR VARIATION IN TRANS-CONDUCTANCE UNDER CONDITIONS OF MAXIMUM RATED PLATE DISSIPATION. AT THE END OF 1 HOUR, THE VALUE OF TRANSCONDUCTANCE IS READ. THE VARIATIONS IN TRANSCONDUCTANCE FROM THE O-HOUR READING SHALL NOT EXCEED 10 PER CENT.

100-HOUR LIFE PERFORMANCE:

THIS TEST IS PERFORMED ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN UNDER THE CONDITIONS OF MAXIMUM RATED PLATE DISSIPATION TO INSURE A LOW PERCENTAGE OF EARLY INOPERATIVES. AT THE END OF 100 HOURS, A TUBE IS CONSIDERED INOPERATIVE IF IT SHOWS A PERMANENT OR TEMPORARY SHORT OR OPEN CIRCUIT, OR A VALUE OF REVERSE GRID CURRENT IN EXCESS OF 1.4 MICROAMPERES UNDER THE CONDITIONS SPECIFIED IN CHARACTERISTICS RANGE VALUES FOR REVERSE GRID CURRENT.

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SPECIAL RATINGS AND PERFORMANCE DATA - CONT'D.

500-HOUR AVERAGE LIFE PERFORMANCE:

THIS TEST IS MADE ON A SAMPLE LOT OF TUBES FROM EACH PRODUCTION RUN TO INSURE HIGH QUALITY OF THE INDIVIDUAL TUBE AND TO GUARD AGAINST EPIDEMIC FAILURES OF ANY OF THE CHARACTERISTICS INDICATED BELOW. WITH BOTH UNITS OPERATING, EACH UNIT IS LIFE TESTED SEPARATELY AT ROOM TEMPERATURE UNDER THE FOLLOWING CONDITIONS: HEATER VOLTS = 12.6 AC OR DC (SERIES CONNECTION), PLATE-SUPPLY VOLTS = 250, CATHODE RESISTOR = 200 OHMS, GRID-CIRCUIT RESISTANCE = 0.5 MEGOHM, HEATER 135 VOLTS POSITIVE WITH RESPECT TO CATHODE, AND BULB TEMPERATURE = 180°C. AT THE END OF 500 HOURS, TUBE SHALL NOT SHOW PERMANENT SHORTS OR OPEN CIRCUITS AND SHALL BE CRITICIZED FOR THE TOTAL NUMBER OF TUBES FAILING TO PASS THE ESTABLISHED INITIAL LIMITS FOR HEATER CURRENT, REVERSE GRID CURRENT, HEATER-CATHODE LEAKAGE CURRENT, AND 500 HOUR LIMITS FOR TRANSCONDUCTANCE (1), TRANSCONDUCTANCE CHANGE, AND LEAKAGE RESISTANCE AS SHOWN UNDER CHARACTERISTICS RANGE VALUES.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

VALUES ARE FOR EACH UNIT AND ARE INITIAL
UNLESS OTHERWISE SPECIFIED

EACH TUBE IS STABILIZED BEFORE CHARACTERISTICS TESTING BY CONTINUOUS OPERATION FOR AT LEAST 45 HOURS AT ROOM TEMPERATURE AND WITH DISSIPATION VALUES EQUIVALENT TO LIFE TEST CONDITIONS.

	NOTE	MIN.	MAX.	
HEATER CURRENT	1	0.138	0.162	AMP.
DIRECT INTERELECTRODE CAPACITANCES:				
GRID TO PLATE	2	1.3	1.9	pf
GRID TO CATHODE AND HEATER	2	2	3	pf
PLATE TO CATHODE AND HEATER (UNIT #1)	2	0.2	0.7	pf
PLATE TO CATHODE AND HEATER (UNIT #2)	2	0.16	0.6	pf
HEATER TO CATHODE	2	2.1	3.5	pf
PLATE TO PLATE	3	0.15	0.33	pf
AMPLIFICATION FACTOR	1,4	50	70	
PLATE CURRENT (1)	1,4	7	14	MA.
PLATE CURRENT DIFFERENCE BETWEEN UNITS	1,4	---	3.2	MA.
PLATE CURRENT (2)	1,5	---	100	μA
TRANSCONDUCTANCE (1)	1,4	4500	6500	μMHOS
TRANSCONDUCTANCE (1) AT 500 HOURS	1,4	3800	6500	μMHOS
TRANSCONDUCTANCE CHANGE: DIFFERENCE BETWEEN AVERAGE TRANSCONDUCTANCE (1) INITIALLY, AND AVERAGE AFTER 500 HOURS, EXPRESSED AS A PERCENTAGE OF THE INITIAL AVERAGE	1,4	---	20	PERCENT
TRANSCONDUCTANCE (2)	6,4	4000	---	μMHOS
REVERSE GRID CURRENT	1,7	---	0.7	μA
GRID EMISSION CURRENT	8,9	---	1.5	μA
HEATER-CATHODE LEAKAGE CURRENT:				
HEATER NEGATIVE WITH RESPECT TO CATHODE	1,10	---	10	μA
HEATER POSITIVE WITH RESPECT TO CATHODE	1,10	---	10	μA

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TUNG-SOL

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CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN
(CONTINUED)

VALUES ARE FOR EACH UNIT AND ARE INITIAL
UNLESS OTHERWISE SPECIFIED

EACH TUBE IS STABILIZED BEFORE CHARACTERISTICS TESTING BY CONTINUOUS OPERATION FOR AT LEAST 45 HOURS AT ROOM TEMPERATURE AND WITH DISSIPATION VALUES EQUIVALENT TO LIFE TEST CONDITIONS.

	NOTE	MIN.	MAX.	
LEAKAGE RESISTANCE: BETWEEN GRID AND ALL OTHER ELECTRODES TIED TOGETHER	1,11	100	---	MEGOHMS
LEAKAGE RESISTANCE: BETWEEN PLATE AND ALL OTHER ELECTRODES TIED TOGETHER	1,12	100	---	MEGOHMS
LEAKAGE RESISTANCE AT 500 HOURS: BETWEEN GRID AND ALL OTHER ELECTRODES TIED TOGETHER	1,11	50	---	MEGOHMS
BETWEEN PLATE AND ALL OTHER ELECTRODES TIED TOGETHER	1,12	50	---	MEGOHMS

NOTES

1 WITH 12.6 VOLTS AC OR DC ON HEATER (SERIES CONNECTION).

2 WITHOUT EXTERNAL SHIELD AND WITH UNIT NOT UNDER TEST CONNECTED TO GROUND.

3 WITHOUT EXTERNAL SHIELD.

4 WITH DC PLATE-SUPPLY VOLTS = 250, CATHODE RESISTOR = 200 OHMS, AND CATHODE BYPASS CAPACITOR OF 1000 μf. EACH UNIT TESTED SEPARATELY. UNIT NOT UNDER TEST CONNECTED TO GROUND.

5 WITH DC PLATE-SUPPLY VOLTS = 250, PLATE LOAD RESISTANCE = 0.1 MEGOHM, AND DC GRID VOLTS = -20. EACH UNIT TESTED SEPARATELY. UNIT NOT UNDER TEST CONNECTED TO GROUND

6 WITH 11.0 VOLTS AC OR DC ON HEATER (SERIES CONNECTION).

7 WITH DC PLATE-SUPPLY VOLTS = 250, GRID-CIRCUIT RESISTANCE = 0.5 MEGOHM, CATHODE RESISTOR = 200 OHMS, AND CATHODE BYPASS CAPACITOR OF 1000 μf. EACH UNIT IS TESTED SEPARATELY. UNIT NOT UNDER TEST CONNECTED TO GROUND.

8 WITH 15.0 VOLTS AC OR DC ON HEATER (SERIES CONNECTION).

9 WITH DC PLATE VOLTS = 250, GRID-CIRCUIT RESISTANCE = 0.5 MEGOHM, AND DC GRID VOLTS = -20. EACH UNIT TESTED SEPARATELY.

10 WITH 100 VOLTS DC BETWEEN HEATER AND CATHODE AND UNITS CONNECTED IN PARALLEL.

11 WITH GRID 100 VOLTS NEGATIVE WITH RESPECT TO ALL OTHER ELECTRODES TIED TOGETHER.

12 WITH PLATE 300 VOLTS NEGATIVE WITH RESPECT TO ALL OTHER ELECTRODES TIED TOGETHER.

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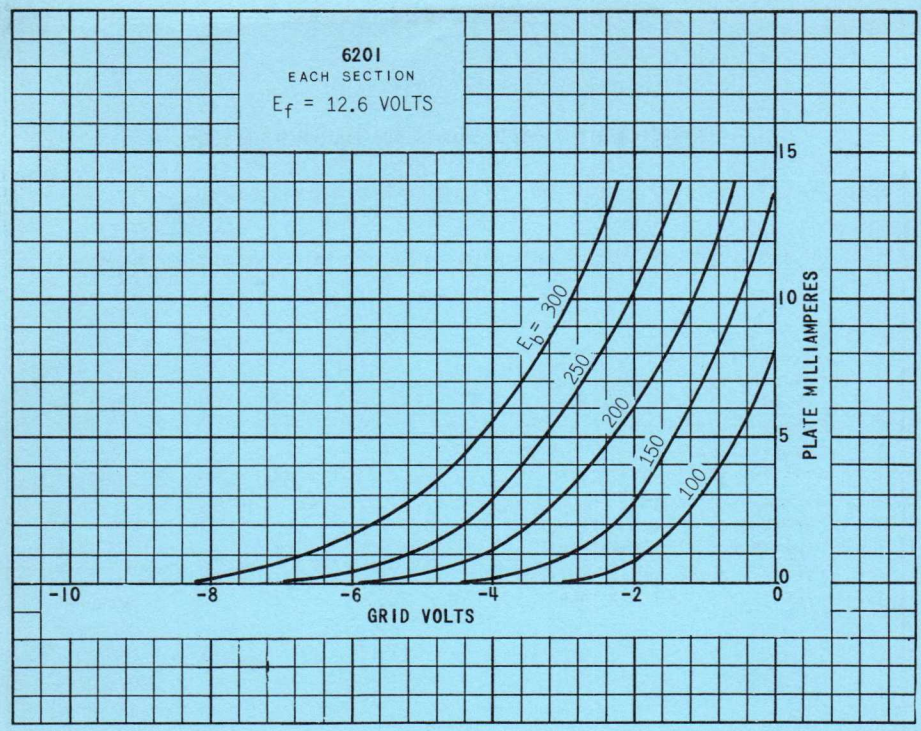
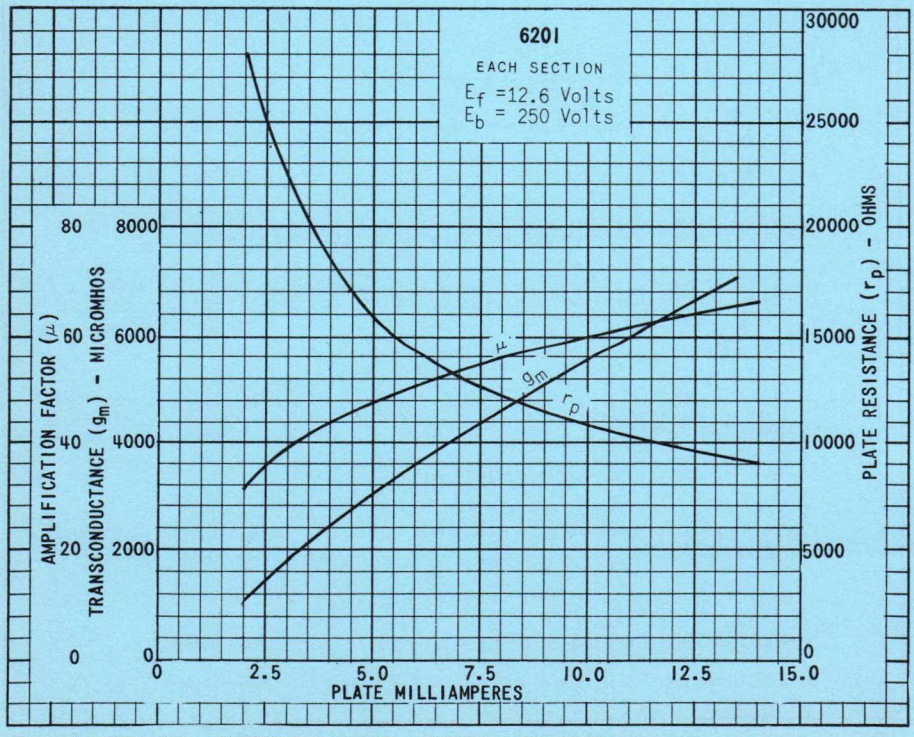
6201


6201
EACH SECTION
E_f = 12.6 VOLTS
E_b = 300
250
200
150
100
PLATE MILLIAMPERES
GRID VOLTS
-10
-8
-6
-4
-2
0
15
10
5
0


6201
EACH SECTION
E_f =12.6 Volts
E_b = 250 Volts
AMPLIFICATION FACTOR (μ)
TRANSCONDUCTANCE (g_m) - MICROMHOS
PLATE RESISTANCE (r_p) - OHMS
PLATE MILLIAMPERES
μ
g_m
r_p
0
2.5
5.0
7.5
10.0
12.5
15.0
80
60
40
20
0
8000
6000
4000
2000
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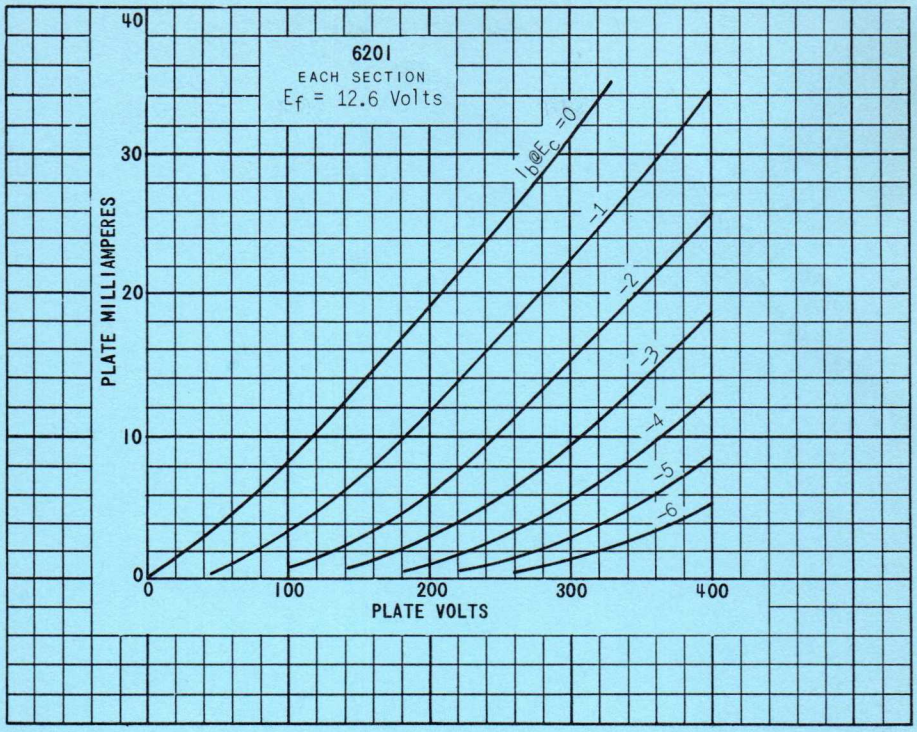

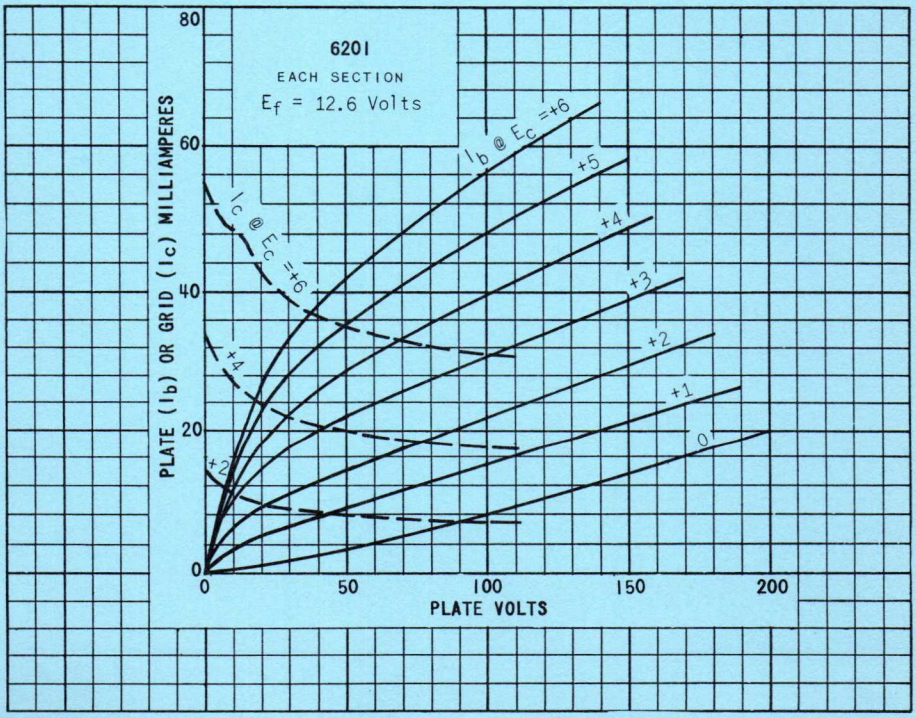

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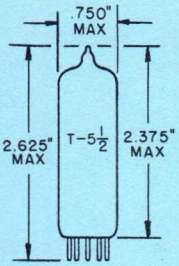
TUNG-SOL

TWIN DIODE

MINIATURE TYPE



GLASS BULB

MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-3

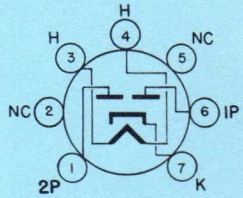
TWIN DIODES

FOR

FULL-WAVE POWER-RECTIFIER
SERVICE IN MOBILE
AND AIRCRAFT APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 5BS

THE 6202 IS A FULL-WAVE HIGH-VACUUM RECTIFIER IN THE 7 PIN MINIATURE CONSTRUCTION. IT IS INTENDED FOR USE IN POWER SUPPLIES IN WHICH THE DC CURRENT REQUIREMENTS DO NOT EXCEED 50 MILLIAMPERES.
THE 6202 IS A DIRECT REPLACEMENT FOR THE 6X4.

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	600	MA.
LIMITS OF APPLIED VOLTAGE			6.3±0.6	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			450	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS

MAXIMUM RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

RECTIFIER SERVICE

SINUSOIDAL SUPPLY VOLTAGES, FREQUENCY 25 TO 1000 CYCLES PER SECOND

PEAK INVERSE VOLTAGE			
ALTITUDES UP TO 40,000 FEET[A]		1250	VOLTS
ALTITUDES FROM 40,000 TO 60,000 FEET[A]		850	VOLTS
AC PLATE SUPPLY VOLTAGE, PER PLATE RMS	See Chart 1		
STEADY-STATE PEAK PLATE CURRENT PER PLATE		200	MA.
TRANSIENT PEAK PLATE CURRENT PER PLATE MAX. DURATION 0.2 SECOND		1.45	AMP.
DC OUTPUT CURRENT	See Rating Chart 1		
PEAK IMPACT ACCELERATION		700	G
BULB TEMPERATURE AT HOTTEST POINT (ABS. MAX.)		+165	°C

[A]THE ALTITUDE RATINGS AS PRESENTED REFER TO THE LIMITATIONS OF THE TUBE ITSELF. BECAUSE THE SOCKET EMPLOYED CAN BECOME THE LIMITING FACTOR IN HIGH-ALTITUDE OPERATION, CONSIDERATION MUST BE GIVEN TO THE VOLTAGE-BREAKDOWN CAPABILITIES OF THE TUBE AND SOCKET COMBINATION EMPLOYED.

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TYPICAL OPERATING CHARACTERISTICS

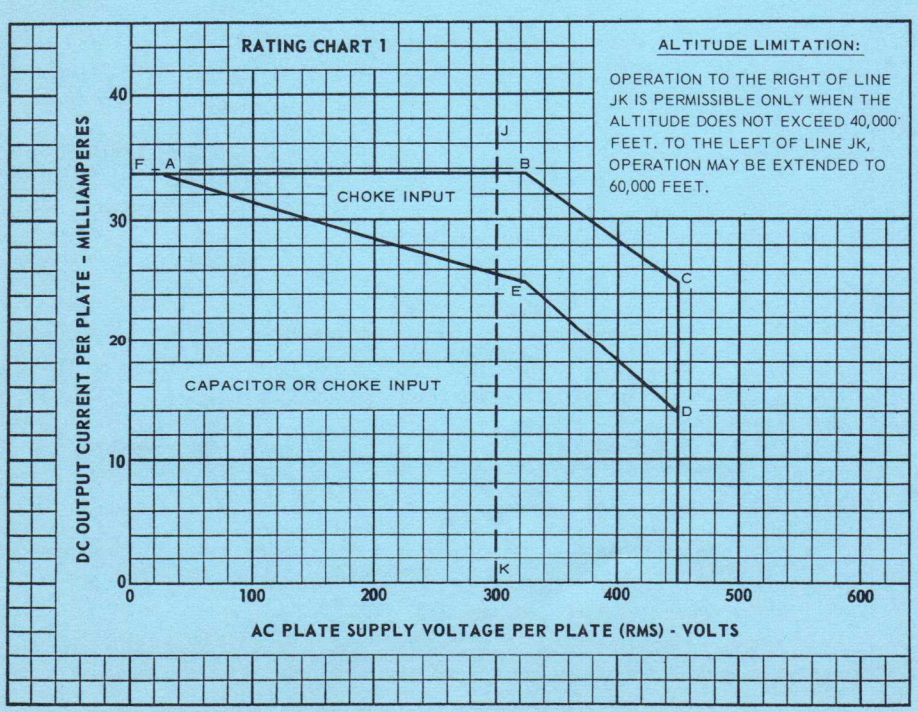
FULL WAVE RECTIFIER

ALTITUDES UP TO 40,000 FEET

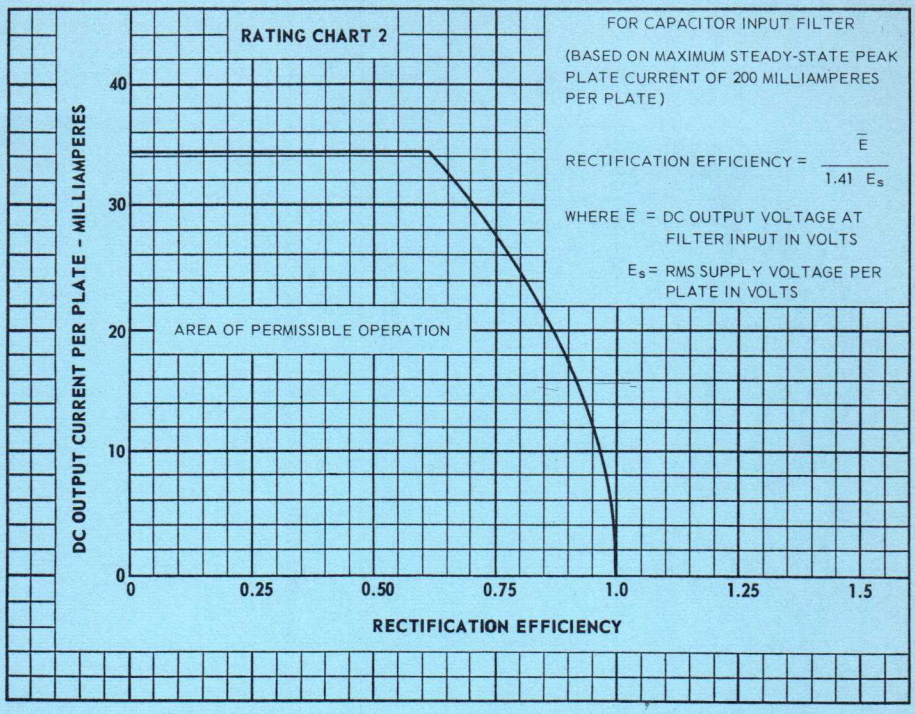
AC PLATE-SUPPLY VOLTAGE PER PLATE, RMS	325	450	VOLTS
FILTER INPUT CAPACITOR	4	-----	μf
FILTER INPUT CHOKE	-----	8	HENRYS
TOTAL PLATE-SUPPLY RESISTANCE PER PLATE	175	-----	OHMS
DC OUTPUT CURRENT	50	50	MA.
DC OUTPUT VOLTAGE AT FILTER INPUT	365	375	VOLTS
TUBE VOLTAGE DROP			
MEASURED WITH APPLIED DC AT 50 MA. PER PLATE		22	VOLTS

SPECIAL TESTS AND RATINGS

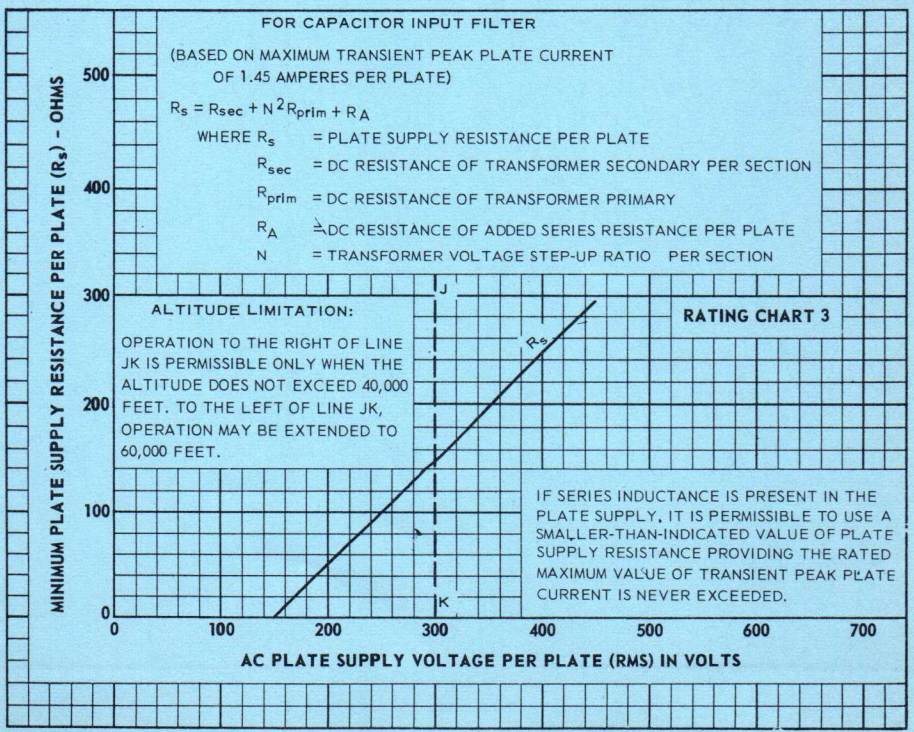
HEATER CYCLING RATING			
SHOCK RATING			
VIBRATION RATING			
ALTITUDE RATING	TO	60,000	FEET



RATING CHART 2



RATING CHART 3



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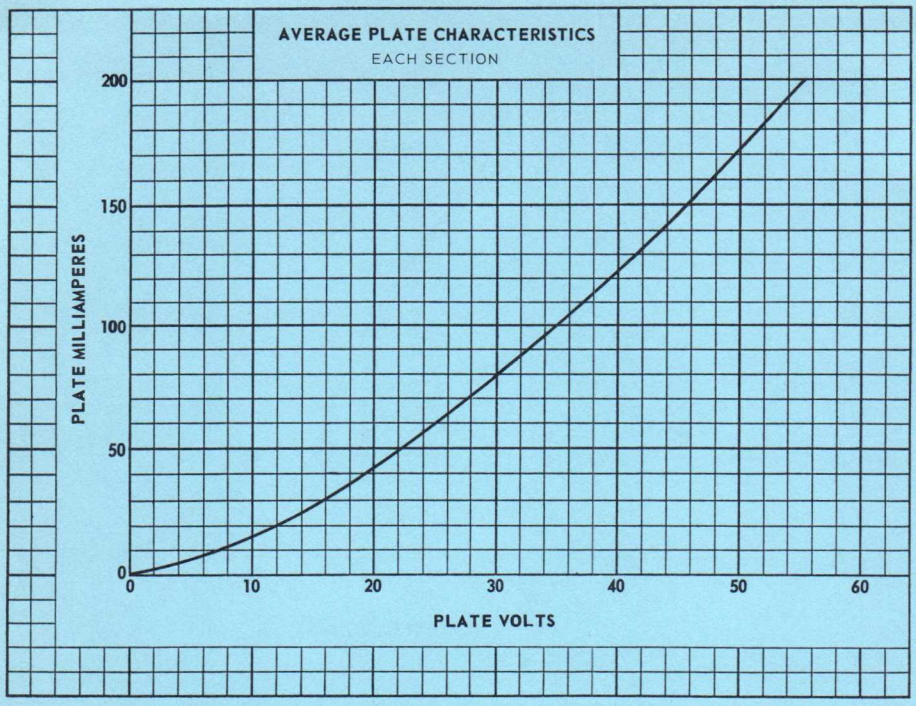
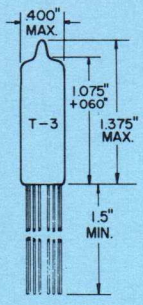

AVERAGE PLATE CHARACTERISTICS
EACH SECTION
PLATE MILLIAMPERES
200
150
100
50
0
0
10
20
30
40
50
60
PLATE VOLTS

TUNG-SOL

PENTODE

SUBMINIATURE TYPE



GLASS BULB
SUBMINIATURE BUTTON
8 LEAD BASE E8-10
OUTLINE DRAWING
JEDEC 3-1

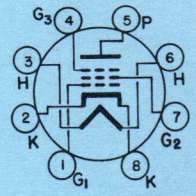
COATED UNIPOTENTIAL CATHODE

HEATER

6.3±5% VOLTS 0.15 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 8DC

THE 6205 IS A SHARP-CUTOFF PENTODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE IN HIGH-FREQUENCY CIRCUITS. IN ON-OFF CONTROL APPLICATIONS, THE TUBE WILL MAINTAIN ITS EMISSION CAPABILITIES AFTER LONG PERIODS OF OPERATION UNDER CUTOFF CONDITIONS. EXCEPT FOR THE INCORPORATION OF AN EXTERNAL CONNECTION FOR THE SUPPRESSOR GRID, THE 6205 IS IDENTICAL TO THE 5840.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID #1 TO PLATE, MAX.	0.015	0.03	μμf
INPUT	4.2	4.0	μμf
OUTPUT	3.4	1.9	μμf

[A] WITH EXTERNAL SHIELD OF 0.405 INCH INSIDE DIAMETER CONNECTED TO CATHODE

RATINGS
ABSOLUTE MAXIMUM VALUES

HEATER VOLTAGE	6.3±5%	VOLTS
MAXIMUM PLATE VOLTAGE	165	VOLTS
MAXIMUM SCREEN VOLTAGE	155	VOLTS
MAXIMUM SUPPRESSOR VOLTAGE	22	VOLTS
MAXIMUM POSITIVE DC GRID #1 VOLTAGE	0	VOLTS
MAXIMUM NEGATIVE DC GRID #1 VOLTAGE	55	VOLTS
MAXIMUM PLATE DISSIPATION	→ 1.1	WATTS
MAXIMUM SCREEN DISSIPATION	→ 0.55	WATTS
MAXIMUM DC CATHODE CURRENT	16.5	MA.
MAXIMUM HEATER=CATHODE VOLTAGE:		
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.1	MEGOHMS
MAXIMUM BULB TEMPERATURE AT HOTTEST POINT	220	C

→ INDICATES A CHANGE.

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A_1 AMPLIFIER

HEATER VOLTAGE	6.3±5%	VOLTS
HEATER CURRENT	0.15	AMP.
PLATE VOLTAGE	100	VOLTS
SUPPRESSOR, CONNECTED TO CATHODE AT SOCKET		
SCREEN VOLTAGE	100	VOLTS
CATHODE-BIAS RESISTOR	150	OHMS
PLATE RESISTANCE, APPROX.	0.26	MEG.
TRANSCONDUCTANCE	5000	μMHOS
PLATE CURRENT	7.5	MA.
SCREEN CURRENT	2.4	MA.
GRID #1 VOLTAGE, APPROX. Ib = 10 μAMPS.	-9.0	VOLTS

CLASS A RESISTANCE COUPLED AMPLIFIER

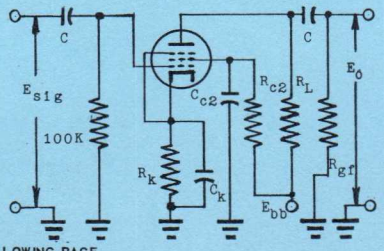
LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)

R_L	R_{gf}	Ebb = 90 VOLTS				Ebb = 150 VOLTS				Ebb = 225 VOLTS			
		R_k	R_{c2}	E_o	Gain	R_k	R_{c2}	E_o	Gain	R_k	R_{c2}	E_o	Gain
0.10	0.10	1000	0.2	13	50	500	0.3	19	83	400	0.3	29	110
0.10	0.24	1000	0.2	16	73	500	0.3	25	120	400	0.3	38	160
0.24	0.24	1700	0.5	13	72	1500	0.6	20	100	700	0.8	29	160
0.24	0.51	2000	0.6	15	89	1500	0.7	24	140	700	0.9	35	210
0.51	0.51	2500	1.3	11	93	2000	1.5	18	140	1000	1.7	28	200
0.51	1.0	3000	1.5	13	110	2000	1.7	20	180	1000	2.0	31	260

HIGH IMPEDANCE DRIVE (APPROXIMATELY 100 K OHMS)

R_L	R_{gf}	Ebb = 90 VOLTS				Ebb = 150 VOLTS				Ebb = 225 VOLTS			
		R_k	R_{c2}	E_o	Gain	R_k	R_{c2}	E_o	Gain	R_k	R_{c2}	E_o	Gain
0.10	0.10	1200	0.2	13	48	700	0.2	18	77	500	0.3	28	110
0.10	0.24	1300	0.2	16	70	800	0.3	24	110	500	0.3	37	150
0.24	0.24	2800	0.4	12	68	1700	0.6	20	100	1200	0.8	29	150
0.24	0.51	3000	0.5	15	82	1800	0.7	24	140	1300	0.8	35	190
0.51	0.51	5500	1.0	11	76	3500	1.3	18	120	2400	1.6	26	180
0.51	1.0	6200	1.2	12	92	3800	1.6	19	160	2500	1.8	31	230

1. E_o IS MAXIMUM RMS VOLTAGE OUTPUT FOR APPROXIMATELY 5% TOTAL HARMONIC DISTORTION.
2. GAIN IS MEASURED FOR AN OUTPUT VOLTAGE OF TWO VOLTS RMS.
3. R_k IS IN OHMS; R_{c2}, R_L, & R_{gf}, ARE IN MEGOHMS.
4. COUPLING CAPACITORS (C) SHOULD BE SELECTED TO GIVE DESIRED FREQUENCY RESPONSE. R_k & R_{c2} SHOULD BE ADEQUATELY BY-PASSED.



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CHARACTERISTICS LIMITS

		MIN.	MAX.	
HEATER CURRENT:				
Ef =6.3 VOLTS	INITIAL	140	160	MA.
	500-HR.	138	164	MA.
PLATE CURRENT:				
Ef=6.3 VOLTS, Eb= 100 VOLTS, Ec2= 100 VOLTS, Rk =150 OHMS (BYPASSED), g3 TIED TO k	INITIAL	5.5	9.5	MA.
SCREEN CURRENT:				
Ef =6.3 VOLTS, Eb =100 VOLTS, Ec2= 100 VOLTS, Rk=150 OHMS (BYPASSED) g3 TIED TO k	INITIAL	1.5	3.3	MA.
TRANSCONDUCTANCE (1):				
Ef =6.3 VOLTS, Eb =100 VOLTS, Ec2=100 VOLTS, Rk =150 OHMS (BYPASSED), g3 TIED TO k	INITIAL	4200	5800	μMHOS
TRANSCONDUCTANCE CHANGE WITH HEATER VOLTAGE				
DIFFERENCE BETWEEN TRANSCONDUCTANCE (1) AND TRANSCONDUCTANCE AT Ef=5.7 VOLTS (OTHER CONDITIONS THE SAME) EXPRESSED AS A PERCENTAGE OF TRANSCONDUCTANCE (1)	INITIAL	---	10	PERCENT
	500-HR.	---	15	PERCENT
TRANSCONDUCTANCE CHANGE WITH OPERATION:				
DIFFERENCE BETWEEN TRANSCONDUCTANCE (1) INITIALLY AND AFTER OPERATION EXPRESSED AS A PERCENTAGE OF INITIAL VALUE	500-HR.	---	20	PERCENT
AVERAGE TRANSCONDUCTANCE CHANGE WITH OPERATION:				
AVERAGE OF VALUES FOR "TRANSCONDUCTANCE CHANGE WITH OPERATION"	500-HR.	---	15	PERCENT
PLATE RESISTANCE:				
Ef=6.3 VOLTS, Eb=100 VOLTS, Ec2= 100 VOLTS, Rk=150 OHMS (BYPASSED), g3 TIED TO k	INITIAL	0.175	---	MEGOHMS
PLATE CURRENT CUTOFF:				
Ef=6.3 VOLTS, Eb=100 VOLTS, Ec2= 100 VOLTS, Ec1 =-9.0 VOLTS, g3 TIED TO k	INITIAL	---	50	μAMPS.
INTERELECTRODE CAPACITANCES:				
GRID #1 TO PLATE (G1 TO P)	INITIAL	---	0.015	μμf
INPUT (G1 TO H,K,G2,G3)	INITIAL	3.5	4.9	μμf
OUTPUT (P TO H, K, G2G3)	INITIAL	2.9	3.9	μμf
(MEASURED WITH EXTERNAL SHIELD OF 0.405-INCH INSIDE DIAMETER CONNECTED TO CATHODE.				
NEGATIVE GRID #1 CURRENT:				
Ef=6.3 VOLTS, Eb=100 VOLTS, Ec2= 100 VOLTS, Rk=150 OHMS (BYPASSED) Rg1 =1.0 MEG., g3 TIED TO k	INITIAL	0	0.3	μAMPS.
	500-HR.	0	0.8	μAMPS.

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CHARACTERISTICS LIMITS - cont'd.

		MIN.	MAX.	
HEATER-CATHODE LEAKAGE CURRENT:				
Ef =6.3 VOLTS, Ehk=100 VOLTS				
HEATER POSITIVE WITH RESPECT TO				
CATHODE	INITIAL	---	5.0	μAMPS.
	500-HR.	---	10	μAMPS.
HEATER NEGATIVE WITH RESPECT TO				
CATHODE	INITIAL	---	5.0	μAMPS.
	500-HR.	---	10	μAMPS.
INTERELECTRODE LEAKAGE RESISTANCE:				
Ef=6.3 VOLTS. POLARITY OF APPLIED				
DC INTERELECTRODE VOLTAGE IS SUCH				
THAT NO CATHODE EMISSION RESULTS.				
GRID #1 TO ALL AT 100 VOLTS DC	INITIAL	100	---	MEG.
	500 HR.	50	---	MEG.
PLATE TO ALL AT 300 VOLTS DC	INITIAL	100	---	MEG.
	500-HR.	50	---	MEG.
VIBRATIONAL NOISE OUTPUT VOLTAGE, RMS:				
Ef=6.3 VOLTS, Ebb=100 VOLTS, Ec2=100 VOLTS,				
Rk=150 OHMS (BYPASSED) RL =10,000 OHMS,				
g3 TIED TO k, VIBRATION ACCELERATION =				
15 G AT 40 cps	INITIAL	---	60	MV.
GRID #1 EMISSION CURRENT:				
Ef=7.5 VOLTS, Eb=100 VOLTS, Ec2 =100				
VOLTS, Ec1=-9.0 VOLTS, Rg1=1.0 MEG.,				
g3 TIED TO k	INITIAL	0	0.5	μAMPS.

THE INDICATED 500-HOUR VALUES ARE LIFE-TEST END POINTS FOR THE FOLLOWING CONDITIONS OF OPERATION: Ef=6.3 VOLTS, Eb=100 VOLTS, Ec2=100 VOLTS, Rk=150 OHMS, g3 TIED TO k, Rg1=1.0 MEG, Ehk=200 VOLTS WITH HEATER POSITIVE WITH RESPECT TO CATHODE, AND BULB TEMPERATURE=220 C.

SPECIAL TESTS AND RATINGS

STABILITY LIFE TEST
STATISTICAL SAMPLE OPERATED FOR ONE HOUR TO EVALUATE AND CONTROL INITIAL VARIATIONS IN TRANSCONDUCTANCE.

SURVIVAL RATE LIFE TEST
STATISTICAL SAMPLE OPERATED FOR ONE HUNDRED HOURS TO EVALUATE AND CONTROL EARLY-LIFE ELECTRICAL AND MECHANICAL INOPERATIVES.

HEATER-CYCLING LIFE TEST
STATISTICAL SAMPLE OPERATED FOR 2000 CYCLES MINIMUM TO EVALUATE AND CONTROL HEATER-CATHODE DEFECTS. CONDITIONS OF TEST INCLUDE Ef=7.0 VOLTS CYCLED FOR ONE MINUTE ON AND FOUR MINUTES OFF, Eb=Ec3=Ec2=Ec1=0 VOLTS, AND Ehk=140 VOLTS RMS.

SHOCK RATING-450 G
STATISTICAL SAMPLE SUBJECTED TO FIVE IMPACT ACCELERATIONS OF 450 G IN EACH OF FOUR DIFFERENT POSITIONS. THE ACCELERATING FORCES ARE APPLIED BY THE NAVY-TYPE HIGH IMPACT (FLYWEIGHT) SHOCK MACHINE FOR ELECTRONIC DEVICES OR ITS EQUIVALENT.

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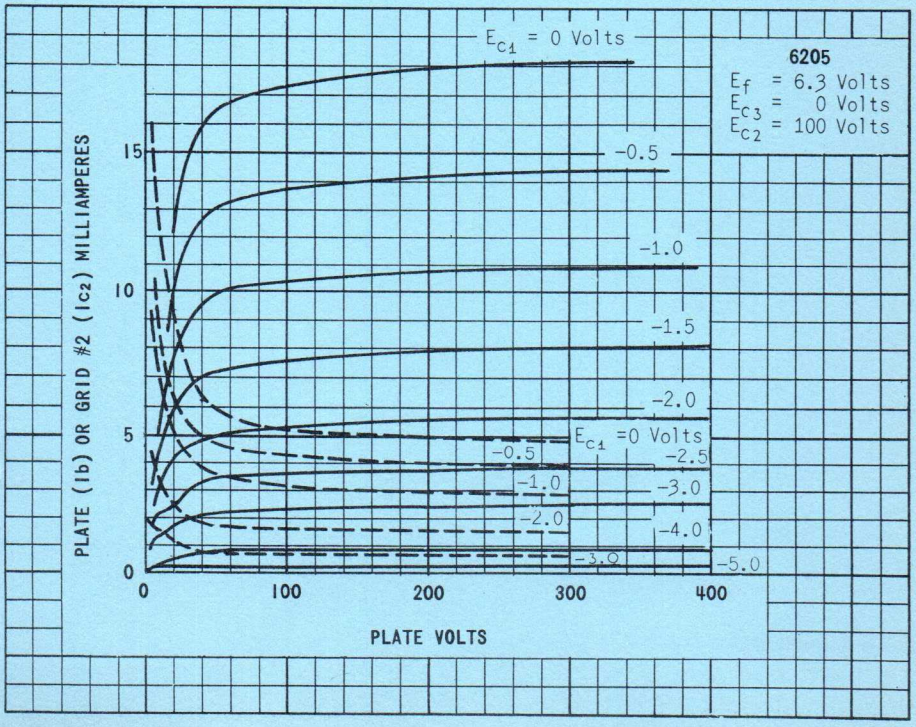
SPECIAL TESTS AND RATINGS

FATIGUE RATING–2.5 G
STATISTICAL SAMPLE SUBJECTED TO VIBRATIONAL ACCELERATION OF 2.5 G FOR 32 HOURS MINIMUM IN EACH OF THREE DIFFERENT POSITIONS. THE SINUSOIDAL VIBRATION IS APPLIED AT A FIXED FREQUENCY BETWEEN 25 AND 60 CYCLES PER SECOND.

ALTITUDE RATING–60,000 FEET
STATISTICAL SAMPLE SUBJECTED TO PRESSURE OF 55 MILLIMETERS OF MERCURY TO EVALUATE AND CONTROL ARCING AND CORONA.

NOTE: THE CONDITIONS FOR SOME OF THE INDICATED TESTS HAVE DELIBERATELY BEEN SELECTED TO AGGRAVATE TUBE FAILURES FOR TEST AND EVALUATION PURPOSES. IN NO SENSE SHOULD THESE CONDITIONS BE INTERPRETED AS SUITABLE CIRCUIT OPERATING CONDITIONS. IN THE DESIGN OF MILITARY EQUIPMENT EMPLOYING THIS TUBE, REFERENCE SHOULD BE MADE TO THE APPROPRIATE MIL-E-1 SPECIFICATION.



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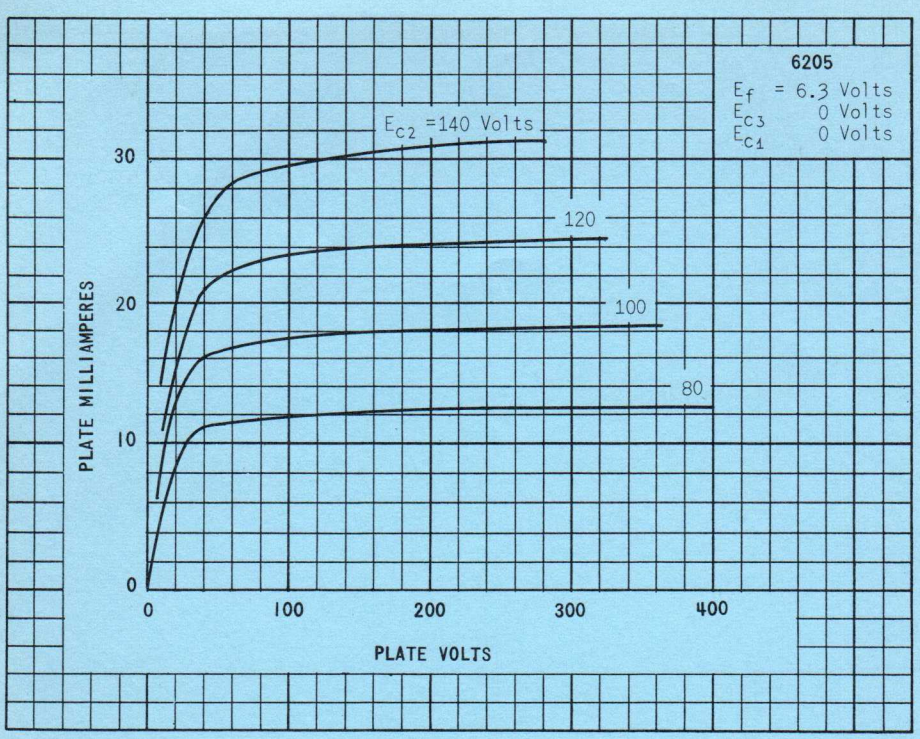
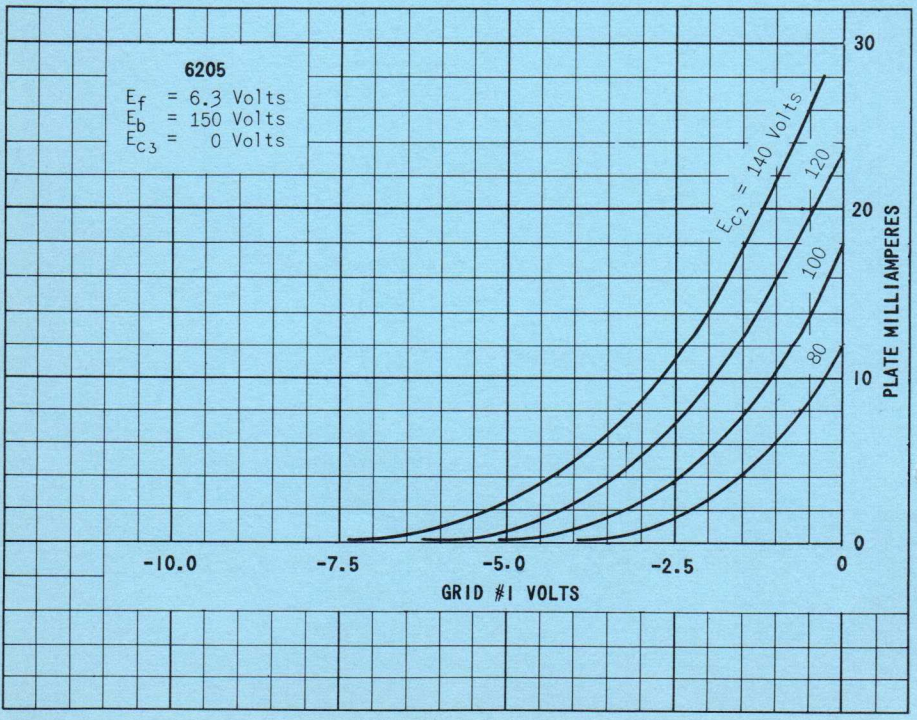
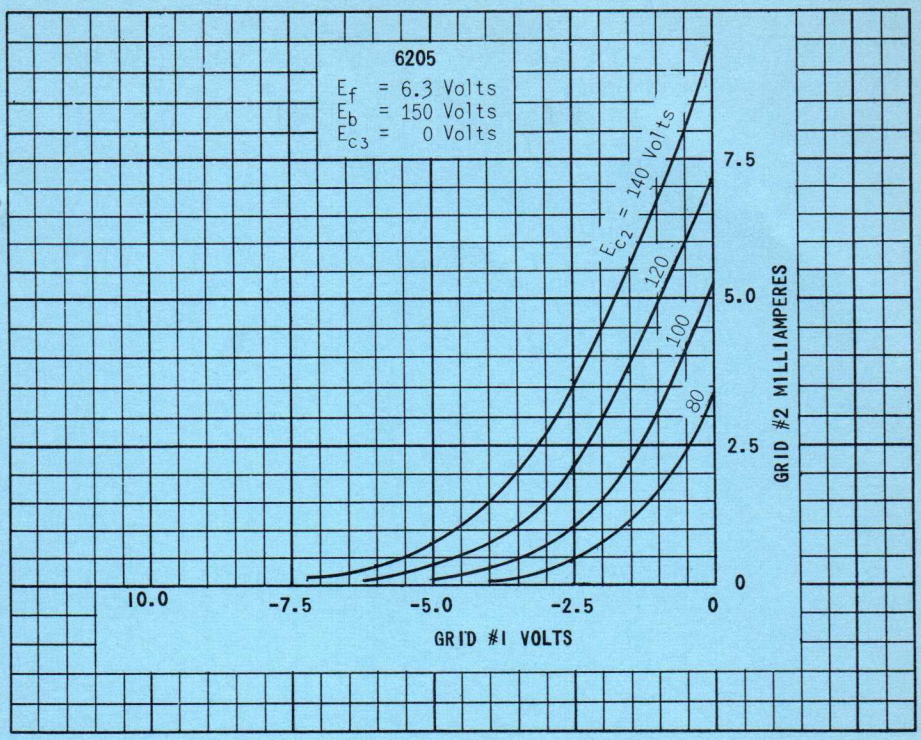
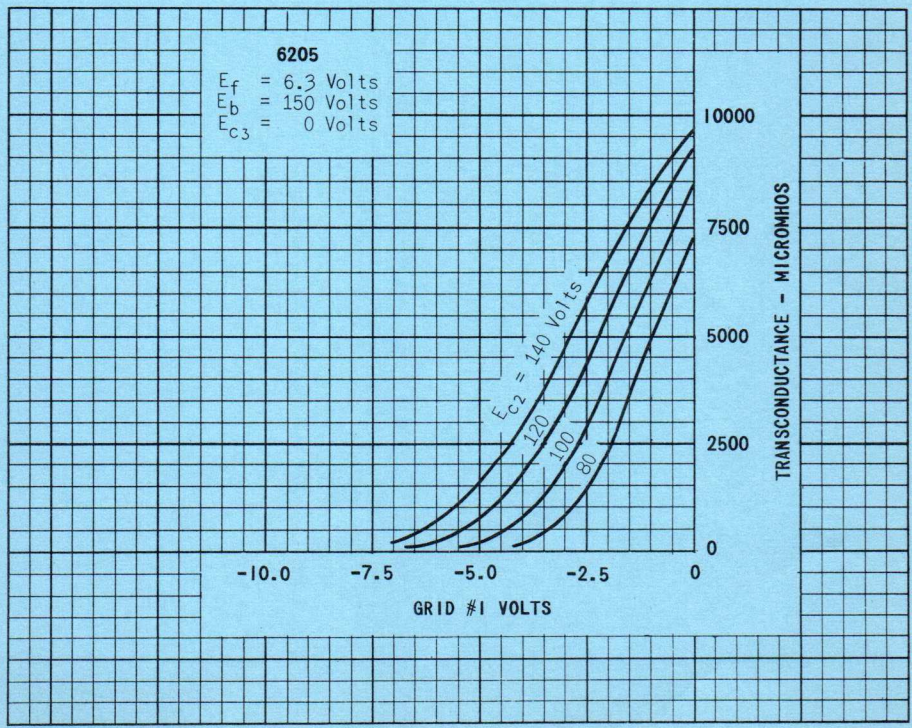

6205
E_f = 6.3 Volts
E_{c3} 0 Volts
E_{c1} 0 Volts
E_{c2} =140 Volts
120
100
80
PLATE MILLIAMPERES
30
20
10
0
0
100
200
300
400
PLATE VOLTS


6205
E_f = 6.3 Volts
E_b = 150 Volts
E_{c3} = 0 Volts
E_{c2} = 140 Volts
120
100
80
PLATE MILLIAMPERES
30
20
10
0
-10.0
-7.5
-5.0
-2.5
0
GRID #1 VOLTS





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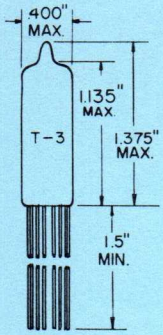
TUNG-SOL

PENTODE

SUBMINIATURE TYPE

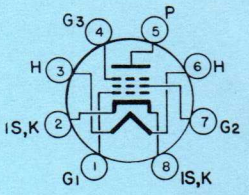


GLASS BULB
SUBMINIATURE BUTTON
FLEXIBLE LEADS
BASE E8-10
OUTLINE DRAWING
JEDEC 3-1

COATED UNIPOTENTIAL CATHODE

FOR MOBILE AND AIRCRAFT
EQUIPMENT APPLICATIONS

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 8DC

THE 6206 IS A SEMI-REMOTE CUTOFF RF PENTODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED FOR OPERATION IN THE UHF REGION UNDER CONDITIONS OF SEVERE SHOCK, VIBRATION, HIGH TEMPERATURE AND HIGH ALTITUDE.

DIRECT INTERELECTRODE CAPACITANCES

	WITHOUT SHIELD	WITH SHIELD [B]	
GRID #1 TO PLATE, MAX.	0.03	0.015	pf
INPUT	4.0	4.2	pf
OUTPUT	1.9	3.4	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE VALUES

AVERAGE CHARACTERISTICS	6.3 VOLTS	150	MA.
HEATER SUPPLY LIMITS:			
VOLTAGE OPERATION		6.3±0.6	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE		±200	VOLTS

RATINGS

MECHANICAL

MAXIMUM IMPACT ACCELERATION[C]	450	G
MAXIMUM UNIFORM ACCELERATION[D]	1 000	G
MAXIMUM VIBRATIONAL ACCELERATION FOR EXTENDED PERIODS[E]	2.5	G
MAXIMUM BULB TEMPERATURE	250	°C

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MAXIMUM RATINGS

ABSOLUTE VALUES

PLATE VOLTAGE, DC	165	VOLTS
GRID #2 VOLTAGE, DC	155	VOLTS
PLATE DISSIPATION	1.1	WATTS
GRID #2 DISSIPATION	0.55	WATTS
CATHODE CURRENT	16.5	MA.
NEGATIVE GRID #1 VOLTAGE	55	VOLTS

TYPICAL OPERATING CHARACTERISTICS

CONDITIONS:		
HEATER VOLTAGE	6.3	VOLTS
PLATE VOLTAGE, DC	100	VOLTS
GRID #3 VOLTAGE[F]	0	VOLTS
GRID #2 VOLTAGE, DC	100	VOLTS
CATHODE BIAS RESISTOR	120	OHMS
PLATE CURRENT	7.2	MA.
GRID #2 CURRENT	2.2	MA.
TRANSCONDUCTANCE	4 500	μMHOS
PLATE RESISTANCE	260 000	OHMS
GRID VOLTAGE FOR 25 μMHOS TRANSCONDUCTANCE	−14	VOLTS
NOISE OUTPUT VOLTAGE[G] MAXIMUM	60	MV.
LIFE EXPECTANCY:		
30° C AMBIENT TEMPERATURE	5 000	HOURS
175°C AMBIENT TEMPERATURE	1 000	HOURS

[B] WITH EXTERNAL SHIELD OF 0.405 INCH DIAMETER CONNECTED TO CATHODE.

[C] FORCES IN ANY DIRECTION AS APPLIED BY THE NAVY TYPE HIGH IMPACT (FLYWEIGHT) SHOCK MACHINE FOR ELECTRIC DEVICES OR EQUIVALENT.

[D] FORCES IN ANY DIRECTION APPLIED GRADUALLY, AS IN CENTRIFUGE.

[E] VIBRATIONAL FORCES IN ANY DIRECTION AT 60 CYCLES PER SECOND FOR A PERIOD EXCEEDING 100 HOURS.

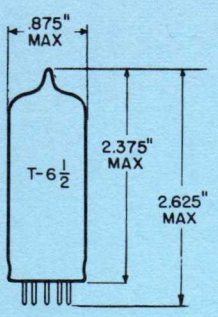
[F] GRID #3 CONNECTED TO CATHODE AT SOCKET.

[G] ACROSS PLATE RESISTOR OF 10,000 OHMS, WITH APPLIED VIBRATIONAL ACCELERATION OF 15G AT 40 CYCLES PER SECOND.

TUNG-SOL

BEAM PENTODE

MINIATURE TYPE



GLASS BULB

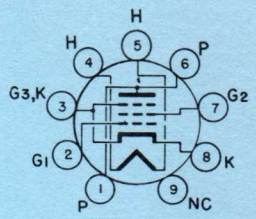
MINIATURE
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-3

COATED UNIPOTENTIAL CATHODE

FOR MOBILE AND

AIRCRAFT APPLICATIONS

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 9CE

THE 6216 IS A BEAM PENTODE POWER AMPLIFIER IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS EXTREMELY RESISTANT TO THE VIBRATIONS ENCOUNTERED IN PRESENT HIGH-SPEED MILITARY AIRCRAFT.

THE 6216 MAY BE USED IN CLASS A, CLASS B, AND CLASS C AMPLIFIER APPLICATIONS, AS A PASSING TUBE IN ELECTRONIC VOLTAGE-REGULATED POWER SUPPLIES, IN WIDE BAND VIDEO AMPLIFIERS, AND IN PASSIVE SWITCHING APPLICATIONS.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT SHIELD

GRID TO PLATE: (G1 TO P), MAX.	0.370	pf
INPUT: G1 TO (H+K+G2+G3+B.P.+B.S.+I.S.)	12.3	pf
OUTPUT: P TO (H+K+G2+G3+B.P.+B.S.+I.S.)	6.7	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS:		
VOLTAGE	6.3	VOLTS
CURRENT	1200	MA.
MAXIMUM HEATER-CATHODE VOLTAGE	150	VOLTS

MAXIMUM RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	300	VOLTS
GRID #2 VOLTAGE	200	VOLTS
POSITIVE DC GRID #1 VOLTAGE	0	VOLTS
PLATE DISSIPATION	10	WATTS

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MAXIMUM RATINGS - CONT'D.

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

GRID #2 DISSIPATION	1.0	WATTS
CATHODE CURRENT	110	MA.
BULB TEMPERATURE AT ANY POINT	210	°C
GRID #1 CIRCUIT RESISTANCE (FIXED BIAS)	0.1	MEGOHM
GRID #1 CIRCUIT RESISTANCE (SELF BIAS)	0.5	MEGOHM

AVERAGE CHARACTERISTICS

FILTER REACTOR

PLATE VOLTAGE	100	VOLTS
GRID #2 VOLTAGE	100	VOLTS
GRID #1 VOLTAGE	-3	VOLTS
GRID #1 RESISTOR	0.1	MEGOHM
PLATE RESISTANCE (APPROX.)	18 500	OHMS
TRANSCONDUCTANCE	12 800	μMHOS
PLATE CURRENT	72	MA.
GRID #2 CURRENT	3	MA.
GRID #1 VOLTAGE (APPROX.) FOR Ib = 50 μA	-25	VOLTS

TYPICAL OPERATION

FILTER REATOR (SEE CIRCUIT)

DC PLATE SUPPLY VOLTAGE (INPUT TO FILTER)	400	VOLTS
DC PLATE VOLTAGE (PLATE TO CATHODE)	60	VOLTS
DC GRID #2 VOLTAGE	100	VOLTS
DC GRID #1 VOLTAGE	-1	VOLTS
DC OUTPUT VOLTAGE (OUTPUT FROM FILTER)	335	VOLTS
DC CATHODE CURRENT	110	MA DC
RMS RIPPLE VOLTAGE (IN OUTPUT)(NOTE 1)	210	MV.

CLASS A AUDIO AMPLIFIER

PLATE VOLTAGE	200	VOLTS
GRID #2 (SCREEN) VOLTAGE	100	VOLTS
GRID #1 (CONTROL GRID) VOLTAGE	-6	VOLTS
PEAK AF GRID #1 VOLTAGE	6	VOLTS
ZERO SIGNAL PLATE CURRENT	47	MA.
MAX. SIGNAL PLATE CURRENT	51	MA.
ZERO SIGNAL GRID #2 CURRENT	2.0	MA.
MAX. SIGNAL GRID #2 CURRENT	4.0	MA.
PLATE RESISTANCE	38 800	OHMS
TRANSCONDUCTANCE	8 800	μMHOS
LOAD RESISTANCE	4 500	OHMS
TOTAL HARMONIC	10	PERCENT
MAX. SIGNAL POWER OUTPUT	3.8	WATTS

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TYPICAL OPERATION - CONT'D.

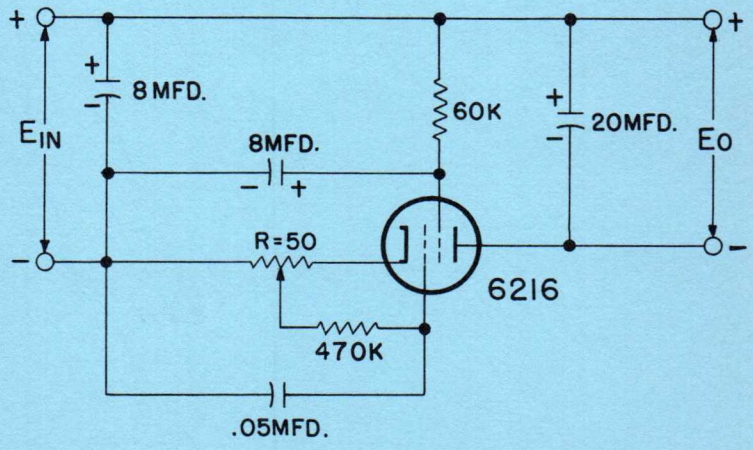
CLASS C OSCILLATOR–AMPLIFIER – 50 MC

DC PLATE VOLTAGE	300	VOLTS
DC GRID #2 VOLTAGE	150	VOLTS
DC GRID #1 VOLTAGE[A]	-50	VOLTS
	22 000	OHMS
PEAK RF GRID #1 VOLTAGE	65	VOLTS
DC PLATE CURRENT	63	MA.
DC GRID #2 CURRENT	8.0	MA.
DC GRID #1 CURRENT	2.0	MA.
GRID #1 DRIVING POWER (APPROX.)	0.3	WATTS
USEFUL POWER OUTPUT	8.8	WATTS

[A] OBTAINED FROM FIXED SOURCE OF GRID RESISTOR OF VALUE SHOWN.

NOTE

[1] WHEN THE 6216 IS USED IN THE CIRCUIT SHOWN BELOW, THE PETENTIOMETER R SHOULD BE ADJUSTED FOR MINIMUM AC OUTPUT VOLTAGE ACROSS THE E_o TERMINALS. THE CURVE SHOWN IN THE APPENDIX REPRESENTS ADJUSTMENT FOR MINIMUM AC OUTPUT VOLTAGE AT 100 MA DC LOAD CURRENT.



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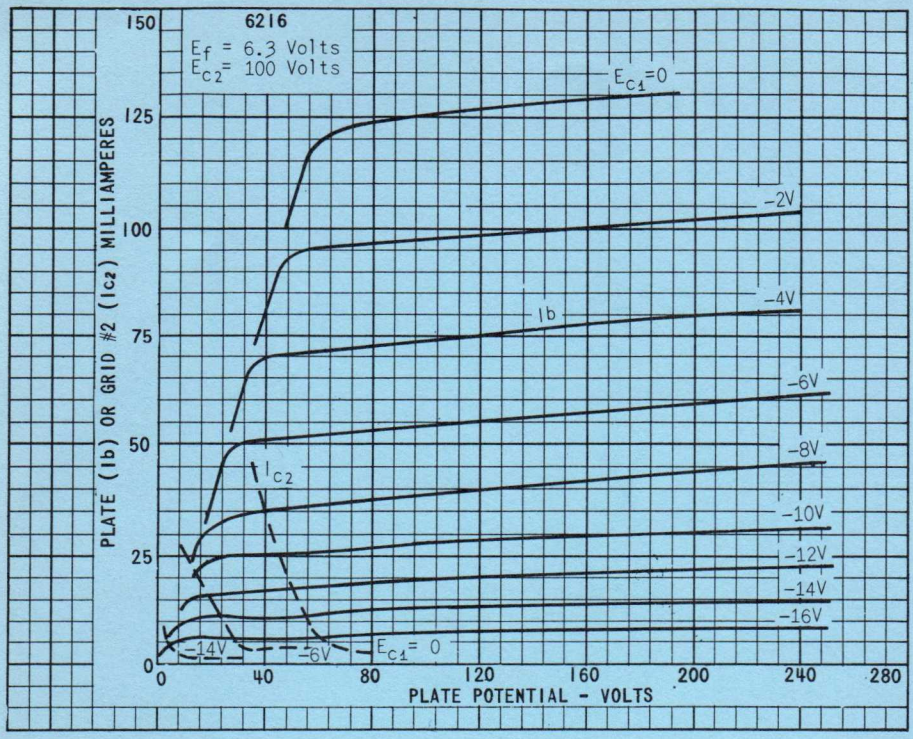
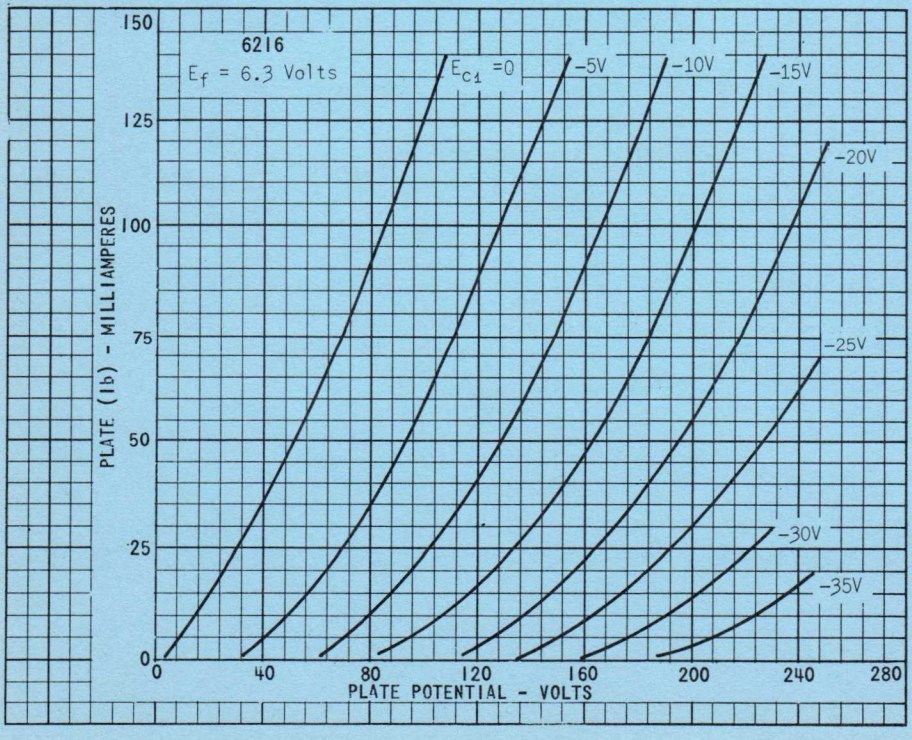
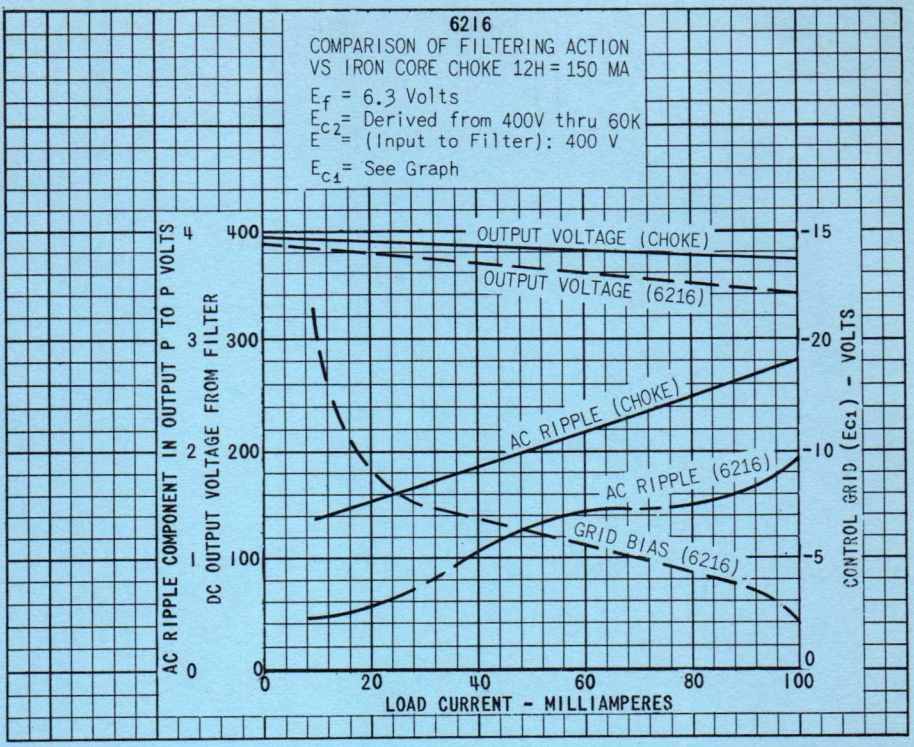

6216
E_f = 6.3 Volts
E_{c2} = 100 Volts
PLATE (Ib) OR GRID #2 (I_{c2}) MILLIAMPERES
PLATE POTENTIAL - VOLTS
E_{c1}=0
-2V
-4V
-6V
-8V
-10V
-12V
-14V
-16V
Ib
I_{c2}
-14V
-6V
E_{c1}= 0
0
25
50
75
100
125
150
0
40
80
120
160
200
240
280


6216
E_f = 6.3 Volts
PLATE (Ib) - MILLIAMPERES
PLATE POTENTIAL - VOLTS
E_{c1} =0
-5V
-10V
-15V
-20V
-25V
-30V
-35V
0
25
50
75
100
125
150
0
40
80
120
160
200
240
280



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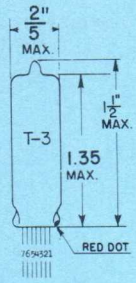
PENTODE

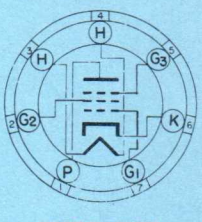
SUBMINIATURE TYPE



GLASS BULB

HEATER

ANY MOUNTING POSITION



BOTTOM VIEW

0.016" TINNED
FLEXIBLE LEADS
0.048" CENTER-TO-CENTER

THE 6245 IS A HEATER-CATHODE TYPE SHARP-CUTOFF PENTODE OF SUBMINIATURE CONSTRUCTION CAPABLE OF OPERATION IN THE UHF REGION. THE CONTROLLED CHARACTERISTICS GIVE UNIFORM PERFORMANCE AT LOW VOLTAGES. IT IS DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED. A SEPARATE TERMINAL CONNECTION IS PROVIDED FOR GRID #3, WHICH UNDER SELF-BIAS CONDITIONS CAN BE CONNECTED DIRECTLY TO GROUND, PERMITTING THE CATHODE BY-PASS CAPACITOR TO BE OMITTED FOR LOWER GRID LOADING. THE FLEXIBLE LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO CIRCUIT COMPONENTS WITHOUT THE USE OF SOCKETS. STANDARD SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE LEADS TO 0.20" LENGTH.

RATINGS

MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST-NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HOUR FATIGUE TEST-NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	265	°C

RATINGS

AND NORMAL OPERATION

	MIL-E-1B SYMBOL	ABS MIN.	NORM. TEST CONDITIONS (NOTE 7)	NORMAL OPERATION (NOTE 6)	ABS MAX	MIL-E-1B UNITS
HEATER VOLTAGE (NOTE 8)	Ef	5.7	6.3	6.3	6.9	V
PLATE VOLTAGE	Eb:		120	20	200	Vdc
GRID #1 VOLTAGE	Ec1:	-55	0	0	0	Vdc
GRID #2 VOLTAGE	Ec2:		120	30	155	Vdc
GRID #3 VOLTAGE	Ec3:		0	0	0	Vdc
PLATE DISSIPATION	Pp:			0.05	1.85	W
GRID #2 DISSIPATION	Pg2:			0.03	0.55	W
GRID #1 CIRCUIT RESISTANCE	Rg1:			1.0		MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200		100	+200	Vdc
CATHODE CURRENT	Ik:	0.5			20	mAdc
CATHODE RESISTANCE	Rk:		200	0		OHMS

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

TEST	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOG	UAL	MAX	ALD	MIL-E-1B UNITS
CONTINUITY & TAP SHORTS:	0.4								
ACCEPTANCE TESTS GROUP A.	COMBINED AQL=2.5%								
HEATER CURRENT:	0.65	If:	183		200		217		mA
HEATER-CATHODE LEAKAGE (1):									
Ehk=+100 Vdc	0.65	Ihk(1):					7		μAdc
HEATER-CATHODE LEAKAGE (2):									
Ehk=−100 Vdc	0.65	Ihk(2):					−7		μAdc
GRID CURRENT (1)	0.65	Ic1(1):					−0.1		μAdc
PLATE CURRENT (1):	0.65	Ib(1):	5.5	6.9	7.5	8.1	9.5	2.3	mAdc
PLATE CURRENT (2):									
Ec1 =−9.0 Vdc	0.65	Ib(2):					50		μAdc
TRANSCONDUCTANCE (1):	0.65	Sm(1):	4200	4775	5000	5225	5800	860	μMHOS
TRANSCONDUCTANCE (3): Eb =20 Vdc; Ec2=30 Vdc; Ec1=Ec3 =0; Rg1 = 500 OHMS MAX; Rk = 0	0.65	Sm(3):	2250		3275		4300		μMHOS
PLATE CURRENT (3): Eb =20 Vdc; Ec2=30 Vdc; Ec1 = Ec3 = 0; Rg1 = 500 OHMS MAX. Rk =0.	0.65	Ib(3):	1.0		2.5		4.0		mAdc
SCREEN CURRENT (2): Eb = 20 Vdc; Ec2 =30 Vdc; Ec1=Ec3 =0; Rg1 = 500 OHMS MAX. Rk =0.	0.65	Ic2(2):					1.5		mAdc
ACCEPTANCE TEST GROUP B									
INSULATION OF ELECTRODES: Ef =6.3 V									
Eg-all=−100 Vdc	2.5	Rg1-all:	100						MEG.
Ep-all=−300 Vdc	2.5	Rp-all:	100						MEG.
SCREEN CURRENT:	2.5	Ic2)1):	1.7	2.4	2.6	2.8	3.5	0.8	mAdc
TRANSCONDUCTANCE (2):									
Ef=5.5 V (NOTE 9)	2.5	ΔSm(2):					10		PERCENT
AF NOISE: Esig=50 mVac; Rg1 =0.1 MEG; Ec2 =19 Vdc; Rg2 = 1000 OHMS; Rp =0.2 MEG.	2.5	EB:					17		VU
VIBRATION: F = 40 cps; G= 15; Rp = 10,000 OHMS	2.5	Ep:					50		mVac
SUBMINIATURE LEAD FATIGUE TEST:	2.5		4.0						arcs
ACCEPTANCE TEST GROUP C									
GRID CURRENT (2): AFTER 5 MINUTES AT Ef=7.0 V; MEASURE GRID CURRENT AT Ef =7.0 V; 3 MINUTE TEST NOT PERMITTED.	6.5	Ic1(2):					−0.1		μAdc

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST	AQL %	MIL-E-1B SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1B UNITS
ACCEPTANCE TESTS									
GROUP C - cont'd.									
PLATE RESISTANCE:	6.5	Rp:	0.15						MEG.
CAPACITANCE:		Cg1p:					0.03		μμf
CAPACITANCE: (NOTE 2)	6.5	Cin:	3.6		4.35		5.1		μμf
CAPACITANCE:		Cout:	2.6		3.15		3.7		μμf

TEST	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
ACCEPTANCE TESTS					
GROUP D					
SHOCK					
HAMMER ANGLE =30°					
NOTE 3					
POST SHOCK LIMITS:					
VIBRATION:					
F=40 cps; G=15; Rp=10,000					
OHMS		Ep:		100	mVac
HEATER-CATHODE LEAKAGE (1):					
Ehk=+100 Vdc		Ihk(1):		20	μAdc
HEATER-CATHODE LEAKAGE (2):					
Ehk=-100 Vdc		Ihk(2):		-20	μAdc
TRANSC. (1) CHANGE OF INDIVIDUAL					
TUBES FROM INITIAL:					
Ef = 6.3 V.		ΔSm(1):		20	%
FATIGUE:					
96 HOURS; NOTE 5					
POST FATIGUE LIMITS:					
VIBRATION:					
F=40 cps; G=15; Rp=10,000 OHMS		Ep:		100	mVac
HEATER-CATHODE LEAKAGE (1):					
Ehk =+ 100 Vdc		Ihk(1):		10	μAdc
HEATER-CATHODE LEAKAGE (2):					
Ehk=-100 Vdc		Ihk(2):		-10	μAdc
TRANSC. (1) CHANGE OF INDIVIDUAL					
TUBES FROM INITIAL:					
Ef = 6.3 V		ΔSm(1):		15	%

TEST	AQL %
ACCEPTANCE TESTS	
GROUP E	
GLASS STRAIN (THERMAL SHOCK):	10
VISUAL AND MECHANICAL INSPECTION:	
MAJOR COMBINED	0.4
MINOR A COMBINED	2.5
MINOR B PER ITEM	6.5

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
ACCEPTANCE LIFE TESTS					
HEATER CYCLE: Ef =7.5 V; Eb=Ec1=Ec2=Ec3=0V; Ehk=140 Vac; 1 MIN ON, 1 MIN. OF F			2000		CYCLES
1 HOUR STABILITY LIFE TEST: TA=ROOM: Ehk=+200 Vdc; Rg1 = 1.0 MEG.					
1 HOUR STABILITY LIFE TEST END POINTS: TRANSC. (1) CHANGE OF INDIVIDUAL TUBES TUBES FROM INITIAL: (TYPICAL SAMPLE SIZE = 25 TUBES)	10	ΔSm(1):		8.0	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST: TA = ROOM: Ehk=+200 Vdc; Rg1 = 1.0 MEG.					
100 HOUR SURVIVAL RATE LIFE TEST END POINTS: INOPERATIVES: (TYPICAL SAMPLES SIZE = 200 TUBES)	0.4				
TRANSCOND. (1): (TYPICAL SAMPLE SIZE = 25 TUBES)	1.0	Sm(1):	3250		μMHOS

TEST	MAX. DEFECTS PER CHARACTERISTICS	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST (1): TA = 200°C; Ehk=+200 Vdc; Rg1 = 1.0 MEG.					
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST (1) END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES) (TOTAL ALLOWABLE COMBINED DEFECTS = 4 TUBES)					
INOPERATIVES:	1				
HEATER CURRENT:	4	If:	183	217	mA
HEATER CATHODE LEAKAGE (1):	2	Ihk(1):	0	10	μAdc
HEATER CATHODE LEAKAGE (2):	2	Ihk(2):	0	-10	μAdc
GRID CURRENT (1):	2	Ic1(1):	0	-0.3	μAdc
GRID CURRENT (2):	2	Ic1(2):	0	-0.3	μAdc
TRANSC. (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	ΔSm(1):		25	PERCENT
TRANSC. (2) CHANGE OF INDIVIDUAL TUBES FROM Ef=6.3 TO 5.5 V:	4	ΔSm(2):		15	PERCENT
INSULATION OF ELECTRODES:	4	Rg1-all:	50		MEG.
INSULATION OF ELECTRODES:	4	Rp-all:	50		MEG.

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST

5000 HOUR INTERMITTENT LIFE TEST (2):
TA = ROOM: Ebk=+200 Vdc; Rg1 =1.0 MEG.

5000 HOUR INTERMITTENT LIFE TEST (2)
END POINTS:
READ FOR SAME CHARACTERISTICS AS FOR LIFE TEST (1): LIMITS NOT ESTABLISHED.

NOTES

NOTE 1: CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1B, "INSPECTION INSTRUCTIONS FOR ELECTRON TUBES" AND MIL-STD-105A.

NOTE 2: WITH A CYLINDRICAL SHIELD (0.405" I.D.-1 7/8" LONG) CONNECTED TO LEAD 6.

NOTE 3: TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1B BASIC SPECIFICATION.

NOTE 4: CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.

NOTE 5: TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1B BASIC SPECIFICATIONS.

NOTE 6: THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.

NOTE 7: THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.

NOTE 8: FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY ± 10% HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.

NOTE 9: CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef = 6.3 V TO THAT VALUE MEASURED AT Ef = 5.5 V.

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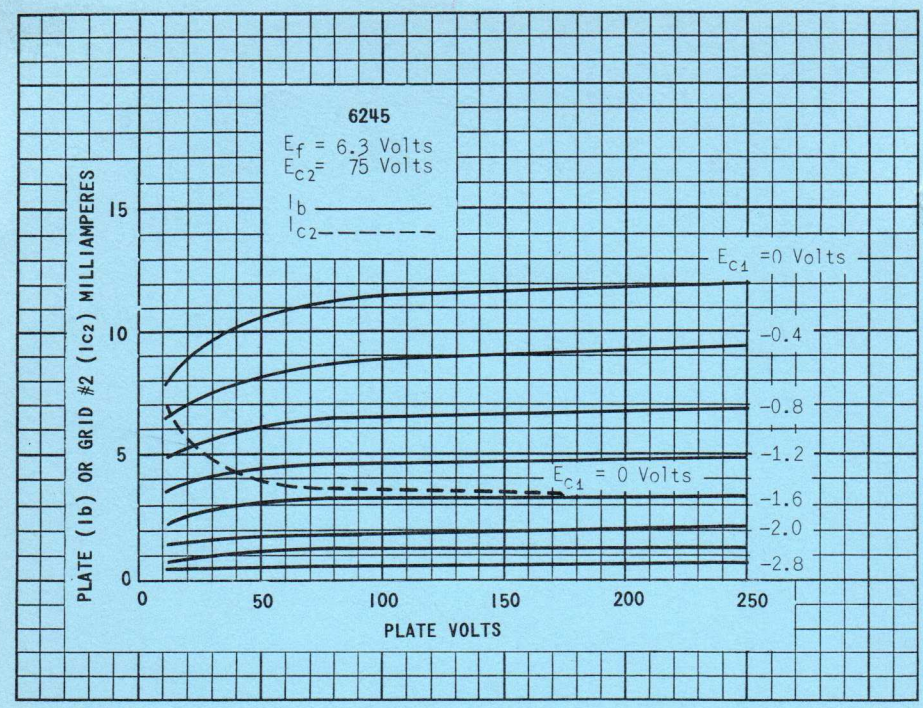
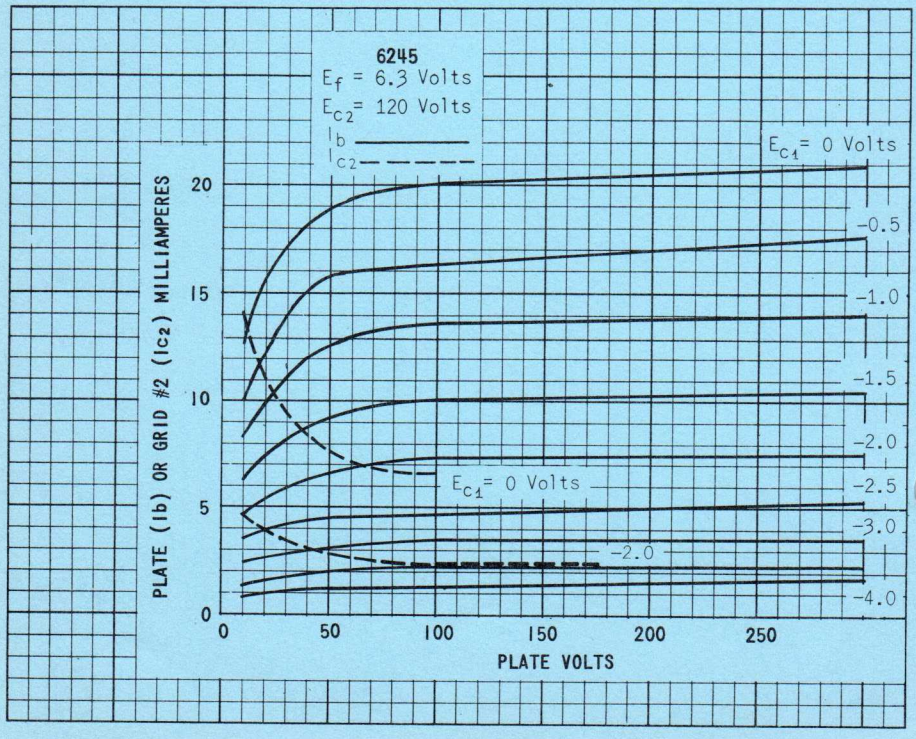
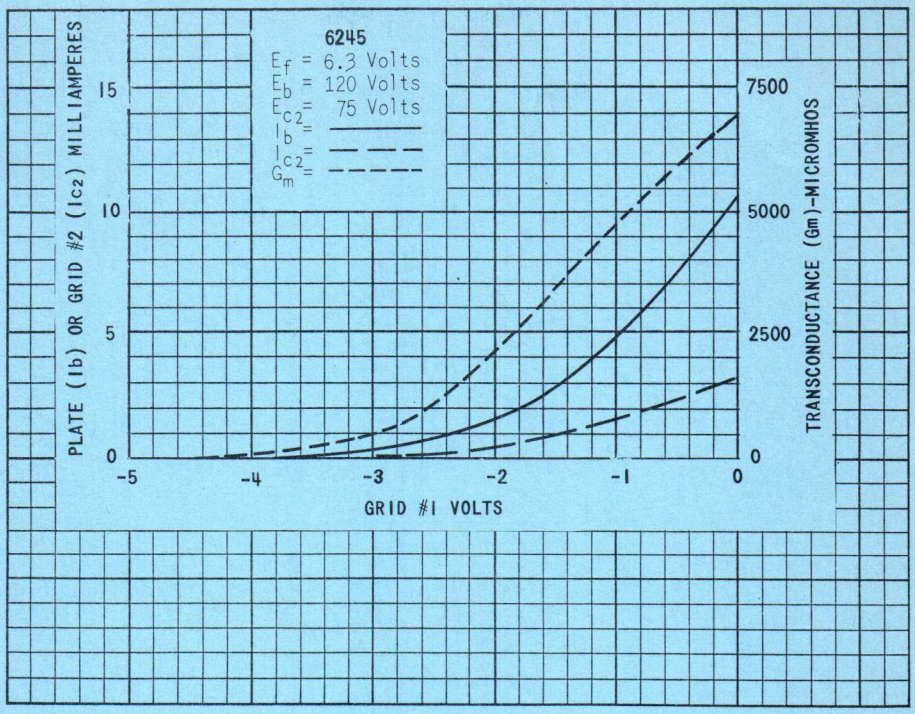
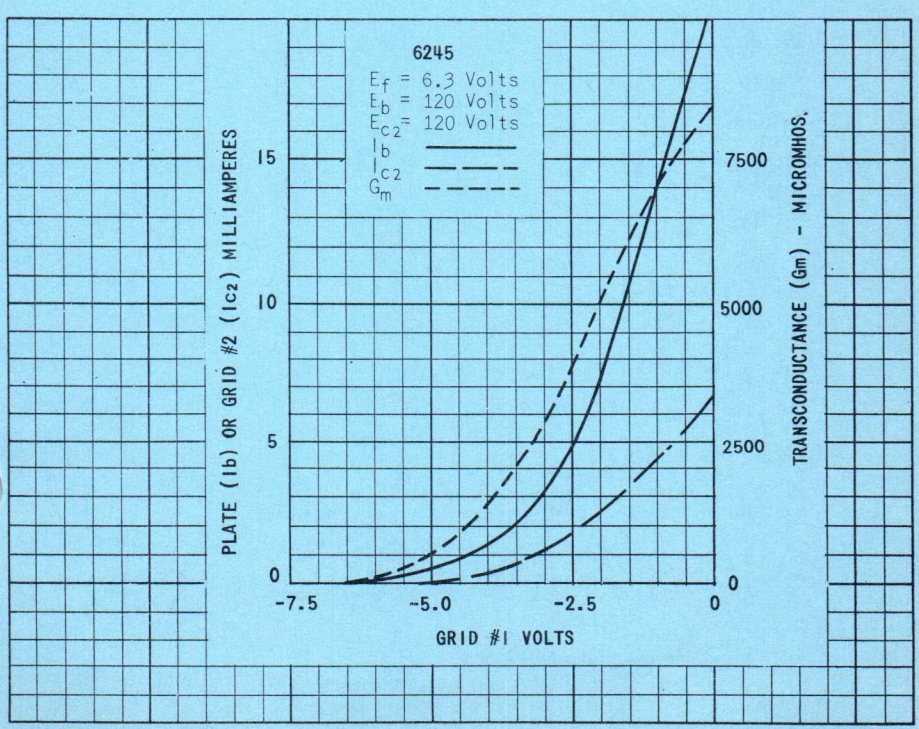

6245
E_f = 6.3 Volts
E_{c2}= 75 Volts
I_b
I_{c2}
E_{c1} =0 Volts
-0.4
-0.8
-1.2
E_{c1} = 0 Volts
-1.6
-2.0
-2.8
PLATE (Ib) OR GRID #2 (Ic2) MILLIAMPERES
0
5
10
15
0
50
100
150
200
250
PLATE VOLTS


6245
E_f = 6.3 Volts
E_{c2}= 120 Volts
I_b
I_{c2}
E_{c1}= 0 Volts
-0.5
-1.0
-1.5
-2.0
E_{c1}= 0 Volts
-2.5
-3.0
-2.0
-4.0
PLATE (Ib) OR GRID #2 (Ic2) MILLIAMPERES
0
5
10
15
20
0
50
100
150
200
250
PLATE VOLTS





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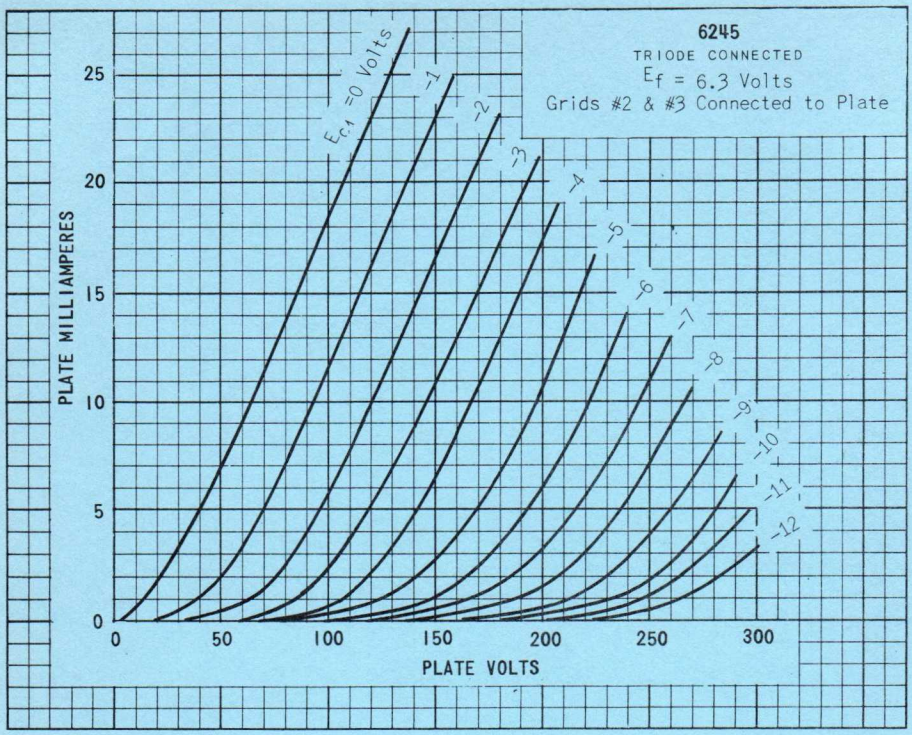
6245
TRIODE CONNECTED
E_f = 6.3 Volts
Grids #2 & #3 Connected to Plate
E_{c1} =0 Volts
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
PLATE MILLIAMPERES
0
5
10
15
20
25
0
50
100
150
200
250
300
PLATE VOLTS

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UHF POWER TRIODE

PENCIL TYPE

FOR

RF POWER AMPLIFIER, OSCILLATOR

AND FREQUENCY MULTIPLIER APPLICATIONS

IN MOBILE AND AIRCRAFT EQUIPMENT

PHYSICAL DIMENSIONS SEE OUTLINE DRAWING

ELECTRODE TERMINATIONS SEE OUTLINE DRAWING

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION

THE 6263A IS A COAXIAL METAL-GLASS PENCIL-TYPE MEDIUM MU TRIODE WITH AN EXTERNAL PLATE RADIATOR. ITS MAXIMUM PLATE DISSIPATION IS 13 WATTS ICAS. THE TUBE MAY BE OPERATED WITH FULL RATINGS UP TO A FREQUENCY OF 500 MC/S, AND WITH REDUCED RATINGS UP TO 1700 MC/S.

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE		1.7	pf
GRID TO CATHODE		2.9	pf
PLATE TO CATHODE	MAX.	0.08	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.0	VOLTS	280	MA.
LIMITS OF APPLIED VOLTAGE				
UNDER TRANSMITTING CONDITIONS			6.0 ± 0.6	VOLTS
UNDER STANDBY CONDITIONS - MAXIMUM			6.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			50	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			50	VOLTS

AVERAGE STATIC CHARACTERISTICS

PLATE VOLTAGE	200	VOLTS
PLATE CURRENT	27	MA.
TRANSCONDUCTANCE	7,000	μMHOS
AMPLIFICATION FACTOR	27	

CLASS C TELEGRAPHY - RF POWER AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS - ABSOLUTE MAXIMUM SYSTEM

	CCS	ICAS	
DC PLATE VOLTAGE	330	400	VOLTS
DC GRID VOLTAGE	-100	-100	VOLTS
DC PLATE CURRENT	40	55	MA.
DC GRID CURRENT	25	25	MA.
DC CATHODE CURRENT	55	70	MA.

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CLASS C TELEGRAPHY - RF POWER AMPLIFIER AND OSCILLATOR - cont'd.

MAXIMUM RATINGS - ABSOLUTE MAXIMUM SYSTEM

	CCS	ICAS	
PLATE INPUT	13.2	22	WATTS
PLATE DISSIPATION	8	13	WATTS
PLATE SEAL TEMPERATURE	175	175	°C
FREQUENCY FOR OPERATION AT FULL RATINGS	500	500	MC/S
ALTITUDE FOR OPERATION AT FULL RATINGS	60,000	60,000	FEET
GRID CIRCUIT RESISTANCE	0.1	0.1	MEGOHMS

TYPICAL OPERATION AS RF AMPLIFIER WITH CATHODE DRIVE AT 500 MC/S

DC PLATE-TO-GRID VOLTAGE	348	408	VOLTS
DC CATHODE-TO-GRID VOLTAGE	48	58	VOLTS
FROM GRID RESISTOR OR COMBINATION OF GRID RESISTOR WITH FIXED SUPPLY OR CATHODE RESISTOR			
DC PLATE CURRENT	35	40	MA.
DC GRID CURRENT	13	15	MA.
DRIVING POWER	2.2	3	WATTS
USEFUL POWER OUTPUT	7	10	WATTS
WITH APPROX. 75% OUTPUT CIRCUIT EFFICIENCY			

CLASS C TELEPHONY - PLATE-MODULATED RF POWER AMPLIFIER

MAXIMUM RATINGS - ABSOLUTE MAXIMUM SYSTEM

	CCS	ICAS	
DC PLATE VOLTAGE	275	330	VOLTS
DC GRID VOLTAGE	-100	-100	VOLTS
DC PLATE CURRENT	33	46	MA.
DC GRID CURRENT	25	25	MA.
DC CATHODE CURRENT	50	60	MA.
PLATE INPUT	9	15	WATTS
PLATE DISSIPATION	5.5	9	WATTS
PLATE SEAL TEMPERATURE	175	175	°C
FREQUENCY FOR OPERATION AT FULL RATINGS	500	500	MC/S
ALTITUDE FOR OPERATION AT FULL RATINGS	60,000	60,000	FEET
GRID CIRCUIT RESISTANCE	0.1	0.1	MEGOHMS

TYPICAL OPERATION - CATHODE DRIVEN AT 500 MC/S

DC PLATE-TO-GRID VOLTAGE	317	372	VOLTS
DC CATHODE TO GRID VOLTAGE	42	52	VOLTS
FROM GRID RESISTOR OR COMBINATION OF GRID RESISTOR WITH FIXED SUPPLY OR CATHODE RESISTOR			
DC PLATE CURRENT	35	35	MA.
DC GRID CURRENT	13	12	MA.
DRIVING POWER	2	2.4	WATTS
USEFUL POWER OUTPUT	6.7	8	WATTS
WITH APPROX. 75% OUTPUT CIRCUIT EFFICIENCY			

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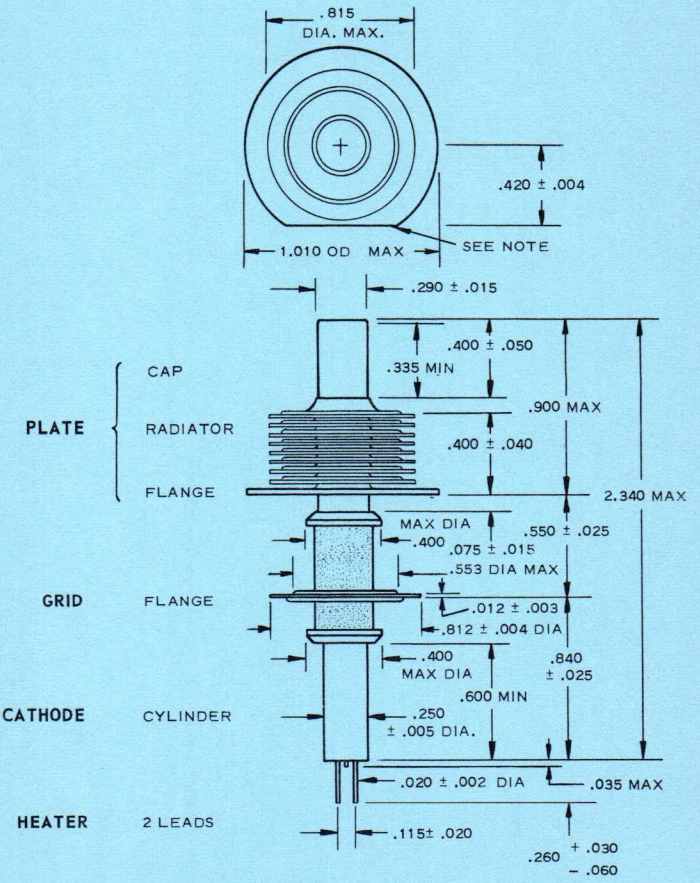
SPECIAL TESTS AND PERFORMANCE DATA

CONTROLLED ON A SAMPLING BASIS

LOW-PRESSURE VOLTAGE BREAKDOWN TEST
HIGH-FREQUENCY VIBRATION TEST
SEAL FRACTURE
HEATER CYCLING
1 - HOUR STABILITY LIFE PERFORMANCE
50 - HOUR SURVIVAL LIFE PERFORMANCE
500 - HOUR INTERMITTENT LIFE PERFORMANCE

OUTLINE DRAWING



NOTE:

THE STRAIGHT EDGE ON THE PERIMETER OF THE LARGE FIN (PLATE TERMINAL) IS PARALLEL TO A PLANE THROUGH THE CENTERS OF THE HEATER PINS AT THEIR SEALS WITHIN 15°.

ALL DIMENSIONS IN INCHES

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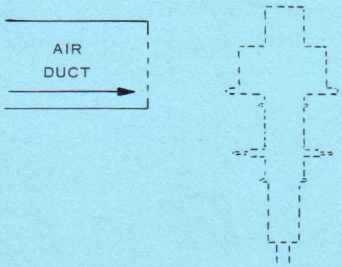
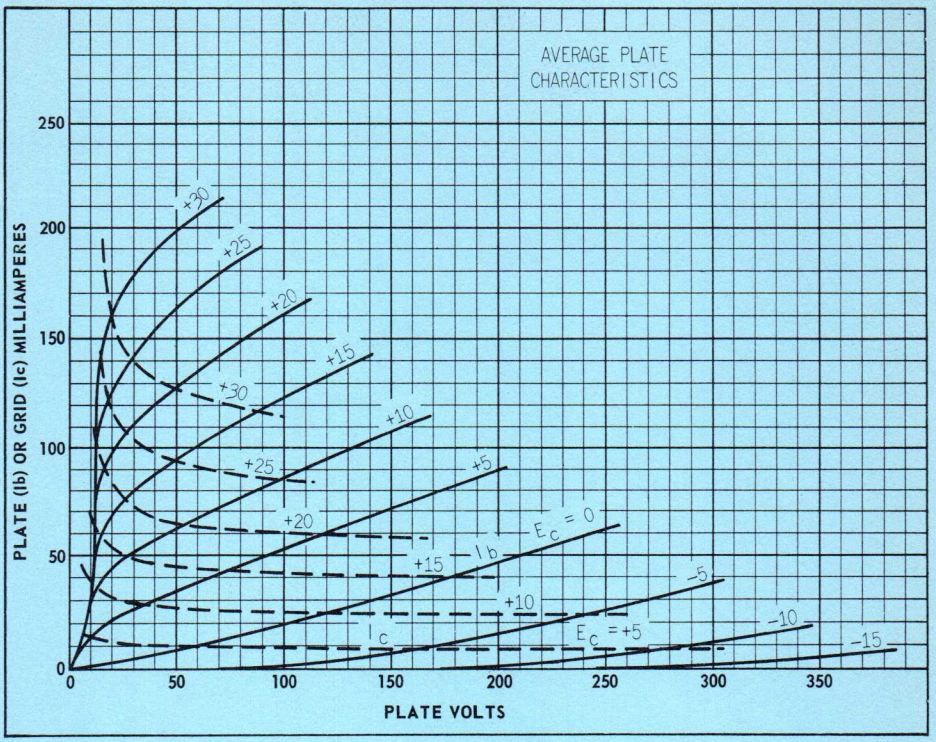
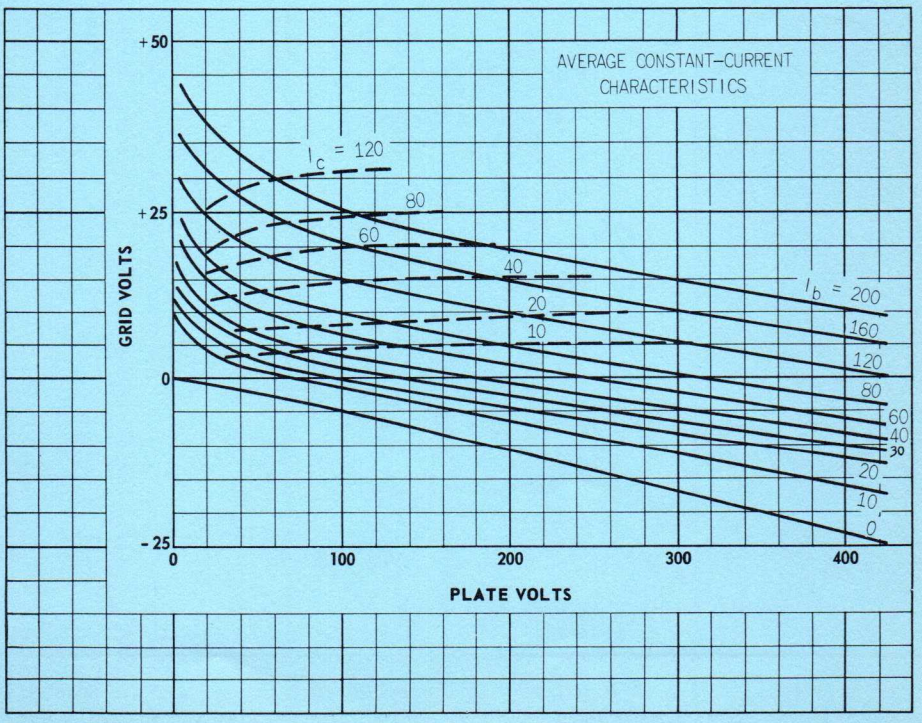
COOLING REQUIREMENTS

MAXIMUM PLATE - SEAL TEMPERATURE = 175° C
AIR - DUCT OPENING = 1 5/32" X 1 5/32"
WITH AIR-DUCT LOCATED AS SHOWN ON SKETCH







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UHF POWER TRIODE

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IN MOBILE AND AIRCRAFT EQUIPMENT

PHYSICAL DIMENSIONS SEE OUTLINE DRAWING

ELECTRODE TERMINATIONS SEE OUTLINE DRAWING

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION

THE 6264A IS A COAXIAL METAL-GLASS PENCIL-TYPE MEDIUM MU TRIODE WITH AN EXTERNAL PLATE RADIATOR. ITS MAXIMUM PLATE DISSIPATION IS 13 WATTS ICAS. THE TUBE MAY BE OPERATED WITH FULL RATINGS UP TO A FREQUENCY OF 500 MC/S, AND WITH REDUCED RATINGS UP TO 1700 MC/S.

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE		1.75	pf
GRID TO CATHODE		2.95	pf
PLATE TO CATHODE	MAX.	0.07	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.0	VOLTS	280	MA.
LIMITS OF APPLIED VOLTAGE				
UNDER TRANSMITTING CONDITIONS			6.0 ± 0.6	VOLTS
UNDER STANDBY CONDITIONS - MAXIMUM			6.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			50	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			50	VOLTS

AVERAGE STATIC CHARACTERISTICS

PLATE VOLTAGE	200	VOLTS
PLATE CURRENT	18.5	MA.
TRANSCONDUCTANCE	6,800	μMHOS
AMPLIFICATION FACTOR	40	

CLASS C TELEGRAPHY - RF POWER AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS - ABSOLUTE MAXIMUM SYSTEM

	CCS	ICAS	
DC PLATE VOLTAGE	330	400	VOLTS
DC GRID VOLTAGE	-100	-100	VOLTS
DC PLATE CURRENT	40	55	MA.
DC GRID CURRENT	25	25	MA.
DC CATHODE CURRENT	55	70	MA.

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CLASS C TELEGRAPHY - RF POWER AMPLIFIER AND OSCILLATOR - cont'd.

MAXIMUM RATINGS - ABSOLUTE MAXIMUM SYSTEM

	CCS	ICAS	
PLATE INPUT	13.2	22	WATTS
PLATE DISSIPATION	8	13	WATTS
PLATE SEAL TEMPERATURE	175	175	°C
FREQUENCY FOR OPERATION AT FULL RATINGS	500	500	MC/S
ALTITUDE FOR OPERATION AT FULL RATINGS	60,000	60,000	FEET
GRID CIRCUIT RESISTANCE	0.1	0.1	MEGOHMS

TYPICAL OPERATION AS RF AMPLIFIER WITH CATHODE DRIVE AT 500 MC/S

DC PLATE-TO-GRID VOLTAGE	342	395	VOLTS
DC CATHODE-TO-GRID VOLTAGE	42	45	VOLTS
FROM GRID RESISTOR OR COMBINATION OF GRID RESISTOR WITH FIXED SUPPLY OR CATHODE RESISTOR			
DC PLATE CURRENT	35	40	MA.
DC GRID CURRENT	13	15	MA.
DRIVING POWER	2.2	3	WATTS
USEFUL POWER OUTPUT	7	10	WATTS
WITH APPROX. 75% OUTPUT CIRCUIT EFFICIENCY			

FREQUENCY MULTIPLIER

MAXIMUM RATINGS - ABSOLUTE MAXIMUM SYSTEM

	CCS	ICAS	
DC PLATE VOLTAGE	300	350	VOLTS
DC GRID VOLTAGE	-125	-140	VOLTS
DC PLATE CURRENT	33	45	MA.
DC GRID CURRENT	25	25	MA.
DC CATHODE CURRENT	45	55	MA.
PLATE INPUT	9.9	15.9	WATTS
PLATE DISSIPATION	6	9.5	WATTS
PLATE SEAL TEMPERATURE	175	175	°C
FREQUENCY FOR OPERATION AT FULL RATINGS	500	500	MC/S
ALTITUDE FOR OPERATION AT FULL RATINGS	60,000	60,000	FEET
GRID CIRCUIT RESISTANCE	0.1	0.1	MEGOHMS

TYPICAL OPERATION - TRIPLER TO 510 MC/S
CATHODE DRIVE CIRCUIT

DC PLATE-TO-GRID VOLTAGE	410	472	VOLTS
DC CATHODE TO GRID VOLTAGE	110	122	VOLTS
FROM GRID RESISTOR OR COMBINATION OF GRID RESISTOR WITH FIXED SUPPLY OR CATHODE RESISTOR			
DC PLATE CURRENT	26	36.5	MA.
DC GRID CURRENT	4.1	5.8	MA.
DRIVING POWER	2.75	4.5	WATTS
USEFUL POWER OUTPUT	2.1	3.4	WATTS
WITH APPROX. 75% OUTPUT CIRCUIT EFFICIENCY			

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TUNG-SOL

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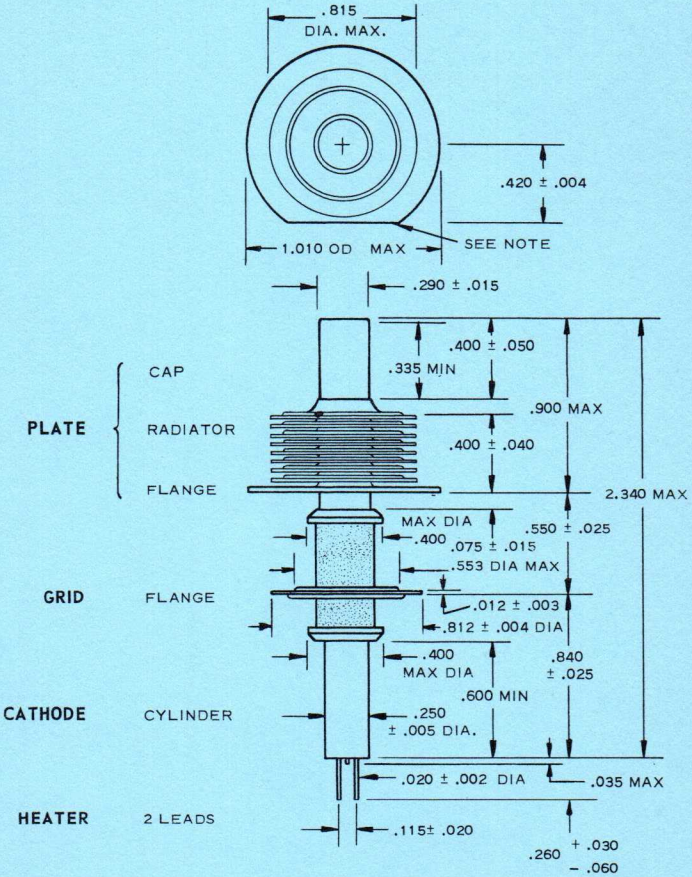
SPECIAL TESTS AND PERFORMANCE DATA

CONTROLLED ON A SAMPLING BASIS

LOW-PRESSURE VOLTAGE BREAKDOWN TEST
HIGH-FREQUENCY VIBRATION TEST
SEAL FRACTURE
HEATER CYCLING
1 - HOUR STABILITY LIFE PERFORMANCE
50 - HOUR SURVIVAL LIFE PERFORMANCE
500 - HOUR INTERMITTENT LIFE PERFORMANCE

OUTLINE DRAWING



NOTE:

THE STRAIGHT EDGE ON THE PERIMETER OF THE LARGE FIN (PLATE TERMINAL) IS PARALLEL TO A PLANE THROUGH THE CENTERS OF THE HEATER PINS AT THEIR SEALS WITHIN 15°.

ALL DIMENSIONS IN INCHES

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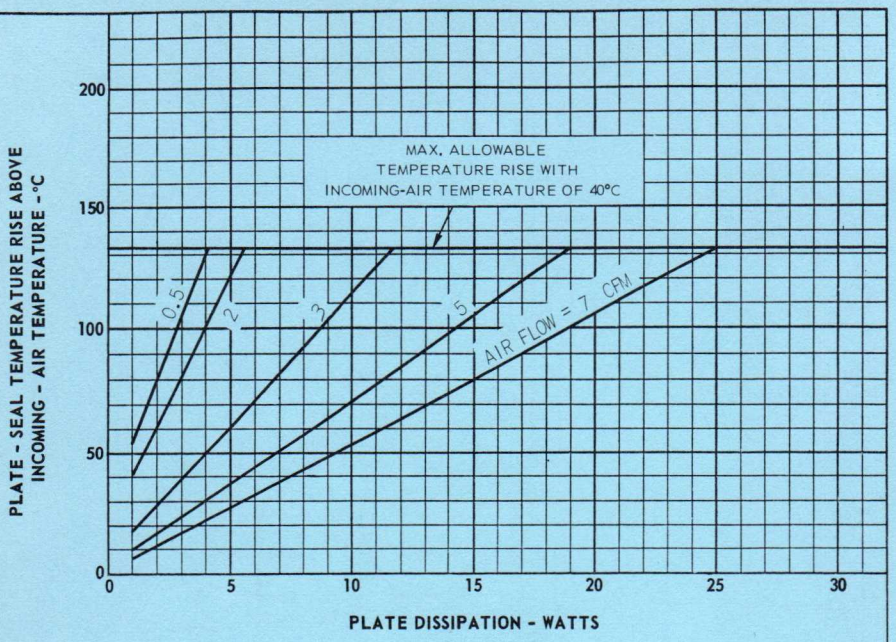
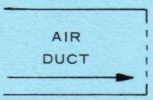
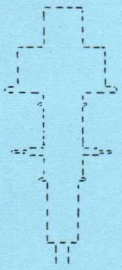
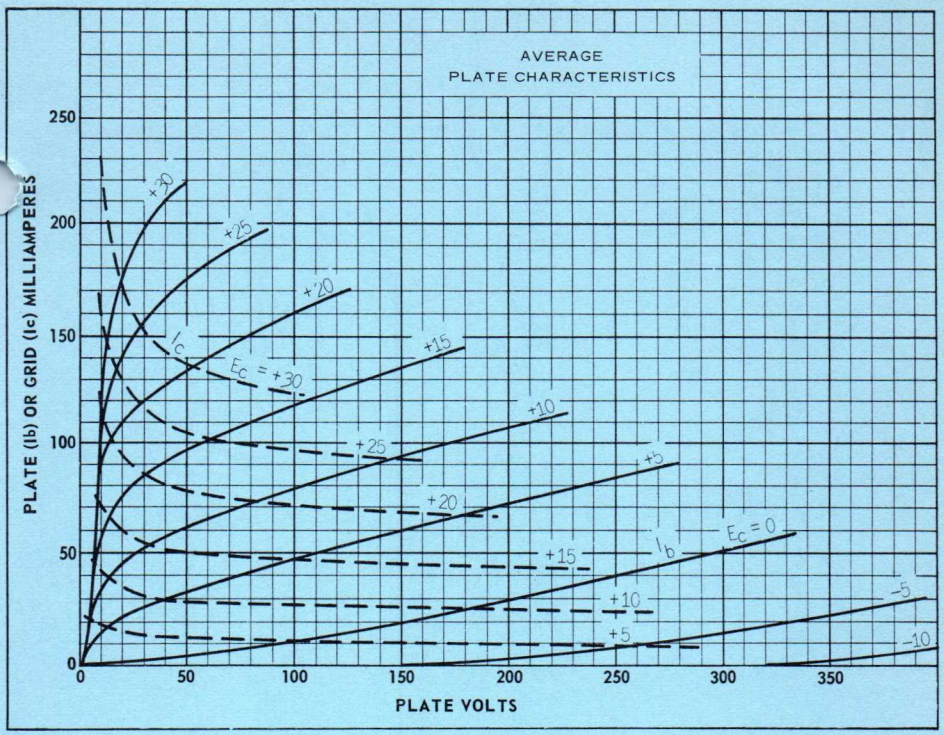


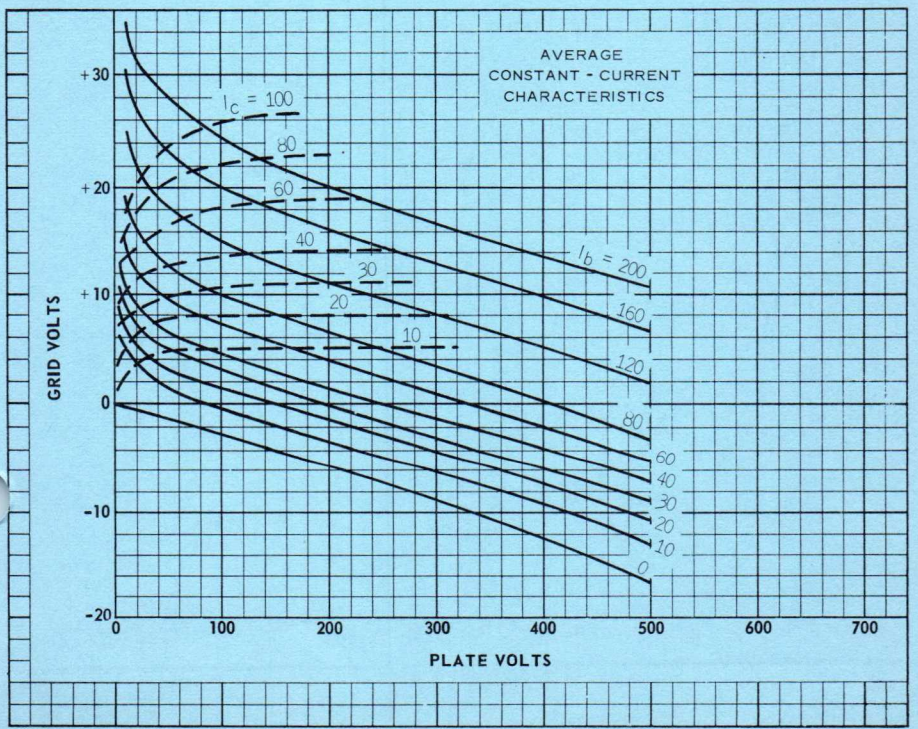
COOLING REQUIREMENTS

MAXIMUM PLATE - SEAL TEMPERATURE = 175° C
AIR - DUCT OPENING = 1 5/32" X 1 5/32"
WITH AIR-DUCT LOCATED AS SHOWN ON SKETCH









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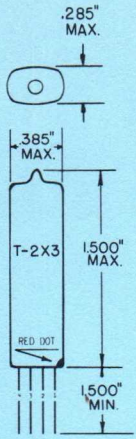


GLASS BULB

DOT IS ADJACENT TO LEAD 1

TRIODE

SUBMINIATURE TRIODE

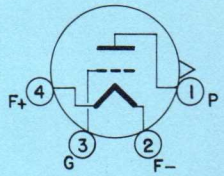
FOR

AMPLIFIER OR OSCILLATOR

APPLICATIONS

COATED FILAMENT

ANY MOUNTING POSITION



BOTTOM VIEW
0.016" TINNED
FLEXIBLE LEADS
0.048" CENTER-TO-CENTER
IN-LINE

THE 6286 IS A FILAMENTARY TYPE TRIODE OF SUBMINIATURE CONSTRUCTION WITH 4 FLEXIBLE LEADS. IT IS DESIGNED FOR USE AS AN AMPLIFIER OR OSCILLATOR IN MILITARY APPLICATIONS.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE	1.6	pf
GRID TO FILAMENT	1.3	pf
PLATE TO FILAMENT	2.1	pf

FILAMENT CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	1.25	VOLTS	125	MA.
LIMITS OF APPLIED VOLTAGE			1.25±.25	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	100	VOLTS
PLATE DISSIPATION	0.45	WATT
PLATE CURRENT	7.0	MA.

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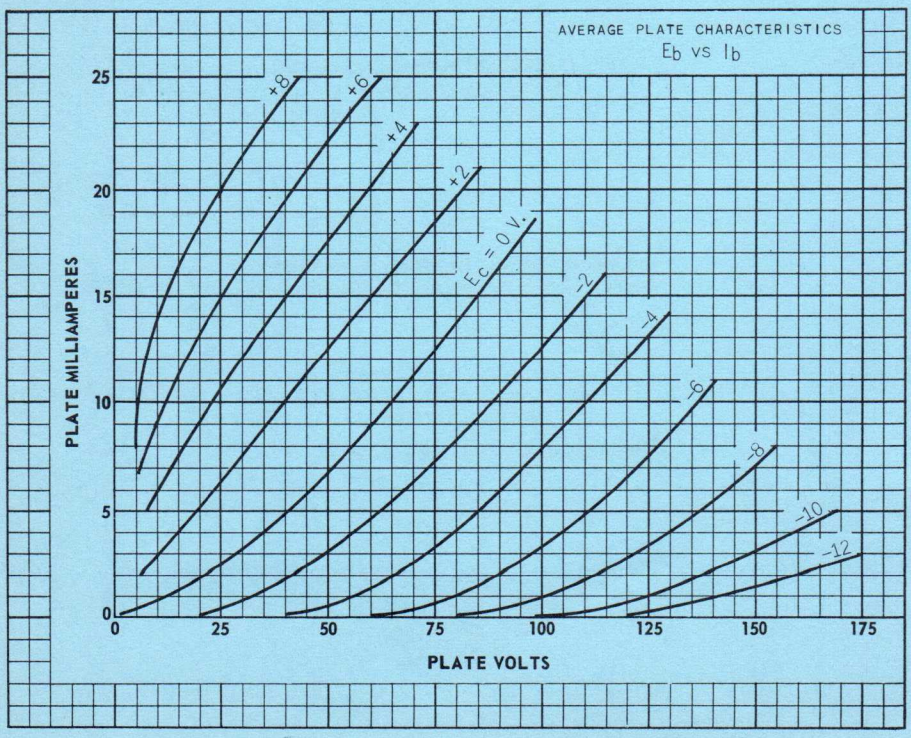
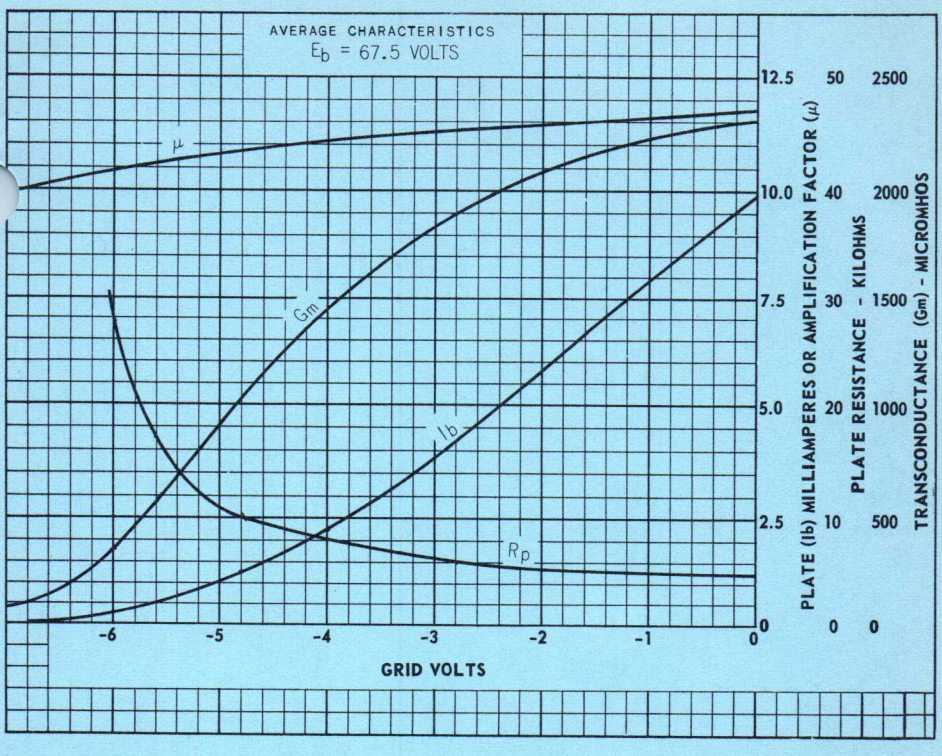
CHARACTERISTICS

PLATE VOLTAGE	67.5	VOLTS
GRID VOLTAGE	−2.0	VOLTS
PLATE CURRENT	6.0	MA.
TRANSCONDUCTANCE	2,100	μMHOS
AMPLIFICATION FACTOR	11.5	
GRID VOLTAGE (APPROX.) FOR Ib = 50 μA	−8.5	VOLTS

TYPICAL OSCILLATOR CHARACTERISTICS AT 25 MC/S

PLATE VOLTAGE	67.5	VOLTS
PLATE SUPPLY RESISTANCE	1,500	OHMS
GRID RESISTANCE	18,000	OHMS
PLATE CURRENT	5.25	MA.
GRID CURRENT	325	μA





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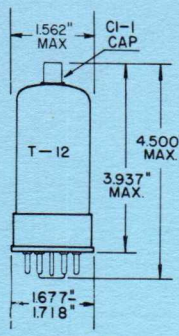
PENTODE



GLASS BULB

LARGE WAFER MICANOL 8 PIN OCTAL WITH EXTERNAL BARRIERS AND SLEEVE

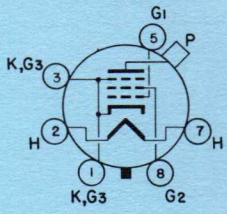
BASE B8-98

COATED UNIPOTENTIAL CATHODE

HEATER

6.3±5% VOLTS 800 MA.

ANY MOUNTING POSITION



BOTTOM VIEW

THE 6327 IS A BEAM POWER PENTODE PRIMARILY DESIGNED FOR RADAR DEFLECTION AMPLIFIER SERVICE. IT WILL PERFORM ESSENTIALLY THE SAME FUNCTION AS TWO 6AR6'S CONNECTED IN PARALLEL. A TOP CAP CONNECTION FOR THE PLATE LEAD (AND A BUTTON STEM) PROVIDES ADEQUATE INSULATION FOR OPERATION AT 60,000 FEET PROVIDED THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID #1 TO PLATE (MAX.)	0.60	pf
INPUT	13.0	pf
OUTPUT	13.0	pf

RATINGS

ABSOLUTE MAXIMUM

MAXIMUM HEATER-CATHODE VOLTAGE	±200	VOLTS
MAXIMUM DC PLATE VOLTAGE	1 650	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	330	VOLTS
MAXIMUM DC GRID #1 VOLTAGE	-330	VOLTS
MAXIMUM PEAK PLATE VOLTAGE	3 300	VOLTS
MAXIMUM PLATE DISSIPATION	35	WATTS
MAXIMUM GRID #2 DISSIPATION	6.0	WATTS
MAXIMUM DC CATHODE CURRENT	165	MA.
MAXIMUM PEAK CATHODE CURRENT	660	MA.
MAXIMUM GRID #1 CIRCUIT RESISTANCE	250	KILOHMS
MAXIMUM BULB TEMPERATURE	250[A]	°C

[A] FOR OPTIMUM LIFE MAINTAIN A BULB TEMPERATURE OF 175°C MAX. WITH FORCED AIR COOLING.

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TUNG-SOL

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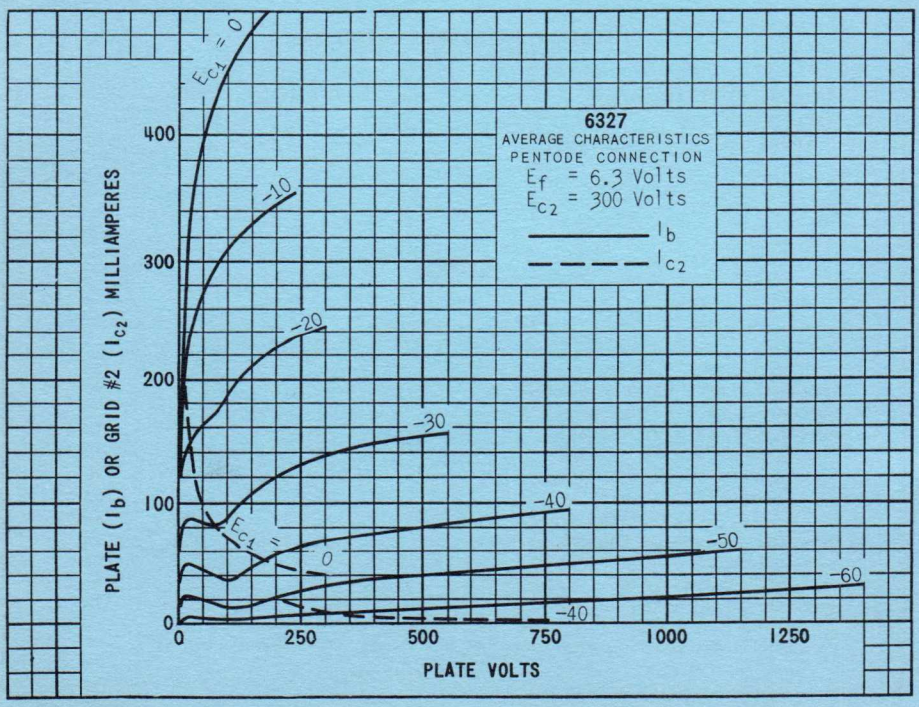
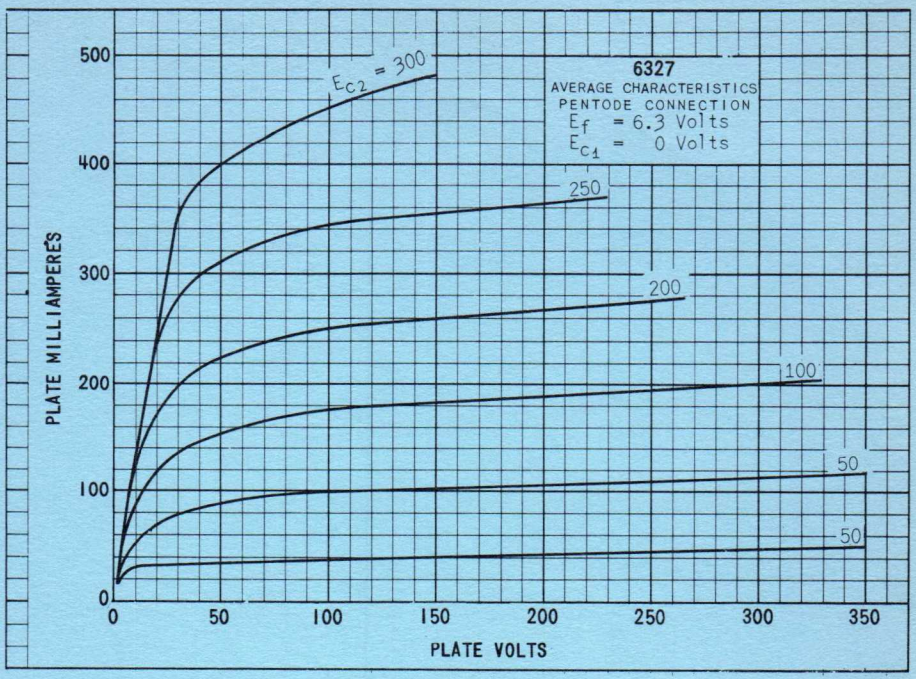
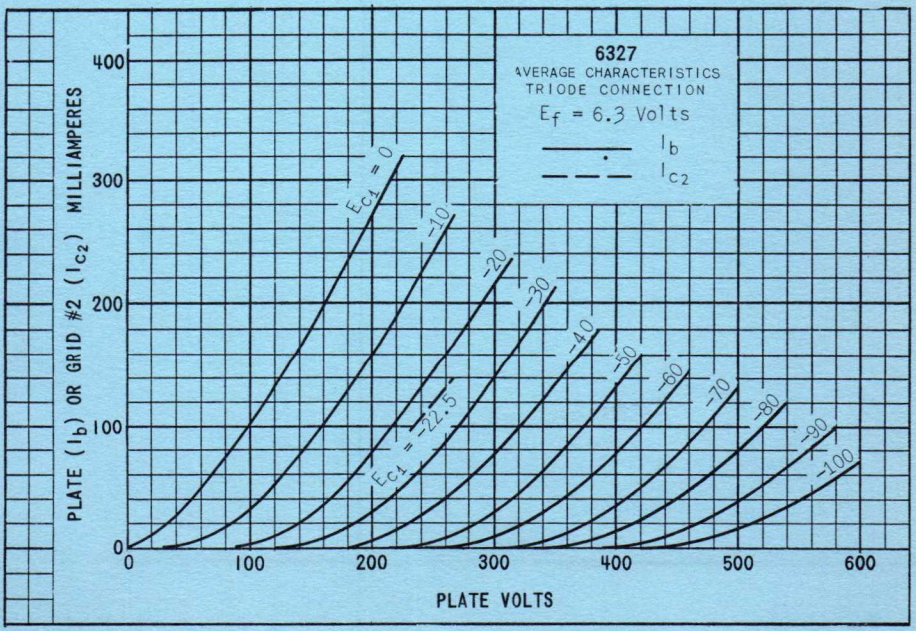
TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC PLATE VOLTAGE	250	400	VOLTS
DC GRID #2 VOLTAGE	250	300	VOLTS
DC GRID #1 VOLTAGE	-22.5	-40	VOLTS
DC PLATE CURRENT	120	75	MA.
DC GRID #2 CURRENT	7.0	3.5	MA.
TRANSCONDUCTANCE	8 000	5 500	μMHOS
TRIODE AMPLIFICATION FACTOR	5.0	5.0	
PLATE RESISTANCE (APPROX.)	---	20.0	KILOHMS
DC GRID #1 VOLTAGE FOR 1 MA. PLATE CURRENT	-65	-80	VOLTS







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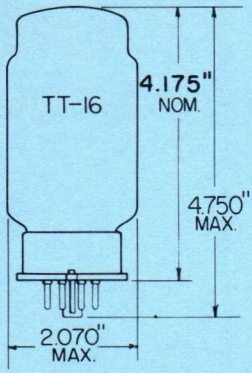
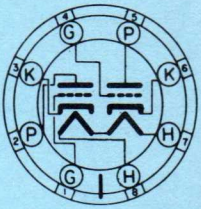
TWIN POWER TRIODE



GLASS BULB

HEATER
6.3±10% VOLTS 5.0 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW
LARGE WAFER WITH
METAL SLEEVE
8 PIN BASE

THE 6336A IS A LONG LIFE, MECHANICALLY RUGGED, TWIN POWER TRIODE DEVELOPED ESPECIALLY FOR USE AS A PASSING TUBE IN SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINSIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 6336A ADEQUATELY MEETS THESE REQUIREMENTS.

THE DESIGN FEATURES ZIRCONIUM COATED GRAPHITE ANODES THAT, WHILE LIGHTER IN WEIGHT THAN SIMILAR METAL ANODES, REMAIN WARP FREE DURING LIFE AND PROVIDE ONE OF THE BEST GAS "GETTERING" MEANS KNOWN. THE ANODES ARE SUPPORTED BY CERAMIC INSULATORS. THE USE OF THESE INSULATORS AND THE HARD GLASS ENVELOPE PERMIT THE TUBE TO BE OUTGASSED AT HIGH TEMPERATURES DURING THE MANUFACTURING EXHAUST PROCESS. THIS ALLOWS THE TUBE TO BE RUN AT HIGH TEMPERATURES DURING OPERATION, WITHOUT THE EVOLUTION OF HARMFUL GAS FROM THE TUBE PARTS.

MASSIVE CATHODES PROVIDE ADEQUATE EMISSION CURRENT RESERVE. GOLD PLATED MOLYBDENUM WIRES ARE EMPLOYED IN THE RUGGED GRID STRUCTURE. THE TUBE MOUNT IS BUILT ON A RUGGED BUTTON STEM, AND IS SUPPORTED FROM THE BULB BY MEANS OF FLEXIBLE METAL VIBRATION SNUBBERS.

IN MANY CIRCUITS, ONE 6336A HAS REPLACED TWO OR THREE TUBE TYPE 6080WA OR 6AS7G REGULATOR TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OF POWER, MANY 6336A TUBE SECTIONS CAN BE PARALLED AS EXPLAINED IN THE APPLICATION NOTES.

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ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (E_f=6.3 VOLTS)	5.0	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	13 500	μMHOS
AMPLIFICATION FACTOR	2.7	
INTER ELECTRODE CAPACITANCES PER TRIODE SECTION:		
GRID TO CATHODE	16.7	μμf
GRID TO PLATE	21.8	μμf
CATHODE TO PLATE	3.8	μμf
HEATER TO CATHODE	15.0	μμf
INTER ELECTRODE CAPACITANCES BETWEEN TRIODE SECTIONS:		
SECTION #1 PLATE TO SECTION #2 PLATE	0.6	μμf

MECHANICAL DATA

MOUNTING POSITION	ANY	
(IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)		
BULB	TT 16	NONEX
BASE	LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JETEC #B8-98	
AVERAGE NET WEIGHT	3.5	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	720	G
MAXIMUM VIBRATION RATING:		
(0 TO 50 CPS)	10	G
(50 TO 500 CPS)	5	G

RATINGS

ABSOLUTE VALUES

	MINIMUM	MAXIMUM	
POWER DISSIPATION PER PLATE	---	30	WATTS
PLATE CURRENT PER PLATE	---	400	MADC
IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE			
PLATE VOLTAGE	0	400	VOLTS DC
HEATER-CATHODE VOLTAGE	-300	+300	VOLTS DC
GRID VOLTAGE	-300	0	VOLTS DC
GRID CURRENT PER GRID	---	0	MA.
HEATER VOLTAGE	5.7	6.9	VOLTS
ENVELOPE TEMPERATURE	---	250	°C
ALTITUDE FOR FULL RATINGS	---	10 000	FEET
IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FEET			
CIRCUIT VALUES			
TOTAL GRID CIRCUIT RESISTANCE	500	500000	OHMS
RESISTANCE PER GRID LEG WHEN TRIODE SECTIONS ARE PARALLELED	500	---	OHMS

CATHODE RESISTANCE: MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 27 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.

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ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 48° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (720G/MSEC)

LIFE TEST: 1000 HOURS UNDER PLATE CURRENT TEST CONDITIONS

POST SHOCK AND LIFE TEST END POINTS:

PLATE CURRENT (MIN.)	150	MA
TRANSCONDUCTANCE PER SECTION (MIN.)	9 000	μMHO
HK LEAKAGE (MAX.)	100	μA
GRID CURRENT (MAX.)	-8	μA

RANGE OF VALUES

CONDITIONS: E_f = 6.3V, E_b = 190V.
E_c =-0, $R_{k/k}$ = 200 Ω, $R_{g/g}$= 500Ω
BOTH SECTIONS OPERATING. READINGS TAKEN AFTER 5 MINUTES POWER PRE-HEATING. EACH SECTION READ SEPARATELY.

PLATE CURRENT PER SECTION	165	200	MA,DC
AMPLIFICATION FACTOR	2.0	3.4	
TRANSCONDUCTANCE	11 000	16 000	μMHOS
HEATER CURRENT PER TUBE	4.75	5.25	AMP.

CONDITIONS: E_f = 6.3V, E_b = 200V.
E_c =- 100V, R_k = 0

PLATE CURRENT PER SECTION	0	10	MA.

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APPLICATION NOTES

THE 6336A IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS. RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED, USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE RESISTANCE BECAUSE IT PROVIDES MORE BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE FOURTH THE VALUE $(\frac{R}{u+1})$ OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE FOURTH THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (ABOUT TWO WATTS) AND THE ADDITIONAL VOLTAGE (LESS THAN 10 VOLTS) NECESSARY FROM THE UNREGULATED SUPPLY. A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE PASSING TUBE TO WORK WITH HIGHER BIAS AND HENCE WITH GREATER TUBE DROP.

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A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 6.3 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.

TUNG-SOL

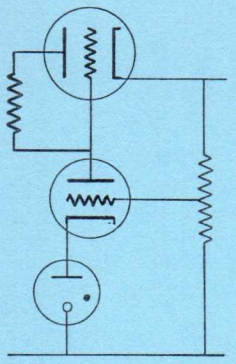


FIGURE 1

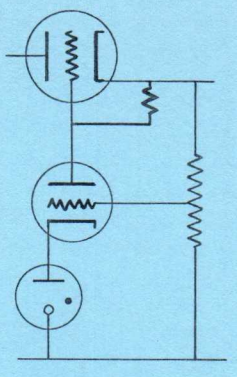


FIGURE 2

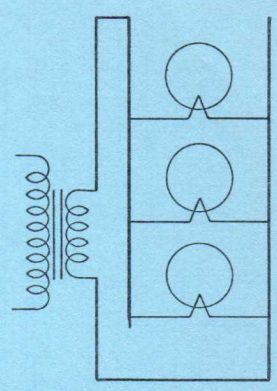
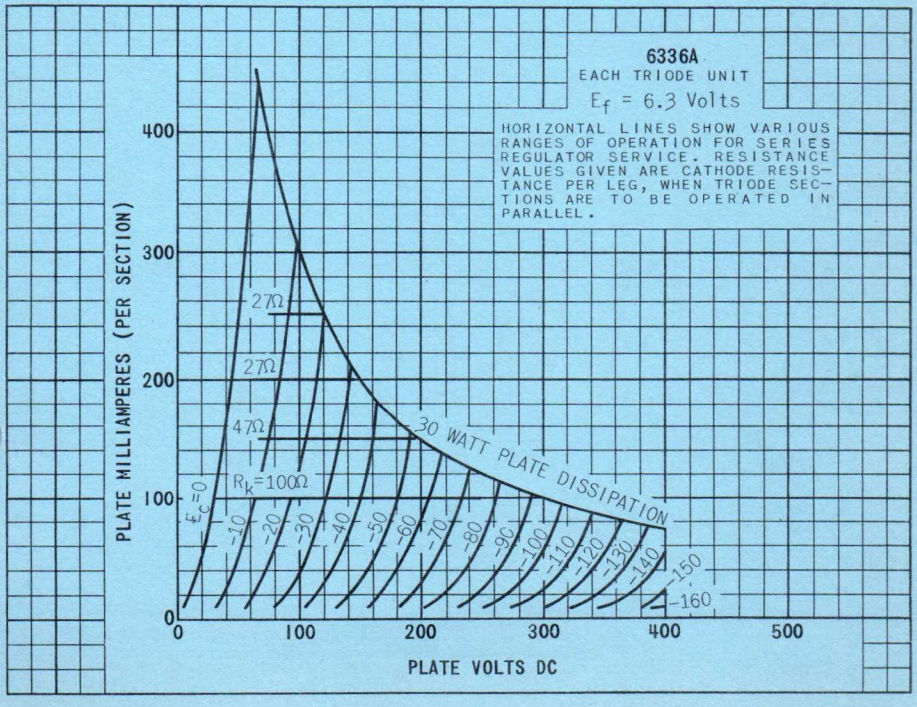


FIGURE 3



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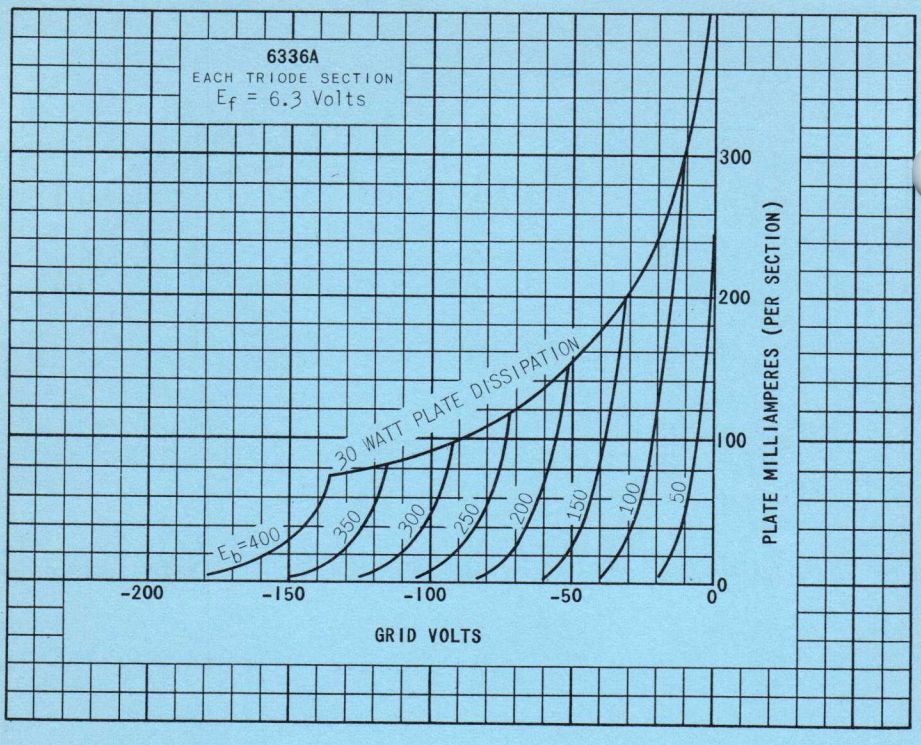
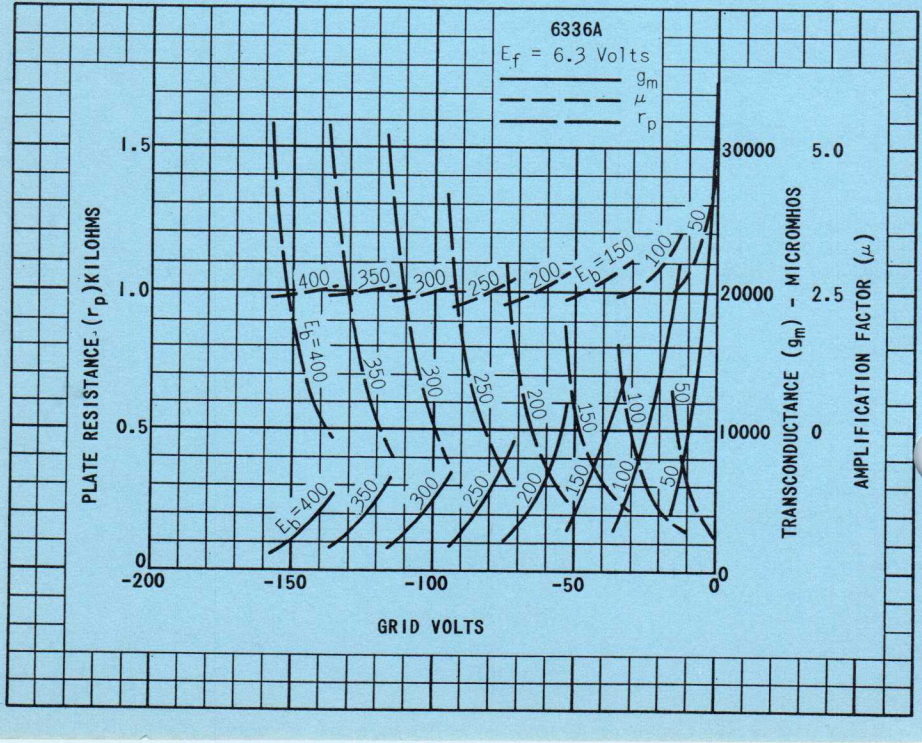
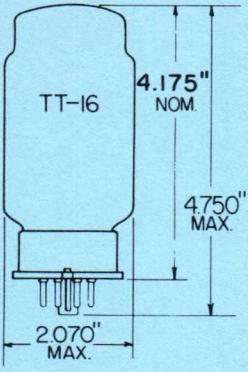

6336A
EACH TRIODE SECTION
E_f = 6.3 Volts
30 WATT PLATE DISSIPATION
E_b=400
350
300
250
200
150
100
50
-200
-150
-100
-50
0
GRID VOLTS
300
200
100
0
PLATE MILLIAMPERES (PER SECTION)


6336A
E_f = 6.3 Volts
g_m
μ
r_p
E_b=400
350
300
250
200
150
100
50
1.5
1.0
0.5
0
PLATE RESISTANCE-(r_p)KILOHMS
30000
20000
10000
0
TRANSCONDUCTANCE (g_m) - MICROMHOS
5.0
2.5
0
AMPLIFICATION FACTOR (μ)
-200
-150
-100
-50
0
GRID VOLTS

TUNG-SOL

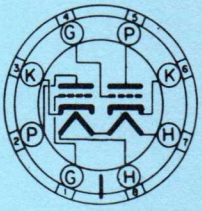
TWIN POWER TRIODE



GLASS BULB

HEATER
26.5±10% VOLTS 1.30 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW
LARGE WAFER WITH METAL SLEEVE 8 PIN BASE

THE 6394A IS A LONG LIFE, MECHANICALLY RUGGED, TWIN POWER TRIODE DEVELOPED ESPECIALLY FOR USE AS A PASSING TUBE IN SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINSIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 6394A ADEQUATELY MEETS THESE REQUIREMENTS.

THE DESIGN FEATURES ZIRCONIUM COATED GRAPHITE ANODES THAT, WHILE LIGHTER IN WEIGHT THAN SIMILAR METAL ANODES, REMAIN WARP FREE DURING LIFE AND PROVIDE ONE OF THE BEST GAS "GETTERING" MEANS KNOWN. THE ANODES ARE SUPPORTED BY CERAMIC INSULATORS. THE USE OF THESE INSULATORS AND THE HARD GLASS ENVELOPE PERMIT THE TUBE TO BE OUTGASSED AT HIGH TEMPERATURES DURING THE MANUFACTURING EXHAUST PROCESS. THIS ALLOWS THE TUBE TO BE RUN AT HIGH TEMPERATURES DURING OPERATION, WITHOUT THE EVOLUTION OF HARMFUL GAS FROM THE TUBE PARTS.

MASSIVE CATHODES PROVIDE ADEQUATE EMISSION CURRENT RESERVE. GOLD PLATED MOLYBDENUM WIRES ARE EMPLOYED IN THE RUGGED GRID STRUCTURE. THE TUBE MOUNT IS BUILT ON A RUGGED BUTTON STEM, AND IS SUPPORTED FROM THE BULB BY MEANS OF FLEXIBLE METAL VIBRATION SNUBBERS.

IN MANY CIRCUITS, ONE 6394A HAS REPLACED TWO OR THREE TUBE TYPE 6080WA OR 6AS7G REGULATOR TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OF POWER, MANY 6394A TUBE SECTIONS CAN BE PARALLED AS EXPLAINED IN THE APPLICATION NOTES.

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TUNG-SOL

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ELECTRICAL DATA

HEATER VOLTAGE	26.5	VOLTS
HEATER CURRENT (E_f=26.5 VOLTS)	1.30	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	13 500	μMHOS
AMPLIFICATION FACTOR	2.7	
INTER ELECTRODE CAPACITANCES PER TRIODE SECTION:		
GRID TO CATHODE	16.7	μμf
GRID TO PLATE	21.8	μμf
CATHODE TO PLATE	3.8	μμf
HEATER TO CATHODE	15.0	μμf
INTER ELECTRODE CAPACITANCES BETWEEN TRIODE SECTIONS:		
SECTION #1 PLATE TO SECTION #2 PLATE	0.6	μμf

MECHANICAL DATA

MOUNTING POSITION	ANY	
(IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)		
BULB	TT 16	NONEX
BASE	LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JETEC #B8-98	
AVERAGE NET WEIGHT	3.5	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	720	G
MAXIMUM VIBRATION RATING:		
(0 TO 50 CPS)	10	G
(50 TO 500 CPS)	5	G

RATINGS

ABSOLUTE VALUES

	MINIMUM	MAXIMUM	
POWER DISSIPATION PER PLATE	---	30	WATTS
PLATE CURRENT PER PLATE	---	400	MADC
IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE			
PLATE VOLTAGE	0	400	VOLTS DC
HEATER-CATHODE VOLTAGE	-300	+300	VOLTS DC
GRID VOLTAGE	-300	0	VOLTS DC
GRID CURRENT PER GRID	---	0	MA.
HEATER VOLTAGE	24.0	29.0	VOLTS
ENVELOPE TEMPERATURE	---	250	°C
ALTITUDE FOR FULL RATINGS	---	10 000	FEET
IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FEET			
CIRCUIT VALUES			
TOTAL GRID CIRCUIT RESISTANCE	500	500000	OHMS
RESISTANCE PER GRID LEG WHEN TRIODE SECTIONS ARE PARALLELED	500	---	OHMS

CATHODE RESISTANCE: MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 27 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.

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ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 48° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (720G/MSEC)

LIFE TEST: 1000 HOURS UNDER PLATE CURRENT TEST CONDITIONS

POST SHOCK AND LIFE TEST END POINTS:

PLATE CURRENT (MIN.)	150	MA
TRANSCONDUCTANCE PER SECTION (MIN.)	9 000	μMHO
HK LEAKAGE (MAX.)	100	μA
GRID CURRENT (MAX.)	-8	μA

RANGE OF VALUES

CONDITIONS: E_f = 26.5V, E_b = 190V. E_c =-0, $R_{k/k}$ = 200 Ω, $R_{g/g}$= 500Ω BOTH SECTIONS OPERATING. READINGS TAKEN AFTER 5 MINUTES POWER PRE-HEATING. EACH SECTION READ SEPARATELY.

PLATE CURRENT PER SECTION	165	200	MA,DC
AMPLIFICATION FACTOR	2.0	3.4	
TRANSCONDUCTANCE	11 000	16 000	μMHOS
HEATER CURRENT PER TUBE	4.75	5.25	AMP.

CONDITIONS: E_f = 26.5V, E_b = 200V. E_c =- 100V, R_k = 0

PLATE CURRENT PER SECTION	0	10	MA.

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TUNG-SOL

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TUNG-SOL

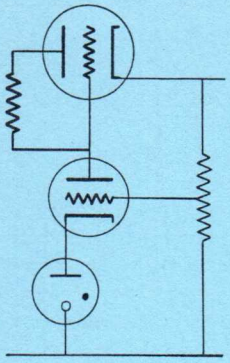


FIGURE 1

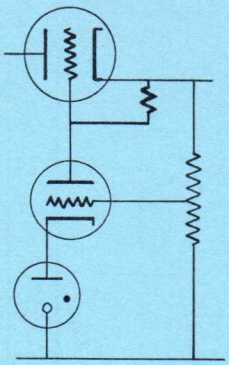


FIGURE 2

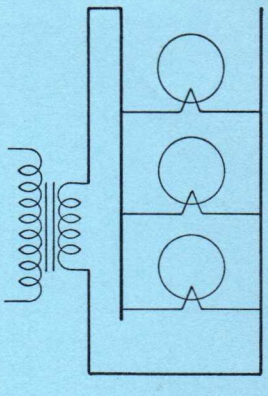
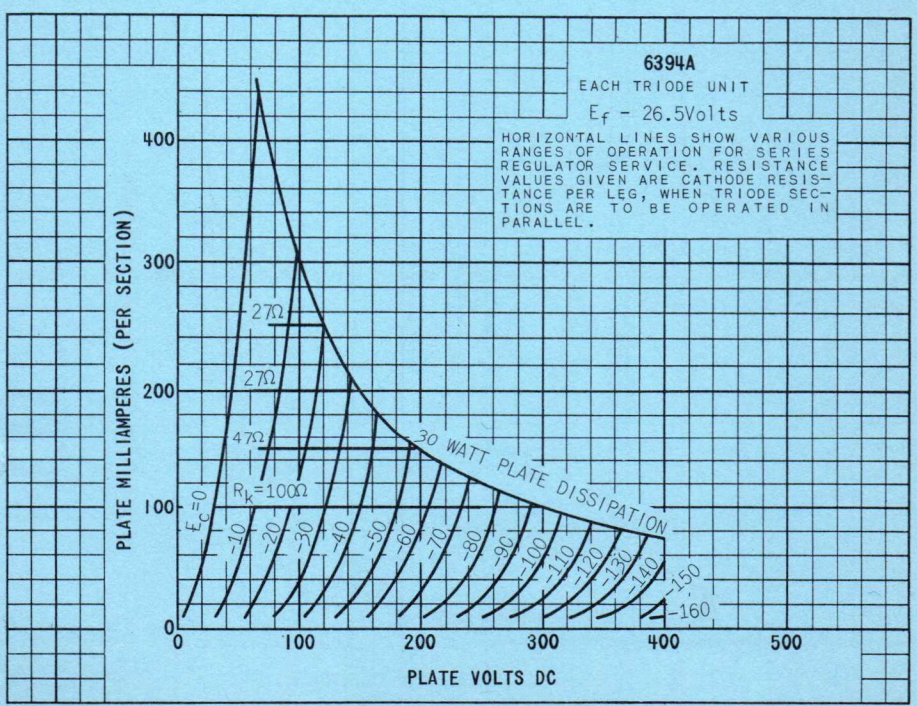


FIGURE 3



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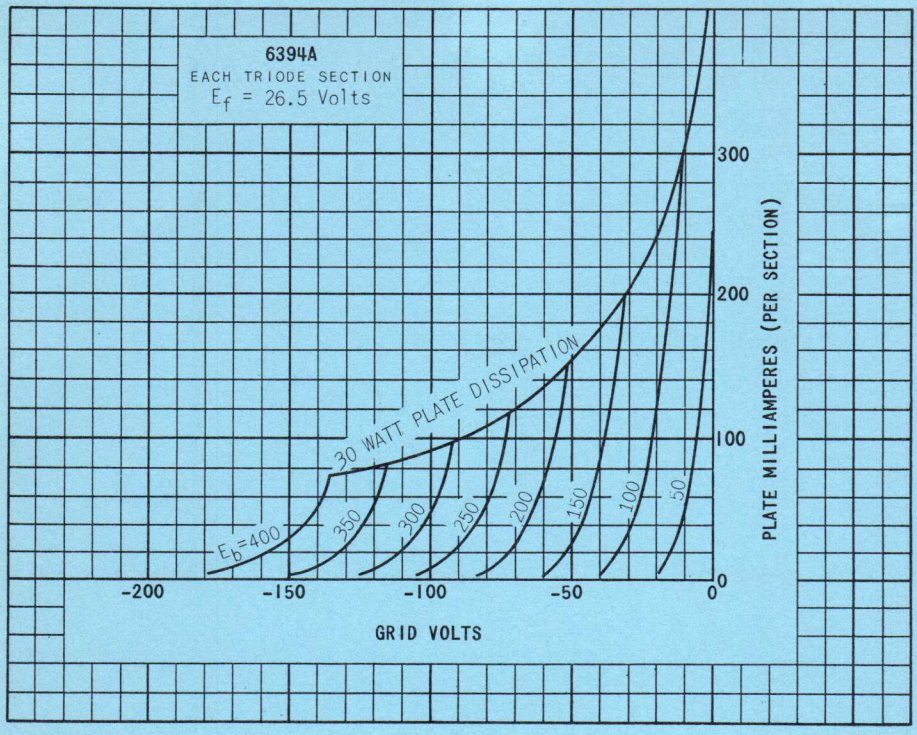
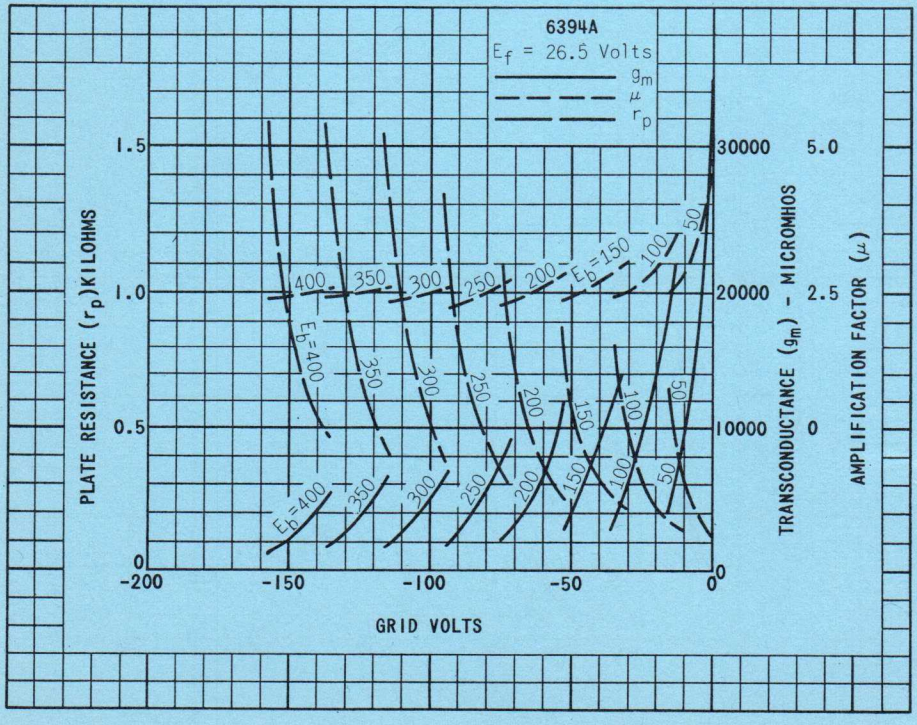
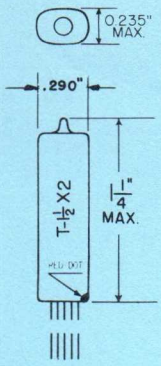

6394A
EACH TRIODE SECTION
E_f = 26.5 Volts
30 WATT PLATE DISSIPATION
E_b=400
350
300
250
200
150
100
50
300
200
100
0
-200
-150
-100
-50
0
GRID VOLTS
PLATE MILLIAMPERES (PER SECTION)


6394A
E_f = 26.5 Volts
g_m
μ
r_p
E_b=400
350
300
250
200
150
100
50
1.5
1.0
0.5
0
30000
20000
10000
0
5.0
2.5
0
-200
-150
-100
-50
0
GRID VOLTS
PLATE RESISTANCE (r_p) KILOHMS
TRANSCONDUCTANCE (g_m) - MICROMHOS
AMPLIFICATION FACTOR (μ)

TUNG-SOL

PENTODE

SUBMINIATURE TYPE



GLASS BULB

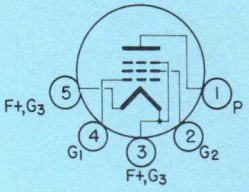
DOT IS ADJACENT TO LEAD 1

FILAMENT

1.25 ± .25 VOLTS 10 MA.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW A

0.016" TINNED FLEXIBLE LEADS 0.040" CENTER-TO-CENTER IN LINE

THE 6418 IS A FILAMENT TYPE PENTODE OF SUBMINIATURE CONSTRUCTION DESIGNED FOR USE AS A POWER AMPLIFIER IN PORTABLE AND WEARABLE EQUIPMENT. THE FLEXIBLE LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO THE TERMINALS OF CIRCUIT COMPONENTS WITHOUT THE USE OF SOCKETS. STANDARD SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE LEADS TO A SUITABLE LENGTH.

RATINGS

ABSOLUTE MAXIMUM VALUES

FILAMENT VOLTAGE	1.25±20%	VOLTS
MAXIMUM PLATE VOLTAGE	30	VOLTS
MAXIMUM GRID #2 VOLTAGE	30	VOLTS
MAXIMUM CATHODE CURRENT	0.5	MA.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A AMPLIFIER

FILAMENT VOLTAGE	1.25	1.25	VOLTS
FILAMENT CURRENT	.01	.01	AMP.
PLATE VOLTAGE	15	22.5	VOLTS
GRID #2 VOLTAGE	15	22.5	VOLTS
GRID #1 VOLTAGE	-0.8	-1.2	VOLTS
ZERO-SIGNAL PLATE CURRENT.	100	240	μA.
ZERO-SIGNAL GRID #2 CURRENT	25	60	μA.
PEAK AF GRID #1 VOLTAGE	0.8	1.2	VOLTS
TRANSCONDUCTANCE	190	300	μMHOS
PLATE RESISTANCE	0.72	0.42	MEGOHMS
LOAD RESISTANCE	150	100	KILOHMS
TOTAL DISTORTION (APPROX.)	12	12	PERCENT
POWER OUTPUT	0.6	2.2	MW.

A
GRID #3 IS COMPOSED OF TWO DEFLECTOR PLATES, ONE BEING CONNECTED TO LEAD 3 AND THE OTHER TO LEAD 5.

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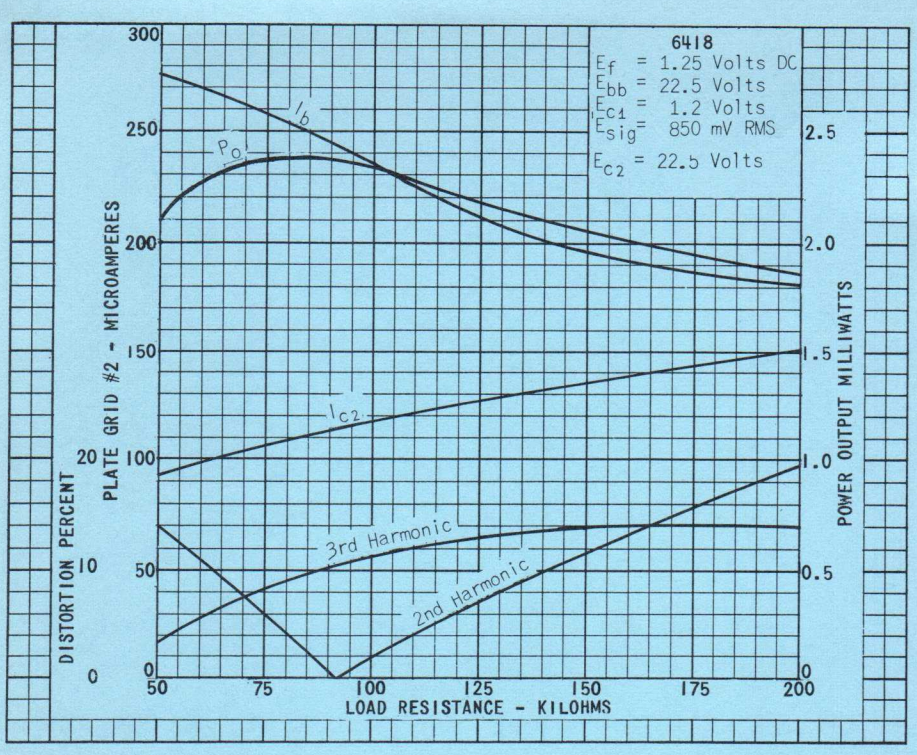
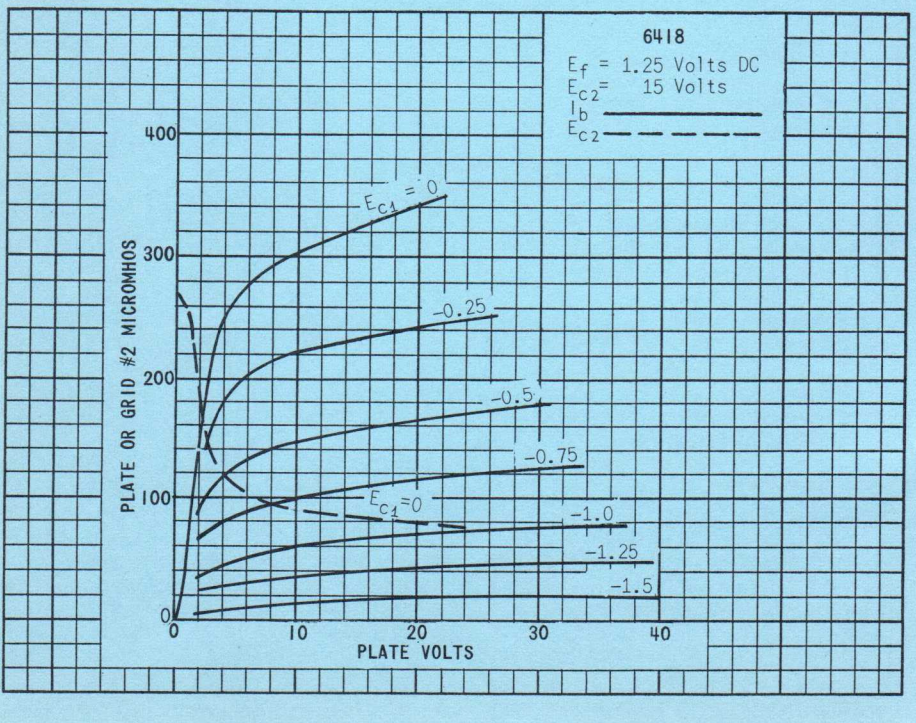
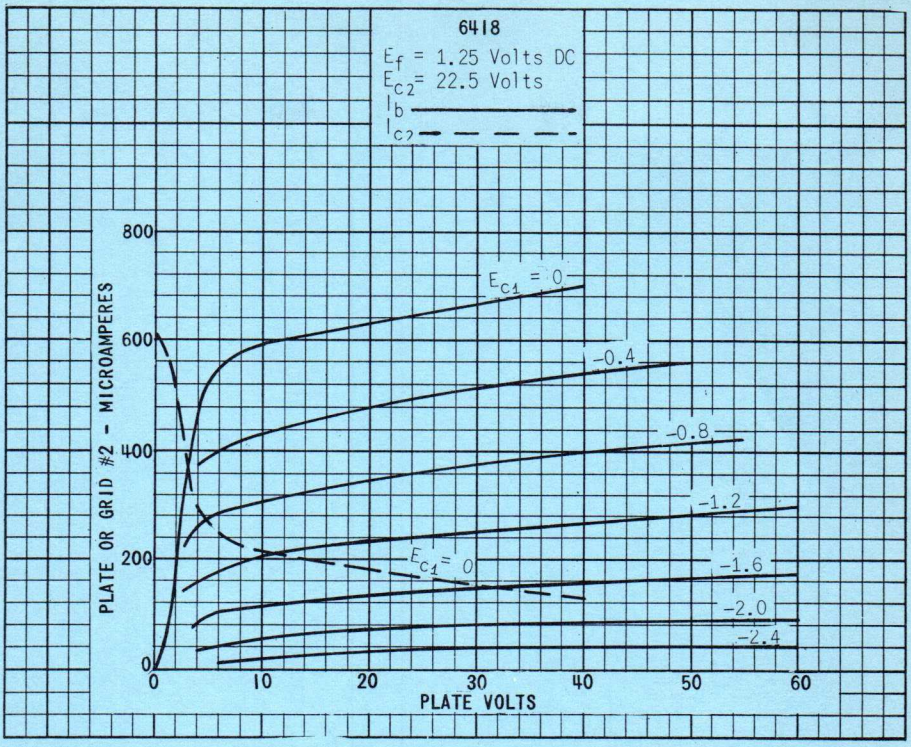
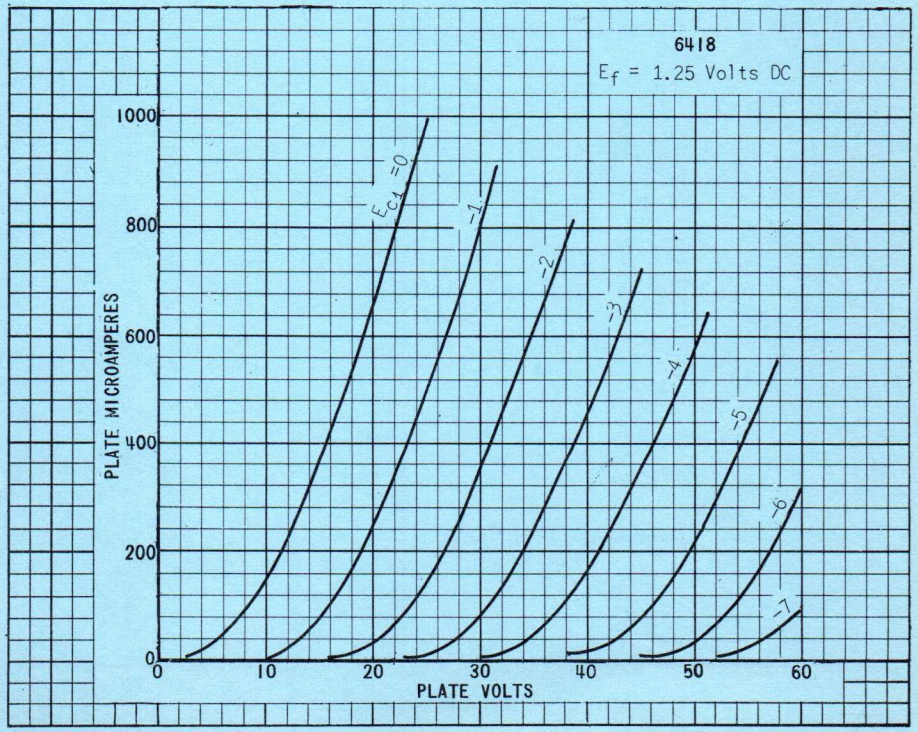

6418
E_f = 1.25 Volts DC
E_{bb} = 22.5 Volts
E_{c1} = 1.2 Volts
E_{sig} = 850 mV RMS
E_{c2} = 22.5 Volts
I_b
P_o
I_{c2}
3rd Harmonic
2nd Harmonic
DISTORTION PERCENT
PLATE GRID #2 - MICROAMPERES
POWER OUTPUT MILLIWATTS
LOAD RESISTANCE - KILOHMS
0
10
20
0
50
100
150
200
250
300
0
0.5
1.0
1.5
2.0
2.5
50
75
100
125
150
175
200


6418
E_f = 1.25 Volts DC
E_{c2} = 15 Volts
I_b
E_{c2}
E_{c1} = 0
-0.25
-0.5
-0.75
E_{c1}=0
-1.0
-1.25
-1.5
PLATE OR GRID #2 MICROMHOS
PLATE VOLTS
0
100
200
300
400
0
10
20
30
40





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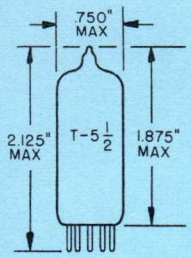
PENTODE

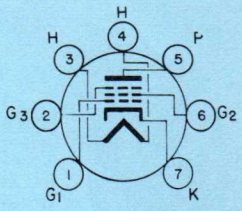
MINIATURE TYPE



GLASS BULB
MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-2

FOR
VOLTAGE AMPLIFIER SERVICE
IN TV APPLICATIONS

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 7CC

THE 6485 IS A HIGH TRANSCONDUCTANCE, SHARP CUT-OFF PENTODE IN THE 7 PIN MINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE AS A WIDE BAND OR IF AMPLIFIER. THE TUBE WILL MAINTAIN ITS EMISSION AND FREEDOM FROM EXCESSIVE CATHODE INTERFACE RESISTANCE EVEN AFTER LONG PERIODS OF OPERATION UNDER CUT-OFF CONDITIONS. OTHERWISE, THE 6485 IS IDENTICAL TO THE 6AH6.

DIRECT INTERELECTRODE CAPACITANCES

	WITHOUT SHIELD	WITH [A] SHIELD	
GRID 1 TO PLATE: (G1 TO P) (MAX.)	0.030	0.020	pf
INPUT: G1 to (H + K + G2 + G3)	10	10	pf
OUTPUT: P TO (H + K + G2 + G3)	2.0	3.6	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	450	MA.

MAXIMUM RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	300	VOLTS
GRID 2 VOLTAGE	150	VOLTS
PLATE DISSIPATION [B]	3.2	WATTS
GRID 2 DISSIPATION	0.6	WATT
CATHODE CURRENT	25	MA.

[A] USING JEDEC SHIELD 316 CONNECTED TO CATHODE.

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TYPICAL OPERATING CHARACTERISTICS

	PENTODE CONNECTED	TRIODE CONNECTED	
PLATE VOLTAGE	300	150	VOLTS
GRID 2 VOLTAGE	150	D	VOLTS
CATHODE RESISTOR	160	160	OHMS
PLATE CURRENT	10	12.5	MA.
TRANSCONDUCTANCE	9000	11000	μMHOS
AMPLIFICATION FACTOR		40	
PLATE RESISTANCE	0.5	.0036	MEGOHMS
GRID 2 CURRENT	2.5		MA.
GRID 1 VOLTAGE FOR Ib = 10 μA. (APPROX.)	−7	−7	VOLTS
TRANSCONDUCTANCE (GRID 3 - PLATE)	C		

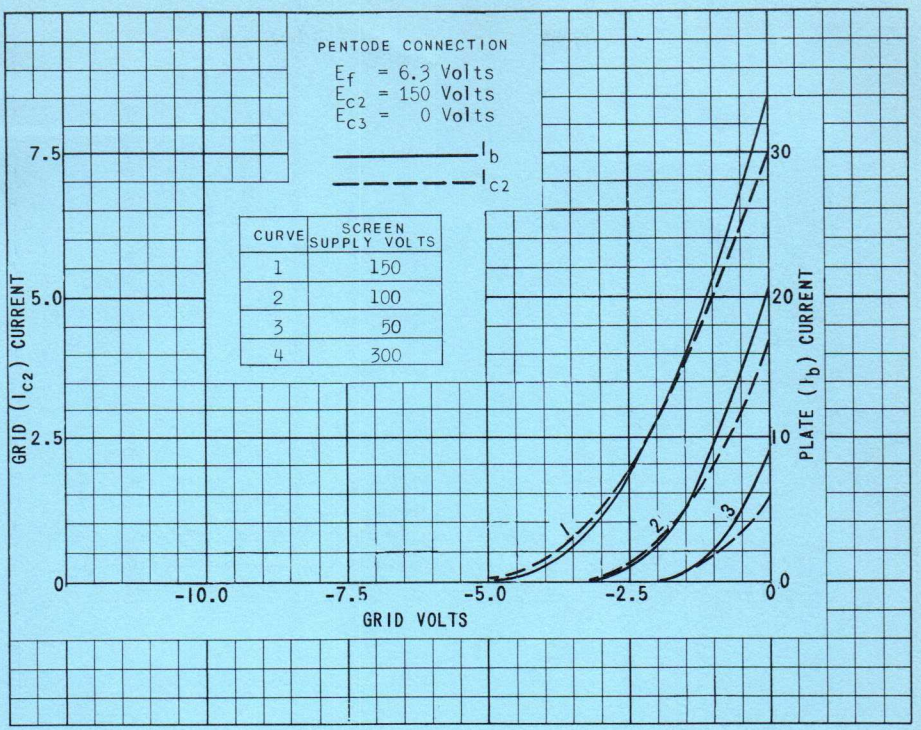
B AT MAXIMUM RATINGS, IT IS NECESSARY THAT AT LEAST ONE SURFACE OF THE SHIELD, IF USED BE BLACKENED.

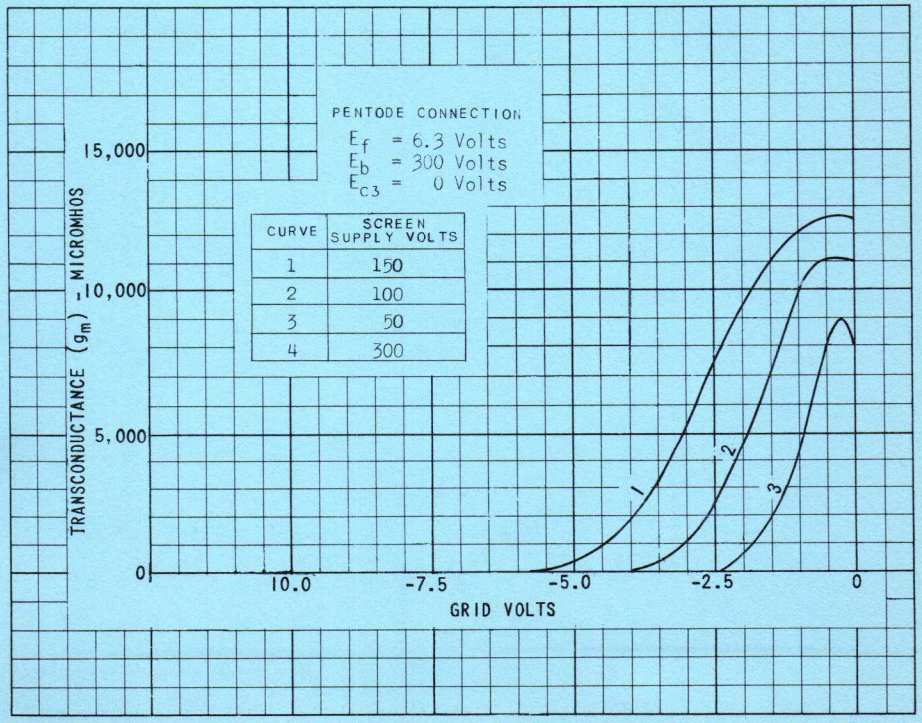
C GRID 3 HAS PRACTICALLY NO CONTROL CHARACTERISTICS AND IT IS NOT INTENDED TO BE USED AS A CONTROL ELECTRODE. ITS TRANSCONDUCTANCE TO THE PLATE APPROXIMATES 2 MICROMHOS AND THE μ IS 0.7 TO 1.0

D GRID 2 AND GRID 3 TIED TO PLATE

INPUT COUPLING AND SYNC. POLARITY	OUTPUT VOLTS P P	VOLTAGE GAIN	MAX. WATTS DISSIPATION SCREEN	PLATE	CATHODE RESISTOR OHMS	CATHODE CURRENT NO SIG. (MA.)	WITH SIG. (MA.)	GRID RESISTOR OHMS
DC−	66	22	0.6	3.2	39	20	13	5000
DC+	100	25	0.4	3.2	270	8	15	5000
AC−	100	25	0.4	3.2	39	20	21	1 meg.
AC+	100	25	0.6	3.2	39	20	18	1 meg.

ALL DATA TAKEN WITH SCREEN VOLTAGE OF 150 AND PLATE LOAD OF 4000 OHMS WITH TYPICAL ON-THE-AIR TELEVISION SIGNALS AND AVERAGE PRODUCTION TUBES





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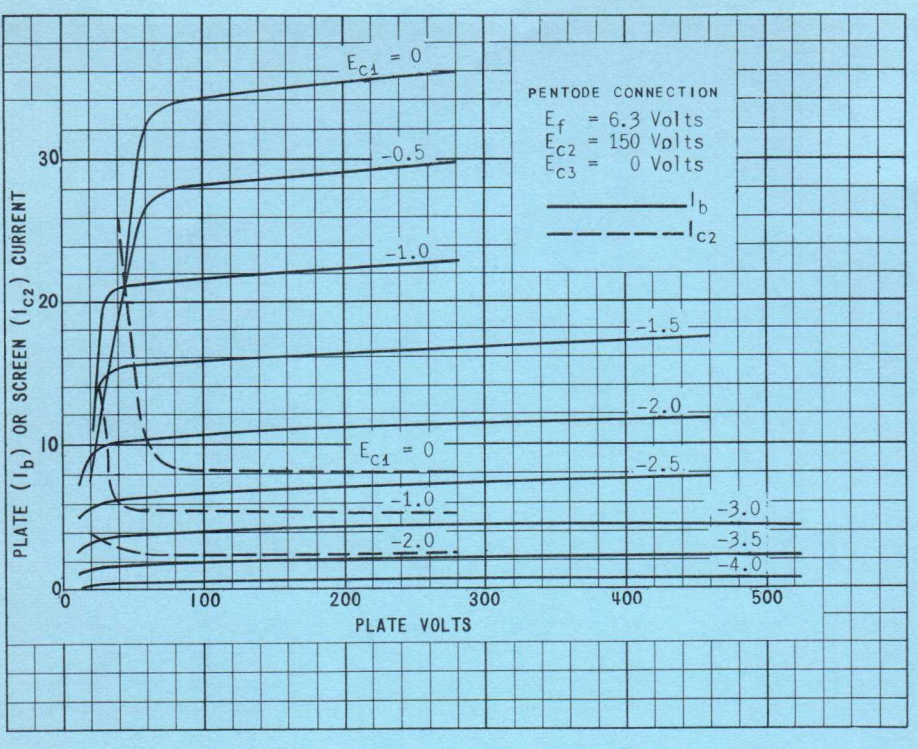
PENTODE CONNECTION
E_f = 6.3 Volts
E_{c2} = 150 Volts
E_{c3} = 0 Volts
I_b
I_{c2}
E_{c1} = 0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
E_{c1} = 0
-1.0
-2.0
PLATE (I_b) OR SCREEN (I_{c2}) CURRENT
PLATE VOLTS
0
10
20
30
100
200
300
400
500

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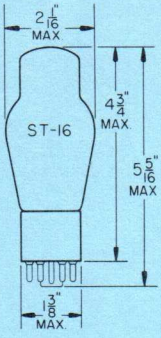
TWIN TRIODE



GLASS BULB

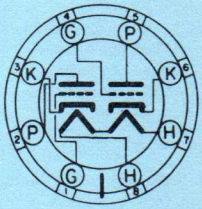
UNIPOTENTIAL CATHODE

HEATER

6.3±10% VOLTS 2.5 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
MEDIUM SHELL
8 PIN OCTAL

THE 6520 IS A LOW-MU, HIGH PERVEANCE, TWIN POWER TRIODE OF THE HEATER-CATHODE TYPE INTENDED FOR USE AS A REGULATOR TUBE IN DC POWER SUPPLY UNITS, WHERE UTMOST RELIABILITY IS REQUIRED IN RESPECT TO TRIODE BALANCE, ABSENCE OF EXCESSIVE PLATE CURRENT DRIFT AND GRID TO PLATE INSULATION. IN ADDITION TO THE STANDARD 6AS7G CHARACTERISTICS, THE 6520 FEATURES A 600 VOLT POTENTIAL INSULATION BETWEEN GRID AND PLATE AND A COMBINED CATHODE AND FIXED BIAS TEST TO GUARANTEE RELIABLE PERFORMANCE WITHOUT EXCESSIVE TRIODE UNBALANCE OR PLATE CURRENT DRIFT.

GENERAL DATA

HEATER VOLTAGE (AC OR DC)	6.3±10%	VOLTS
HEATER CURRENT	2.5	AMP.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

EACH UNIT

GRID TO PLATE	9.4	μμf
INPUT	8.4	μμf
OUTPUT	2.2	μμf
HEATER TO CATHODE:		
TRIODE UNIT #1	6.5	μμf
TRIODE UNIT #2	6.1	μμf
GRID OF UNIT #1 TO GRID OF UNIT #2	0.50	μμf
PLATE OF UNIT #1 TO PLATE OF UNIT #2	2.20	μμf

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CHARACTERISTICS

EACH UNIT

CATHODE BIAS CONDITIONS		
PLATE-SUPPLY VOLTAGE	135	VOLTS
CATHODE-BIAS RESISTOR	250	OHMS
AMPLIFICATION FACTOR	2	
PLATE RESISTANCE	280	OHMS
TRANSCONDUCTANCE	7000	μMHOS
PLATE CURRENT	112	MA.
COMBINED FIXED AND CATHODE BIAS OPERATION		
PLATE-SUPPLY VOLTAGE	150	VOLTS
CATHODE BIAS RESISTOR	100	OHMS
FIXED GRID BIAS	55	VOLTS
PLATE CURRENT	58	MA.

MECHANICAL DATA

MOUNTING POSITION	ANY	
MAXIMUM OVERALL LENGTH	5.32	INCHES
MAXIMUM SEATED LENGTH	4.77	INCHES
MAXIMUM DIAMETER	2.0	INCHES
BULB	ST-16	
BASE	MEDIUM SHELL OCTAL 8 PIN	

RATINGS

ABSOLUTE MAXIMUM VALUES

D C AMPLIFIER

VALUES ARE FOR EACH UNIT

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT	2.5	AMP.
MAXIMUM PLATE VOLTAGE	300	VOLTS
MAXIMUM PLATE CURRENT	125	MA.
MAXIMUM PLATE DISSIPATION	14	WATTS
MAXIMUM PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	300	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	300	VOLTS
PEAK SIMULTANEOUS GRID TO PLATE VOLTAGE:		
PLATE	+300	VOLTS
GRID	-300	VOLTS
MAXIMUM BULB TEMPERATUBE (AT HOTTEST POINT ON BULB SURFACE)	200	°C

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TUNG-SOL

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MAXIMUM CIRCUIT VALUES

MAXIMUM GRID-CIRCUIT RESISTANCE:		
FOR CATHODE-BIAS OPERATION	1.0	MEGOHM
FOR FIXED-BIAS OPERATION[A]	0.1	MEGOHM
FOR COMBINED FIXED-AND CATHODE-BIAS OPERATION[B]	0.1	MEGOHM

[A] WHEN FIXED BIAS IS USED, THE PLATE CIRCUIT SHOULD CONTAIN A PROTECTIVE RESISTANCE TO PROVIDE A MINIMUM DROP OF 15 VOLTS DC AT THE NORMAL OPERATING CONDITIONS. EXCLUSIVE FIXED BIAS IS NOT RECOMMENDED.

[B] WHEN COMBINED FIXED-AND CATHODE-BIAS IS USED, THE CATHODE-BIAS PORTION SHOULD HAVE A MINIMUM VALUE OF 7.5 VOLTS DC AT THE NORMAL OPERATING CONDITIONS.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	MIN.	MAX.	
HEATER CURRENT[C]	2.26	2.74	AMP.
GRID-PLATE CAPACITANCE (EACH UNIT)	6.9	9.9	μμf
INPUT CAPACITANCE (EACH UNIT)	4.7	7.7	μμf
OUTPUT CAPACITANCE (EACH UNIT)	1.7	2.7	μμf
HEATER-CATHODE CAPACITANCE:			
TRIODE UNIT #1	4.5	8.5	μμf
TRIODE UNIT #2	4.1	8.1	μμf
AMPLIFICATION FACTOR (EACH UNIT)[C,D]	1.9	2.5	
PLATE CURRENT (EACH UNIT)[C,D]	100	125	MA.
TRANSCONDUCTANCE (EACH UNIT)[C,D]	6400	7800	μMHOS
REVERSE GRID CURRENT (EACH UNIT)[C,E]	---	2.5	μAMP

[C] WITH 6.3 VOLTS AC OR DC ON HEATER.

[D] WITH PLATE-SUPPLY VOLTAGE OF 135 VOLTS, AND CATHODE-BIAS RESISTOR OF 250 OHMS IN EACH CATHODE (BOTH TRIODE UNITS OPERATING).

[E] WITH PLATE-SUPPLY VOLTAGE OF 135 VOLTS, AND GRID RESISTOR OF 1 MEGOHM IN EACH GRID (BOTH TRIODE UNITS OPERATING).

OPERATING NOTES

THE MAXIMUM RATINGS IN THE TABULATED DATA FOR THE 6520 ARE LIMITING VALUES ABOVE WHICH THE SERVICEABILITY OF THE 6520 MAY BE IMPAIRED FROM THE VIEWPOINT OF THE LIFE AND SATISFACTORY PERFORMANCE. THEREFORE, IN ORDER NOT TO EXCEED THESE ABSOLUTE RATINGS, THE EQUIPMENT DESIGNER HAS THE RESPONSIBILITY OF DETERMINING AN AVERAGE DESIGN VALUE FOR EACH RATING BELOW THE ABSOLUTE VALUE OF THAT RATING BY AN AMOUNT SUCH THAT THE ABSOLUTE VALUES WILL NEVER BE EXCEEDED UNDER ANY USUAL CONDITION OF SUPPLY-VOLTAGE VARIATION IN THE EQUIPMENT ITSELF.

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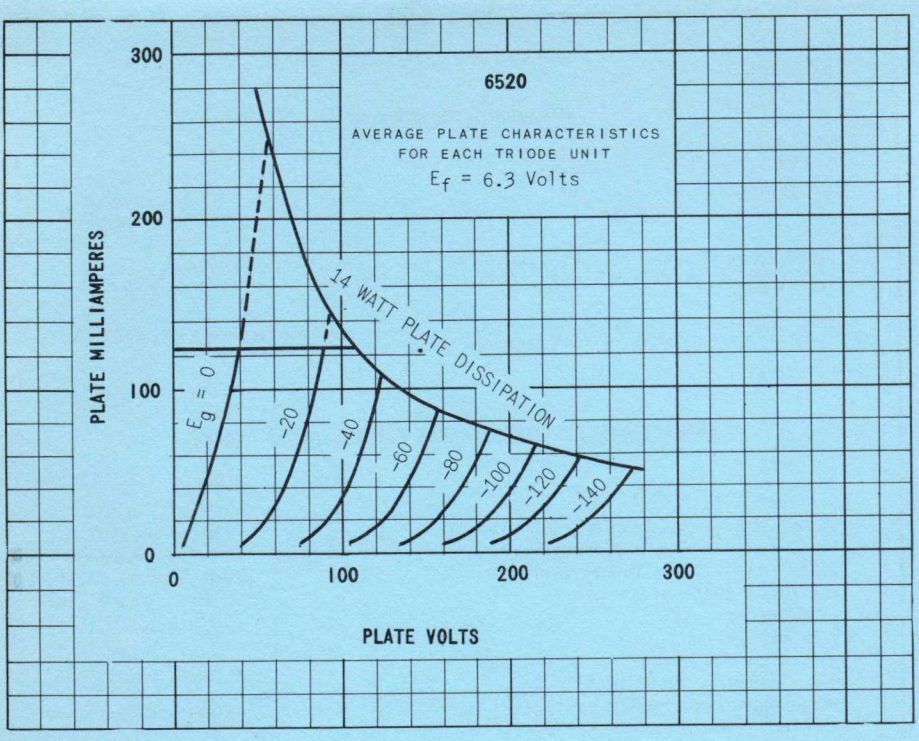
6520
AVERAGE PLATE CHARACTERISTICS
FOR EACH TRIODE UNIT
E_f = 6.3 Volts
14 WATT PLATE DISSIPATION
E_g = 0
-20
-40
-60
-80
-100
-120
-140
PLATE MILLIAMPERES
PLATE VOLTS
0
100
200
300

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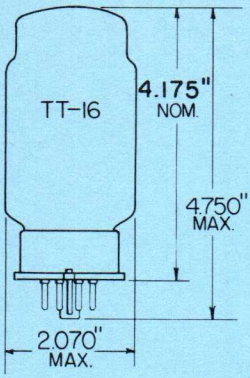
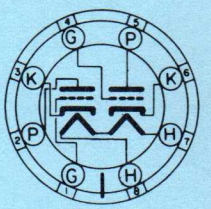
TWIN POWER TRIODE



GLASS BULB

HEATER
6.3±10% VOLTS 5.0 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW
LARGE WAFER WITH
METAL SLEEVE
8 PIN BASE

THE 6528 IS A LONG LIFE, MECHANICALLY RUGGED, TWIN POWER TRIODE DEVELOPED ESPECIALLY FOR USE AS A PASSING TUBE IN SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINSIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 6528 ADEQUATELY MEETS THESE REQUIREMENTS.

THE DESIGN FEATURES ZIRCONIUM COATED GRAPHITE ANODES THAT, WHILE LIGHTER IN WEIGHT THAN SIMILAR METAL ANODES, REMAIN WARP FREE DURING LIFE AND PROVIDE ONE OF THE BEST GAS "GETTERING" MEANS KNOWN. THE ANODES ARE SUPPORTED BY CERAMIC INSULATORS. THE USE OF THESE INSULATORS AND THE HARD GLASS ENVELOPE PERMIT THE TUBE TO BE OUTGASSED AT HIGH TEMPERATURES DURING THE MANUFACTURING EXHAUST PROCESS. THIS ALLOWS THE TUBE TO BE RUN AT HIGH TEMPERATURES DURING OPERATION, WITHOUT THE EVOLUTION OF HARMFUL GAS FROM THE TUBE PARTS.

MASSIVE CATHODES PROVIDE ADEQUATE EMISSION CURRENT RESERVE. GOLD PLATED MOLYBDENUM WIRES ARE EMPLOYED IN THE RUGGED GRID STRUCTURE. THE TUBE MOUNT IS BUILT ON A RUGGED BUTTON STEM, AND IS SUPPORTED FROM THE BULB BY MEANS OF FLEXIBLE METAL VIBRATION SNUBBERS.

IN MAKING CIRCUITS ONE 6528 WILL REPLACE TWO OR THREE TYPE 6080WA OR THREE OR FOUR BEAM POWER TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OR POWER, MANY 6528 TUBE SECTIONS CAN BE PARALLELED AS EXPLAINED IN THE APPLICATION NOTES.

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ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (E_f=6.3 VOLTS)	5.0	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	37 000	μMHOS
AMPLIFICATION FACTOR	9.0	
INTER ELECTRODE CAPACITANCES PER TRIODE SECTION:		
GRID TO CATHODE	17.8	μμf
GRID TO PLATE	23.8	μμf
CATHODE TO PLATE	2.9	μμf
HEATER TO CATHODE	15.0	μμf
INTER ELECTRODE CAPACITANCES BETWEEN TRIODE SECTIONS:		
SECTION #1 PLATE TO SECTION #2 PLATE	0.6	μμf
PLATE RESISTANCE	245	OHMS

MECHANICAL DATA

MOUNTING POSITION	ANY	
(IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)		
BULB	TT 16	NONEX
BASE	LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JETEC #B8-86	
AVERAGE NET WEIGHT	3.5	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	720	G
MAXIMUM VIBRATION RATING:		
(0 TO 50 CPS)	10	G
(50 TO 500 CPS)	5	G

RATINGS

ABSOLUTE VALUES

	MINIMUM	MAXIMUM	
POWER DISSIPATION PER PLATE	---	30	WATTS
PLATE CURRENT PER PLATE	---	300	MADC
IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE			
PLATE VOLTAGE	0	400	VOLTS DC
HEATER–CATHODE VOLTAGE	-300	+300	VOLTS DC
GRID VOLTAGE	-300	0	VOLTS DC
GRID CURRENT PER GRID	---	0	MA.
HEATER VOLTAGE	5.7	6.9	VOLTS
ENVELOPE TEMPERATURE	---	250	°C
ALTITUDE FOR FULL RATINGS	---	10 000	FEET
IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FEET			
TOTAL GRID CIRCUIT RESISTANCE IN REGULATOR SERVICE OR WITH FIXED BIAS	500	50000	OHMS
TOTAL GRID CIRCUIT RESISTANCE WITH CATHODE BIAS ONLY	500	500000	OHMS
RESISTANCE PER GRID LEG WHEN TRIODE SECTIONS ARE PARALLELED	500	---	OHMS

CATHODE RESISTANCE: MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 10 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.

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ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 48° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (720G/MSEC)

LIFE TEST: 1000 HOURS UNDER PLATE CURRENT TEST CONDITIONS

POST SHOCK AND LIFE TEST END POINTS:

PLATE CURRENT (MIN.)	($R_g I_g$ = .05 MEG.)	130	MA
TRANSCONDUCTANCE PER SECTION (MIN.)		23 500	μMHO
HK LEAKAGE (MAX.)		100	μA
GRID CURRENT (MAX.)		-4	μA

RANGE OF VALUES

CONDITIONS: E_f = 6.3V, E_b = 100V.
E_c = -4, $R_{g/g}$ = 500Ω

BOTH SECTIONS OPERATING. READINGS TAKEN AFTER 2 MIN. PREHEATING UNDER CONDITIONS OF E_f = 6.3, E_{bb} = 190 V, E_c = 0, R_c = 200 OHMS. EACH SECTION READ SEPARATELY.

PLATE CURRENT PER SECTION	140	230	MA, DC
AMPLIFICATION FACTOR	7.0	11.0	
TRANSCONDUCTANCE	29 000	45 000	μMHOS
HEATER CURRENT PER TUBE	4.75	5.25	AMP.

CONDITIONS: E_f = 6.3V, E_b = 400V.
E_c = -75V, R_k = 0

PLATE CURRENT PER SECTION	0	3	MA.

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APPLICATION NOTES

THE 6528 IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS. RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED, USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE RESISTANCE BECAUSE IT PROVIDES MORE BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE TENTH THE VALUE $(\frac{R}{U+1})$ OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE TENTH THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (LESS THAN ONE WATT) AND THE ADDITIONAL VOLTAGE (LESS THAN 6 VOLTS) NECESSARY FROM THE UNREGULATED SUPPLY. A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE PASSING TUBE TO WORK WITH HIGHER BIAS AND HENCE WITH GREATER TUBE DROP.

A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASSING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATOR OUTPUT IS LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A TUBE DROP AS POSSIBLE. A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES. SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE DUE TO TUBE AGING.

A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 6.3 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.

TUNG-SOL

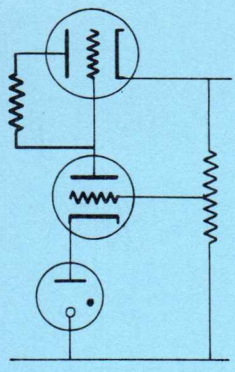


FIGURE 1

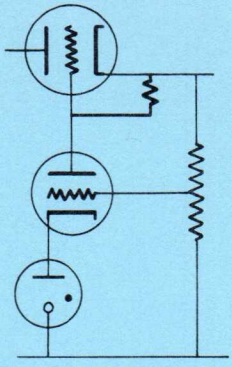


FIGURE 2

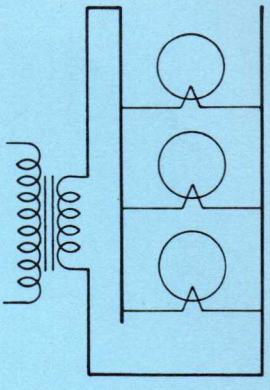
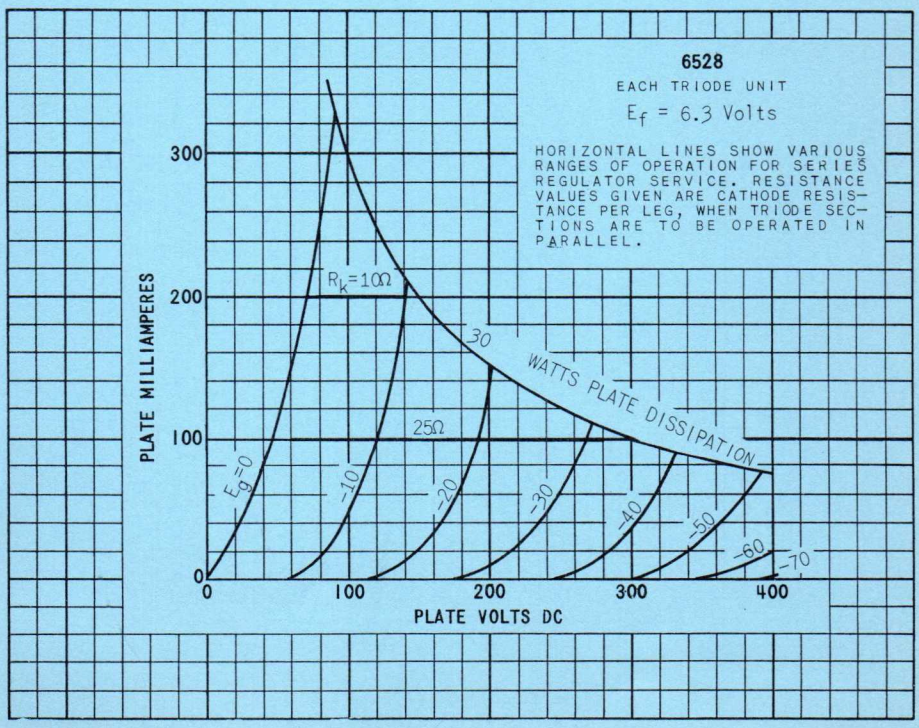


FIGURE 3



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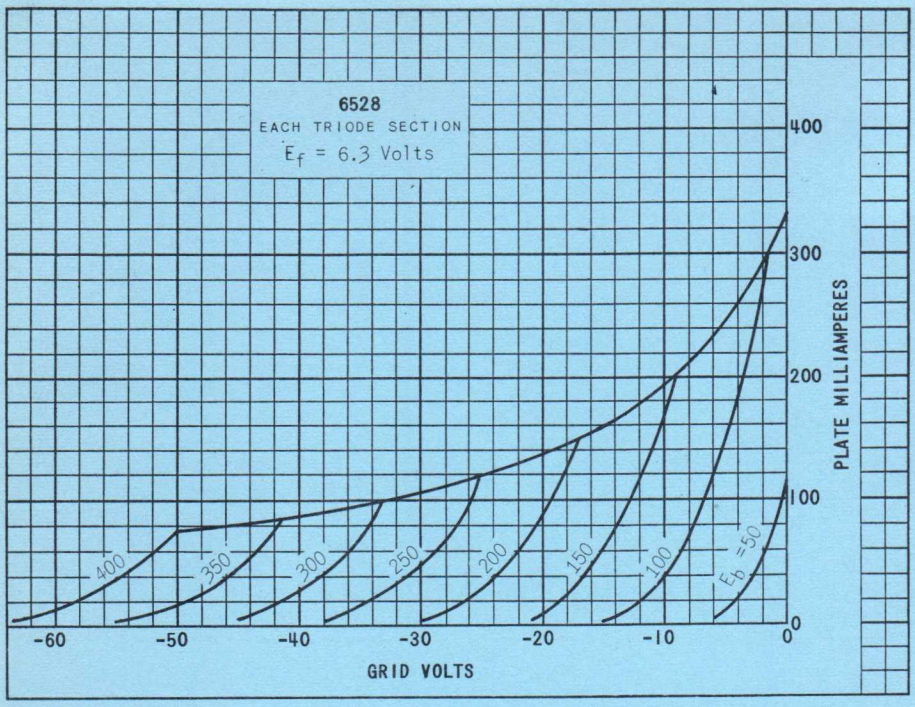

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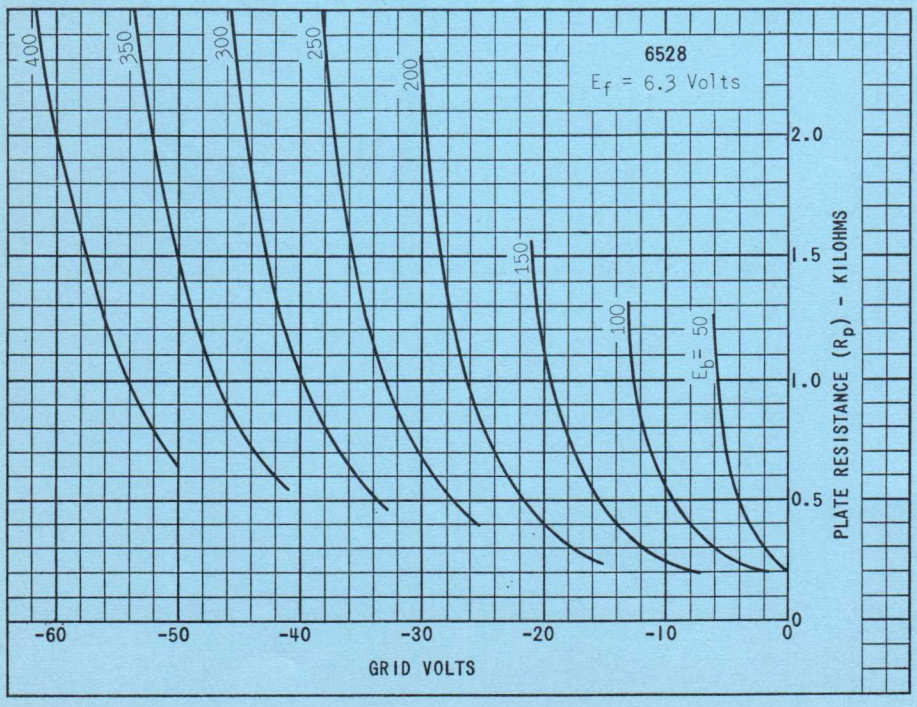

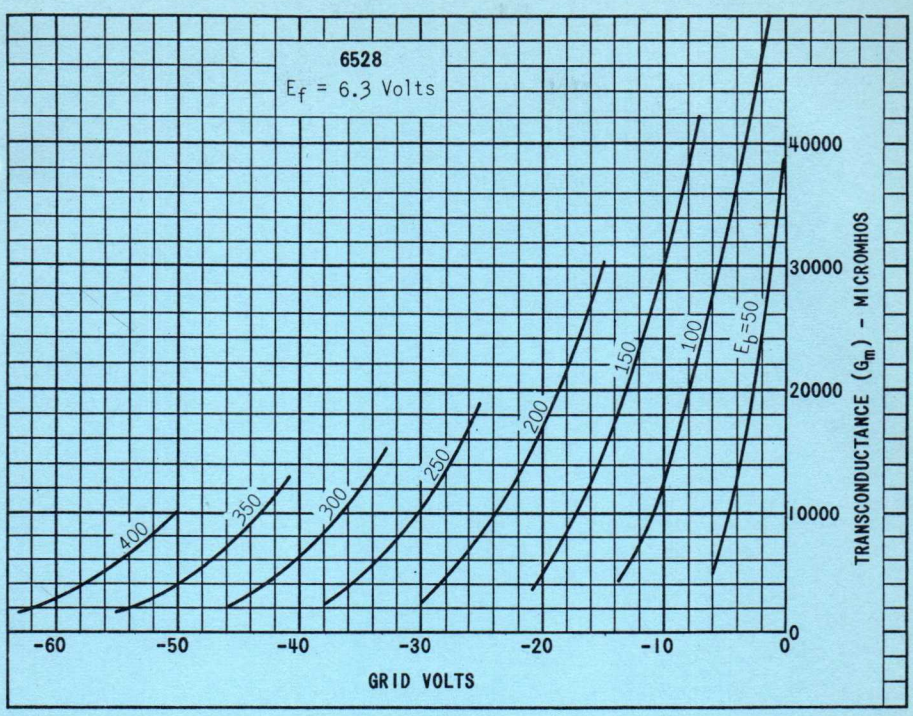

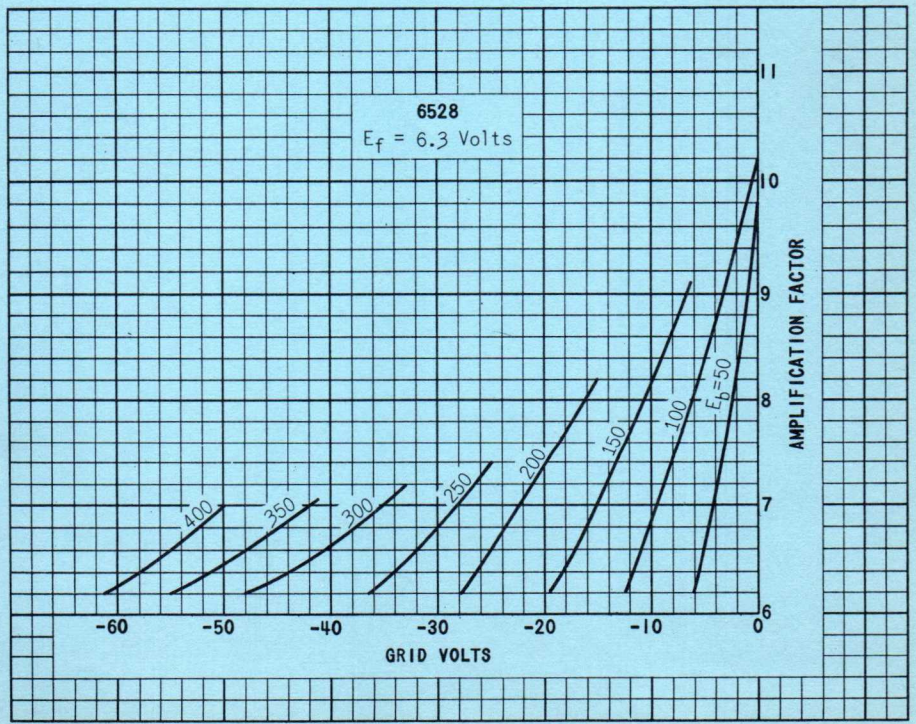

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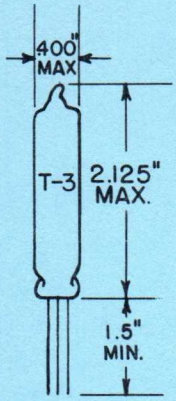
VOLTAGE REGULATOR

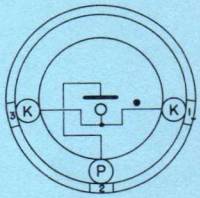
SUB-MINIATURE TYPE



GLASS BULB

COLD CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW

0.016" TINNED
FLEXIBLE LEADS
0.096" CENTER TO CENTER

THE 6542 IS A TWO ELECTRODE, INERT-GAS-FILLED COLD CATHODE SUBMINIATURE TUBE INTENDED FOR USE AS A VOLTAGE REGULATOR. THE TUBE HAS A MAINTAINING VOLTAGE OF APPROXIMATELY 150 VOLTS OVER A CURRENT RANGE OF 5 TO 25 MA. THE 6542 IS EXCELLENT FOR APPLICATIONS WHICH REQUIRE GOOD VOLTAGE REGULATION AND LONG LIFE, CONSISTENT WITH SMALL SIZE AND LOW WEIGHT.

ELECTRICAL DATA

CATHODE	COLD

MECHANICAL DATA

MOUNTING POSITION	ANY	
MAXIMUM OVERALL LENGTH	2.125	INCHES
MAXIMUM DIAMETER	0.400	INCHES
WEIGHT (APPROX.)	0.16	OUNCES
BULB	T-3	
BASE	SUB-MINIATURE FLAT PRESS WITH 3 FLYING LEADS	

CONTINUED ON FOLLOWING PAGE

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TUNG-SOL

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RATINGS
ABSOLUTE VALUES

MAXIMUM DC CATHODE CURRENT	25	MA.
MINIMUM DC CATHODE CURRENT	5	MA.
MAXIMUM BULB TEMPERATURE	155	°C
MINIMUM AMBIENT TEMPERATURE	−55	°C
MAXIMUM ALTITUDE	60 000	FEET

CIRCUIT VALUES

MAXIMUM SHUNT CAPACITOR	0.1	μf
SERIES RESISTOR	SEE OPERATION NOTES	

EQUIPMENT DESIGN AND RANGE VALUES

	MIN.	AVG.	MAX.	
DC ANODE SUPPLY VOLTAGE	185*	---	---	VOLTS
ANODE BREAKDOWN VOLTAGE	---	150	180	VOLTS
TUBE VOLTAGE DROP	140	147	168	VOLTS
REGULATION (5 TO 30 MA.)	---	0.8	6	VOLTS

* IN ORDER TO ASSURE STARTING THROUGH TUBE LIFE NOT LESS THAN THE SPECIFIED SUPPLY VOLTAGE SHOULD BE PROVIDED.

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OPERATING NOTES

IN THE OPERATION OF A GLOW TUBE THERE ARE SEVERAL REQUIREMENTS WHICH MUST ALWAYS BE MET. THE FIRST IS THAT THE SUPPLY VOLTAGE MUST ALWAYS BE GREATER THAN THE ANODE BREAKDOWN VOLTAGE AND THE SECOND IS THAT SUFFICIENT RESISTANCE MUST ALWAYS BE PUT IN SERIES WITH THE TUBE IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM AND MAXIMUM VALUES GIVEN IN THE RATINGS.

IN ORDER TO ILLUSTRATE HOW TO CALCULATE THE VALUE OF THE SERIES RESISTANCE A TYPICAL REGULATOR CIRCUIT IS SHOWN IN FIGURE 1.

FROM FIGURE 1 WE SEE THAT V_1 IS THE UNREGULATED SUPPLY VOLTAGE, V_2 IS THE TUBE VOLTAGE DROP ON THE REGULATED VOLTAGE SUPPLIED TO THE LOAD, R_1 IS THE SERIES LIMITING RESISTOR, R_L IS THE VARIABLE LOAD, I_T IS THE TUBE CURRENT AND I_L IS THE LOAD CURRENT.

WE SEE THAT THE TUBE CURRENT WILL BE A MAXIMUM WHEN THE SUPPLY VOLTAGE IS A MAXIMUM (V_1 MAX.); WHEN THE LOAD CURRENT IS A MINIMUM (I_L MIN.); AND WHEN THE TUBE VOLTAGE DROP IS A MINIMUM (V_2 MIN.). THEREFORE THE CONDITIONS WHICH DETERMINE THE LOWER LIMIT FOR THE SERIES RESISTANCE R_1 ARE THAT

$$R_1 > \frac{V_1 \text{ MAX.} - V_2 \text{ MIN.}}{I_T \text{ MAX.} + I_L \text{ MIN.}}$$

IN A LIKE MANNER IT CAN BE SHOWN THAT THE VALUE OF R_1 IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM VALUE REQUIRES THAT

$$R_1 < \frac{V_1 \text{ MIN.} - V_2 \text{ MAX.}}{I_T \text{ MIN.} + I_L \text{ MAX.}}$$

WHEN THESE VALUES HAVE BEEN COMPUTED, ONE SHOULD CHECK TO SEE IF THERE IS SUFFICIENT STARTING VOLTAGE BY THE FOLLOWING RELATION

$$V_1 \text{ MIN.} \frac{R_L}{R_1 + R_L} < V \text{ STARTING}$$

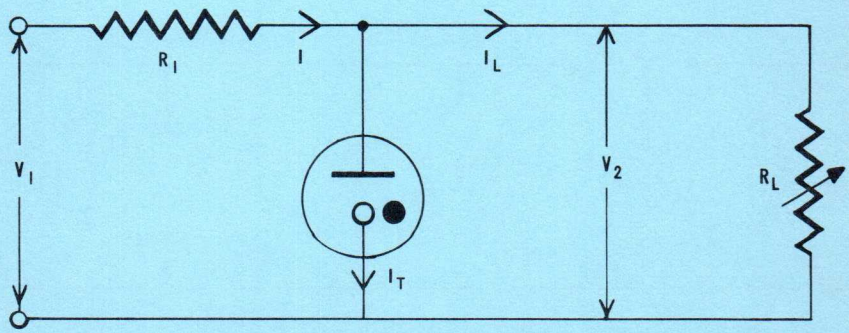

FIGURE 1

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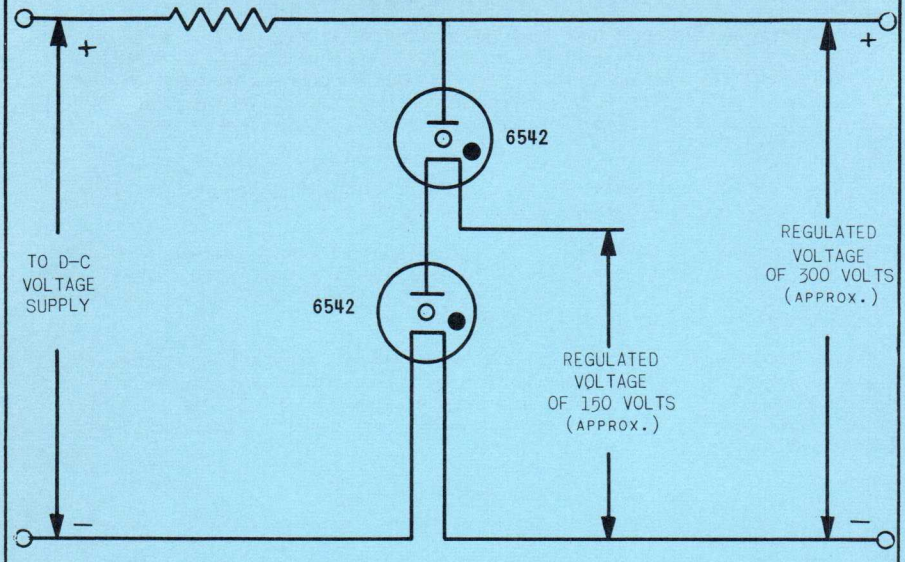
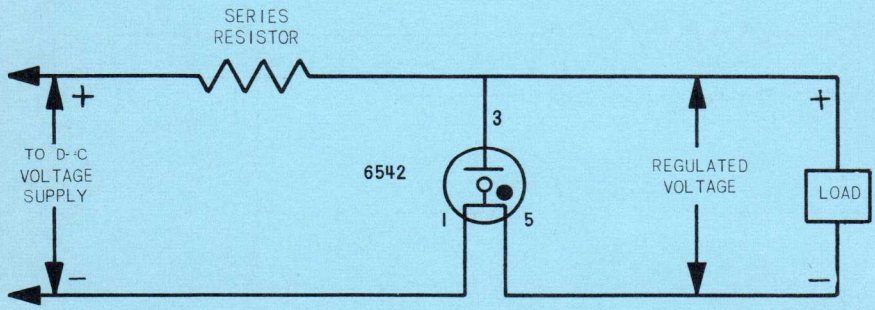


OPERATION OF REGULATOR TUBES IN SERIES
FIGURE 2



TYPICA CIRCUIT FOR VOLTAGE REGULATOR
FIGURE 3

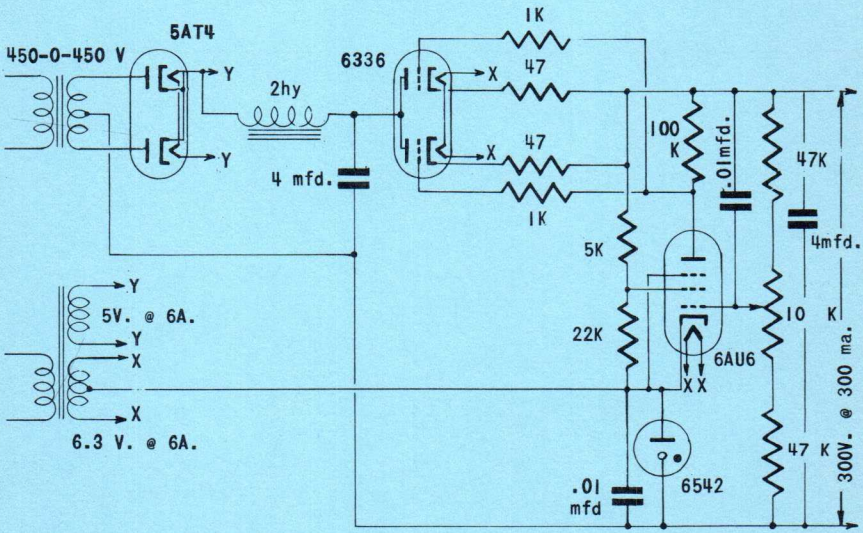
TUNG-SOL

WHEN THESE CALCULATIONS HAVE BEEN MADE AND THERE IS INSUFFICIENT STARTING VOLTAGE, A NEW LOAD CURRENT OF LOWER VALUE MUST BE USED AND THE CALCULATIONS REPEATED.

CIRCUITS WHICH HAVE A CAPACITOR IN SHUNT WITH THE 6542 SHOULD BE LIMITED IN VALUE TO 0.1 μf, LARGER VALUES MIGHT CAUSE OSCILLATIONS.

OPERATION OF THE 6542 IN PARALLEL IS NOT RECOMMENDED UNLESS A RESISTANCE OF APPROXIMATELY 100 OHMS IS USED IN SERIES WITH EACH 6542 TO EQUILIZE DIVISION OF CURRENT. HOWEVER, IT SHOULD BE NOTED THAT WHILE THIS ENABLES ONE TO HANDLE MORE LOAD CURRENT IT REDUCES THE REGULATION THAT CAN BE OBTAINED.

IF IT IS DESIRED TO OBTAIN HIGHER REGULATING VOLTAGES, TUBES MAY BE OPERATED IN SERIES AS INDICATED IN FIGURE 2. HOWEVER, CARE SHOULD BE TAKEN TO SEE THAT SUFFICIENT SUPPLY VOLTAGE IS AVAILABLE TO START BOTH TUBES.



TYPICAL APPLICATION OF 6542
USED IN VOLTAGE REGULATED POWER SUPPLY
FIGURE 4

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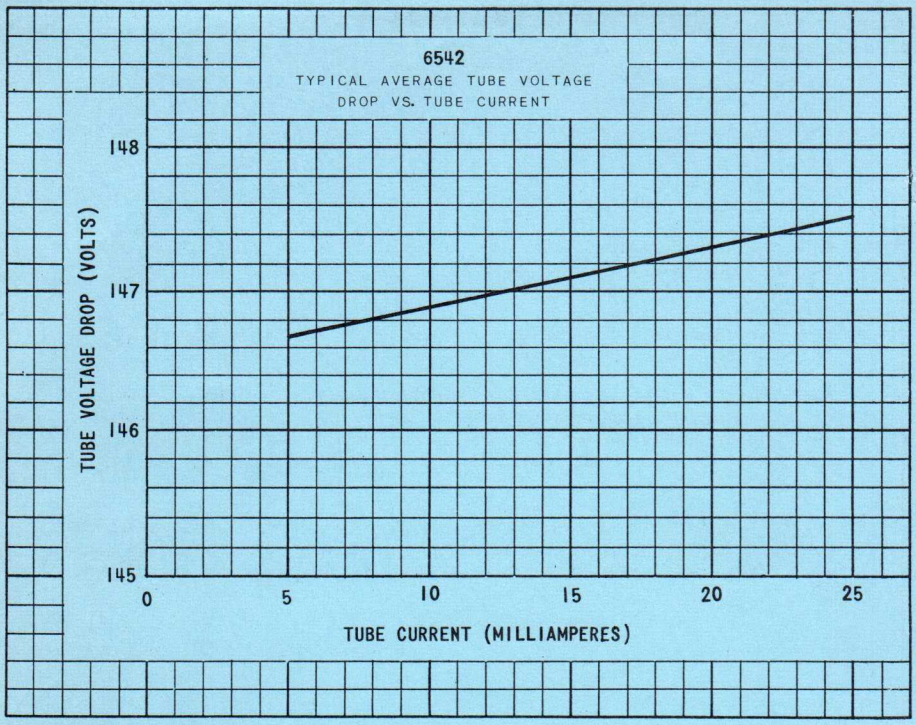
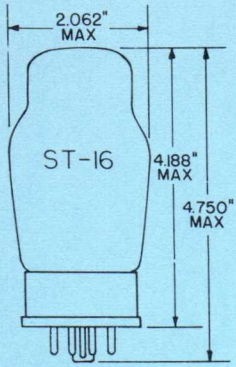

6542
TYPICAL AVERAGE TUBE VOLTAGE
DROP VS. TUBE CURRENT
TUBE VOLTAGE DROP (VOLTS)
148
147
146
145
0
5
10
15
20
25
TUBE CURRENT (MILLIAMPERES)

TUNG-SOL

PENTODE

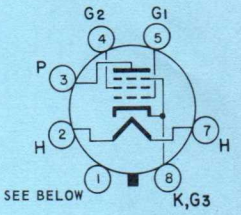


GLASS BULB
LARGE WAFER OCTAL ←
WITH BARRIERS
7 PIN LOW LOSS B7-99

FOR
AUDIO SERVICE APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 7AC

PIN 1 - NO CONNECTION
OR BASE SHELL

THE 6550 IS A BEAM PENTODE POWER AMPLIFIER PRIMARILY DESIGNED FOR AUDIO SERVICE. IT CARRIES A 42 WATT PLATE DISSIPATION RATING WHICH PROVIDES FOR PUSH-PULL AMPLIFIER DESIGNS UP TO 100 WATTS OUTPUT. CONSTRUCTION FEATURES PROVIDE FOR RELIABLE OPERATION AT FULL RATINGS.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT SHIELD

GRID 1 TO PLATE	0.8	pf
INPUT	15	pf
OUTPUT	10	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	→ 1.6	AMP.
HEATER SUPPLY LIMITS:				
VOLTAGE OPERATION			6.3 ± 0.6	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE				
TOTAL DC AND PEAK			300	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE				
DC			100	VOLTS
TOTAL DC AND PEAK			200	VOLTS

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→ INDICATES A CHANGE.

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE, DC	660	VOLTS
GRID 2 VOLTAGE, DC		
PENTODE CONNECTION	440	VOLTS
TRIODE AND ULTRA-LINEAR CONNECTION	500	VOLTS
GRID 1 VOLTAGE, DC	−300 TO 0	VOLTS
PLATE DISSIPATION	42	WATTS
GRID 2 DISSIPATION		
CONTINUOUS	6.0	WATTS
INTERMITTENT-MUSIC OR SPEECH PEAKS	10.0	WATTS
CATHODE CURRENT, DC	190	MA.
GRID 1 CIRCUIT RESISTANCE		
FIXED BIAS	50	KOHMS
SELF BIAS	250	KOHMS
BULB TEMPERATURE	250	°C

AVERAGE CHARACTERISTICS

PENTODE CONNECTION

PLATE VOLTAGE	250	VOLTS
GRID 2 VOLTAGE	250	VOLTS
GRID 1 VOLTAGE	−14	VOLTS
PLATE CURRENT	140	MA.
GRID 2 CURRENT	12	MA.
TRANSCONDUCTANCE	11,000	μMHOS
PLATE RESISTANCE, APPROX.	15,000	OHMS
TRIODE AMPLIFICATION FACTOR	8	
GRID 1 VOLTAGE FOR 1 MA PLATE CURRENT	−40	VOLTS

TYPICAL OPERATING CONDITIONS

CLASS A1 AUDIO AMPLIFIER - SINGLE TUBE

PLATE VOLTAGE, DC	250	400	VOLTS
GRID 2 VOLTAGE, DC	250	225	VOLTS
GRID 1 VOLTAGE, DC	−14	−16.5	VOLTS
PEAK SIGNAL VOLTAGE	14	16.5	VOLTS
ZERO-SIGNAL PLATE CURRENT, DC	140	87	MA.
MAX. - SIGNAL PLATE CURRENT, DC	150	105	MA.
ZERO-SIGNAL GRID 2 CURRENT, DC	12	4	MA.
MAX. - SIGNAL GRID 2 CURRENT, DC	22	14	MA.
LOAD RESISTANCE	1500	3000	OHMS
TOTAL HARMONIC DISTORTION, APPROX.	7	13.5	PERCENT
MAX. - SIGNAL POWER OUTPUT	12.5	20	WATTS

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TYPICAL OPERATING CONDITIONS - CONT'D.

PUSH-PULL CLASS AB1 AUDIO AMPLIFIER
PENTODE CONNECTION

AVERAGE VALUES FOR TWO MATCHED TUBES[A]

	SELF BIAS	FIXED BIAS			
PLATE VOLTAGE, DC	400	400	450	600	VOLTS
GRID 2 VOLTAGE, DC	310	270	310	300	VOLTS
GRID 1 VOLTAGE, DC	---	-23	-29.5	-32.5	VOLTS
COMMON CATHODE RESISTOR BYPASSED	140	---	---	---	OHMS
PEAK GRID-TO-GRID SIGNAL VOLTAGE	43	46	58	65	VOLTS
ZERO-SIGNAL PLATE CURRENT, DC	170	170	150	100	MA.
MAX.-SIGNAL PLATE CURRENT, DC	185	275	295	270	MA.
ZERO-SIGNAL GRID 2 CURRENT, DC	10	9	9	5	MA.
MAX.-SIGNAL GRID 2 CURRENT, DC	25	35	38	33	MA.
EFFECTIVE LOAD, PLATE-TO-PLATE	5,000	3,500	3,500	5,000	OHMS
TOTAL HARMONIC DISTORTION, APPROX.	0.7	0.6	1.5	3.0	PERCENT
MAX.-SIGNAL POWER OUTPUT	40	60	77	100	WATTS

PUSH-PULL AUDIO AMPLIFIER, ULTRA-LINEAR OPERATION
GRID 2 TAPPED AT 40% OF PRIMARY TURNS

AVERAGE VALUES FOR TWO MATCHED TUBES[A]

	SELF BIAS CLASS A1	FIXED BIAS CLASS AB1	
PLATE AND GRID 2 VOLTAGE, DC	395	450	VOLTS
GRID 1 VOLTAGE, DC	---	-48	VOLTS
COMMON CATHODE RESISTOR -BYPASSED	200	---	OHMS
PEAK GRID-TO-GRID SIGNAL VOLTAGE	70	96	VOLTS
ZERO-SIGNAL PLATE CURRENT, DC	170	150	MA.
MAX.-SIGNAL PLATE CURRENT, DC	174	265	MA.
ZERO-SIGNAL GRID 2 CURRENT, DC	12.5	12	MA.
MAX.-SIGNAL GRID 2 CURRENT, DC	23	38	MA.
EFFECTIVE LOAD, PLATE-TO-PLATE	5600	4000	OHMS
TOTAL HARMONIC DISTORTION (APPROX.)	1.5	2.4	PERCENT
MAX.-SIGNAL POWER OUTPUT	34	70	WATTS

A
A SMALL RESISTOR IN SERIES WITH EACH CATHODE IS RECOMMENDED FOR BETTER MAINTENANCE OF BALANCE BETWEEN TUBES.

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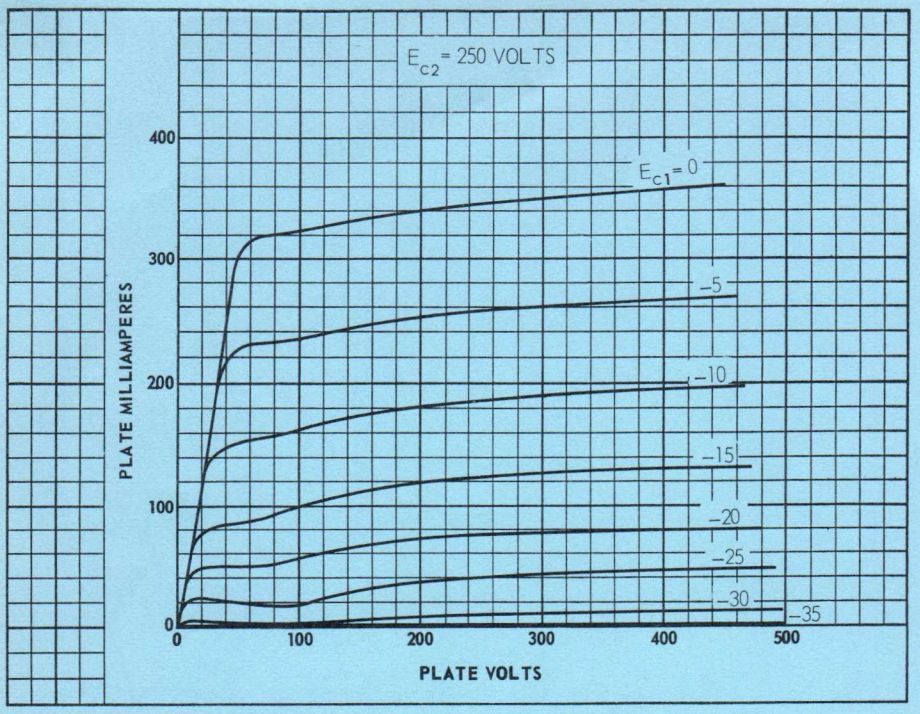
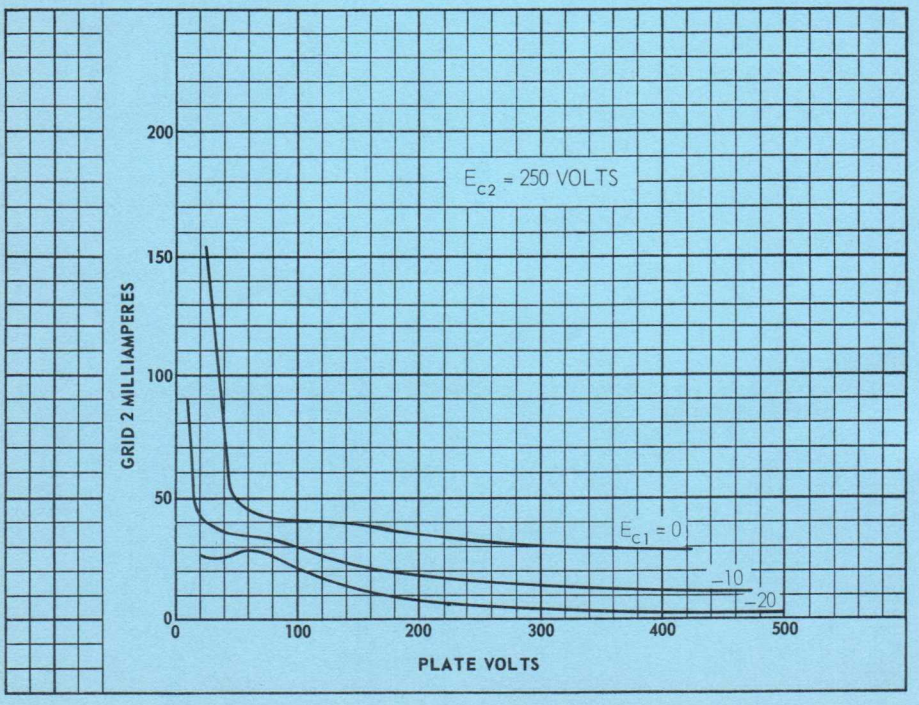
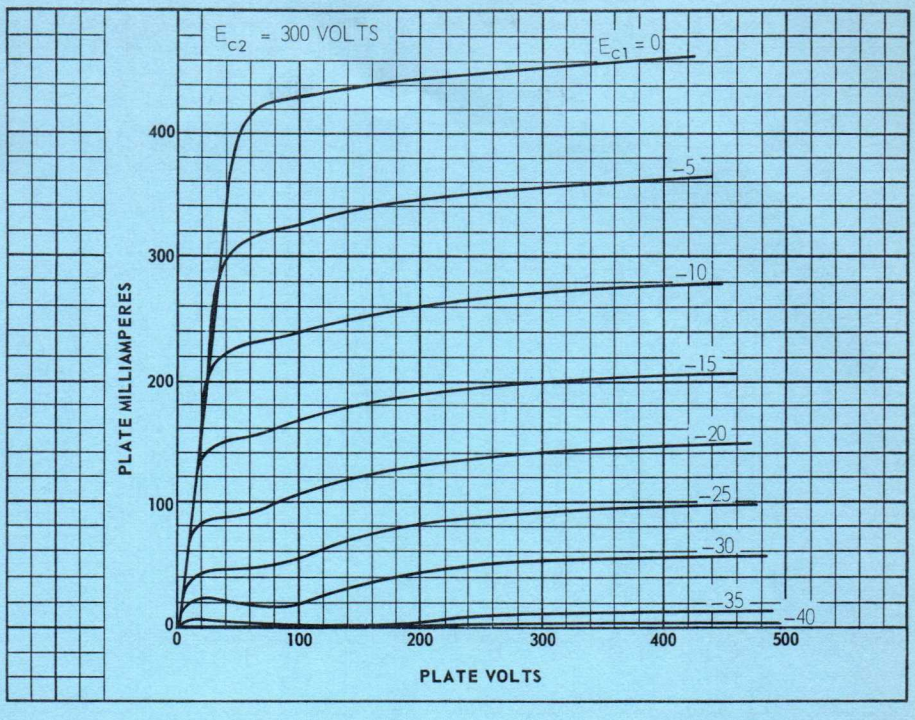
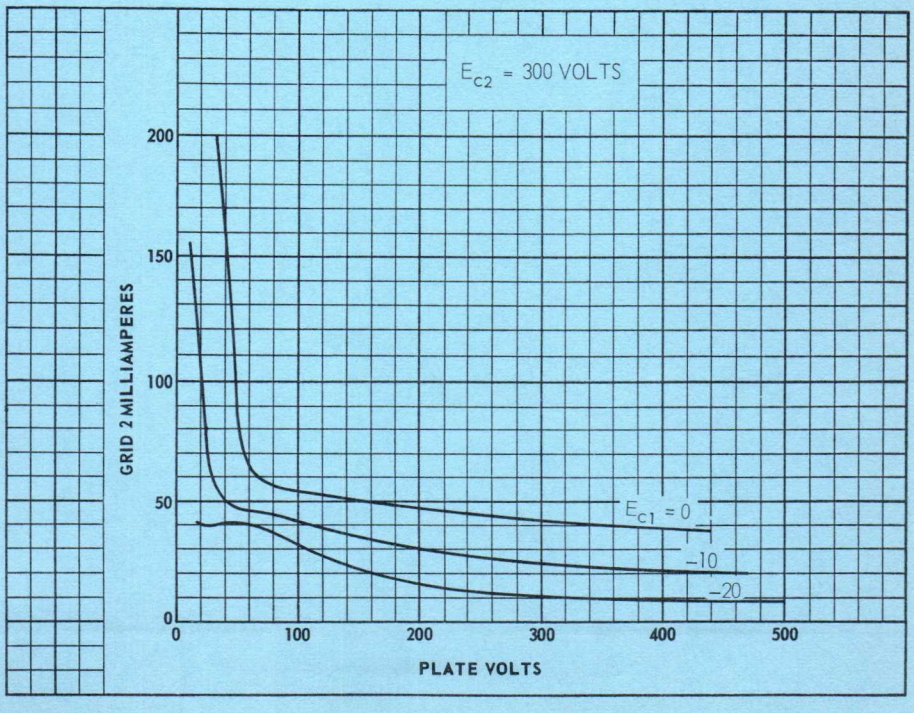

E_{c2} = 250 VOLTS
E_{c1} = 0
-5
-10
-15
-20
-25
-30
-35
PLATE MILLIAMPERES
0
100
200
300
400
0
100
200
300
400
500
PLATE VOLTS


E_{c2} = 250 VOLTS
E_{c1} = 0
-10
-20
GRID 2 MILLIAMPERES
0
50
100
150
200
0
100
200
300
400
500
PLATE VOLTS





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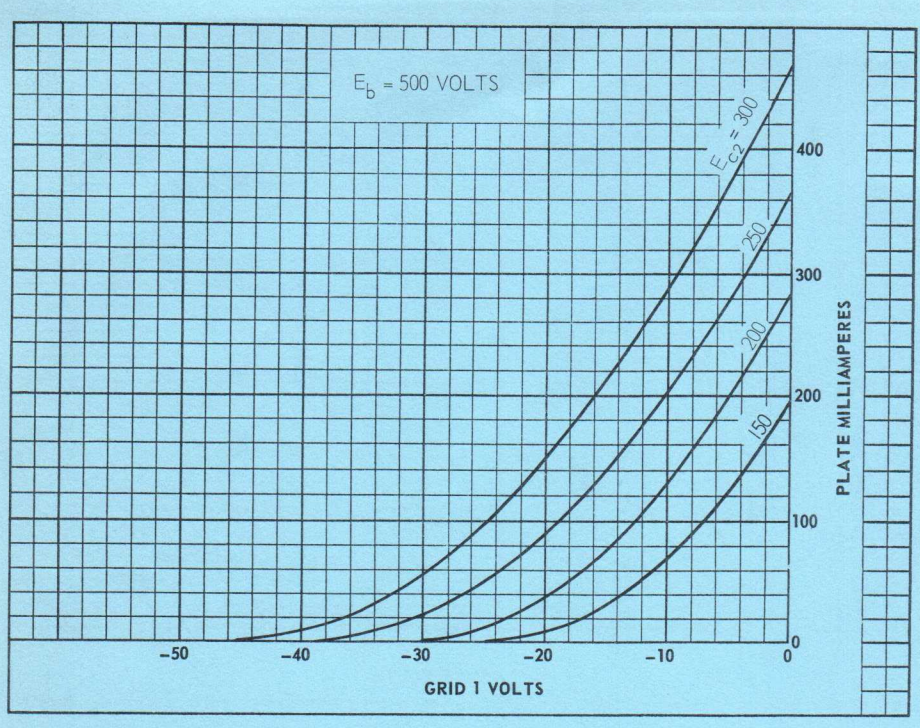
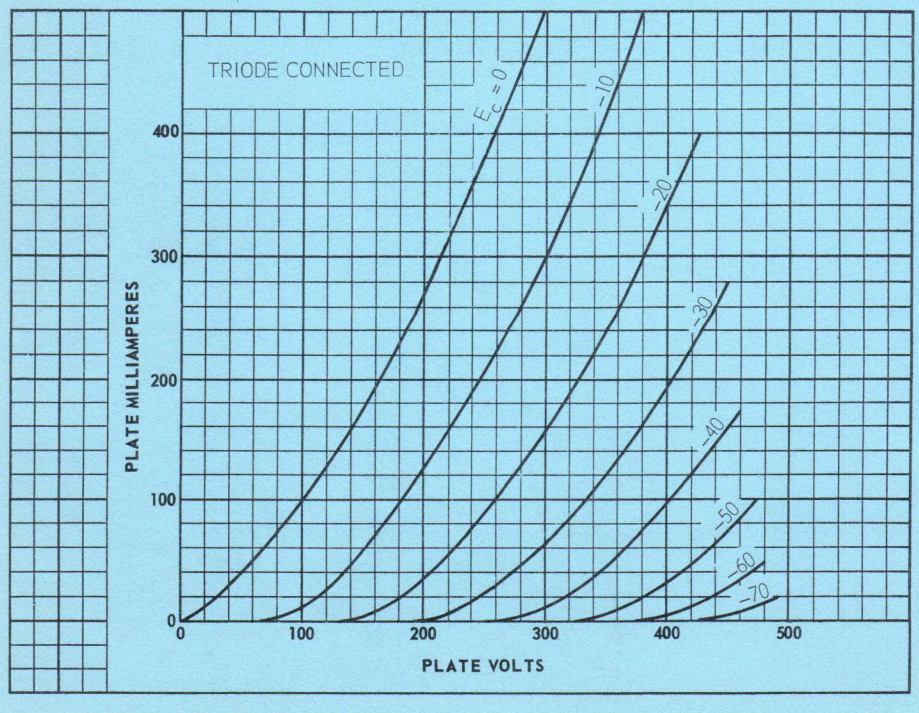
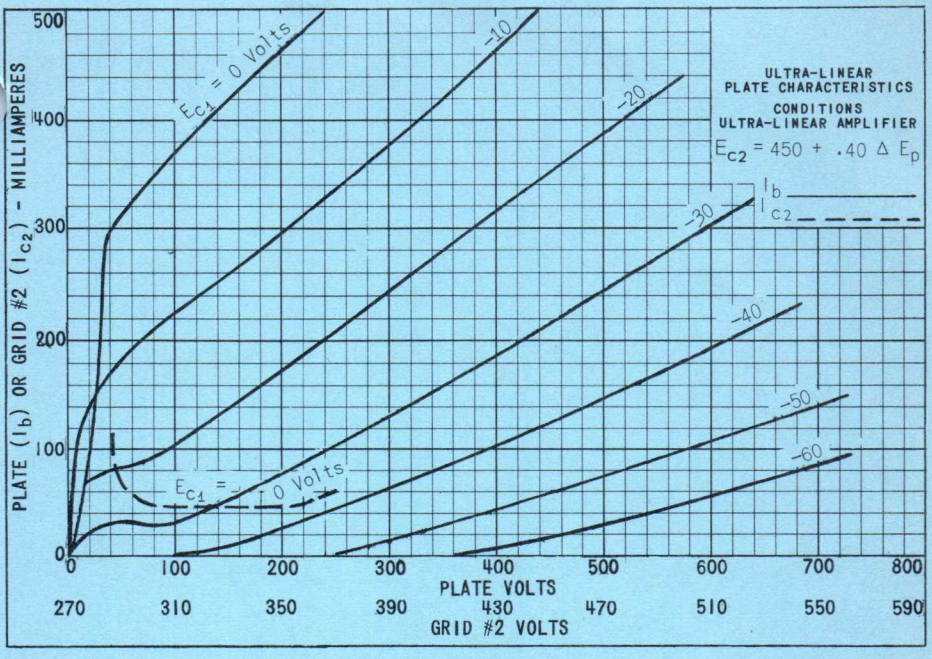
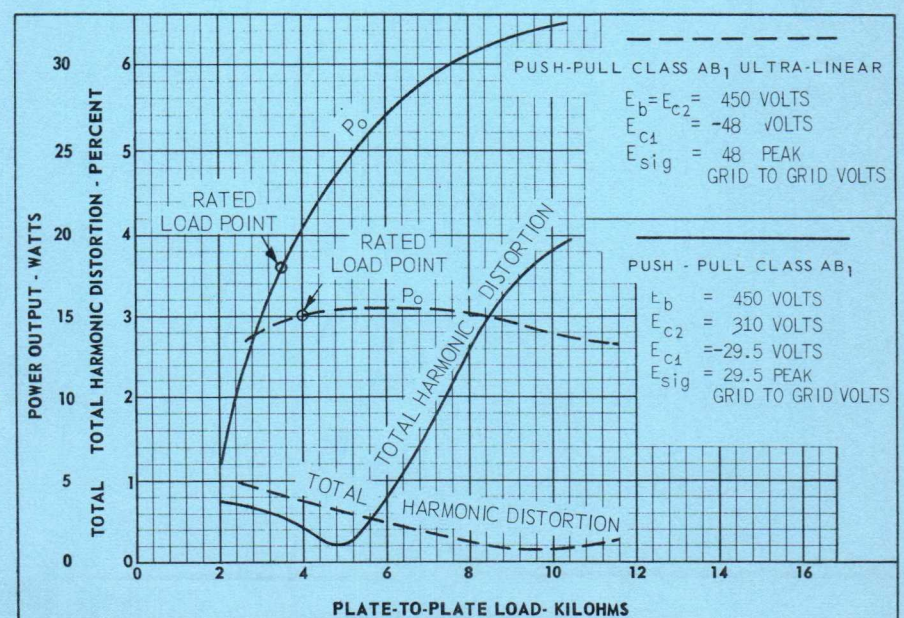

E_b = 500 VOLTS
E_{c2} = 300
250
200
150
400
300
200
100
0
PLATE MILLIAMPERES
−50
−40
−30
−20
−10
0
GRID 1 VOLTS


TRIODE CONNECTED
E_c = 0
−10
−20
−30
−40
−50
−60
−70
400
300
200
100
0
PLATE MILLIAMPERES
0
100
200
300
400
500
PLATE VOLTS





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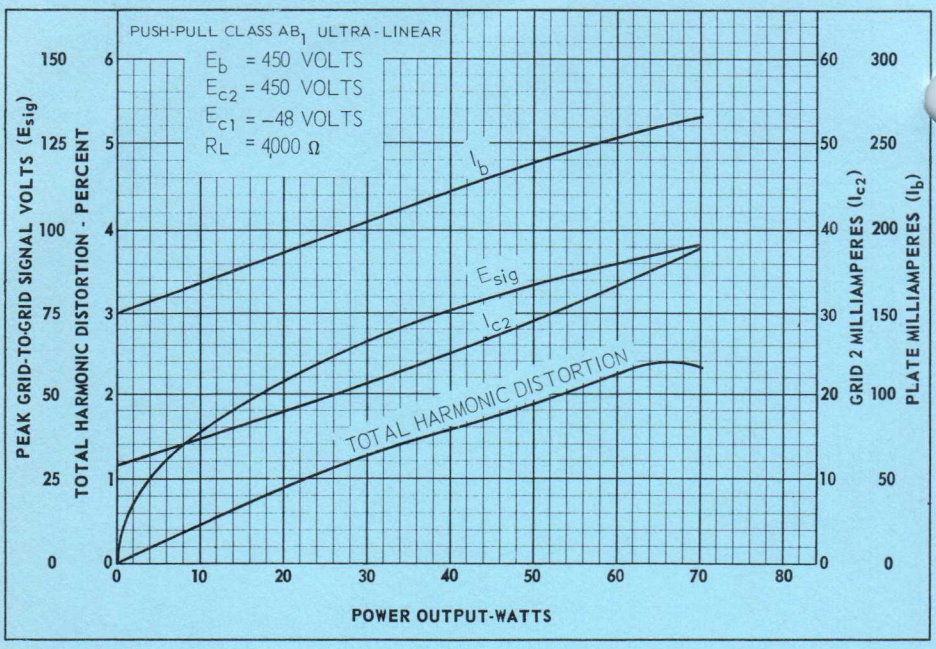
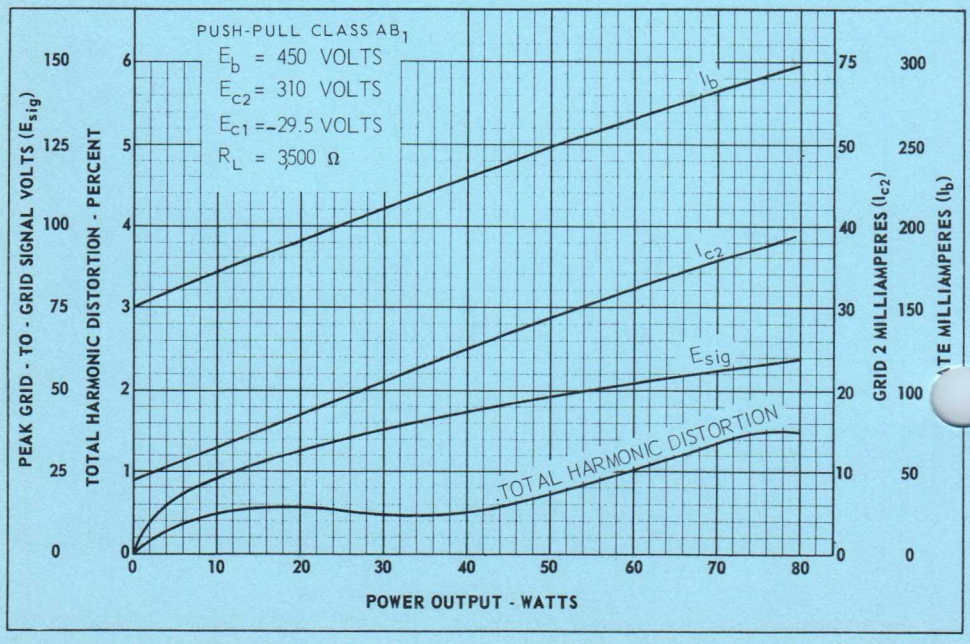

PUSH-PULL CLASS AB1 ULTRA-LINEAR
Eb = 450 VOLTS
Ec2 = 450 VOLTS
Ec1 = −48 VOLTS
RL = 4000 Ω
Ib
Esig
Ic2
TOTAL HARMONIC DISTORTION
PEAK GRID-TO-GRID SIGNAL VOLTS (Esig)
TOTAL HARMONIC DISTORTION - PERCENT
GRID 2 MILLIAMPERES (Ic2)
PLATE MILLIAMPERES (Ib)
POWER OUTPUT-WATTS


PUSH-PULL CLASS AB1
Eb = 450 VOLTS
Ec2 = 310 VOLTS
Ec1 = −29.5 VOLTS
RL = 3500 Ω
Ib
Ic2
Esig
TOTAL HARMONIC DISTORTION
PEAK GRID - TO - GRID SIGNAL VOLTS (Esig)
TOTAL HARMONIC DISTORTION - PERCENT
GRID 2 MILLIAMPERES (Ic2)
POWER OUTPUT - WATTS

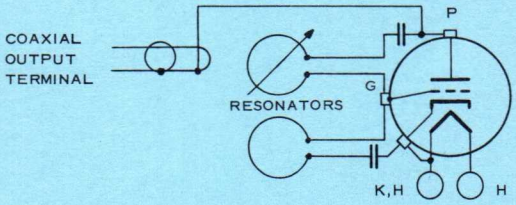
TUNG-SOL

TRIODE OSCILLATOR

THE 6562 IS AN INTEGRAL-CAVITY OSCILLATOR ASSEMBLY DESIGNED FOR TRANSMITTING SERVICE IN BATTERY POWERED RADIOSONDES OPERATING NEAR 1680 MC/S. IT INCORPORATES A PENCIL TRIODE WITH UNUSUALLY LOW HEATER POWER BATTERY DRAIN, RELATIVELY HIGH PLATE CIRCUIT EFFICIENCY, LOW FREQUENCY DRIFT AND A WEIGHT OF ONLY 0.8 OUNCES. THE OUTPUT FREQUENCY CAN BE ADJUSTED BETWEEN 1668 AND 1692 MC/S BY MEANS OF AN ADJUSTMENT SCREW POSITIONED IN THE PLATE RESONATOR. THE CATHODE RESONATOR IS PRE-TUNED FOR UNIFORM POWER OUTPUT OVER THE TUNEABLE FREQUENCY RANGE. THE COAXIAL TERMINAL IS LOOP COUPLED TO THE PLATE RESONATOR.

MECHANICAL DATA

TERMINAL CONNECTIONS



PHYSICAL DIMENSIONS — SEE OUTLINE AND NOTES

ELECTRICAL DATA

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.0	VOLTS	160	MA.
LIMITS OF APPLIED VOLTAGE			5.2 TO 6.6	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

FOR ALTITUDES UP TO 100,000 FEET

DC PLATE-TO-GRID VOLTAGE	120	VOLTS
PLATE DISSIPATION	3.6	WATTS
PLATE INPUT	4	WATTS
DC PLATE CURRENT	34	MA.
DC GRID CURRENT	8	MA.
AMBIENT TEMPERATURE	–55 TO +75	°C

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TUNG-SOL

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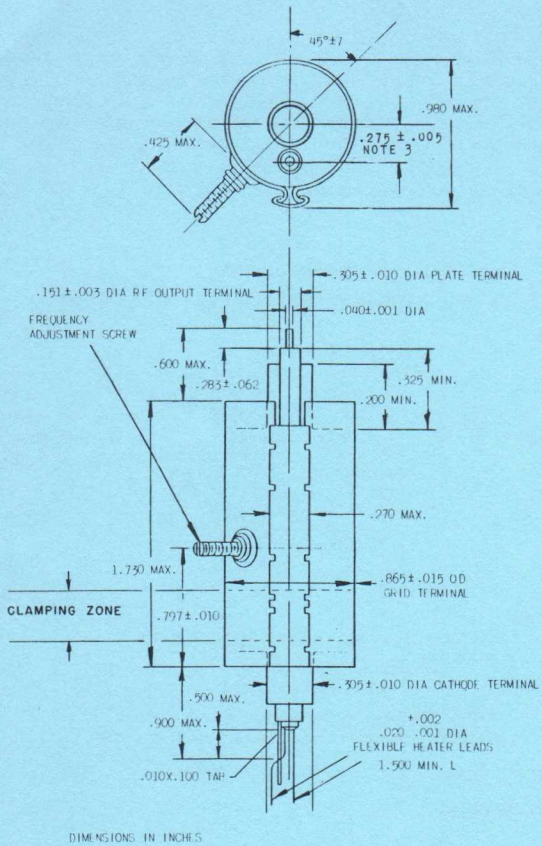
OUTLINE



NOTES:

1. THE AXES OF THE INNER AND OUTER CONDUCTORS OF THE COAXIAL OUTPUT TERMINAL COINCIDE WITHIN 0.010".

2. THE END OF THE INSULATOR IN THE COAXIAL OUTPUT TERMINAL ALIGNS WITH THE EDGE OF THE OUTER CONDUCTOR (0.151" ± 0.003" DIAMETER) WITHIN 0.005"

3. DISTANCE BETWEEN CENTERLINE OF PLATE TERMINAL AND CENTER LINE OF INNER CONDUCTOR (0.040" ± 0.001" DIAMETER).

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OPERATION AS CLASS C OSCILLATOR

OPERATING FREQUENCY	1680	MC/S
CHARACTERISTICS IMPEDANCE OF COAXIAL OUTPUT TERMINAL (APPROX.)	50	Ω
DC PLATE SUPPLY VOLTAGE	105	VOLTS
GRID RESISTOR - ADJUSTED FOR STATED PLATE CURRENT AVG. VALUE	1800	Ω
DC PLATE CURRENT	25.5	MA.
DC GRID CURRENT	3.5	MA.
USEFUL POWER OUTPUT (APPROX.)	370	MW.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	MIN.	MAX.	
TUNING RANGE	1668	1692	MC/S
LOAD ADJUSTED FOR VOLTAGE STANDING WAVE RATIO		1.1	
HEATER CURRENT AT Ef = 5.2 V.	135	157	MA.
GRID RESISTOR - SEE NOTE	1300	2400	Ω
USEFUL POWER OUTPUT AT Ef = 5.2 V., Ebb = 95 V.	300	------	MW.

SPECIAL TESTS AND PERFORMANCE DATA

CONTROLLED ON A SAMPLING BASIS

LOW-PRESSURE VOLTAGE BREAKDOWN TEST

HIGH-FREQUENCY VIBRATION TEST

MILITARY SPECIFICATIONS SHORTS AND CONTINUITY TEST PERFORMED ON ALL DEVICES

TEMPERATURE-FREQUENCY PERFORMANCE

5 HOUR RADIOSONDE LIFE PERFORMANCE TEST

NOTE:

ADJUSTED TO GIVE PLATE CURRENT AS CLOSE AS POSSIBLE, BUT NOT EXCEEDING 33 MA. OPERATE WITH Ef = 6.6 V., Ebb = 117 V., PLATE LOAD RESISTANCE OF 50 Ω, FREQUENCY ADJUSTED TO 1660 +3, −1 MC/S.

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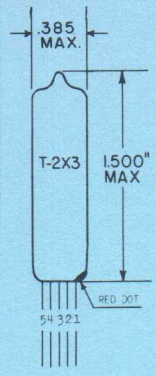
OUTLINE DRAWING
JEDEC 2-1



GLASS BULB
BULB ENTIRELY COATED WITH METALLIC SHIELD CONNECTED TO LEAD #3

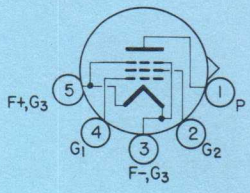
COLOR DOT IS ADJACENT TO LEAD #1

PENTODE
SUBMINIATURE
FILAMENTARY TYPE

FOR RF APPLICATIONS

ANY MOUNTING POSITION

BASING DIAGRAM



BOTTOM VIEW
5 FLEXIBLE IN-LINE TINNED LEADS 0.016" DIA. 0.048" CENTER-TO-CENTER

THE 6611 IS A FILAMENTARY TYPE, FULLY SHIELDED PENTODE IN THE T-2 X 3 SUBMINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE IN RF APPLICATIONS WHERE ECONOMY OF SPACE, WEIGHT AND BATTERY DRAIN IS ESSENTIAL.

DIRECT INTERELECTRODE CAPACITANCES

GRID 1 TO PLATE	MAX. 0.008	pf
INPUT	4.0	pf
OUTPUT	4.0	pf

FILAMENT CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	1.25	VOLTS	20	MA
LIMITS OF APPLIED VOLTAGE			1.25 ± 0.35	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

PLATE VOLTAGE	50	VOLTS
GRID 2 VOLTAGE	50	VOLTS
PLATE DISSIPATION	0.10	WATT
GRID 2 DISSIPATION	0.02	WATT
TOTAL CATHODE CURRENT	1.9	MA

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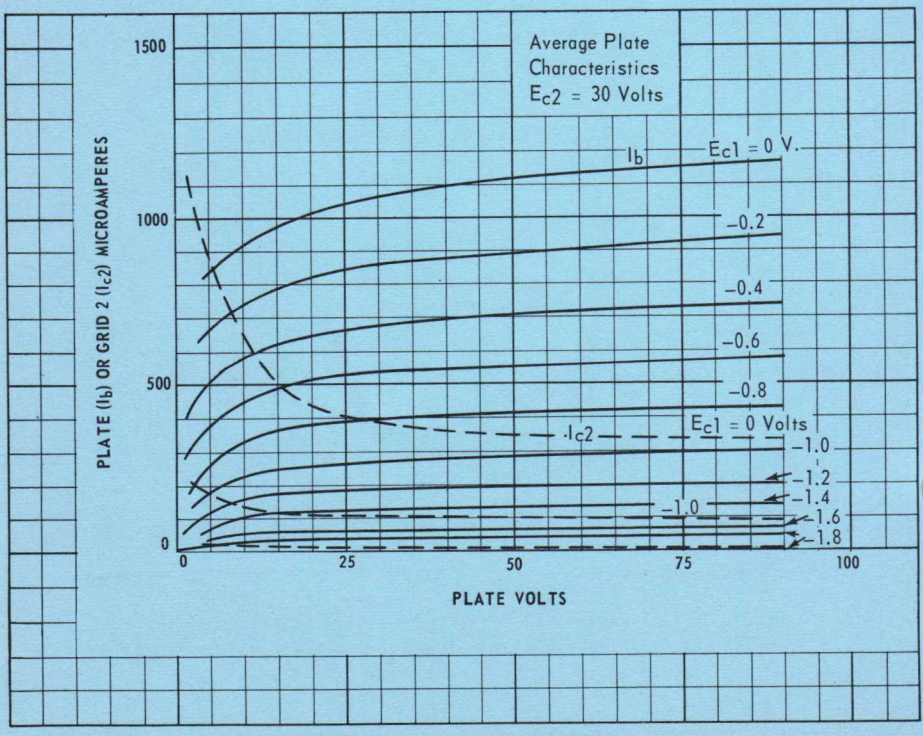
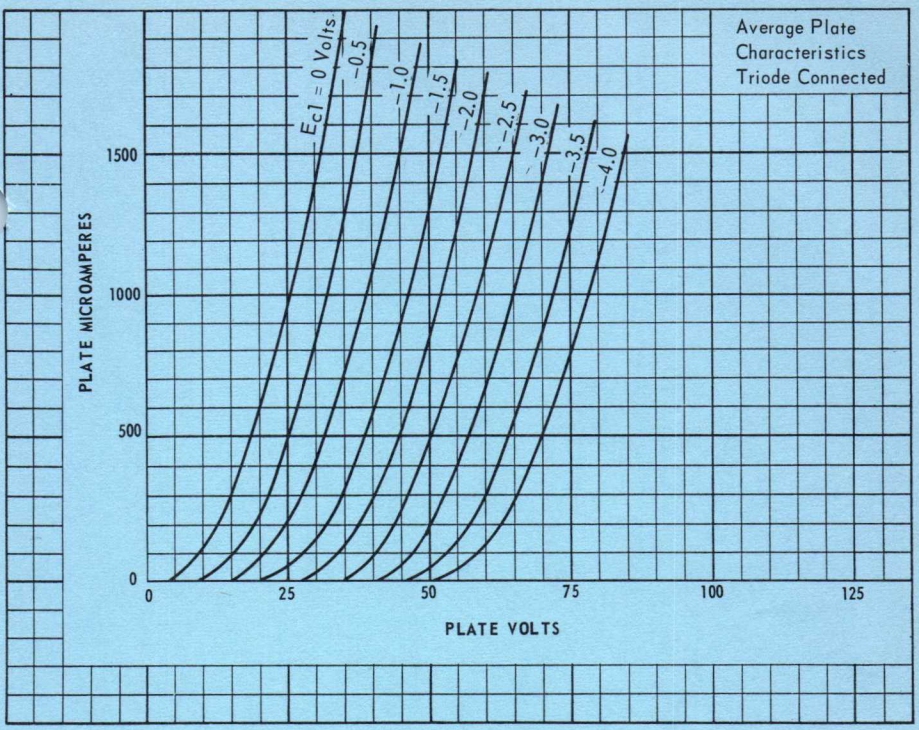
CHARACTERISTICS AND TYPICAL OPERATION

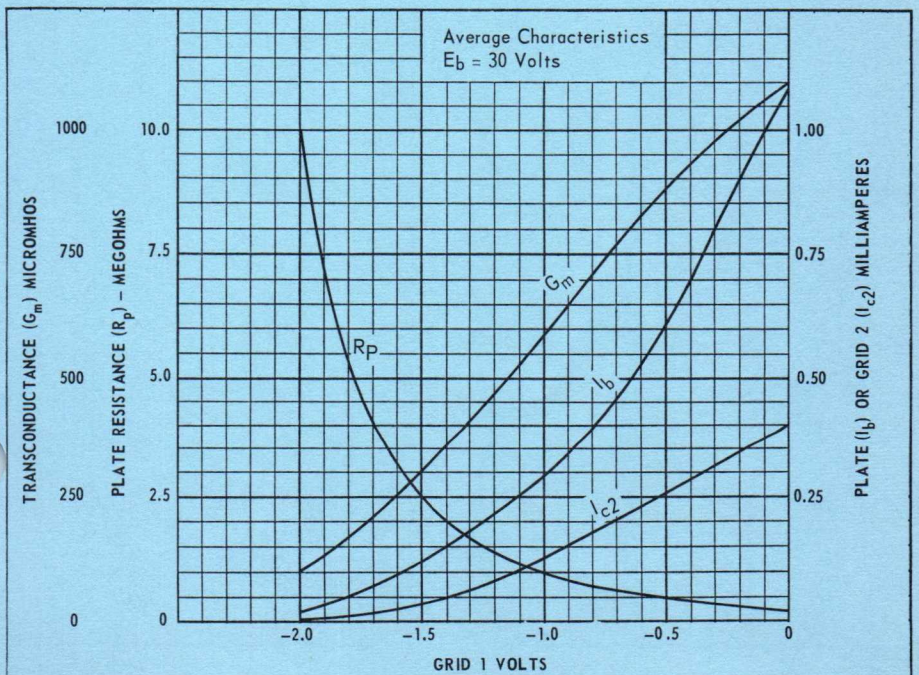
CLASS A_1 AMPLIFIER

PLATE VOLTAGE	30	45	VOLTS
GRID 2 VOLTAGE	30	*45	VOLTS
GRID 1 VOLTAGE (GRID RESISTOR = 5 MEGOHMS)	0	0	VOLTS
PLATE CURRENT	1.0	1.0	MA
GRID 2 CURRENT	0.35	0.35	MA
TRANSCONDUCTANCE	1,000	1,000	μMHOS
PLATE RESISTANCE – APPROX.	0.4	0.4	MEGOHM
GRID 1 VOLTAGE (APPROX.) FOR G_m = 10 μMHOS	–3.0	–	VOLTS

*GRID 2 SUPPLY VOLTAGE THROUGH SERIES 47,000 OHMS SUPPLY RESISTOR.







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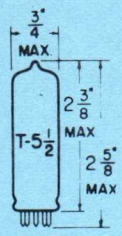
VOLTAGE REGULATOR

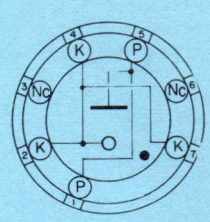
MINIATURE TYPE



GLASS BULB

COLD CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW

SMALL-BUTTON MINIATURE
7 PIN BASE

THE 6627/0B2WA IS A MINIATURE, TWO ELECTRODE, INERT-GAS-FILLED, COLD CATHODE TUBE FOR USE AS A VOLTAGE REGULATOR. IT MAINTAINS PRACTICALLY CONSTANT OPERATING VOLTAGE OVER A CURRENT RANGE OF 5 TO 30 MILLIAMPERES. IT HAS BEEN DESIGNED TO GIVE EXTREMELY SMALL VOLTAGE DRIFT THROUGHOUT LIFE BY CONTROLLED MANUFACTURING PROCESSES. THIS TUBE HAS BEEN SPECIALLY DESIGNED TO MAINTAIN STABLE OPERATING VOLTAGES THROUGH LIFE, EVEN IN APPLICATIONS WHICH REQUIRE TUBES TO OPERATE CONTINUOUSLY UNDER ENVIRONMENTAL CONDITIONS WHICH RAISE THE BULB TEMPERATURE TO A MAXIMUM OF 150°C

OVER THE RANGE OF 6 TO 10 MILLIAMPERES, THIS TUBE EXHIBITS REFERENCE TUBE CHARACTERISTICS. THE 6627/0B2WA ALSO HAS IMPROVED CHARACTERISTICS FOR SHOCK, VIBRATION, AND DARK BREAKDOWN VOLTAGE.

ELECTRICAL DATA

CATHODE	COLD

MECHANICAL DATA

MOUNTING POSITION	ANY	
MAXIMUM OVERALL LENGTH	2 5/8	INCHES
MAXIMUM SEATED LENGTH	2 3/8	INCHES
MAXIMUM DIAMETER	3/4	INCHES
WEIGHT (APPROX.)	0.3	OUNCES
BULB	T-5 1/2	
BASE	SMALL-BUTTON MINIATURE 7 PIN (JEDEC EZ-1)	

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TUNG-SOL

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RATINGS
ABSOLUTE VALUES

MAXIMUM DC CATHODE CURRENT	30	MA.
MINIMUM DC CATHODE CURRENT	5	MA.
MAXIMUM BULB TEMPERATURE	150	°C
MINIMUM AMBIENT TEMPERATURE	−55	°C
MAXIMUM ALTITUDE	120 000	FEET
MAXIMUM INVERSE VOLTAGE	−50.	VOLTS
SHOCK IMPACT	450	G/ms
VIBRATION FATIGUE	2.5	G

CIRCUIT VALUES

MAXIMUM SHUNT CAPACITOR	0.1	μf
SERIES RESISTOR	SEE OPERATION NOTES	

ADDITIONAL TESTS TO INSURE RELIABILITY
RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450 G/msec).

FATIGUE: 25 CPS, 0.08" TOTAL DISPLACEMENT, FOR 32 HOURS IN OF 3 MUTUALLY PERPENDICULAR PLANES (2.5 G).

POST SHOCK AND FATIGUE LIMITS:

IONIZATION VOLTAGE (MAX.)	130	VDC
TUBE VOLTAGE DROP (5. & 30. MA.)	105 TO 111	VDC
REGULATION (5. TO 30. MA.) (MAX.)	2.5	VDC

SURVIVAL RATE LIFE TEST (100 HOURS): END POINT:

CHANGE IN TUBE VOLTAGE DROP FROM INITIAL VALVE	5	PERCENT
VOLTAGE REPEATABILITY (MAX.)	0.4	VDC

INTERMITTENT LIFE TEST: END POINTS (500 HOURS):

CHANGE IN TUBE VOLTAGE DROP FROM INITIAL VALUE (MAX.)	3	PERCENT
TUBE VOLTAGE DROP	103 TO 113	VDC.
REGULATION (MAX.)	3.0	VDC.
IONIZATION VOLTAGE (MAX.)	130	VDC

END POINTS (1000 HOURS):

CHANGE IN TUBE VOLTAGE DROP FROM INITIAL VALUE (MAX.)	4	PERCENT
TUBE VOLTAGE DROP	103 TO 116	VDC
REGULATION (MAX.)	3.0	VDC
IONIZATION VOLTAGE (MAX.)	130	VDC
VOLTAGE REPEATABILITY (MAX.)	0.4	VDC

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TUNG-SOL

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EQUIPMENT DESIGN AND RANGE VALUES

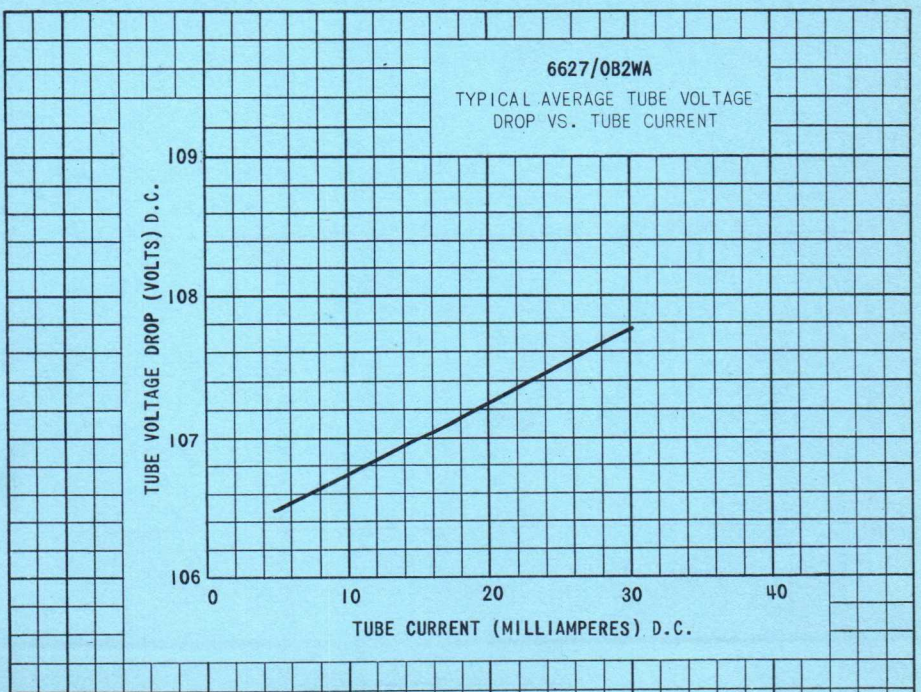
	MIN.	AVG.	MAX.	
DC ANODE SUPPLY VOLTAGE IN DARKNESS	130[A]	---	---	VOLTS
DC ANODE SUPPLY VOLTAGE IN LIGHT	130[A]	---	---	VOLTS
ANODE BREAKDOWN VOLTAGE	---	118	130	VOLTS
TUBE VOLTAGE DROP (1) AT 5.MA.	103	107	---	VOLTS
TUBE VOLTAGE DROP (2) AT 30. MA.	---	108	116	VOLTS
REGULATION	---	1.1	2.5	VOLTS
VOLTAGE JUMP[B]	---	0	100	MVOLTS
VOLTAGE REPEATABILITY[C]	---	0.1	0.4	VOLTS
OSCILLATION (AURAL CHECK)	---	---	---	
NOISE	---	0	5.0	MVOLTS
LEAKAGE CURRENT (E_b= 50V, R_p=3000Ω)	---	0	5.0	μAMPS
MAXIMUM SHUNT CAPACITOR	---	---	0.1	μf
SERIES RESISTOR	D	---	---	
MAXIMUM CURRENT THROUGH INTERCONNECTED LEADS	---	---	1.0	AMP.

[A] TO ASSURE STARTING THROUGHOUT TUBE LIFE, THE SUPPLY VOLTAGE SHOULD NOT BE LESS THAN THIS VALUE.

[B] THE MAXIMUM VOLTAGE FLUCTUATION AT ANY CURRENT LEVEL WITHIN THE CURRENT RANGE OF 6 TO 10 MA.

[C] TUBE IS CYCLED ONE MINUTE ON AND ONE MINUTE OFF FOR FIVE CYCLES. READINGS ARE TAKEN INITIALLY AND AT THE END OF EACH "ON" PERIOD.

[D] SUFFICIENT SERIES RESISTANCE MUST BE USED TO LIMIT THE CURRENT TO A MAXIMUM OF 30. MA. AT THE HIGHEST ANODE SUPPLY VOLTAGE AND TO LIMIT THE CURRENT TO A MINIMUM OF 5. MA. AT THE LOWEST ANODE SUPPLY VOLTAGE.



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TUNG-SOL

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OPERATING NOTES

IN THE OPERATION OF A GLOW TUBE THERE ARE SEVERAL REQUIREMENTS WHICH MUST ALWAYS BE MET. THE FIRST IS THAT THE SUPPLY VOLTAGE MUST ALWAYS BE GREATER THAN THE ANODE BREAKDOWN VOLTAGE AND THE SECOND IS THAT SUFFICIENT RESISTANCE MUST ALWAYS BE PUT IN SERIES WITH THE TUBE IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM AND MAXIMUM VALUES GIVEN IN THE RATINGS.

IN ORDER TO ILLUSTRATE HOW TO CALCULATE THE VALUE OF THE SERIES RESISTANCE A TYPICAL REGULATOR CIRCUIT IS SHOWN IN FIGURE 1.

FROM FIGURE 1 WE SEE THAT V_1 IS THE UNREGULATED SUPPLY VOLTAGE, V_2 IS THE TUBE VOLTAGE DROP OR THE REGULATED VOLTAGE SUPPLIED TO THE LOAD, R_1 IS THE SERIES LIMITING RESISTOR, R_2 IS THE VARIABLE LOAD, I_T IS THE TUBE CURRENT AND I_L IS THE LOAD CURRENT.

WE SEE THAT THE TUBE CURRENT WILL BE A MAXIMUM WHEN THE SUPPLY VOLTAGE IS A MAXIMUM (V_1 MAX.); WHEN THE LOAD CURRENT IS A MINIMUM (I_L MIN.); AND WHEN THE TUBE VOLTAGE DROP IS A MINIMUM (V_2 MIN.). THEREFORE THE CONDITIONS WHICH DETERMINE THE LOWER LIMIT FOR THE SERIES RESISTANCE R_1 ARE THAT

$$R_1 > \frac{V_1 \text{ MAX.} - V_2 \text{ MIN.}}{I_T \text{ MAX.} + I_L \text{ MIN.}}$$

IN A LIKE MANNER IT CAN BE SHOWN THAT THE VALUE OF R_1 IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM VALUE REQUIRES THAT

$$R_1 < \frac{V_1 \text{ MIN.} - V_2 \text{ MAX.}}{I_T \text{ MIN.} + I_L \text{ MAX.}}$$

WHEN THESE VALUES HAVE BEEN COMPUTED, ONE SHOULD CHECK TO SEE IF THERE IS SUFFICIENT STARTING VOLTAGE BY THE FOLLOWING RELATION

$$V_1 \text{ MIN.} \frac{R_2}{R_1 + R_2} > V \text{ STARTING}$$

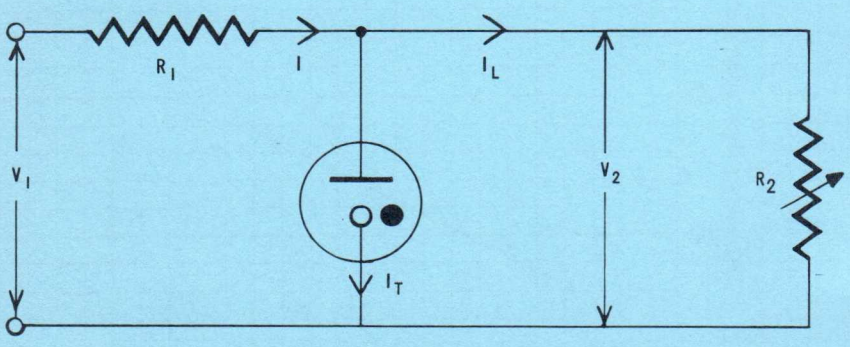

FIGURE 1

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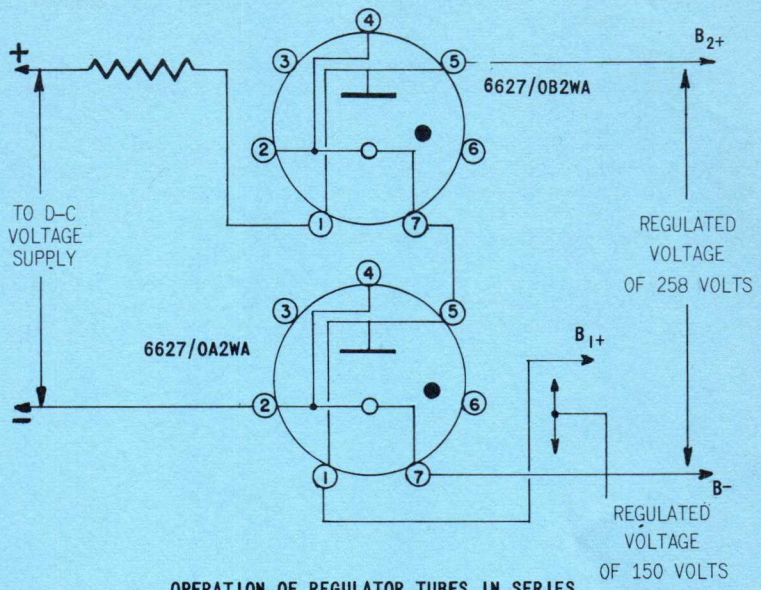
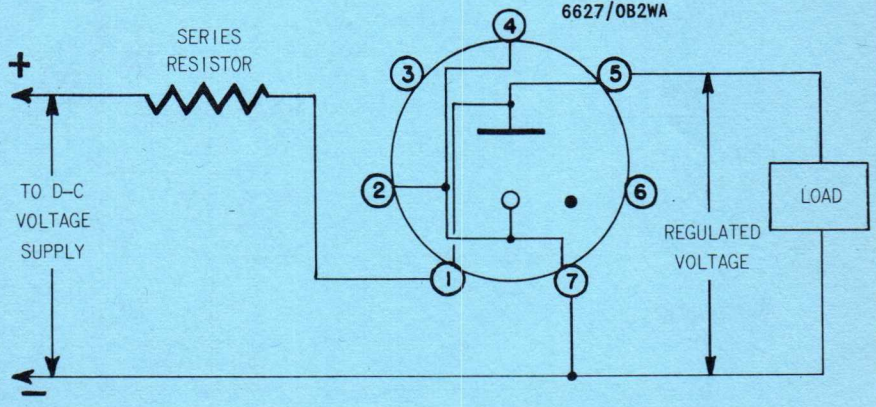


OPERATION OF REGULATOR TUBES IN SERIES
FIGURE 2



TYPICAL CIRCUIT FOR VOLTAGE REGULATOR
FIGURE 3

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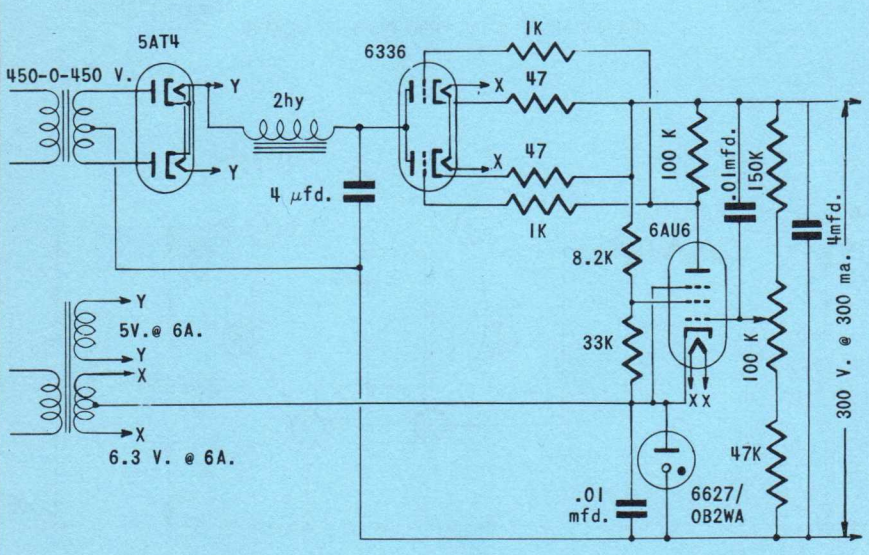
WHEN THESE CALCULATIONS HAVE BEEN MADE AND THERE IS INSUFFICIENT STARTING VOLTAGE, A NEW LOAD CURRENT OF LOWER VALUE MUST BE USED AND THE CALCULATIONS REPEATED.

CIRCUITS WHICH HAVE A CAPACITOR IN SHUNT WITH THE 6627/OB2WA SHOULD BE LIMITED IN VALUE TO 0.1 μfd; LARGER VALUES MAY CAUSE THE TUBE TO OSCILLATE.

OPERATION OF THE 6627/OB2WA IN PARALLEL IS NOT RECOMMENDED UNLESS A RESISTANCE OF APPROXIMATELY 100 OHMS IS USED IN SERIES WITH EACH 6627/OB2WA TO EQUALIZE DIVISION OF THE CURRENT. HOWEVER, IT SHOULD BE NOTED THAT WHILE THIS TYPE OF OPERATION ENABLES ONE TO HANDLE MORE LOAD CURRENT, IT REDUCES THE REGULATION THAT CAN BE OBTAINED.

IF IT IS DESIRED TO OBTAIN HIGHER REGULATING VOLTAGES, TUBES MAY BE OPERATED IN SERIES AS INDICATED IN FIGURE 2. HOWEVER, CARE SHOULD BE TAKEN TO SEE THAT SUFFICIENT SUPPLY VOLTAGE IS AVAILABLE TO START BOTH TUBES.



TYPICAL APPLICATION OF 6627/OB2WA
USED IN VOLTAGE REGULATED POWER SUPPLY
FIGURE 4

TUNG-SOL

PENTODE

MINIATURE TYPE

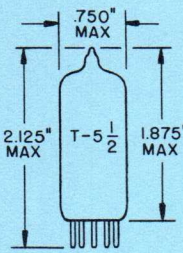
FOR

MOBILE COMMUNICATIONS

EQUIPMENT

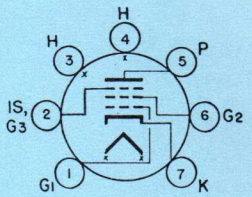
COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB

MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-2



BOTTOM VIEW

BASING DIAGRAM
JEDEC 7CC

THE 6660 IS A MINIATURE REMOTE-CUTOFF PENTODE DESIGNED FOR USE AS A WIDE-BAND HIGH-FREQUENCY AMPLIFIER. FEATURES OF THE TUBE INCLUDE LOW GRID-PLATE CAPACITANCE AND RELATIVELY HIGH TRANSCONDUCTANCE. ITS ELECTRICAL CHARACTERISTICS ARE ESSENTIALLY EQUIVALENT TO THOSE OF THE 6BA6.

THE 6660 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALTHOUGH THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODS, HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY-VOLTAGE REGULATION.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID 1 TO PLATE, MAXIMUM	0.0035	0.0035	pf
INPUT	5.5	5.5	pf
OUTPUT	5.5	5.0	pf

[A] WITH EXTERNAL SHIELD 316 CONNECTED TO PIN 7.

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	300	MA.
HEATER SUPPLY LIMITS:				
VOLTAGE OPERATION			6.3±1.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			100	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	330	VOLTS
GRID 2 SUPPLY VOLTAGE	330	VOLTS
GRID 2 VOLTAGE	See Rating Chart	
POSITIVE DC GRID 1 VOLTAGE	0	VOLTS
NEGATIVE DC GRID 1 VOLTAGE	55	VOLTS
PLATE DISSIPATION	3.3	WATTS
GRID 2 DISSIPATION	0.65	WATTS

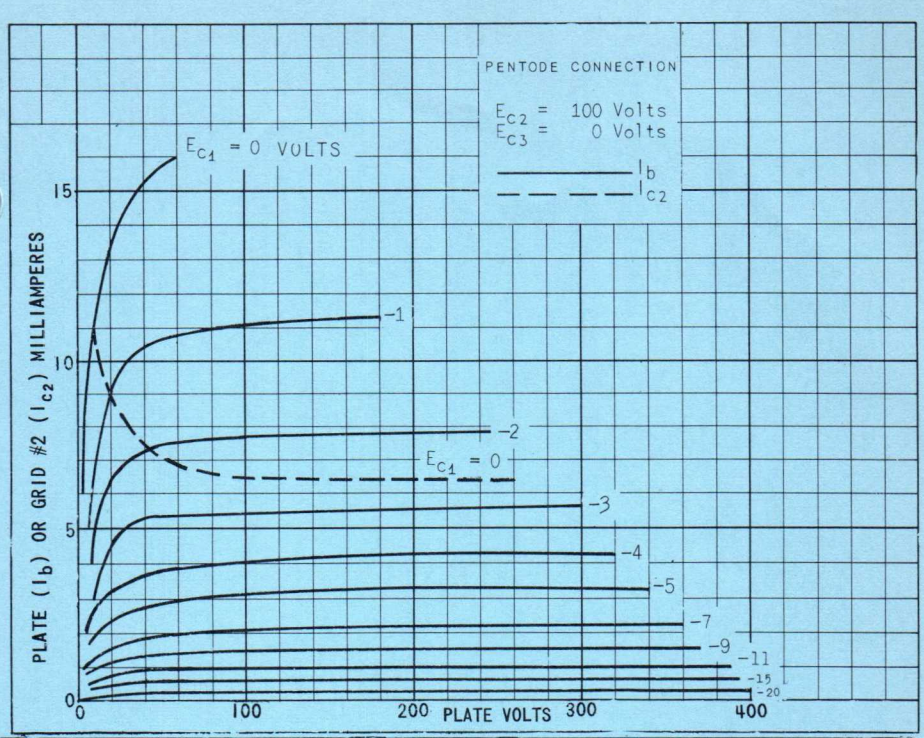
TYPICAL OPERATING CHARACTERISTICS

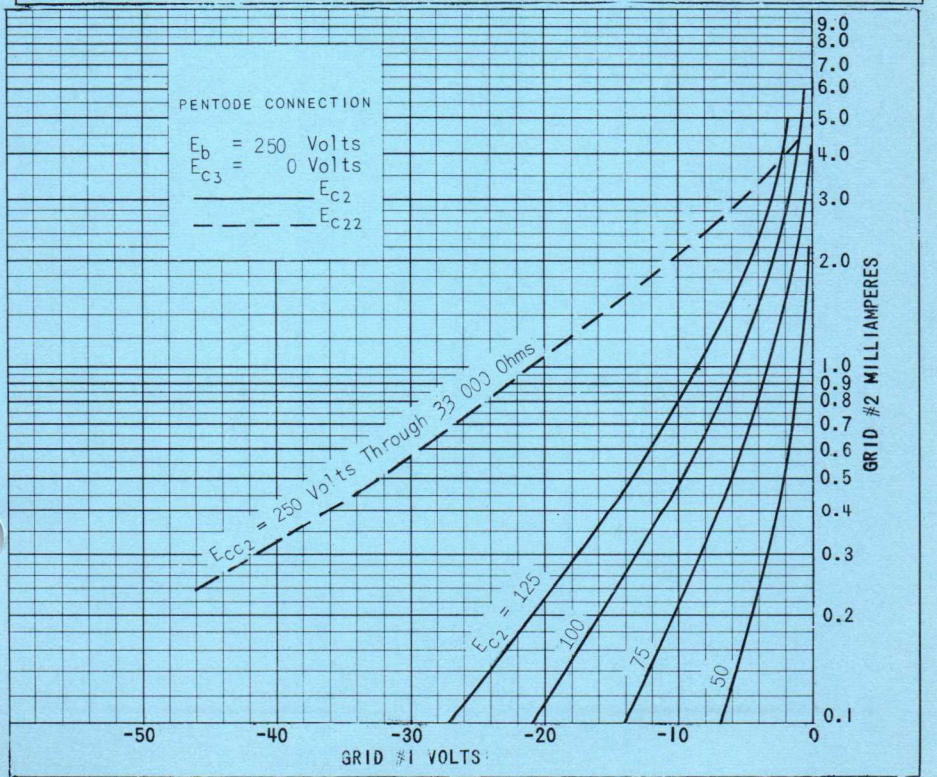
CLASS A1 AMPLIFIER

PLATE VOLTAGE	100	250	VOLTS
GRID 3 VOLTAGE	0	0	VOLTS
GRID 2 VOLTAGE	100	100	VOLTS
CATHODE-BIAS RESISTOR	68	68	OHMS
PLATE CURRENT	10.8	11	MA.
GRID 2 CURRENT	4.4	4.2	MA.
TRANSCONDUCTANCE	4,300	4,400	μMHOS
PLATE RESISTANCE, APPROXIMATE	0.25	1.0	MEGOHMS
GRID 1 VOLTAGE, APPROXIMATE			
Gm = 40 μMHOS	−20	−20	VOLTS

SPECIAL TESTS AND RATINGS

HEATER-CYCLING RATING





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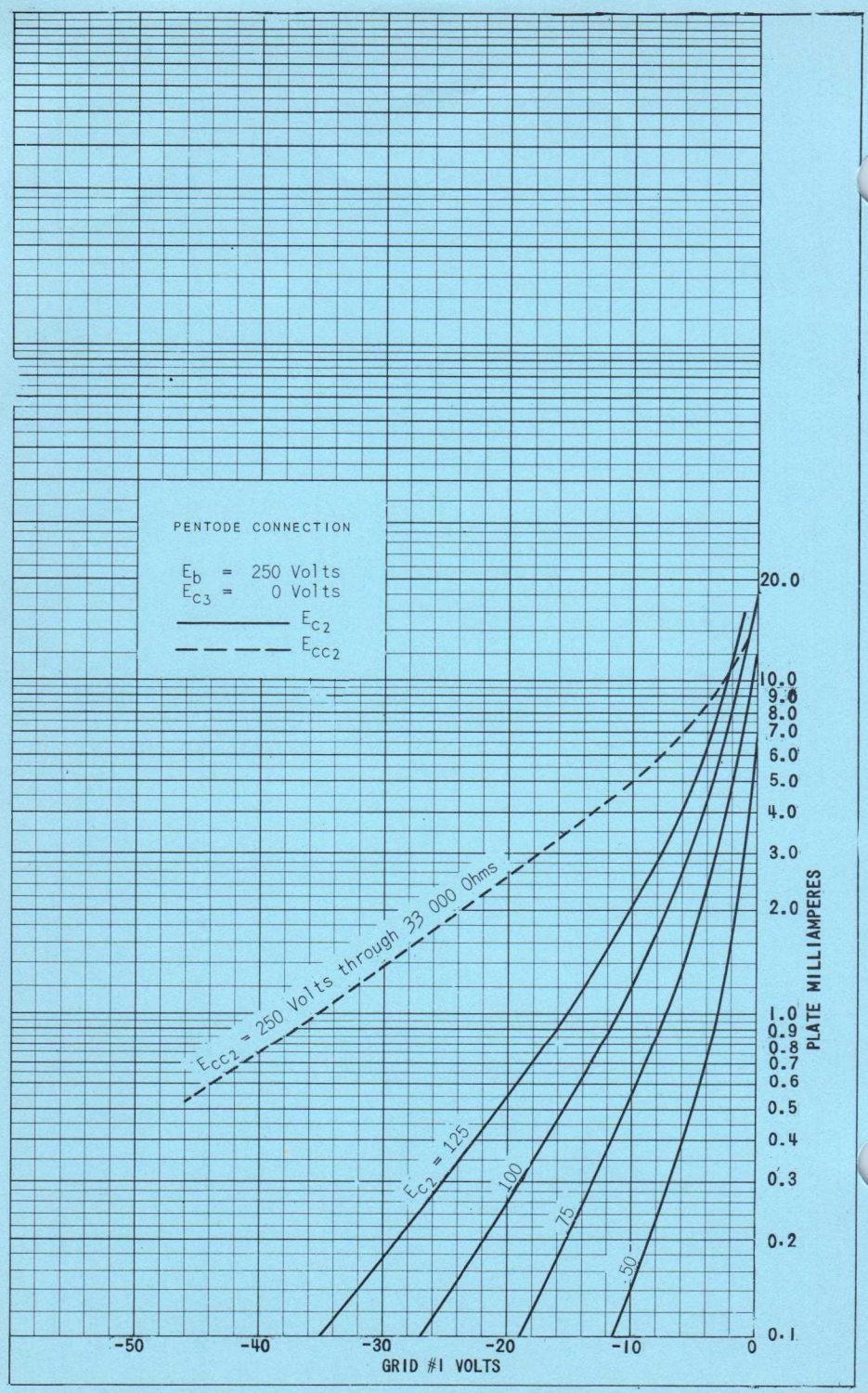
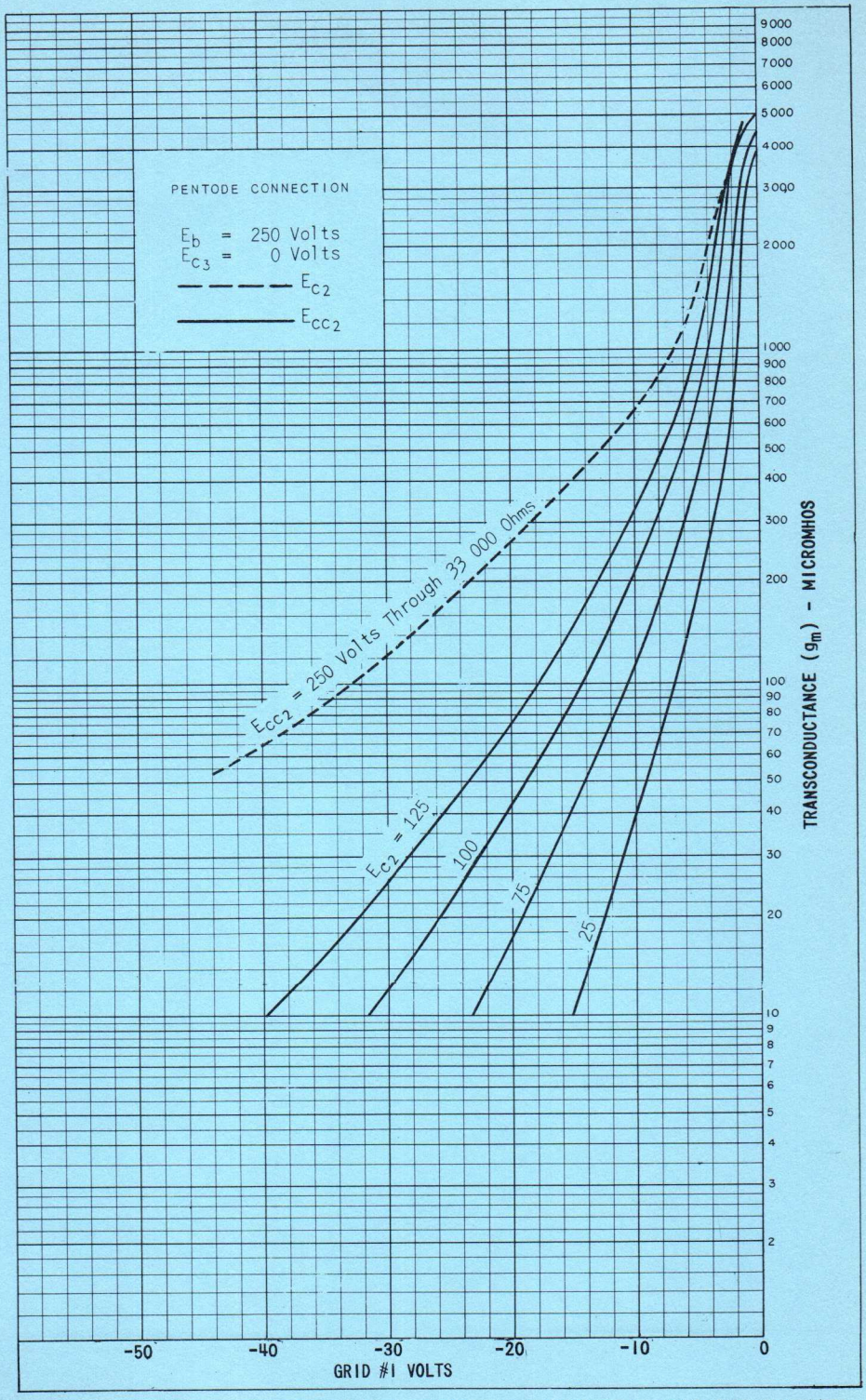

PENTODE CONNECTION
E_b = 250 Volts
E_{c3} = 0 Volts
E_{c2}
E_{cc2}
E_{cc2} = 250 Volts through 33 000 Ohms
E_{c2} = 125
100
75
50
20.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
PLATE MILLIAMPERES
-50
-40
-30
-20
-10
0
GRID #1 VOLTS



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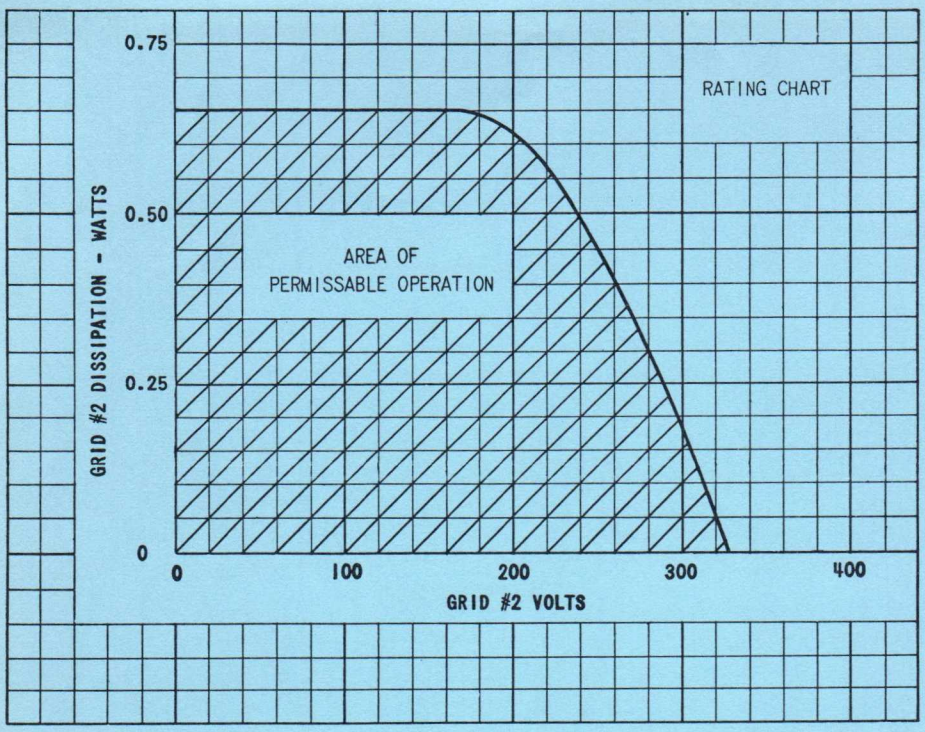

RATING CHART
AREA OF
PERMISSABLE OPERATION
GRID #2 DISSIPATION - WATTS
0.75
0.50
0.25
0
0
100
200
300
400
GRID #2 VOLTS

TUNG-SOL

PENTODE

MINIATURE TYPE

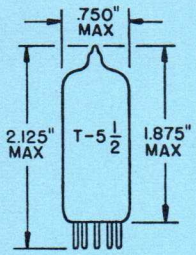
FOR

MOBILE COMMUNICATIONS

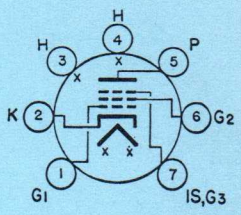
EQUIPMENT

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB
MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-2



BOTTOM VIEW
BASING DIAGRAM
JEDEC 7CM

THE 6661 IS A MINIATURE REMOTE-CUTOFF PENTODE DESIGNED FOR USE AS A WIDE-BAND HIGH-FREQUENCY AMPLIFIER.

THE 6661 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALTHOUGH THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODS, HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY-VOLTAGE REGULATION.

THE ELECTRICAL CHARACTERISTICS OF THE 6661 ARE EQUIVALENT TO THE 6BH6.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID 1 TO PLATE, MAXIMUM	0.0035	0.0035	pf
INPUT	5.4	5.4	pf
OUTPUT	4.4	4.4	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	150	MA.
HEATER SUPPLY LIMITS:				
VOLTAGE OPERATION			6.3±1.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE			100	VOLTS

[A] WITH EXTERNAL SHIELD 316 CONNECTED TO PINS 2 AND 7.

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	330	VOLTS
GRID 2 SUPPLY VOLTAGE	330	VOLTS
GRID 2 VOLTAGE	See Rating Chart	
POSITIVE DC GRID 1 VOLTAGE	0	VOLTS
NEGATIVE DC GRID 1 VOLTAGE	55	VOLTS
PLATE DISSIPATION	3.3	WATTS
GRID 2 DISSIPATION	0.55	WATTS

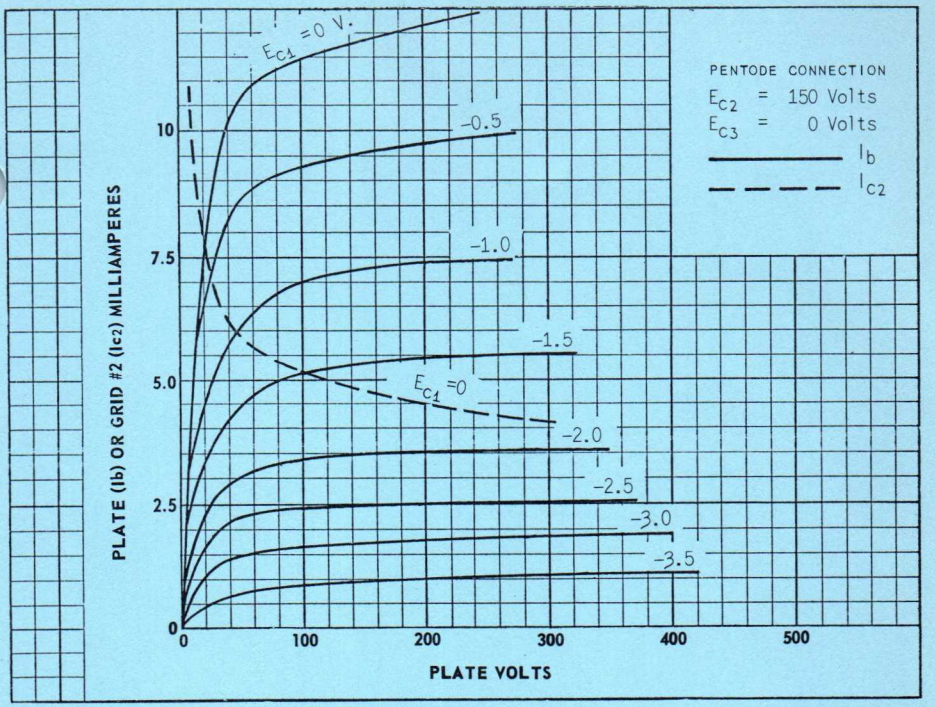
TYPICAL OPERATING CHARACTERISTICS

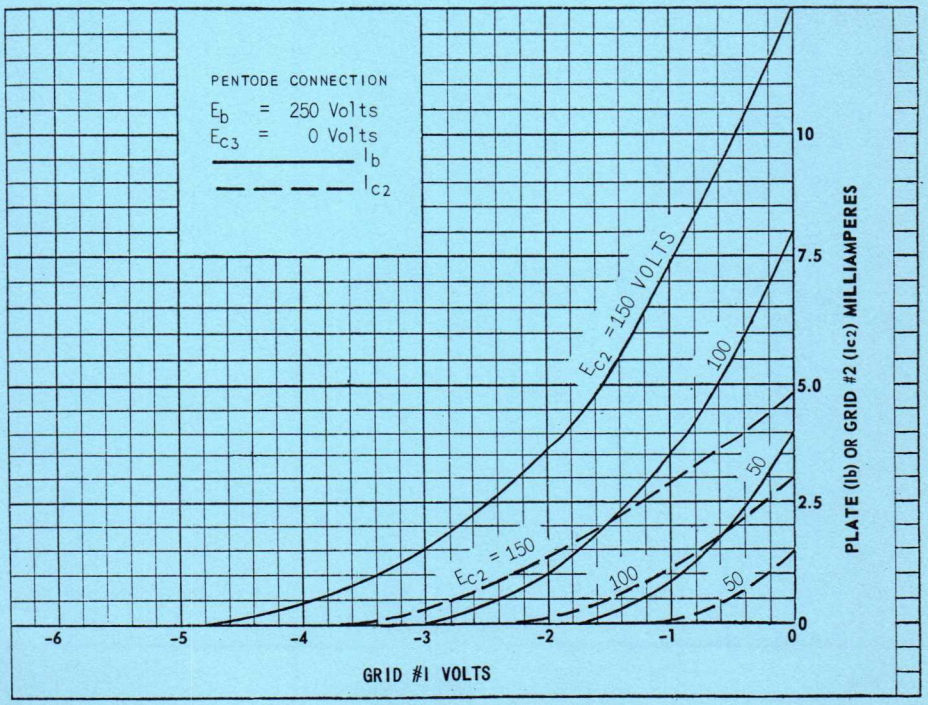
CLASS A1 AMPLIFIER

PLATE VOLTAGE	250	VOLTS
GRID 3 VOLTAGE	0	VOLTS
GRID 2 VOLTAGE	150	VOLTS
CATHODE-BIAS RESISTOR	100	OHMS
PLATE CURRENT	7.4	MA.
GRID 2 CURRENT	2.6	MA.
TRANSCONDUCTANCE	4,600	μMHOS
PLATE RESISTANCE, APPROX.	1.4	MEGOHMS
GRID 1 VOLTAGE (APPROX.) FOR I_b = 10 μAMPS.	-7.7	VOLTS

SPECIAL TESTS AND RATINGS

HEATER-CYCLING RATING





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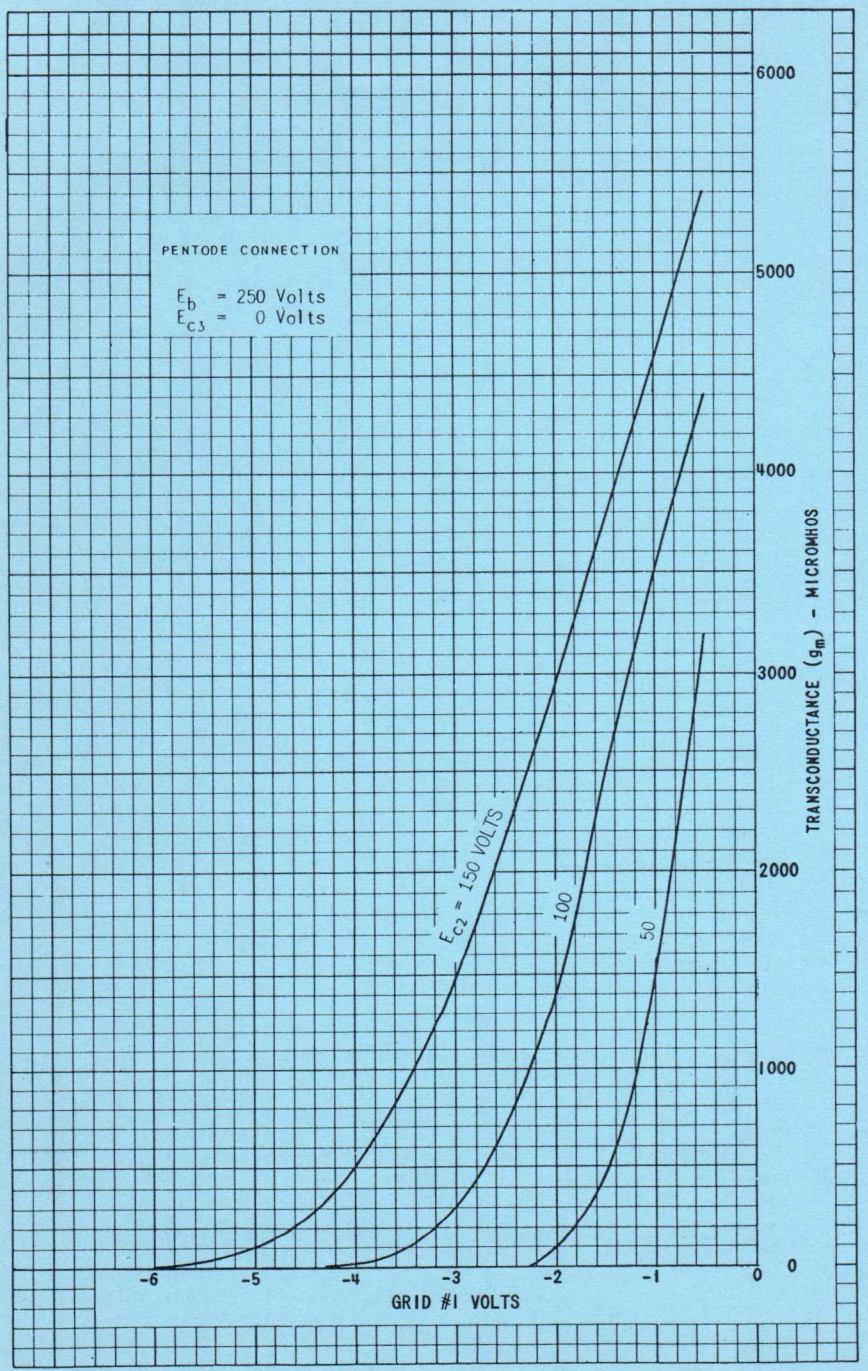
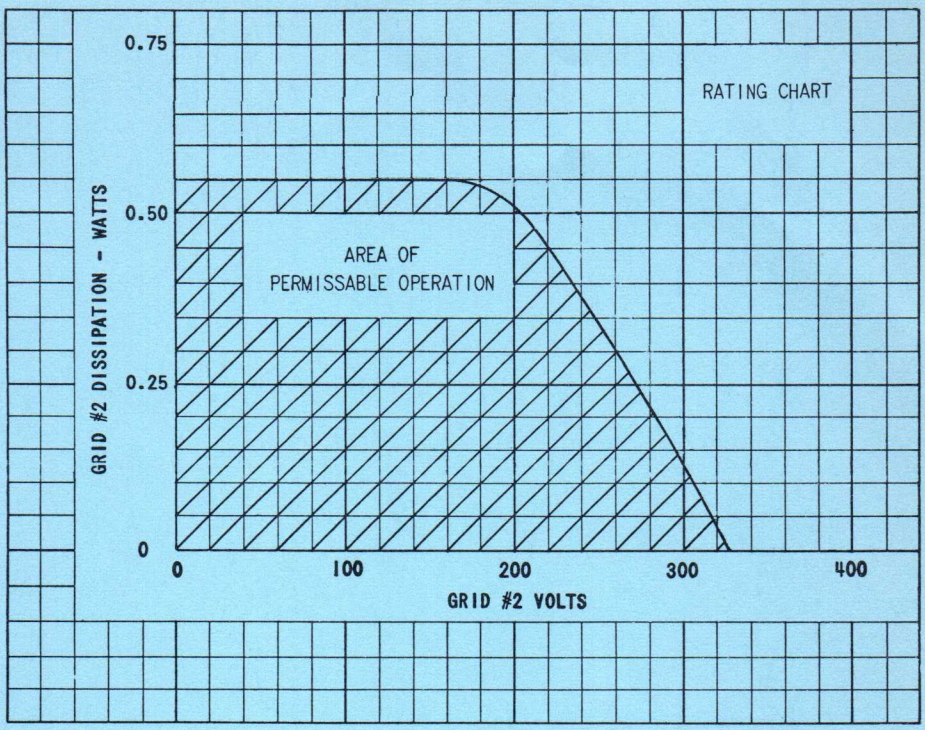

PENTODE CONNECTION
E_b = 250 Volts
E_{c3} = 0 Volts
E_{c2} = 150 VOLTS
100
50
TRANSCONDUCTANCE (g_m) - MICROMHOS
GRID #1 VOLTS
6000
5000
4000
3000
2000
1000
0
-6
-5
-4
-3
-2
-1
0



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TUNG-SOL

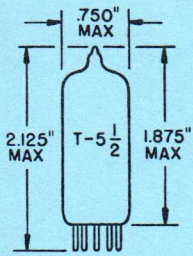
PENTODE

MINIATURE TYPE

FOR

MOBILE COMMUNICATIONS

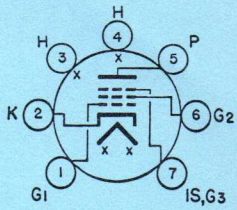
EQUIPMENT



GLASS BULB
MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-2

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 7CM

THE 6662 IS A MINIATURE REMOTE-CUTOFF PENTODE DESIGNED FOR USE AS A WIDE-BAND HIGH-FREQUENCY AMPLIFIER.

THE 6662 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALTHOUGH THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODS, HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY-VOLTAGE REGULATION.

THE ELECTRICAL CHARACTERISTICS OF THE 6662 ARE EQUIVALENT TO THE 6BJ6.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID 1 TO PLATE, MAXIMUM	0.0035	0.0035	pf
INPUT	4.5	4.5	pf
OUTPUT	5.5	5.5	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	150	MA.
HEATER SUPPLY LIMITS:				
VOLTAGE OPERATION			6.3±1.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE			100	VOLTS

[A] WITH EXTERNAL SHIELD 316 CONNECTED TO PINS 2 AND 7.

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	330	VOLTS
GRID 2 SUPPLY VOLTAGE	330	VOLTS
GRID 2 VOLTAGE	See Rating Chart	
POSITIVE DC GRID 1 VOLTAGE	0	VOLTS
NEGATIVE DC GRID 1 VOLTAGE	55	VOLTS
PLATE DISSIPATION	3.3	WATTS
GRID 2 DISSIPATION	0.65	WATTS

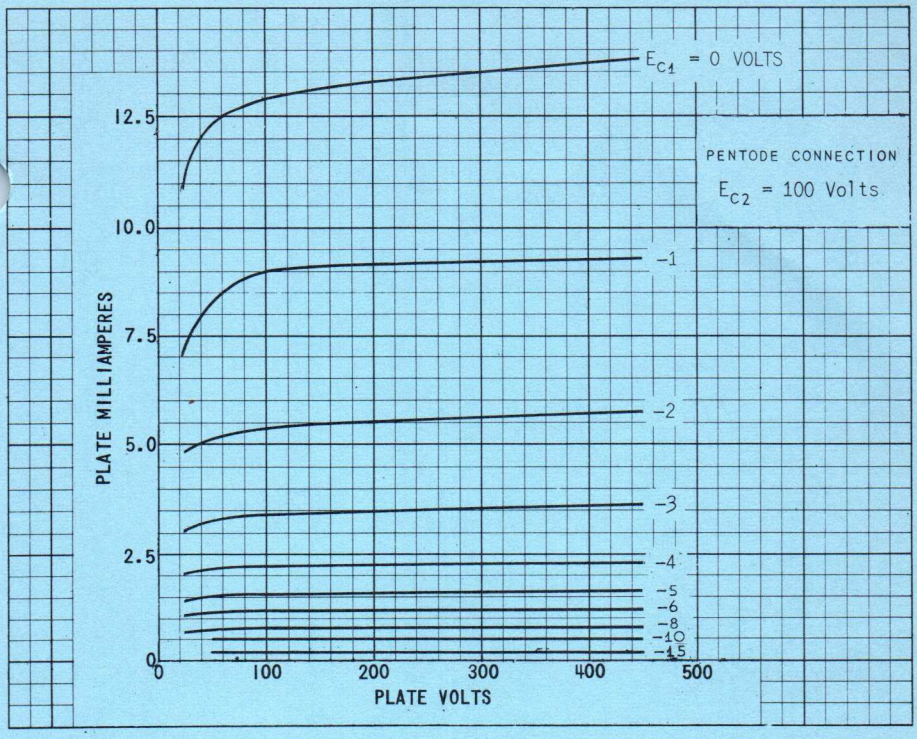
TYPICAL OPERATING CHARACTERISTICS

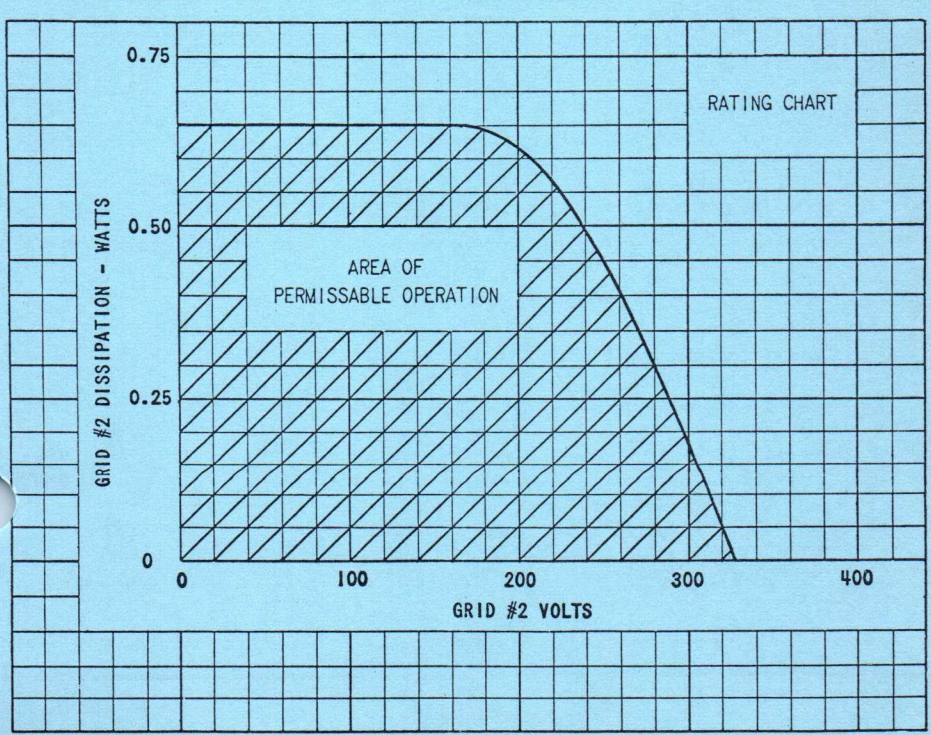
CLASS A1 AMPLIFIER

PLATE VOLTAGE	100	250	VOLTS
GRID 3 VOLTAGE	0	0	VOLTS
GRID 2 VOLTAGE	100	100	VOLTS
CATHODE-BIAS RESISTOR	80	80	OHMS
PLATE CURRENT	9.0	9.2	MA.
GRID 2 CURRENT	3.5	3.3	MA.
TRANSCONDUCTANCE	3,650	3,600	μMHOS
PLATE RESISTANCE, APPROX.	0.25	1.3	MEGOHMS
GRID 1 VOLTAGE (APPROX.) FOR Gm = 10 μMHOS	-20	-20	VOLTS

SPECIAL TESTS AND RATINGS

HEATER-CYCLING RATING





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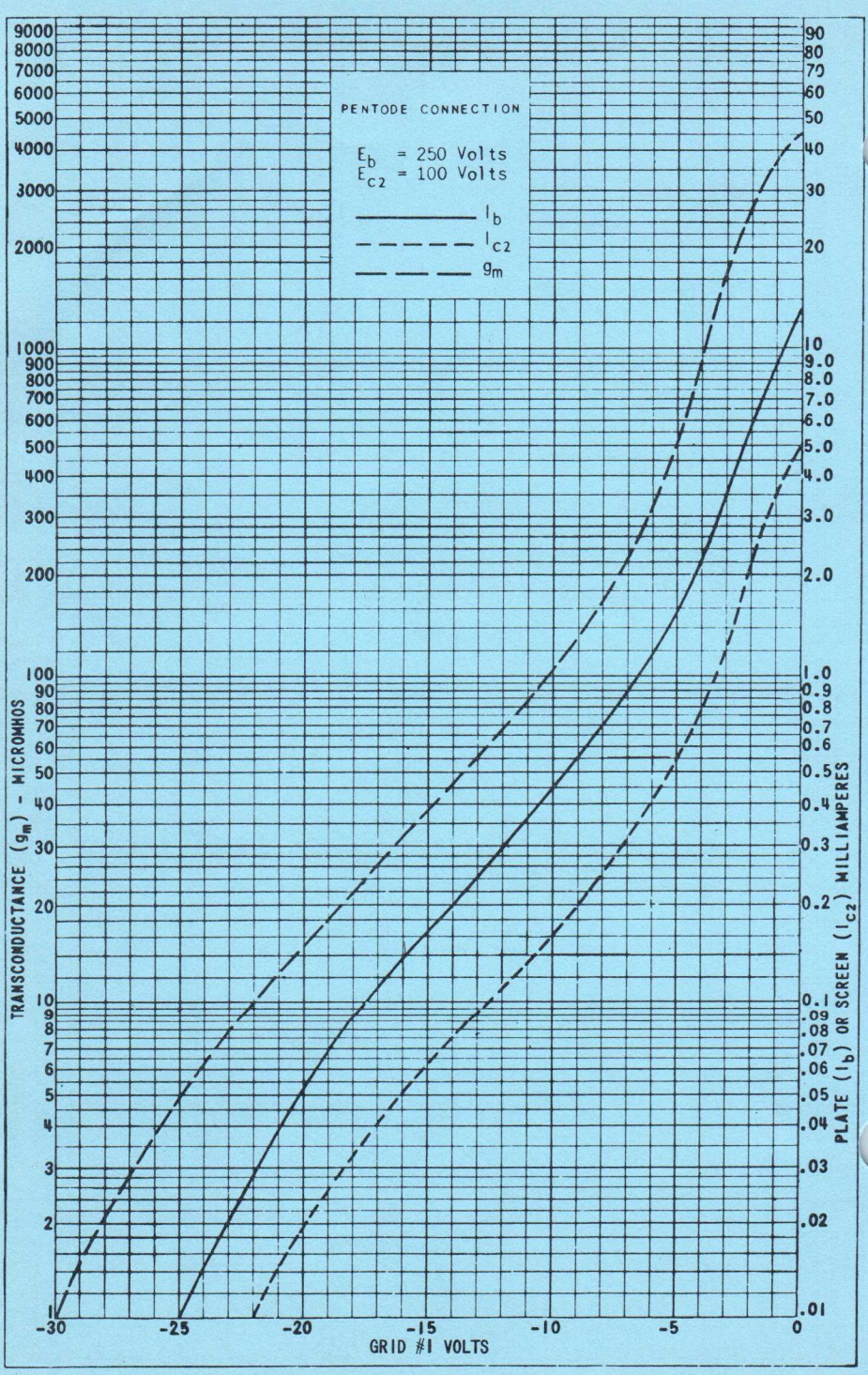
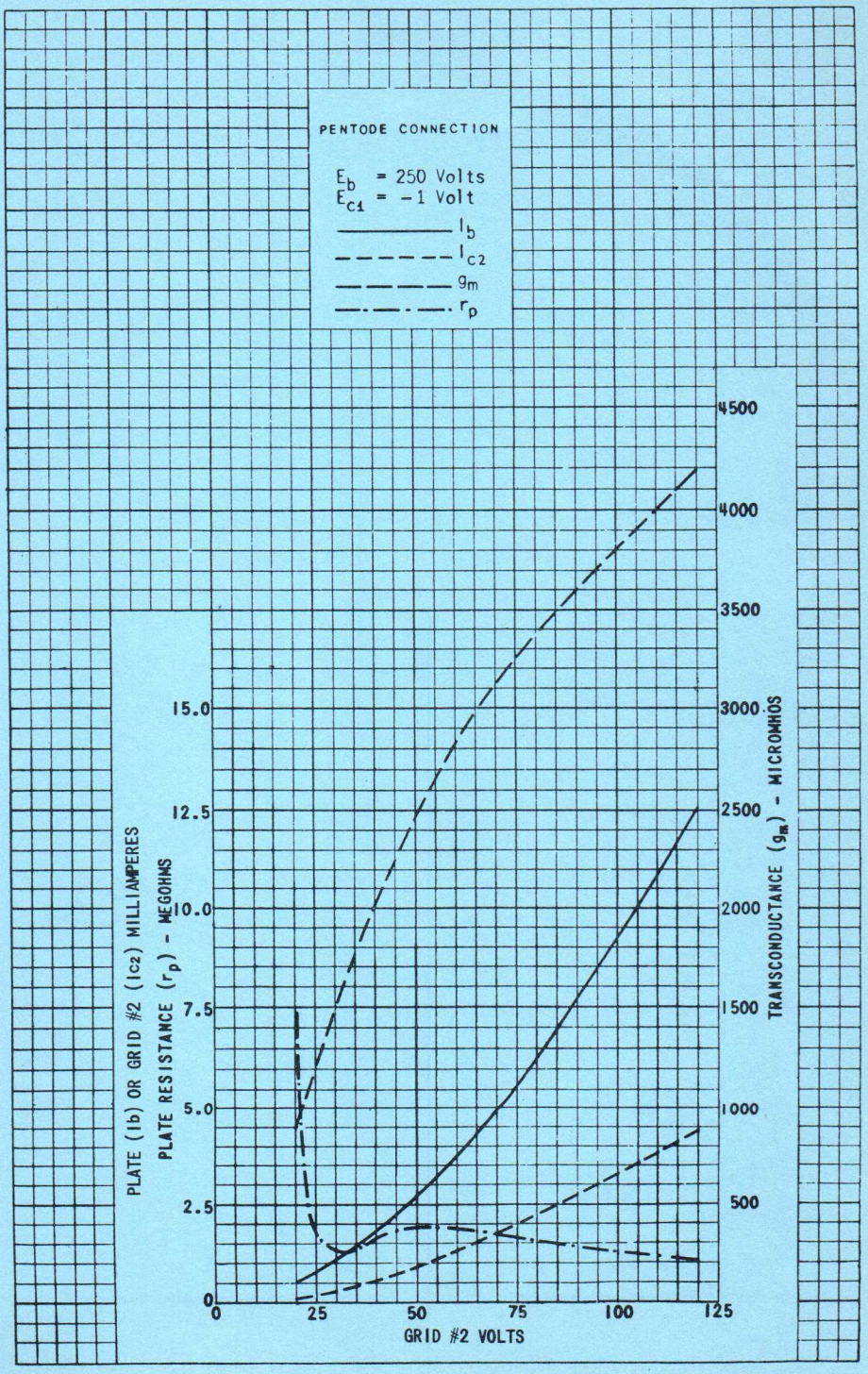
6662


PENTODE CONNECTION
E_b = 250 Volts
E_{c2} = 100 Volts
I_b
I_{c2}
g_m
TRANSCONDUCTANCE (g_m) - MICROMHOS
PLATE (I_b) OR SCREEN (I_{c2}) MILLIAMPERES
GRID #1 VOLTS
9000
8000
7000
6000
5000
4000
3000
2000
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
90
80
70
60
50
40
30
20
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
.09
.08
.07
.06
.05
.04
.03
.02
.01
-30
-25
-20
-15
-10
-5
0



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TUNG-SOL

TWIN DIODE
MINIATURE TYPE

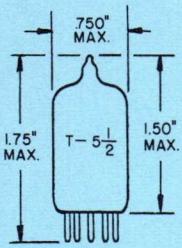
FOR

MOBILE COMMUNICATIONS

EQUIPMENT

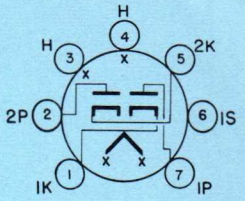
COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB

MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-1



BOTTOM VIEW

BASING DIAGRAM
JEDEC 6BT

THE 6663 IS A MINIATURE HIGH-PERVEANCE TWIN DIODE SUITABLE FOR A WIDE VARIETY OF LOW-CURRENT APPLICATIONS WHICH INCLUDE SERVICE IN FM DISCRIMINATOR CIRCUITS AND IN CLIPPING, SWITCHING AND ISOLATION CIRCUITS. FOR FLEXIBILITY IN CIRCUIT DESIGN, EACH SECTION INCORPORATES A SEPARATE CATHODE CONNECTION AND CAN BE USED INDEPENDENTLY.

THE 6663 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALTHOUGH THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODS, HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY VOLTAGE REGULATION. THE ELECTRICAL CHARACTERISTICS OF THE 6663 ARE EQUIVALENT TO THE 6AL5.

DIRECT INTERELECTRODE CAPACITANCES

		WITH[A] SHIELD	WITHOUT SHIELD	
PLATE 1 TO CATHODE 1, HEATER, & INTERNAL SHIELD		3.2	2.5	pf
PLATE 2 TO CATHODE 2, HEATER, & INTERNAL SHIELD		3.2	2.5	pf
CATHODE 1 TO PLATE 1, HEATER, & INTERNAL SHIELD		3.6	3.4	pf
CATHODE 2 TO PLATE 2, HEATER, & INTERNAL SHIELD		3.6	3.4	pf
PLATE 1 TO PLATE 2	(MAX.)	0.026	0.068	pf

[A] WITH EXTERNAL SHIELD 316 CONNECTED TO PIN 6.

HEATER CHARACTERISTICS AND RATINGS
DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	300	MA.
HEATER SUPPLY LIMITS:				
VOLTAGE OPERATION			6.3 ± 1.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			275	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

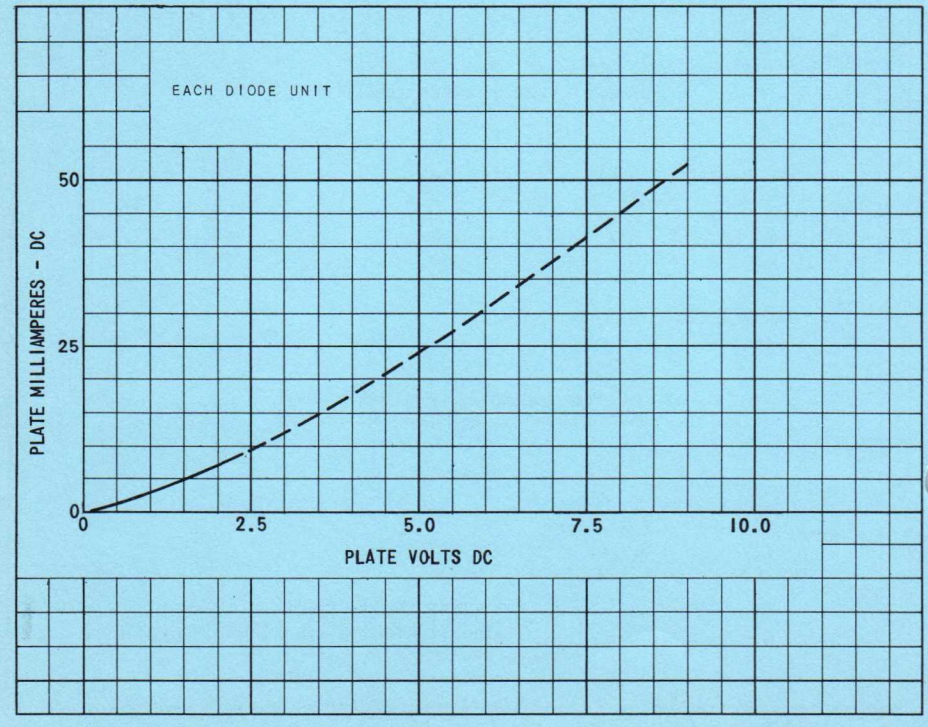
PEAK INVERSE PLATE VOLTAGE	275	VOLTS
STEADY-STATE PEAK PLATE CURRENT PER PLATE	60	MA.
TRANSIENT PEAK PLATE CURRENT PER PLATE MAX. DURATION 0.1 SECOND	350	MA.
DC OUTPUT CURRENT PER PLATE	10	MA.

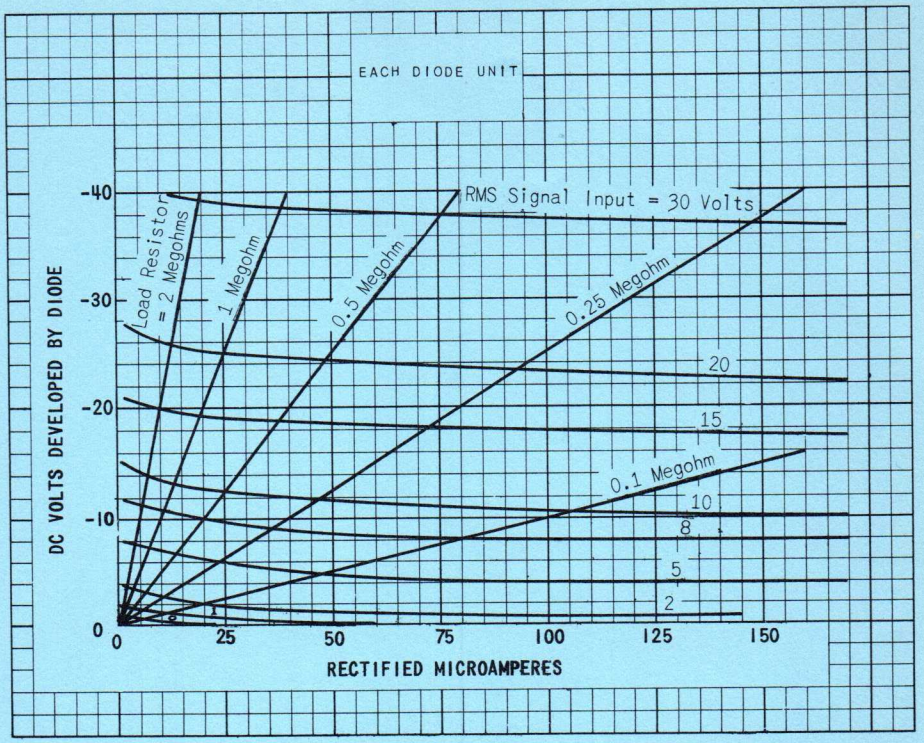
AVERAGE CHARACTERISTICS

TUBE VOLTAGE DROP AT Ib = 60 MA. DC PER PLATE	10	VOLTS

SPECIAL TESTS AND RATINGS

HEATER-CYCLING RATING





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TUNG-SOL

PENTODE

MINIATURE TYPE

BEAM PENTODE

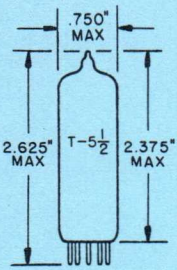
FOR

MOBILE COMMUNICATIONS

EQUIPMENT

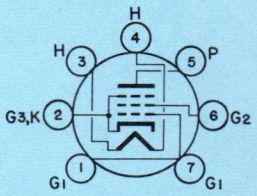
COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB

MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-3



BOTTOM VIEW

BASING DIAGRAM
JEDEC 7BZ

THE 6669 IS A MINIATURE BEAM-POWER PENTODE DESIGNED FOR USE AS AN AUDIO-FREQUENCY POWER AMPLIFIER.

THE 6669 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALTHOUGH THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODS, HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY-VOLTAGE REGULATION.

THE ELECTRICAL CHARACTERISTICS OF THE 6669 ARE EQUIVALENT TO THE 6AQ5.

DIRECT INTERELECTRODE CAPACITANCES - APPROX.

WITHOUT EXTERNAL SHIELD

GRID 1 TO PLATE	0.4	pf
INPUT	8.0	pf
OUTPUT	8.5	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	450	MA.
LIMITS OF APPLIED VOLTAGE			6.3±1.25	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			100	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			100	VOLTS

CONTINUED ON FOLLOWING PAGE

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	275	VOLTS
GRID 2 VOLTAGE	275	VOLTS
PLATE DISSIPATION	12	WATTS
GRID 2 DISSIPATION	2.0	WATTS
GRID 1 CIRCUIT RESISTANCE:		
WITH FIXED BIAS	0.1	MEGOHMS
WITH CATHODE BIAS	0.5	MEGOHMS
BULB TEMPERATURE AT HOTTEST POINT	225°	C

TYPICAL OPERATING CHARACTERISTICS

CLASS A1 AMPLIFIER

PLATE VOLTAGE		250	VOLTS
GRID 2 VOLTAGE		250	VOLTS
GRID 1 VOLTAGE		−12.5	VOLTS
PEAK AF GRID 1 VOLTAGE		12.5	VOLTS
ZERO-SIGNAL PLATE CURRENT		45	MA.
MAXIMUM-SIGNAL PLATE CURRENT		47	MA.
ZERO-SIGNAL GRID 2 CURRENT		4.5	MA.
MAXIMUM-SIGNAL GRID 2 CURRENT		7.0	MA.
PLATE RESISTANCE,	(APPROX.)	52,000	OHMS
TRANSCONDUCTANCE		4,100	μMHOS
LOAD RESISTANCE		5,000	OHMS
TOTAL HARMONIC DISTORTION,	(APPROX.)	8	PERCENT
MAXIMUM-SIGNAL POWER OUTPUT		4.5	WATTS

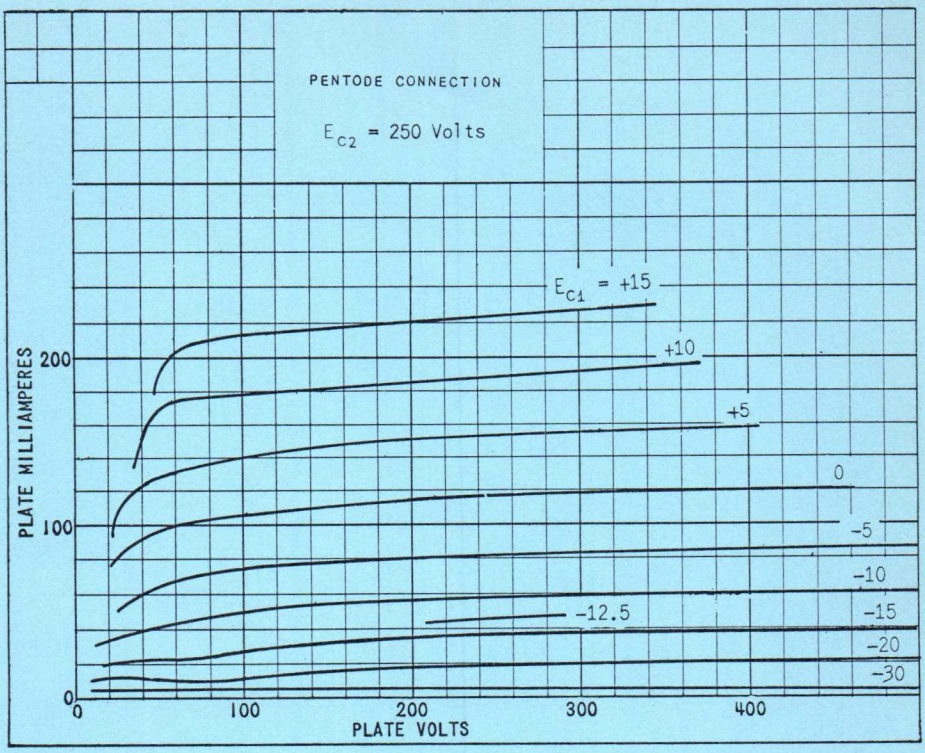
PUSH-PULL CLASS AB_1 AMPLIFIER

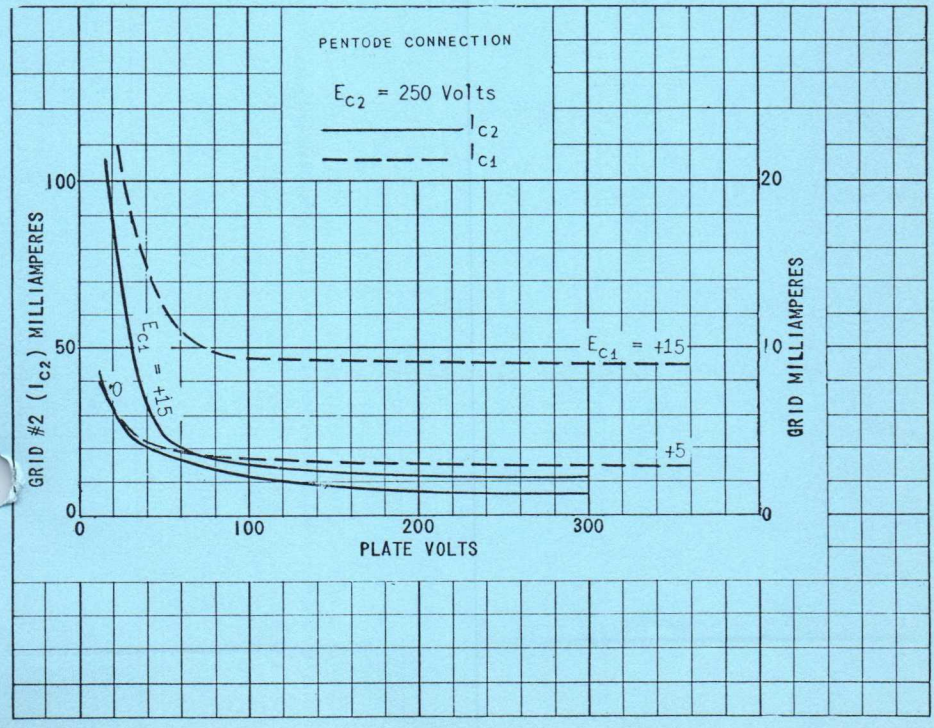
VALUES FOR TWO TUBES

PLATE VOLTAGE	250	VOLTS
GRID 2 VOLTAGE	250	VOLTS
GRID 1 VOLTAGE	−15	VOLTS
PEAK AF GRID TO GRID VOLTAGE	30	VOLTS
ZERO-SIGNAL PLATE CURRENT	70	MA.
MAXIMUM-SIGNAL PLATE CURRENT	79	MA.
ZERO-SIGNAL GRID 2 CURRENT	5.0	MA.
MAXIMUM-SIGNAL GRID 2 CURRENT	13	MA.
EFFECTIVE LOAD RESISTANCE, PLATE-TO-PLATE	10,000	OHMS
TOTAL HARMONIC DISTORTION	5	PERCENT
MAXIMUM-SIGNAL POWER OUTPUT	10	WATTS

SPECIAL TESTS AND RATINGS

HEATER-CYCLING LIFE TEST





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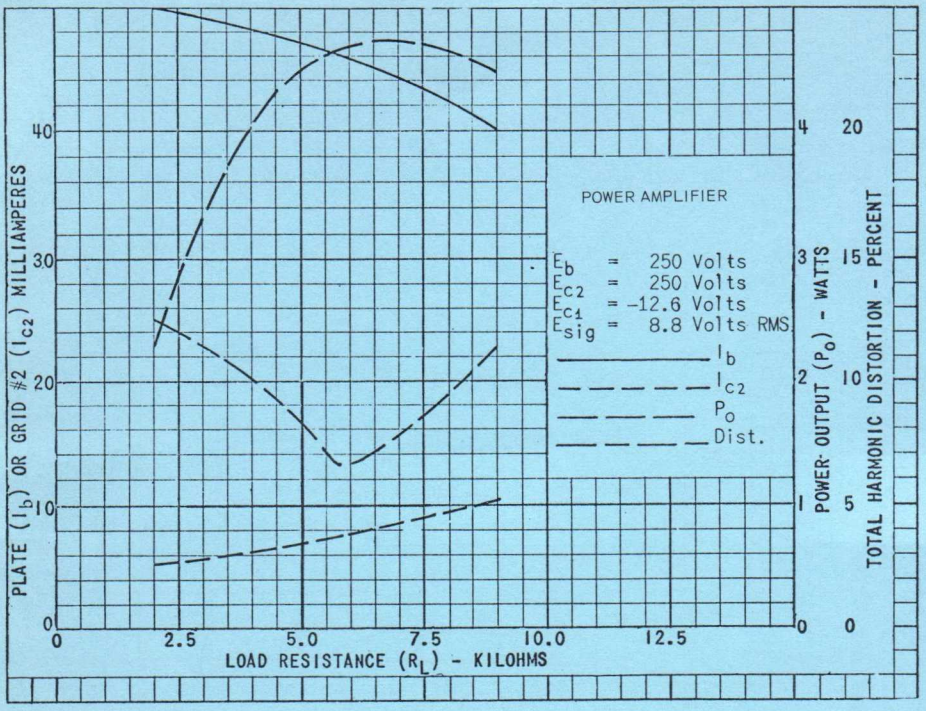
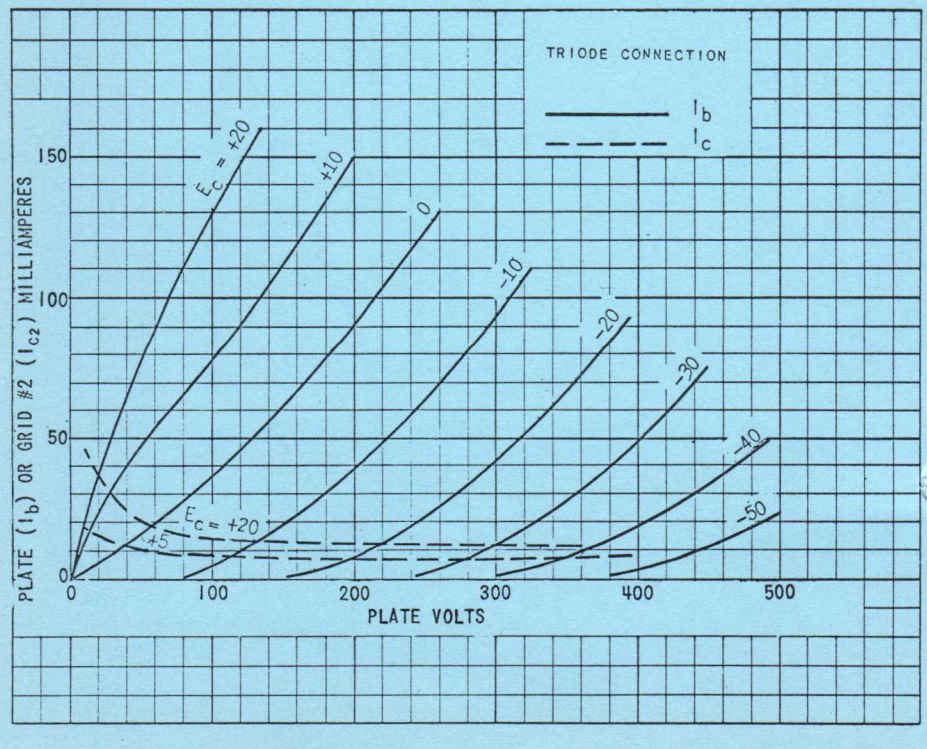

POWER AMPLIFIER
E_b = 250 Volts
E_{c2} = 250 Volts
E_{c1} = -12.6 Volts
E_{sig} = 8.8 Volts RMS
I_b
I_{c2}
P_o
Dist.
PLATE (I_b) OR GRID #2 (I_{c2}) MILLIAMPERES
POWER OUTPUT (P_o) - WATTS
TOTAL HARMONIC DISTORTION - PERCENT
LOAD RESISTANCE (R_L) - KILOHMS
0
2.5
5.0
7.5
10.0
12.5
10
20
30
40
1
2
3
4
5
15
20


TRIODE CONNECTION
I_b
I_c
E_c = +20
+10
0
-10
-20
-30
-40
-50
+5
PLATE (I_b) OR GRID #2 (I_{c2}) MILLIAMPERES
PLATE VOLTS
0
100
200
300
400
500
50
100
150

TUNG-SOL

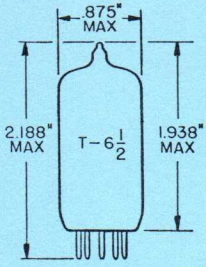
TWIN TRIODE

MINIATURE TYPE

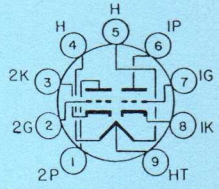
FOR
MOBILE COMMUNICATIONS
EQUIPMENT

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB
SMALL BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9A

THE 6679 IS A HIGH-MU TWIN TRIODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS SUITABLE FOR USE AS A GROUNDED-GRID AMPLIFIER OR AS A FREQUENCY CONVERTER AT FREQUENCIES BELOW APPROXIMATELY 300 MEGACYCLES.

THE 6679 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALSO, THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODES, BUT HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY-VOLTAGE REGULATION.

THE ELECTRICAL CHARACTERISTICS OF THE 6679 ARE EQUIVALENT TO THE 12AT7.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID TO PLATE, EACH SECTION	1.5	1.5	pf
INPUT, EACH SECTION	2.2	2.2	pf
OUTPUT, SECTION 1	1.2	0.5	pf
OUTPUT, SECTION 2	1.5	0.4	pf
HEATER TO CATHODE, EACH SECTION	2.4[B]	2.4	pf
PLATE TO CATHODE, EACH SECTION	0.2	0.2	pf
GROUNDED GRID INPUT, EACH SECTION	4.6	4.6	pf
GROUNDED GRID OUTPUT, EACH SECTION	2.6	1.8	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

SUPPLY CONNECTED TO PINS	4 AND 5	9 AND 4+5	
AVERAGE VALUES - VOLTAGE	12.6	6.3	VOLTS
CURRENT	150	300	MA.
HEATER SUPPLY LIMITS:			
VOLTAGE OPERATION	12.6±2.5	6.3±1.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE	100		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	100		VOLTS

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CONTINUED FROM PRECEDING PAGE

MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

EACH SECTION

PLATE VOLTAGE	330	VOLTS
POSITIVE DC GRID VOLTAGE	0	VOLTS
NEGATIVE DC GRID VOLTAGE	55	VOLTS
PLATE DISSIPATION	2.8	WATTS

TYPICAL OPERATING CHARACTERISTICS

CLASS A1 AMPLIFIER - EACH SECTION

PLATE VOLTAGE	250	VOLTS
CATHODE-BIAS RESISTOR	200	OHMS
PLATE CURRENT	10	MA.
TRANSCONDUCTANCE	5500	μMHOS
AMPLIFICATION FACTOR	60	
PLATE RESISTANCE, APPROX.	10,900	OHMS
GRID VOLTAGE, APPROX.		
Ib = 10 μAMPS.	−12	VOLTS

[A] WITH EXTERNAL SHIELD 315 CONNECTED TO HEATER UNLESS OTHERWISE SPECIFIED.

[B] WITH EXTERNAL SHIELD 315 CONNECTED TO GROUND.

CLASS A RESISTANCE-COUPLED AMPLIFIER

EACH SECTION

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)

R_L	R_{gf}	Ebb = 90 Volts			Ebb = 180 Volts			Ebb = 300 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	1600	5.3	26	1100	12	31	1000	22	32
0.10	0.24	1800	7.8	29	1400	17	33	1200	30	33
0.24	0.24	3800	7.2	28	2800	16	32	2300	28	34
0.24	0.51	4200	9.4	30	3300	20	33	2800	35	33
0.51	0.51	8000	8.3	28	5600	18	31	4900	31	33
0.51	1.0	9600	10	29	6700	23	32	6000	38	33

HIGH IMPEDANCE DRIVE (APPROXIMATELY 100K OHMS)

R_L	R_{gf}	Ebb = 90 Volts			Ebb = 180 Volts			Ebb = 300 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	2000	9.9	25	1200	17	31	900	35	33
0.10	0.24	2400	13	27	1400	28	33	1200	47	33
0.24	0.24	4700	12	27	2900	25	32	2300	42	34
0.24	0.51	5300	15	28	3600	31	33	2900	52	34
0.51	0.51	9300	13	27	6000	27	31	5000	45	33
0.51	1.0	11000	16	28	7100	33	32	6400	55	34

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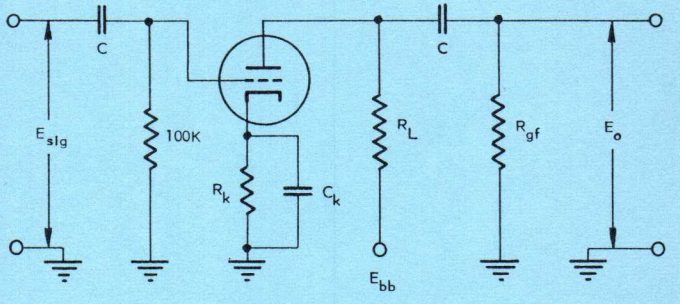
NOTES:

1. E_o IS MAXIMUM RMS VOLTAGE OUTPUT FOR APPROXIMATELY 5% TOTAL HARMONIC DISTORTION.
2. GAIN IS MEASURED FOR AN OUTPUT VOLTAGE OF TWO VOLTS RMS.
3. R_k IS IN OHMS; R_L AND R_{gf} ARE IN MEGOHMS.



COUPLING CAPACITORS (C) SHOULD BE SELECTED TO GIVE DESIRED FREQUENCY RESPONSE. R_k SHOULD BE ADEQUATELY BY-PASSED.

SPECIAL TESTS AND RATINGS

HEATER-CYCLING LIFE TEST

AVERAGE TRANSCONDUCTANCE		
AT REDUCED HEATER VOLTAGE, EACH SECTION	4400	μMHOS
E_f = 10.0 VOLTS, E_b = 250 VOLTS, R_k = 200 OHMS (BYPASSED)		

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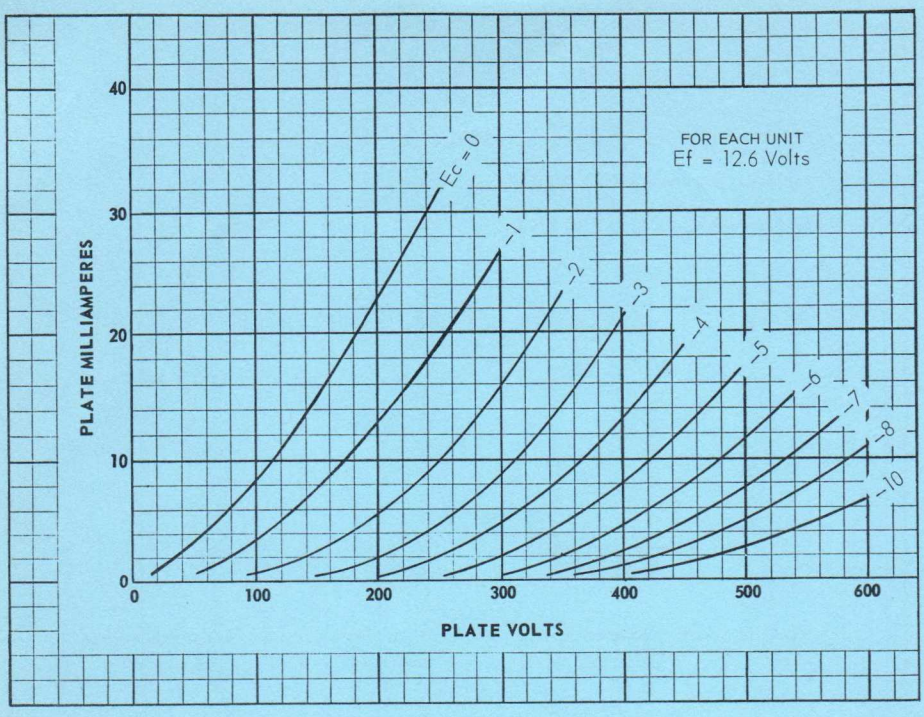
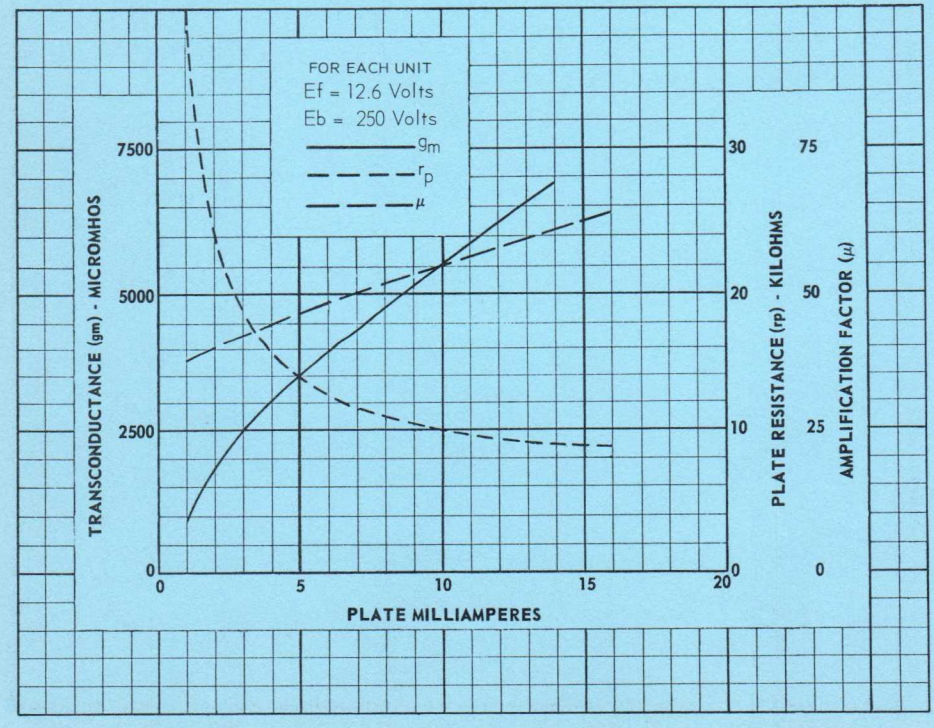

FOR EACH UNIT
Ef = 12.6 Volts
Ec = 0
-1
-2
-3
-4
-5
-6
-7
-8
-10
PLATE MILLIAMPERES
PLATE VOLTS
0
10
20
30
40
100
200
300
400
500
600


FOR EACH UNIT
Ef = 12.6 Volts
Eb = 250 Volts
gm
rp
μ
TRANSCONDUCTANCE (gm) - MICROMHOS
PLATE RESISTANCE (rp) - KILOHMS
AMPLIFICATION FACTOR (μ)
PLATE MILLIAMPERES
0
2500
5000
7500
10
15
20
25
30
50
75

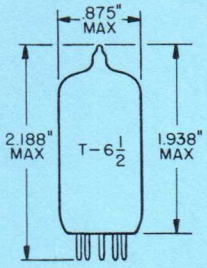
TUNG-SOL

TWIN TRIODE
MINIATURE TYPE

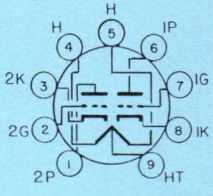
FOR
MOBILE COMMUNICATIONS
EQUIPMENT

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB
SMALL BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9A

THE 6080 IS A MEDIUM-MU TRIODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS PARTICULARLY SUITED FOR USE IN GENERAL-PURPOSE AMPLIFIER AND PHASE-INVERTER CIRCUITS AS WELL AS FOR MULTI-VIBRATOR AND OSCILLATOR APPLICATIONS.
THE 6680 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALSO, THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODS, BUT HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY-VOLTAGE REGULATION.
THE ELECTRICAL CHARACTERISTICS OF THE 6680 ARE EQUIVALENT TO THE 12AU7.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID TO PLATE, EACH SECTION	1.5	1.5	pf
INPUT, EACH SECTION	1.8	1.6	pf
OUTPUT, SECTION 1	2.0	0.4	pf
OUTPUT, SECTION 2	2.0	0.32	pf

[A] WITH EXTERNAL SHIELD (RETMA 315) CONNECTED TO CATHODE OF SECTION UNDER TEST.

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

SUPPLY CONNECTED TO PINS	4 AND 5	9 AND 4 + 5	
AVERAGE VALUES -VOLTAGE	12.6	6.3	VOLTS
-CURRENT	150	300	MA.
HEATER SUPPLY LIMITS:			
VOLTAGE OPERATION	12.6±2.5	6.3±1.3	VOLTS
MAXIMUM HEATER CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			VOLTS
TOTAL DC AND PEAK	200		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			
DC	100		VOLTS
TOTAL DC AND PEAK	200		VOLTS

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

EACH SECTION

PLATE VOLTAGE	330	VOLTS
POSITIVE DC GRID VOLTAGE	0	VOLTS
PLATE DISSIPATION	3.0	WATTS
GRID CIRCUIT RESISTANCE		
WITH FIXED BIAS	0.25	MEGOHMS
WITH CATHODE BIAS	1.0	MEGOHMS

TYPICAL OPERATING CHARACTERISTICS

CLASS A1 AMPLIFIER - EACH SECTION

PLATE VOLTAGE	100	250	VOLTS
GRID VOLTAGE	0	−8.5	VOLTS
PLATE CURRENT	11.8	10.5	MA.
TRANSCONDUCTANCE	3100	2200	μMHOS
AMPLIFICATION FACTOR	20	17	
PLATE RESISTANCE, APPROX.	6500	7700	OHMS
GRID VOLTAGE, APPROX.			
Ib = 10 μAMPS	------	−24	VOLTS

CLASS A RESISTANCE - COUPLED AMPLIFIER

EACH SECTION

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)

R_L	R_{gf}	E_{bb} = 90 Volts			E_{bb} = 180 Volts			E_{bb} = 300 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	3900	10	10	3600	20	11	3500	30	11
0.10	0.24	5000	14	11	4700	27	12	4400	41	12
0.24	0.24	9400	13	11	8700	25	11	8700	38	12
0.24	0.51	11000	17	11	11000	32	12	11000	48	12
0.51	0.51	19000	15	11	18000	29	12	18000	43	12
0.51	1.0	24000	19	11	23000	37	12	23000	54	12

HIGH IMPEDANCE DRIVE (APPROXIMATELY 100K OHMS)

R_L	R_{gf}	E_{bb} = 90 Volts			E_{bb} = 180 Volts			E_{bb} = 300 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	2600	11	12	2000	22	13	18000	31	13
0.10	0.24	3400	16	12	2800	32	13	2600	44	14
0.24	0.24	7200	15	12	5800	29	13	5000	41	13
0.24	0.51	9400	19	12	8400	37	13	7000	52	13
0.51	0.51	17000	16	12	15000	33	13	13000	46	13
0.51	1.0	22000	20	12	20000	42	13	18000	58	13

1. E_o IS MAXIMUM RMS VOLTAGE OUTPUT FOR APPROXIMATELY 5% TOTAL HARMONIC DISTORTION.

2. GAIN IS MEASURED FOR AN OUTPUT VOLTAGE OF TWO VOLTS RMS.

3. R_k IS IN OHMS; R_L AND R_{gf} ARE IN MEGOHMS.

TUNG-SOL

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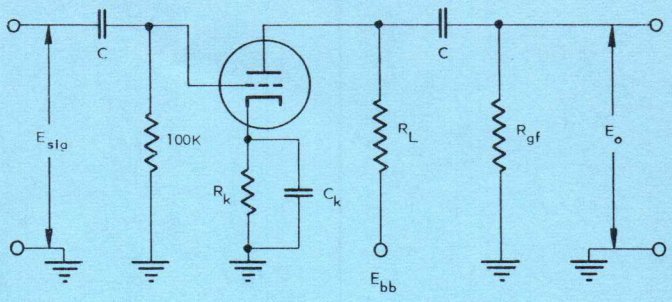
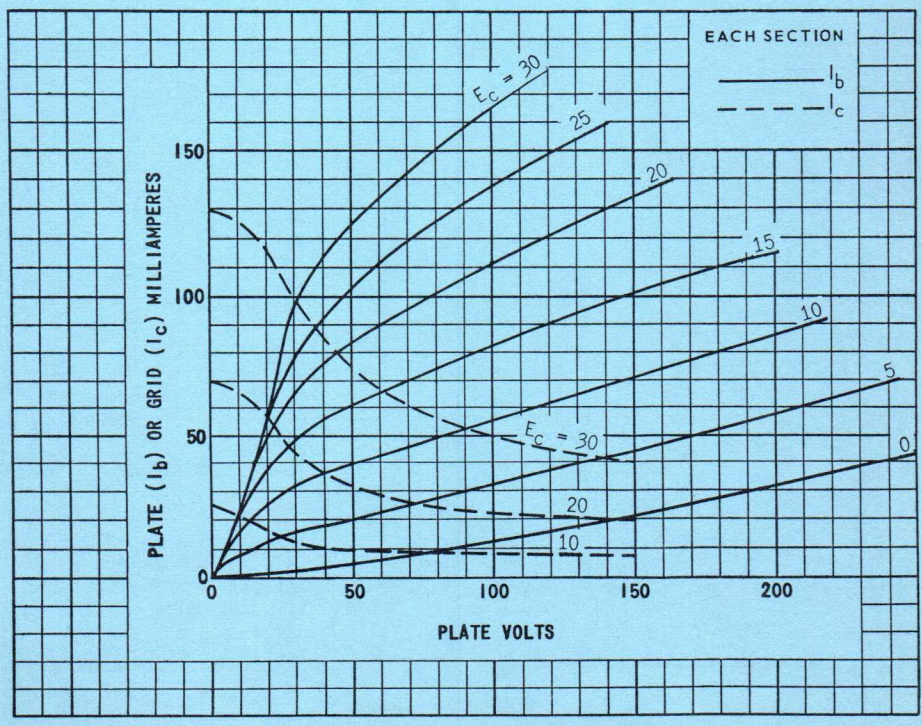


COUPLING CAPACITORS (C) SHOULD BE SELECTED TO GIVE DESIRED FREQUENCY RESPONSE. R_k SHOULD BE ADEQUATELY BY-PASSED.

SPECIAL TESTS AND RATINGS

HEATER-CYCLING LIFE TEST		
AVERAGE TRANSCONDUCTANCE AT REDUCED HEATER VOLTAGE		
EACH SECTION	,750	μMHOS
Ef = 10.0 V., Eb = 250 V., Ec = -8.5 V.		



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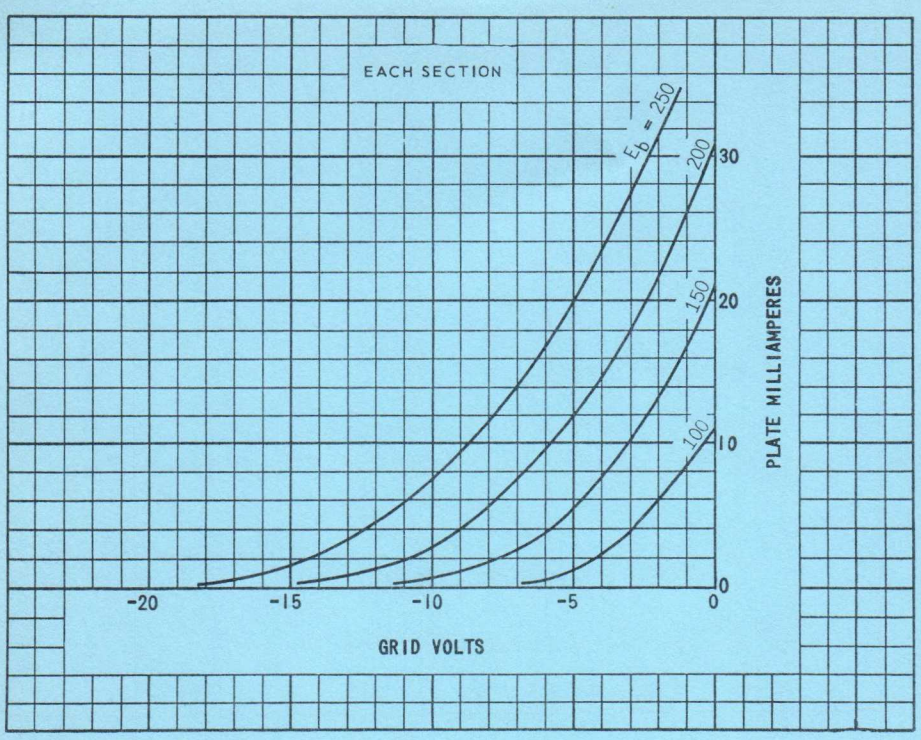
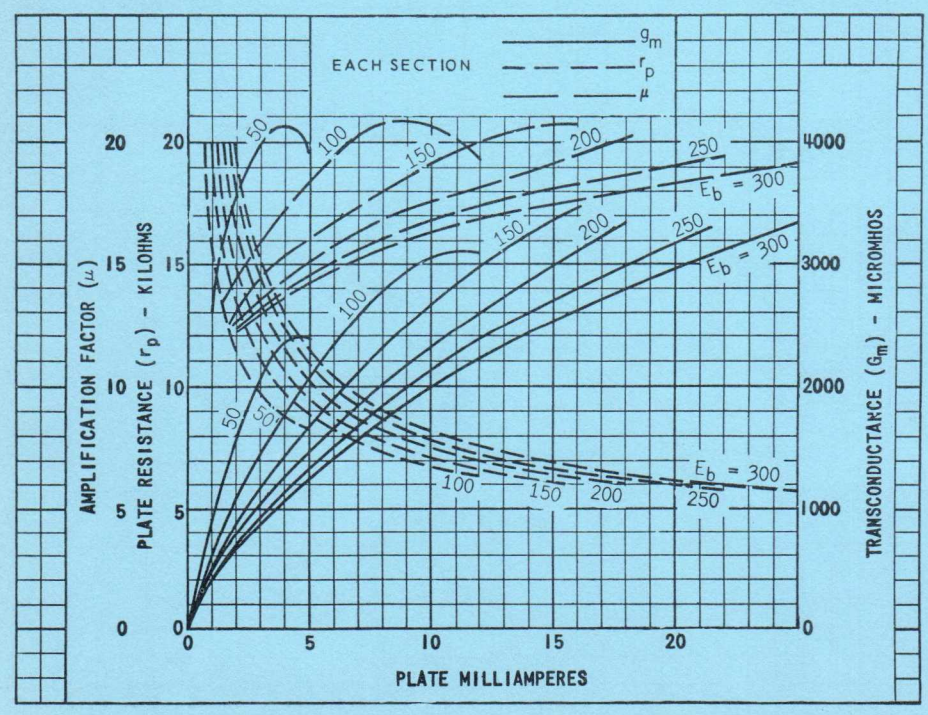
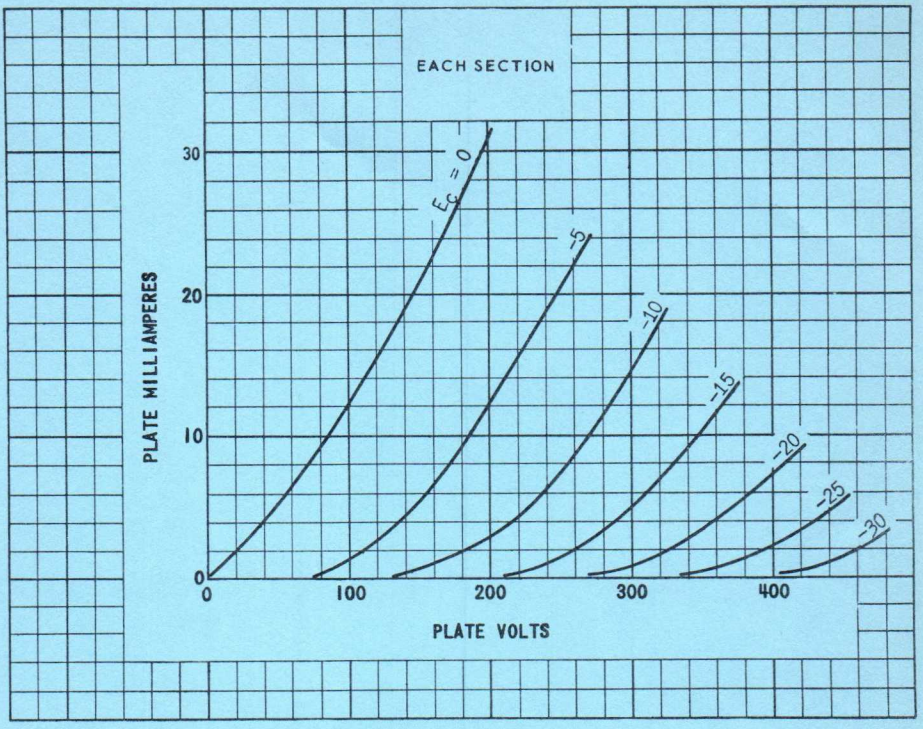

EACH SECTION
E_b = 250
200
150
100
30
20
10
0
PLATE MILLIAMPERES
-20
-15
-10
-5
0
GRID VOLTS


EACH SECTION
g_m
r_p
μ
50
100
150
200
250
E_b = 300
20
15
10
5
0
AMPLIFICATION FACTOR (μ)
PLATE RESISTANCE (r_p) - KILOHMS
4000
3000
2000
1000
0
TRANSCONDUCTANCE (G_m) - MICROMHOS
0
5
10
15
20
PLATE MILLIAMPERES



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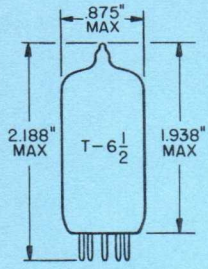
TUNG-SOL

TWIN TRIODE
MINIATURE TYPE

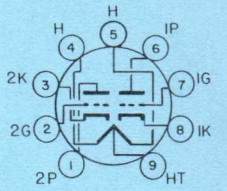
FOR
MOBILE COMMUNICATIONS
EQUIPMENT

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB
SMALL BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9A

THE 6681 IS A HIGH-MU TWIN TRIODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS ESPECIALLY SUITED FOR USE IN RESISTANCE-COUPLED VOLTAGE AMPLIFIERS, PHASE INVERTERS, MULTIVIBRATORS, AND OTHER APPLICATIONS IN WHICH HIGH VOLTAGE GAIN IS DESIRED.
THE 6681 MAY BE OPERATED WITHOUT SERIOUS DEGRADATION UNDER NORMAL VARIATIONS IN SUPPLY VOLTAGE AS ENCOUNTERED WITH AUTOMOTIVE ELECTRICAL SYSTEMS. ALSO, THE TUBE WILL TOLERATE LARGE HEATER VOLTAGE VARIATIONS FOR SHORT PERIODS, BUT HIGHER EQUIPMENT RELIABILITY CAN BE ACHIEVED WITH IMPROVED SUPPLY-VOLTAGE REGULATION.
THE ELECTRICAL CHARACTERISTICS OF THE 6681 ARE EQUIVALENT TO THE 12AX7.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID TO PLATE, EACH SECTION	1.7	1.7	pf
INPUT, EACH SECTION	1.8	1.6	pf
OUTPUT, SECTION 1	1.9	0.46	pf
OUTPUT, SECTION 2	1.9	0.34	pf

[A] WITH EXTERNAL SHIELD (RETMA 315) CONNECTED TO CATHODE OF SECTION UNDER TEST.

HEATER CHARACTERISTICS AND RATINGS
DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

SUPPLY CONNECTED TO PINS	4 AND 5	9 AND 4 + 5	
AVERAGE VALUES -VOLTAGE	12.6	6.3	VOLTS
-CURRENT	150	300	MA.
HEATER SUPPLY LIMITS:			
VOLTAGE OPERATION	12.6±2.5	6.3±1.3	VOLTS
MAXIMUM HEATER CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			VOLTS
TOTAL DC AND PEAK	200		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			
DC	100		VOLTS
TOTAL DC AND PEAK	200		VOLTS

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

EACH SECTION

PLATE VOLTAGE	330	VOLTS
POSITIVE DC GRID VOLTAGE	0	VOLTS
NEGATIVE DC GRID VOLTAGE	55	VOLTS
PLATE DISSIPATION	1.1	WATTS

TYPICAL OPERATING CHARACTERISTICS

CLASS A1 AMPLIFIER - EACH SECTION

PLATE VOLTAGE	100	250	VOLTS
GRID VOLTAGE	−1	−2	VOLTS
PLATE CURRENT	0.5	1.2	MA.
TRANSCONDUCTANCE	1250	1600	μMHOS
AMPLIFICATION FACTOR	100	100	
PLATE RESISTANCE, APPROX.	80,000	62,500	OHMS

CLASS A RESISTANCE - COUPLED AMPLIFIER

EACH SECTION

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)

R_L	R_{gf}	Ebb = 90 Volts			Ebb = 180 Volts			Ebb = 300 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	2500	4.3	32	1500	15	40	1100	33	43
0.10	0.24	2600	6.5	40	1500	22	49	1200	44	53
0.24	0.24	4400	6.3	45	2500	21	56	2000	44	60
0.24	0.51	4800	8.5	50	2800	27	62	2200	54	66
0.51	0.51	8500	7.3	50	4200	21	63	3500	45	69
0.51	1.0	10000	9.4	55	6500	28	66	4700	55	72

HIGH IMPEDANCE DRIVE (APPROXIMATELY 100K OHMS)

R_L	R_{gf}	Ebb = 90 Volts			Ebb = 180 Volts			Ebb = 300 Volts		
		R_k	E_o	Gain	R_k	E_o	Gain	R_k	E_o	Gain
0.10	0.10	3400	7.1	28	1900	18	34	1400	35	40
0.10	0.24	3700	9.4	37	2100	25	46	1600	47	50
0.24	0.24	6100	9.8	42	3500	25	53	2500	47	59
0.24	0.51	6800	12	47	3900	30	58	3000	58	63
0.51	0.51	11000	11	47	6200	27	60	4500	52	66
0.51	1.0	12000	14	50	6800	34	64	5300	64	69

1. E_o IS MAXIMUM RMS VOLTAGE OUTPUT FOR APPROXIMATELY 5% TOTAL HARMONIC DISTORTION.

2. GAIN IS MEASURED FOR AN OUTPUT VOLTAGE OF TWO VOLTS RMS.

3. R_k IS IN OHMS; R_L AND R_{gf} ARE IN MEGOHMS.

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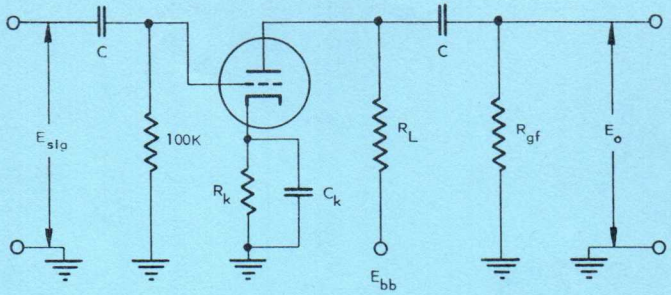
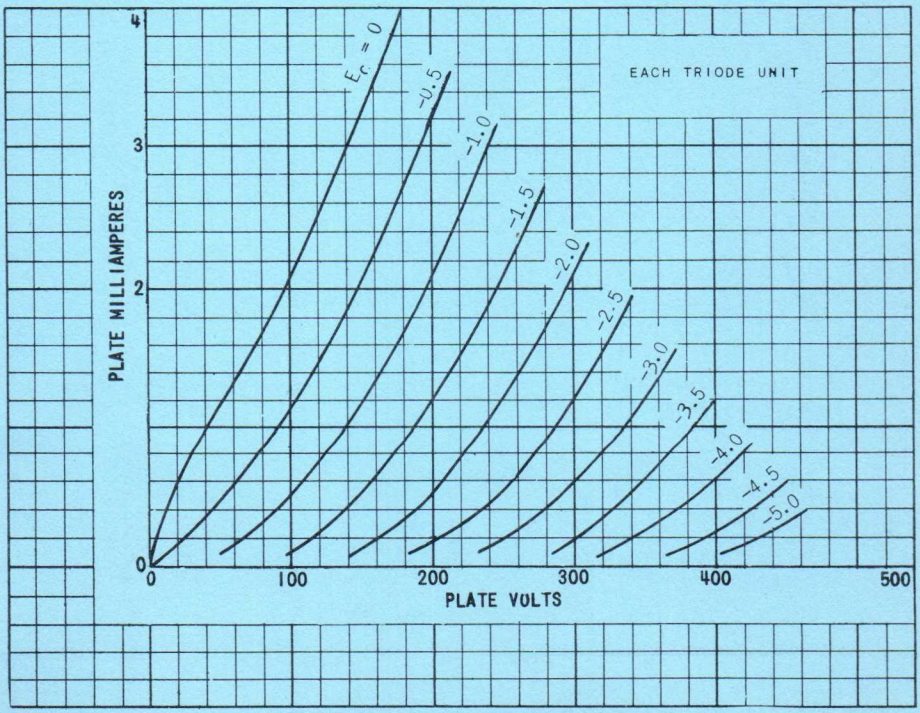


COUPLING CAPACITORS (C) SHOULD BE SELECTED TO GIVE DESIRED FREQUENCY RESPONSE. R_k SHOULD BE ADEQUATELY BY-PASSED.

SPECIAL TESTS AND RATINGS

HEATER-CYCLING LIFE TEST



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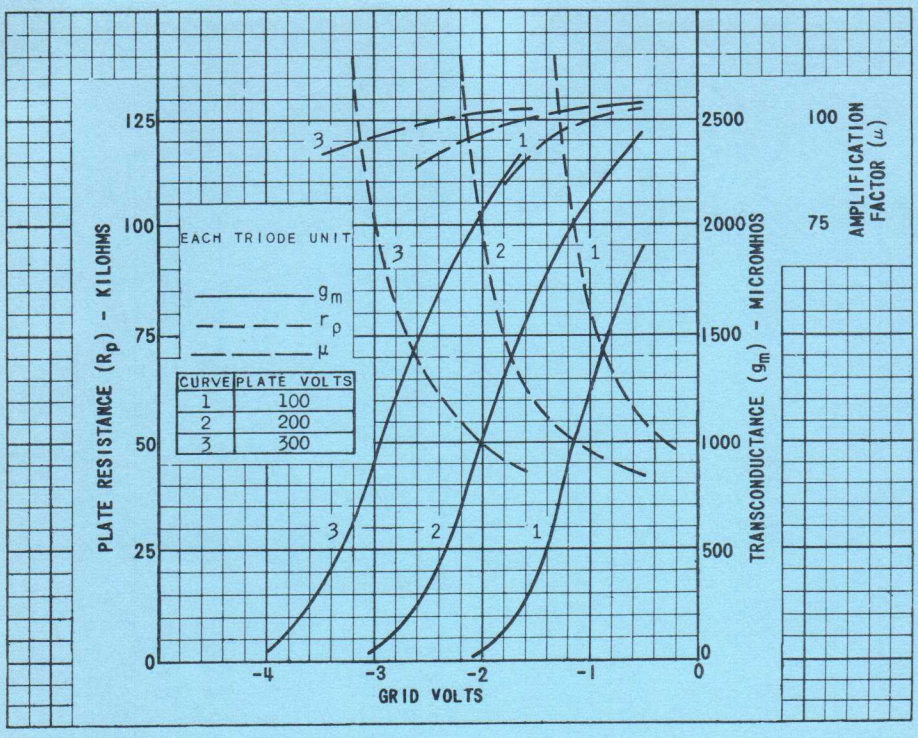
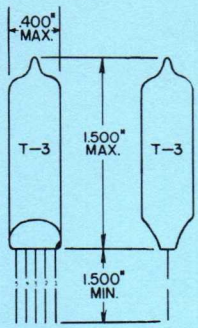

EACH TRIODE UNIT
g_m
r_p
μ
CURVE PLATE VOLTS
1 100
2 200
3 300
PLATE RESISTANCE (R_p) - KILOHMS
TRANSCONDUCTANCE (g_m) - MICROMHOS
AMPLIFICATION FACTOR (μ)
GRID VOLTS
125
100
75
50
25
0
2500
2000
1500
1000
500
0
100
75
-4
-3
-2
-1
0

TUNG-SOL

PENTODE

SUBMINIATURE TYPE

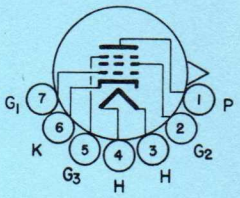


GLASS BULB

OUTLINE DRAWING
JEDEC 3-6
DOT IS ADJACENT TO LEAD #1

RELIABLE
SEMI-REMOTE-CUTOFF
PENTODE
FOR
AGC AMPLIFIER SERVICE
IN MOBILE AND AIRBORNE
EQUIPMENT

COATED UNIPOTENTIAL CATHODE
ANY MOUNTING POSITION



BOTTOM VIEW
7 LEADS 0.048" CENTER-TO-CENTER IN-LINE
LEAD DIAMETER
.016" +.002" −.001"

THE 6872 IS A HEATER-CATHODE TYPE SEMI-REMOTE CUTOFF PENTODE OF SUBMINIATURE CONSTRUCTION. IT IS APPLICABLE TO AMPLIFIER SERVICE IN WHICH AGC IS DESIRABLE. STANDARD INLINE SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE FLEXIBLE LEADS TO A SUITABLE LENGTH.

DIRECT INTERELECTRODE CAPACITANCES

WITH A CYLINDRICAL SHIELD 0.405" I.D. - 1-7/8" LONG CONNECTED TO LEAD 6.

GRID 1 TO PLATE	MAX.	0.03	pf
INPUT		5.0	pf
OUTPUT		3.5	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	200	MA.
LIMITS OF APPLIED VOLTAGE			6.3 ± 0.6	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:			200	VOLTS

MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	165	VOLTS
GRID 1 VOLTAGE	-55	VOLTS
GRID 2 VOLTAGE	155	VOLTS
GRID 3 VOLTAGE	0	VOLTS
PLATE DISSIPATION	1.1	WATTS
GRID 2 DISSIPATION	0.4	WATTS
CATHODE CURRENT	16.5	MA.
GRID 1 CIRCUIT RESISTANCE	1.2	MEGOHMS
TEMPERATURE AT HOTTEST POINT ON BULB	+220	°C

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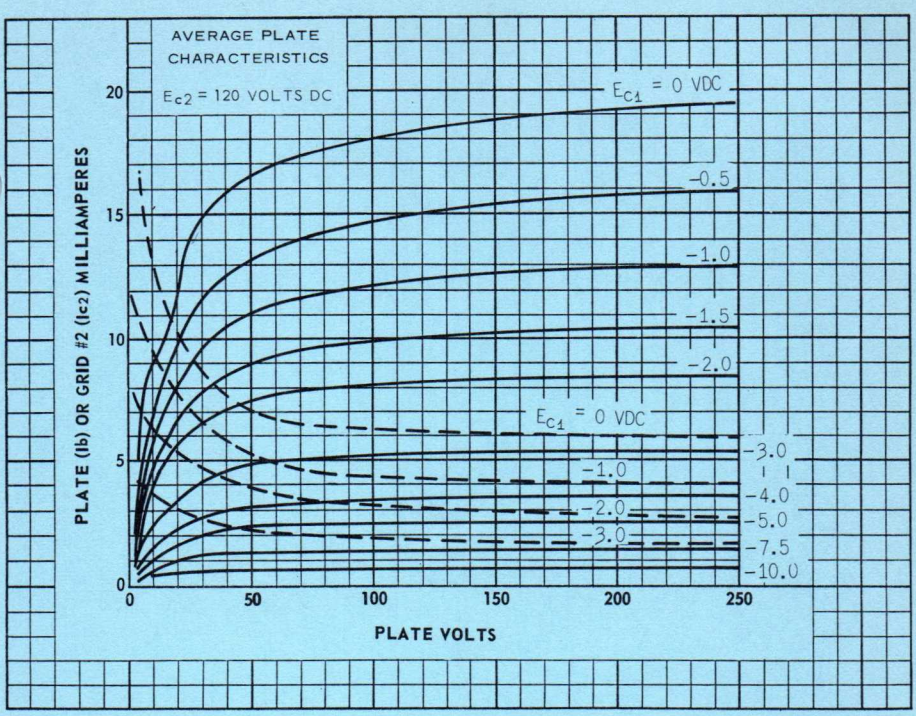
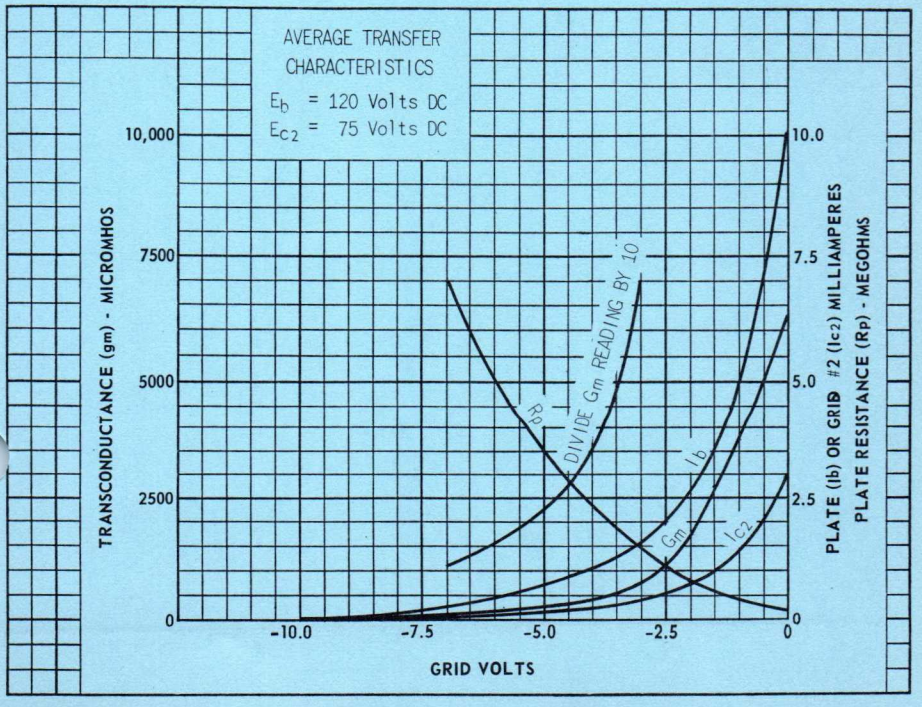
TYPCAL OPERATING CHARACTERISTICS

PLATE VOLTAGE	120	VOLTS
GRID 1 VOLTAGE	0	VOLTS
GRID 2 VOLTAGE	120	VOLTS
GRID 3 VOLTAGE	0	VOLTS
CATHODE BIAS RESISTOR	200	OHMS
PLATE CURRENT	7.75	MA.
GRID 2 CURRENT	2.7	MA.
TRANSCONDUCTANCE	4,100	μMHOS
PLATE RESISTANCE	0.34	MEGOHMS

SPECIAL TESTS AND RATINGS

INTERMITTANT LIFE TEST		
HEATER CYCLING TEST		
SHOCK TEST		
VIBRATION TEST		
ALTITUDE RATING	60,000	FEET





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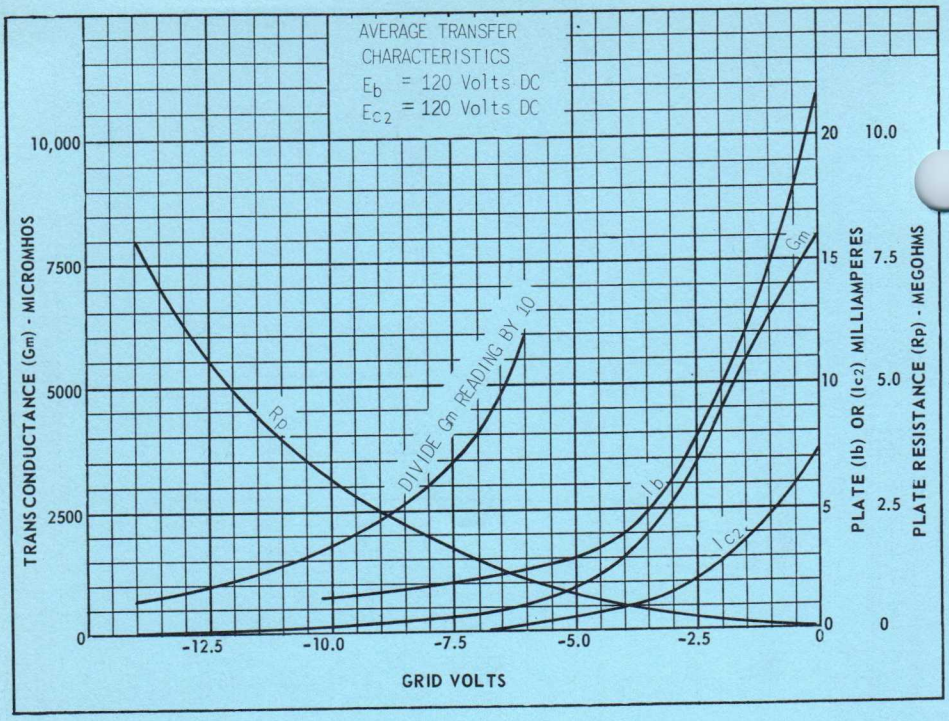
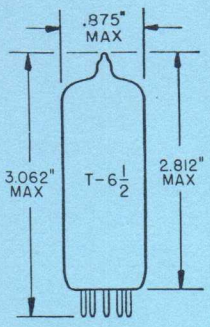

AVERAGE TRANSFER CHARACTERISTICS
E_b = 120 Volts DC
E_{c2} = 120 Volts DC
TRANSCONDUCTANCE (Gm) - MICROMHOS
10,000
7500
5000
2500
0
Rp
DIVIDE Gm READING BY 10
Ib
Ic2
Gm
20
15
10
5
0
10.0
7.5
5.0
2.5
0
PLATE (Ib) OR (I_{c2}) MILLIAMPERES
PLATE RESISTANCE (Rp) - MEGOHMS
-12.5
-10.0
-7.5
-5.0
-2.5
0
GRID VOLTS

TUNG-SOL

OUTLINE DRAWING
JEDEC 6-4



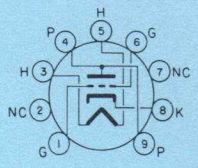
GLASS BULB
MINIATURE BUTTON
BASE 9 PIN E9-1

POWER TRIODE
MINIATURE TYPE

FOR
MILITARY AND INDUSTRIAL
AIRBORNE APPLICATIONS

COATED UNIPOTENTIAL CATHODE
ANY MOUNTING POSITION

BASING DIAGRAM
JEDEC 9GB



BOTTOM VIEW
IF TUBE IS MOUNTED IN A HORIZONTAL POSITION, PINS 1 AND 6 SHOULD LIE IN A VERTICAL PLANE.

THE 6877 IS A HARD GLASS, LOW-MU TRIODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS INTENDED FOR SERVICE AS A PASSING OR REGULATOR TUBE IN REGULATED DC POWER SUPPLIES, CAPABLE OF OPERATION AT HIGH TEMPERATURES AND HIGH ALTITUDES.

HEATER CHARACTERISTICS AND RATINGS
ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	800	mA
CATHODE HEATING TIME			30	SECONDS
LIMITS OF APPLIED VOLTAGE			6.3±0.3	VOLTS
HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			450	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			450	VOLTS

MAXIMUM RATINGS
ABSOLUTE MAXIMUM RATINGS – SEE EIA STANDARD RS-239

PLATE VOLTAGE	200	VOLTS
POSITIVE DC GRID VOLTAGE	5.0	VOLTS
NEGATIVE DC GRID VOLTAGE	150	VOLTS
PLATE DISSIPATION	12	WATTS
DC CATHODE CURRENT	100	mA
DC GRID CURRENT	5	mA
GRID CIRCUIT RESISTANCE	1	MEGOHM

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TUNG-SOL

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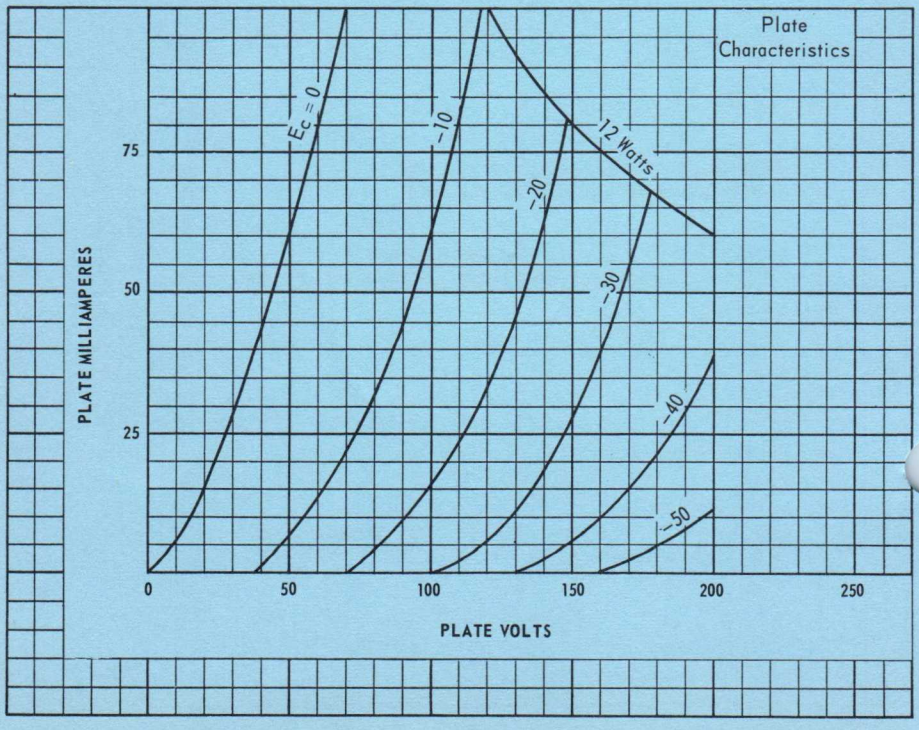
CHARACTERISTICS AND TYPICAL OPERATION

PLATE VOLTAGE	150	VOLTS
GRID VOLTAGE	-12	VOLTS
PLATE CURRENT	75	mA
TRANSCONDUCTANCE	6,500	μMhos
AMPLIFICATION FACTOR	3.75	
PLATE RESISTANCE	2,000	OHMS

SPECIAL TESTS AND RATINGS

SHOCK		
VIBRATION		
HEATER-CYCLING LIFE		
INTERMITTENT LIFE		
BULB TEMPERATURE – ABSOLUTE MAX.	300	°C.
ALTITUDE – ABSOLUTE MAX.	80,000	Ft.

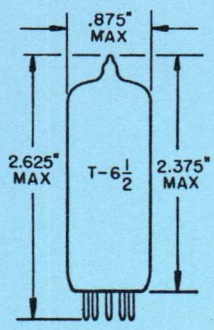


TUNG-SOL

TWIN TRIODE

MINIATURE TYPE

OUTLINE DRAWING
JEDEC 6-8

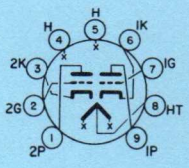


BUTTON 9 PIN MINIATURE
BASE JEDEC E9-1
GOLD PLATED PINS

FOR
PULSE APPLICATIONS
IN MISSILES, AIRCRAFT
AND MILITARY AND INDUSTRIAL
INSTALLATIONS.

TUNGSTEN HEATER
ANY MOUNTING POSITION

BASING DIAGRAM
JEDEC 9H



BOTTOM VIEW

THE 6900 IS A MEDIUM-MU TWIN TRIODE IN THE 9 PIN MINIATURE HARD GLASS CONSTRUCTION. IT IS DESIGNED SPECIFICALLY FOR PULSE APPLICATIONS IN MISSILES, AIRCRAFT AND OTHER MILITARY AND INDUSTRIAL INSTALLATIONS. REQUISITES IN SUCH APPLICATIONS INCLUDE FREEDOM FROM EARLY FAILURES, LONG AVERAGE SERVICE LIFE AND UNIFROM OPERATING CHARACTERISTICS.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE		4.0	pf
INPUT	MAX.	6.5	pf
OUTPUT-SECTION 1		0.8	pf
OUTPUT-SECTION 2		0.61	pf
HEATER TO CATHODE		3.0	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN CENTER VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	1.0	AMPS
	12.6	VOLTS	0.5	AMPS
LIMITS OF APPLIED VOLTAGE			6.3 ± 0.3	VOLTS
			12.6 ± 0.6	VOLTS
HEATER- CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			500	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			500	VOLTS

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MAXIMUM RATINGS

DESIGN CENTER VALUES – SEE EIA STANDARD RS-239

PLATE VOLTAGE	600	VOLTS
PEAK GRID VOLTAGE		
POSITIVE VALUE	100	VOLTS
NEGATIVE VALUE	200	VOLTS
PEAK CATHODE CURRENT ⊕SEE CHART	4.5	AMPS
PLATE DISSIPATION PER PLATE	4.25	WATTS
GRID CIRCUIT RESISTANCE	1.0	MEGOHM
AVERAGE WARM-UP TIME	45	SEC.

AVERAGE CHARACTERISTICS – EACH SECTION

PLATE VOLTAGE	120	VOLTS
GRID VOLTAGE	−2.0	VOLTS
PLATE CURRENT	36	mA
TRANSCONDUCTANCE	11,500	μMHOS
AMPLIFICATION FACTOR	18.5	

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS – PULSE

BOTH SECTIONS IN PARALLEL

PLATE VOLTAGE	500	VOLTS
GRID PULSE (e_{gk})	+50	VOLTS
GRID VOLTAGE	−100	VOLTS
PLATE BIAS VOLTAGE	4.25	AMPS.
GRID CURRENT	0.50	AMP
PULSE TIME	10	μSEC
PULSE REPETITION RATE	250	PPS

SPECIAL TESTS AND RATINGS

ALTITUDE ⊕SEE APPLICATION NOTE	80,000	FT.
BULB TEMPERATURE AT HOTTEST POINT ON BULB	300	°C
IMPACT SHOCK	500	G
VIBRATIONAL ACCELERATION	50	G
LIFE		
HEATER CYCLING LIFE		
FATIGUE		
SHOCK		
GLASS STRAIN		

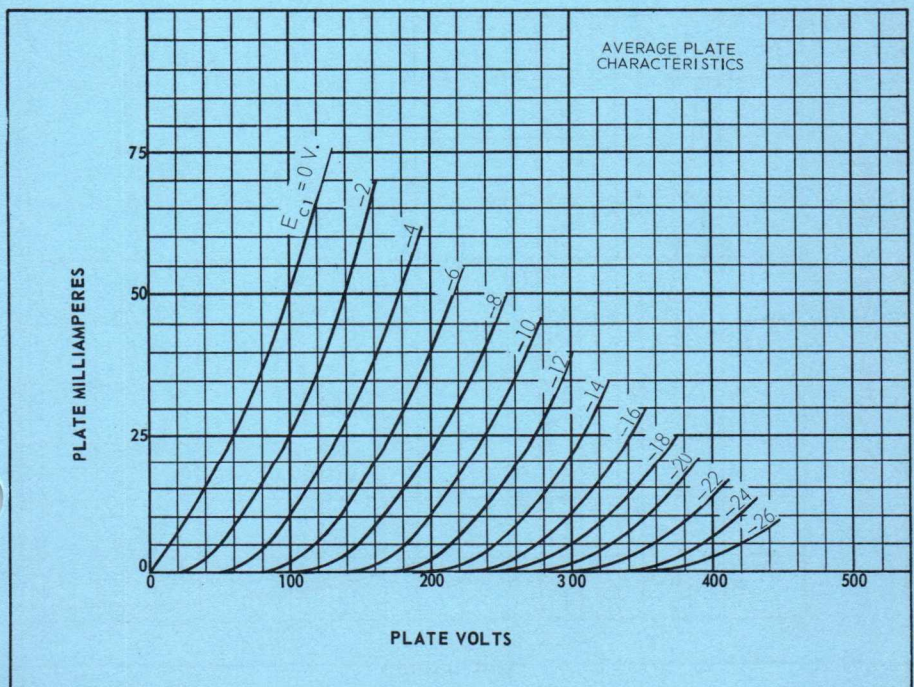
⊕ TO OBTAIN GREATEST LIFE EXPECTANCY FROM TUBE, AVOID DESIGNS WHERE THE TUBE IS SUBJECT TO ALL MAXIMUM RATINGS SIMULTANEOUSLY.

APPLICATION NOTES

SPECIAL ATTENTION SHOULD BE GIVEN TO THE TEMPERATURES AT WHICH THE TUBES ARE TO BE OPERATED. RELIABILITY WILL BE SERIOUSLY IMPAIRED IF MAXIMUM BULB TEMPERATURE IS EXCEEDED. THE LIFE EXPECTANCY WILL BE REDUCED APPRECIABLY IF ABSOLUTE MAXIMUM RATINGS ARE EXCEEDED. BOTH RELIABILITY AND PERFORMANCE WILL BE JEOPARDIZED IF FILAMENT VOLTAGE RATINGS ARE EXCEEDED. LIFE AND RELIABILITY OF PERFROMANCE ARE DIRECTLY RELATED TO THE DEGREE THAT REGULATION OF THE HEATER VOLTAGE IS MAINTAINED AT ITS CENTER RATED VALUE.

THIS TUBE IS CONSTRUCTED USING NONEX GLASS AND THUS CAN WITHSTAND HIGHER AMBIENT TEMPERATURES IN OPERATION. HOWEVER, THE BULB TEMPERATURE SHOULD NEVER EXCEED 300°C AT ITS HOTTEST POINT AND COOLING SHOULD BE EMPLOYED IF NECESSITATED BY THE ADDITIVE EFFECTS OF OPERATION AT HIGH ALTITUDES AND HIGH DISSIPATION SIMULTANEOUSLY OR BY OTHER SOURCES OF HEAT IN THE EQUIPMENT.

THE PLATE VOLTAGE RATING AND HIGH-PERVEANCE OF THE 6900 MAKE IT READILY ADAPTABLE TO VARIED PULSE APPLICATIONS. IN ORDER TO INSURE MAXIMUM RELIABILITY IN PULSE SERVICE THE PEAK CATHODE CURRENT SHOULD NOT EXCEED THE VALUE SHOWN IN PULSE RATING CHART FOR THE REQUIRED DUTY FACTOR.



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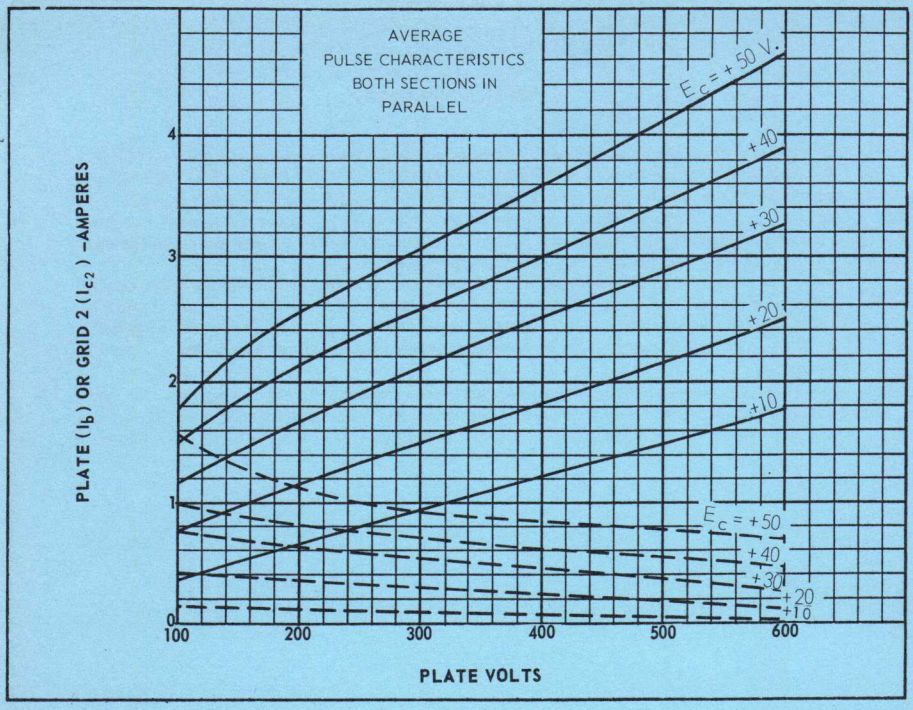
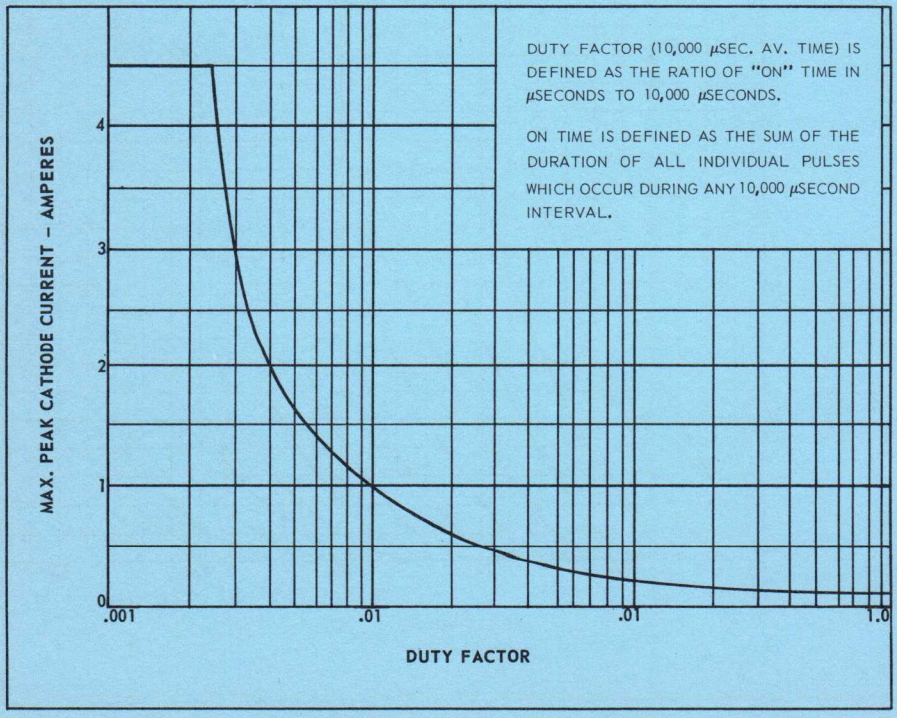
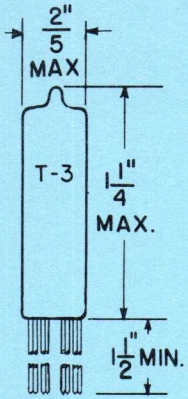

AVERAGE
PULSE CHARACTERISTICS
BOTH SECTIONS IN
PARALLEL
E_c = +50 V.
+40
+30
+20
+10
E_c = +50
+40
+30
+20
+10
PLATE (I_b) OR GRID 2 (I_{c2}) –AMPERES
0
1
2
3
4
100
200
300
400
500
600
PLATE VOLTS


DUTY FACTOR (10,000 μSEC. AV. TIME) IS DEFINED AS THE RATIO OF "ON" TIME IN μSECONDS TO 10,000 μSECONDS.
ON TIME IS DEFINED AS THE SUM OF THE DURATION OF ALL INDIVIDUAL PULSES WHICH OCCUR DURING ANY 10,000 μSECOND INTERVAL.
MAX. PEAK CATHODE CURRENT – AMPERES
0
1
2
3
4
.001
.01
.01
1.0
DUTY FACTOR

TUNG-SOL

PENTODE

SUBMINIATURE TYPE



GLASS BULB

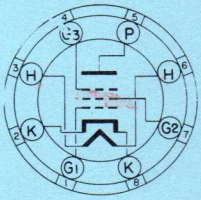
COATED UNIPOTENTIAL CATHODE

HEATER

6.3 VOLTS 0.175 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
SUBMINIATURE BUTTON

8DC

THE 6943 IS A SUBMINIATURE SHARP CUTOFF PENTODE DESIGNED FOR RADIO FREQUENCY AMPLIFIER SERVICE. THIS TYPE IS CHARACTERIZED BY EXTRAORDINARY FREEDOM FROM INTERELEMENT SHORT CIRCUITS OF SHORT TERM DURATION, BY HIGH RESISTANCE TO INTERELEMENT LEAKAGE, AND BY STABLE PERFORMANCE. IN ADDITION, VIBRATIONAL OUTPUT WHEN THE TUBE IS SUBJECTED TO WIDE BAND (WHITE NOISE) VIBRATION IS HELD TO A VERY LOW VALUE. IT IS SUITABLE FOR SERVICE AT HIGH ALTITUDES AND WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK, VIBRATION AND HIGH TEMPERATURE ARE ENCOUNTERED. THESE CHARACTERISTICS GIVE THE TYPE SPECIAL VALUE IN GUIDED MISSILE APPLICATIONS.

DIRECT INTERELECTRODE CAPACITANCES[12]

GRID #1 TO PLATE (MAX.)	0.015	μμf
INPUT: G1 TO (H+K+G2+G3+I.S.+E.S.)	3.0	μμf
OUTPUT: P TO (H+K+G2+G3+I.S.+E.S.)	3.0	μμf

RATINGS[1]

ABSOLUTE VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER VOLTAGE VARIATION	6.3±10%	VOLTS
INSTANTANEOUS PLATE VOLTAGE	360	VOLTS
PLATE VOLTAGE	250	VDC
GRID #2 VOLTAGE	150	VDC
PLATE DISSIPATION	1.0	W
GRID #2 DISSIPATION	0.33	W
POSITIVE GRID #1 VOLTAGE	0	VDC
NEGATIVE GRID #1 VOLTAGE	55	VDC
EXTERNAL GRID #1 CIRCUIT RESISTANCE	1.0	MEG.
AVERAGE CATHODE CURRENT	15	mAdc
HEATER-CATHODE VOLTAGE	200	VOLTS
BULB TEMPERATURE (AT HOTTEST POINT)	250	°C
OPERATIONAL ALTITUDE	80,000	FT.

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

AVERAGE CHARACTERISTICS		
HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.175	AMP.
CONDITIONS:		
HEATER VOLTAGE	6.3	VOLTS
PLATE VOLTAGE	100	VDC
GRID #2 VOLTAGE	100	VDC
GRID #3 VOLTAGE	0	
CATHODE BIAS RESISTOR	150	OHMS
PLATE CURRENT	8.0	mAdc
GRID #2 CURRENT	2.3	mAdc
TRANSCONDUCTANCE	3600	μMHOS
PLATE RESISTANCE	300,000	OHMS
GRID #1 VOLTAGE FOR Ib = 10 μA	−7.5	VDC
GRID #1 VOLTAGE FOR Ib = 200 μA	−5.5	VDC
OPERATION TIME (MAX.)[13]	20	SECS.

DURABILITY CHARACTERISTICS[2]		
IMPACT ACCELERATION [3]	100	G
VIBRATIONAL ACCELERATION FOR AN EXTENDED PERIOD[4]	10	G
ON-OFF HEATER CYCLES [5]	2000	

CONTROLLED DETRIMENTS		
INTERELECTRODE INSULATION (MIN) [6]	250	MEG.
TOTAL GRID CURRENT (MAX.) [7]	−0.1	μAdc
GRID EMISSION[8] (MAX.)	−0.5	μAdc
HUM OUTPUT[9] (MAX.)	15	MV, pk-pk
WHITE NOISE VIBRATION OUTPUT[10] (MAX.)	350	MV. pk-pk
	50	MV rms
HEATER-CATHODE LEAKAGE[11] (MAX.)	5.0	μAdc

NOTES:

1. LIMITING VALUES BEYOND WHICH NORMAL TUBE LIFE AND NORMAL TUBE PERFORMANCE MAY BE IMPAIRED.
2. TESTS PERFORMED AS A MEASURE OF THE MECHANICAL DURABILITY OF THE TUBE STRUCTURE.
3. FORCE AS APPLIED IN ANY DIRECTION BY THE NAVY TYPE HIGH IMPACT (FLYWEIGHT) SHOCK MACHINE FOR ELECTRONIC DEVICES. SHOCK DURATION = 4 MILLISECONDS.
4. VIBRATIONAL FORCES APPLIED IN ANY DIRECTION FOR A PERIOD OF SIX HOURS REPEATEDLY SWEEPING THE RANGE FROM 30 CPS TO 3000 CPS AND BACK, WITH THE PERIOD OF THE SWEEP CYCLE BEING THREE MINUTES.
5. ONE CYCLE CONSISTS OF THE APPLICATION OF Ef = 7.0 V FOR ONE MINUTE AND INTERRUPTION OF THE FILAMENT VOLTAGE FOR FOUR MINUTES. A VOLTAGE OF Ehk = 140 Vac IS APPLIED CONTINUOUSLY.
6. MEASURED WITH Ef = 6.3 V, Ep-all = -300 Vdc; Eg2-all = -200 Vdc; Eg1-all = -100 Vdc; CATHODE IS POSITIVE SO THAT NO CATHODE EMISSION OCCURS.
7. MEASURED WITH Ef = 6.3 V; Eb = Ec2 = 100 Vdc; Rk = 150 OHMS; Rg1 = 1.0 MEG.
8. PREHEATED FOR FIVE MINUTES WITH Ef = 7.5 V; Eb = 250 Vdc; Ec2 = 150 Vdc; Rk = 1000 OHMS; Rg1 = 1.0 MEG; THEN TESTED WITH Ef = 7.5 V; Eb = Ec2 = 100 Vdc; Ec1 = -7.5 Vdc; Rg1 = 1.0 MEG. THIS IS A DESTRUCTIVE TEST AND THEREFORE MUST BE CONDUCTED ON A SAMPLE BASIS.

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9. TEST WITH Ef = 6.3 V (400 CPS), Eb = Ec2 = 100 Vdc; Rk = 150 OHMS; Rg2 = 30,000 OHMS; RL = 10,000 OHMS; MEASURE THE HUM OUTPUT ACROSS R1 IN THE FREQUENCY BAND FROM 20 CPS TO 5,000 CPS.

10. TEST WITH Ef = 6.3 V; Eb = Ec2 = 100 Vdc; Rk = 150 OHMS; Rp = 10,000 OHMS. THE WHITE NOISE VOLTAGE ACROSS Rp IS FILTERED TO ROLL OFF APPROXIMATELY 35 db BETWEEN 10,000 CPS AND 13,000 CPS AND IS THEN MEASURED WITH BOTH A PEAK TO PEAK METER AND AN RMS READING METER. THE VIBRATIONAL FORCE APPLIED TO THE TUBE UNDER TEST IS SUCH THAT THE INSTANTANEOUS VALUES OF ACCELERATION FORM A WHITE NOISE SPECTRUM FROM 100 CPS TO 5000 CPS. ENERGY WITHIN THIS SPECTRUM IS DISTRIBUTED SUCH THAT EACH OCTAVE OF BAND-WIDTH DELIVERS 2.3 G'S RMS ACCELERATION. THE DEGREE OF CLIPPING IS SUCH THAT PEAK VALUES OF ACCELERATION EXCEED 15 G'S.

11. MEASURED WITH Ef = 6.3 V; Ehk = ± 100Vdc.

12. CAPACITANCES ARE MEASURED WITH AN EXTERNAL SHIELD OF 0.405"I.D.

13. OPERATION TIME IS THE TIME REQUIRED FOR A TUBE TO REACH A VALUE OF PLATE CURRENT EQUAL TO 85% OF THAT VALUE ATTAINED AFTER THREE MINUTES.

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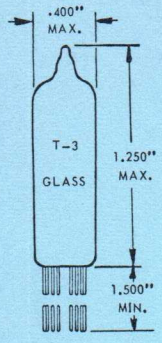
PENTODE

SUBMINIATURE

OUTLINE DRAWING
JEDEC 3-11



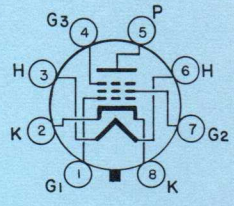
SUBMINIATURE BUTTON
8 FLEXIBLE LEADS
JEDEC E8-10

FOR
GUIDED MISSILE
SERVICE

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION

BASING DIAGRAM
JEDEC 8DC



BOTTOM VIEW

THE 6943 IS A SHARP-CUTOFF RF PENTODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED SPECIFICALLY FOR GUIDED MISSILE SERVICE. THIS TYPE IS CHARACTERIZED BY STABLE PERFORMANCE FOR OPERATION AT HIGH ALTITUDES AND WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK, VIBRATION AND HIGH TEMPERATURE ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

WITH EXTERNAL SHIELD #318 CONNECTED TO CATHODE

GRID 1 TO PLATE	MAX.	0.015	pf
INPUT		3.0	pf
OUTPUT		3.0	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	175	mA
LIMITS OF APPLIED VOLTAGE		5.5 TO 6.9	VOLTS
HEATER-CATHODE VOLTAGE			
HEATER POSITIVE WITH RESPECT TO CATHODE		200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE		200	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

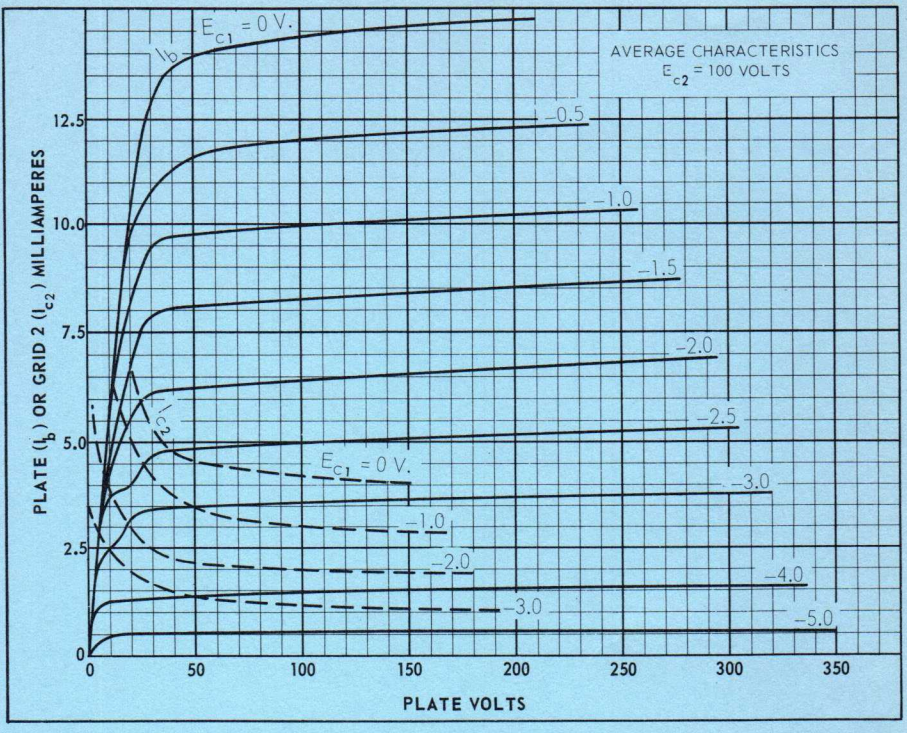
DC PLATE VOLTAGE	250	VOLTS
PEAK – PLATE FORWARD VOLTAGE	360	VOLTS
DC GRID 3 VOLTAGE		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	20	VOLTS
DC GRID 2 VOLTAGE	150	VOLTS
DC GRID 1 VOLTAGE		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	55	VOLTS
PLATE DISSIPATION	1.0	WATTS
GRID 2 DISSIPATION	0.33	WATTS
CATHODE CURRENT	15	mA
GRID 1 CIRCUIT RESISTANCE	1.0	MEGOHM
BULB TEMPERATURE	250	°C

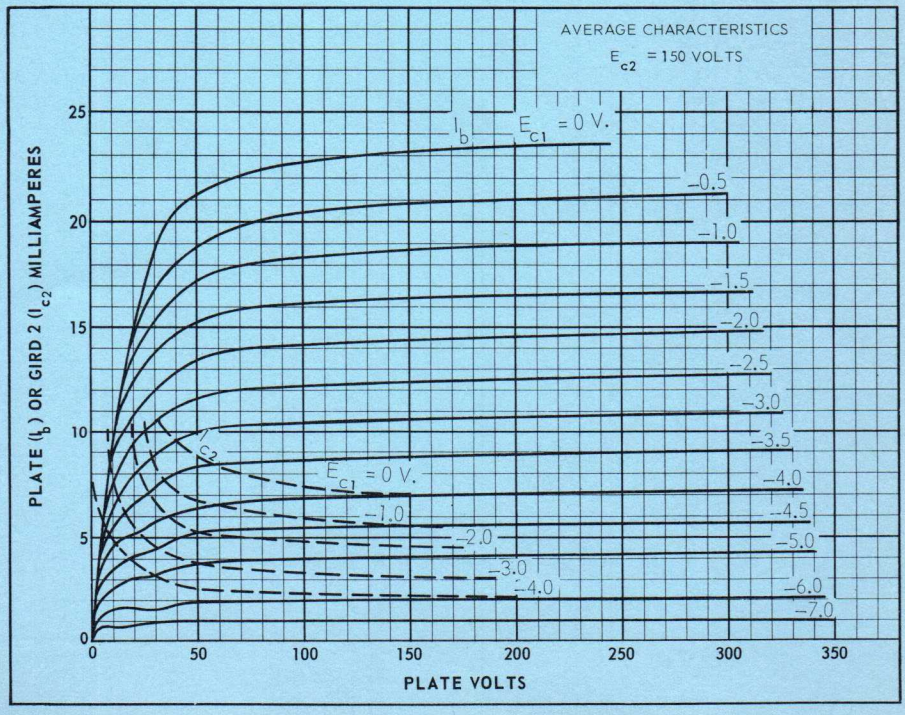
CHARACTERISTICS

DC PLATE VOLTAGE	100	VOLTS
DC GRID 3 VOLTAGE	0	VOLTS
DC GRID 2 VOLTAGE	100	VOLTS
CATHODE RESISTOR	150	OHMS
DC PLATE CURRENT	8.0	mA
DC GRID 2 CURRENT	2.3	mA
TRANSCONDUCTANCE	3,600	μMHOS
PLATE RESISTANCE	300,000	OHMS
DC GRID 1 VOLTAGE FOR I_b = 100 μADC MAX.	–7.5	VOLTS

SPECIAL TESTS AND RATINGS

IMPACT ACCELERATION		
FATIGUE		
FAILURE RATE		
ALTITUDE – ABSOLUTE MAXIMUM	80,000	FT.
RADIATION – ABSOLUTE MAXIMUM		
TOTAL DOSAGE– NEUTRONS/SQ. CM	10^{16}	NVT
DOSE RATE – NEUTRONS/SQ. CM/SEC	10^{12}	NV





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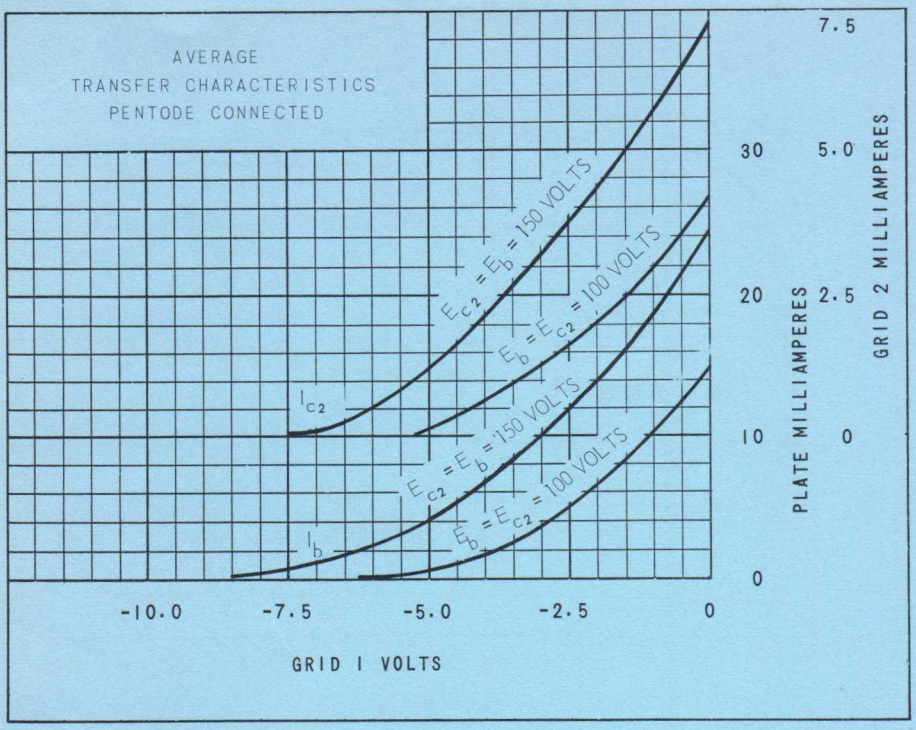
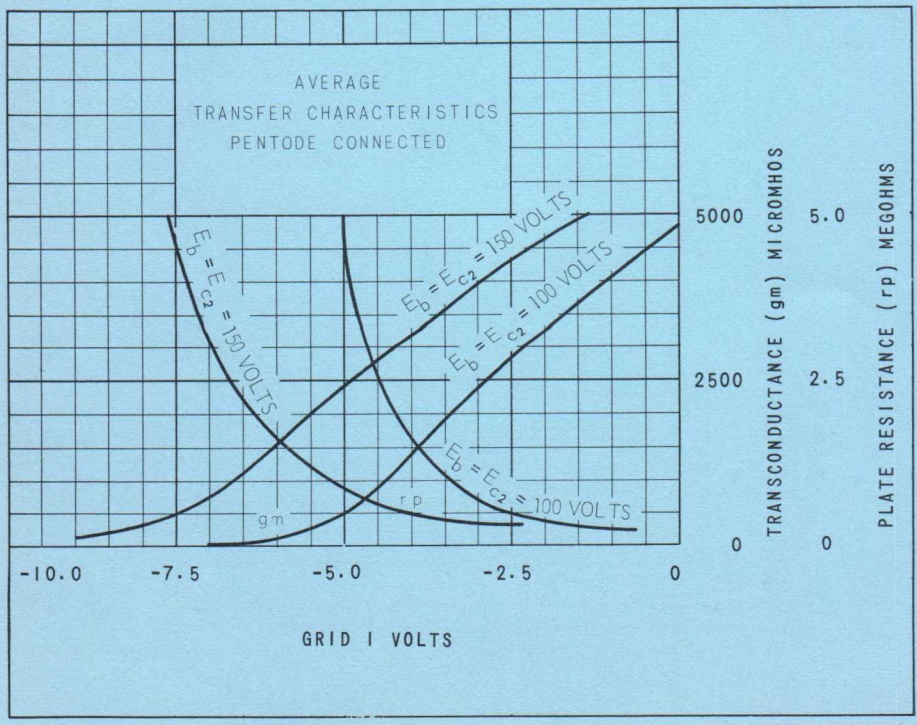

AVERAGE
TRANSFER CHARACTERISTICS
PENTODE CONNECTED
$E_{c2} = E_b = 150$ VOLTS
$E_b = E_{c2} = 100$ VOLTS
$E_{c2} = E_b = 150$ VOLTS
$E_b = E_{c2} = 100$ VOLTS
I_{c2}
I_b
-10.0
-7.5
-5.0
-2.5
0
GRID 1 VOLTS
30
20
10
0
PLATE MILLIAMPERES
7.5
5.0
2.5
0
GRID 2 MILLIAMPERES


AVERAGE
TRANSFER CHARACTERISTICS
PENTODE CONNECTED
$E_b = E_{c2} = 150$ VOLTS
$E_b = E_{c2} = 150$ VOLTS
$E_b = E_{c2} = 100$ VOLTS
$E_b = E_{c2} = 100$ VOLTS
gm
rp
-10.0
-7.5
-5.0
-2.5
0
GRID 1 VOLTS
5000
2500
0
TRANSCONDUCTANCE (gm) MICROMHOS
5.0
2.5
0
PLATE RESISTANCE (rp) MEGOHMS

TUNG-SOL

PENTODE

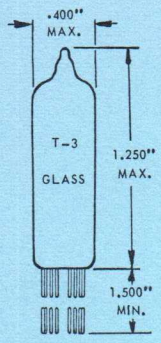
SUBMINIATURE

FOR GUIDED MISSILE SERVICE

COATED UNIPOTENTIAL CATHODE

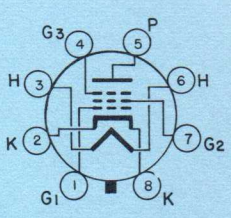
ANY MOUNTING POSITION

OUTLINE DRAWING
JEDEC 3-11



SUBMINIATURE BUTTON
8 FLEXIBLE LEADS
JEDEC E8-10

BASING DIAGRAM
JEDEC 8DC



BOTTOM VIEW

THE 6944 IS A SEMI-REMOTE CUTOFF RF PENTODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED SPECIFICALLY FOR GUIDED MISSILE SERVICE. THIS TYPE IS CHARACTERIZED BY STABLE PERFORMANCE IN OPERATION AT HIGH ALTITUDES AND WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK, VIBRATION AND HIGH TEMPERATURE ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

WITH EXTERNAL SHIELD #318 CONNECTED TO CATHODE

GRID 1 TO PLATE	0.015	pf
INPUT	2.9	pf
OUTPUT	3.1	pf

HEATER CHARACTERISTICS AND RATINGS

AVERAGE CHARACTERISTICS	6.3 VOLTS	175	mA
LIMITS OF APPLIED VOLTAGE		5.5 TO 6.9	VOLTS
HEATER- CATHODE VOLTAGE			
HEATER POSITIVE WITH RESPECT TO CATHODE		200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE		200	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

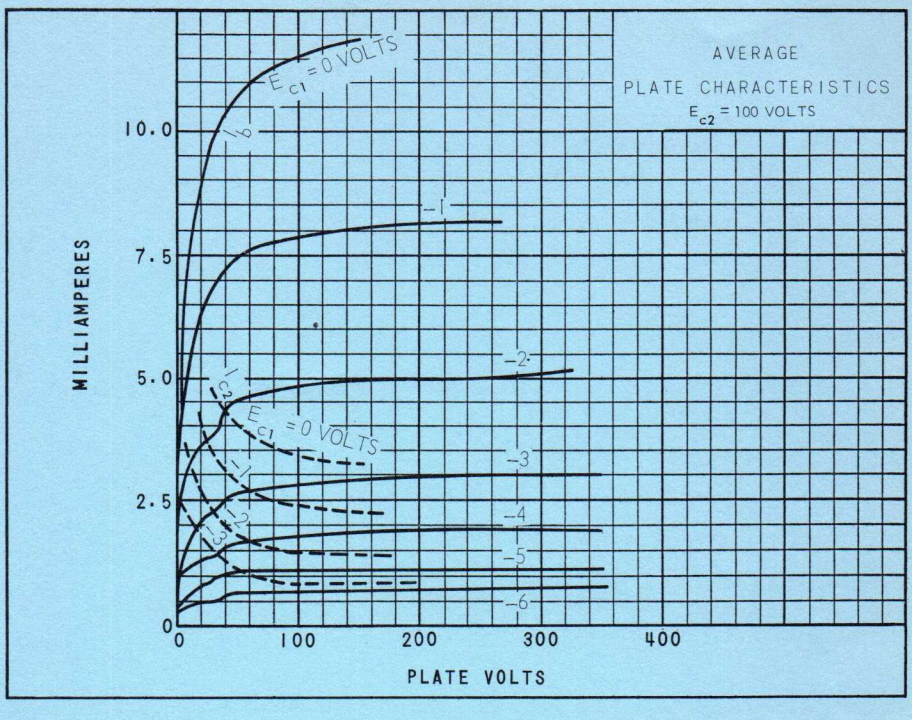
DC PLATE VOLTAGE	250	VOLTS
PEAK-PLATE FORWARD VOLTAGE	360	VOLTS
DC GRID 3 VOLTAGE		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	20	VOLTS
DC GRID 2 VOLTAGE	150	VOLTS
DC GRID 1 VOLTAGE		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	55	VOLTS
PLATE DISSIPATION	1.0	WATTS
GRID 2 DISSIPATION	0.36	WATTS
GRID 1 CIRCUIT RESISTANCE	1.0	MEGOHM
BULB TEMPERATURE	250	°C

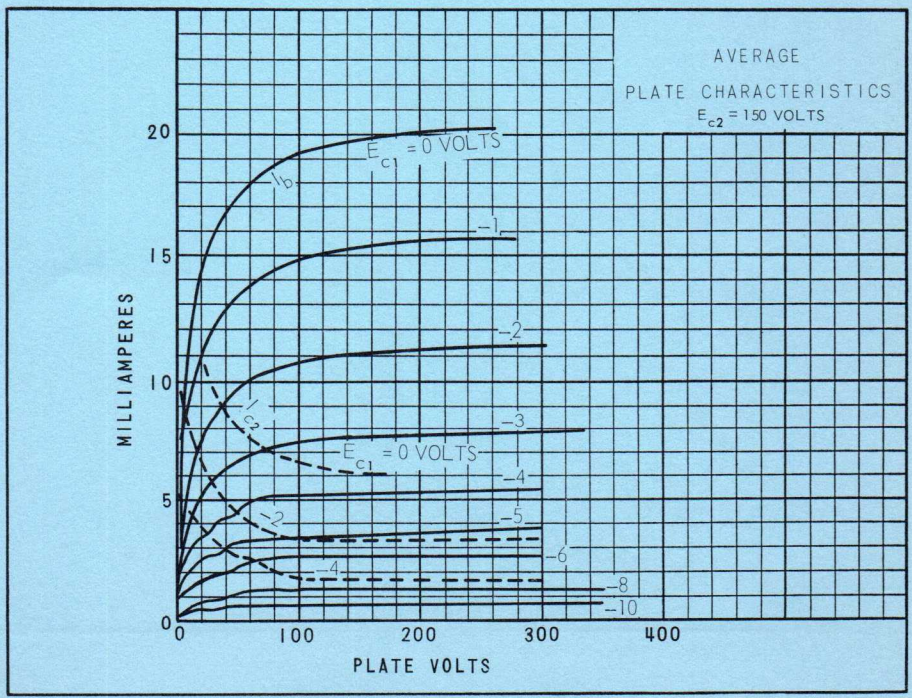
CHARACTERISTICS

DC PLATE VOLTAGE	100	VOLTS
DC GRID 3 VOLTAGE	0	VOLTS
DC GRID 2 VOLTAGE	100	VOLTS
CATHODE RESISTOR	150	OHMS
DC PLATE CURRENT	7.0	mA
DC GRID 2 CURRENT	2.0	mA
TRANSCONDUCTANCE	3,200	μMHOS
PLATE RESISTANCE	280,000	OHMS
DC GRID 1 VOLTAGE FOR G_m = 25 μMHOS APPROX. (75μMHOS MAX.)	–12	VOLTS

SPECIAL TESTS AND RATINGS

IMPACT ACCELERATION		
FATIGUE		
FAILURE RATE		
ALTITUDE – ABSOLUTE MAXIMUM	80,000	FT.
RADIATION – ABSOLUTE MAXIMUM		
TOTAL DOSAGE – NEUTRONS/SQ. CM	10^{16}	NVT
DOSE RATE – NEUTRONS/SQ. CM/SEC.	10^{12}	NV





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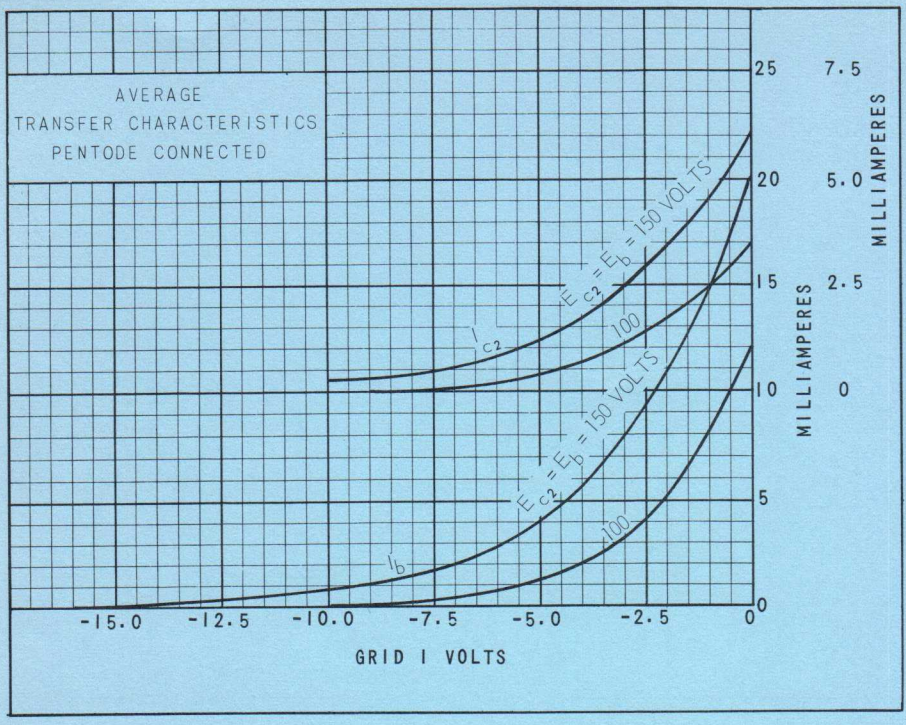
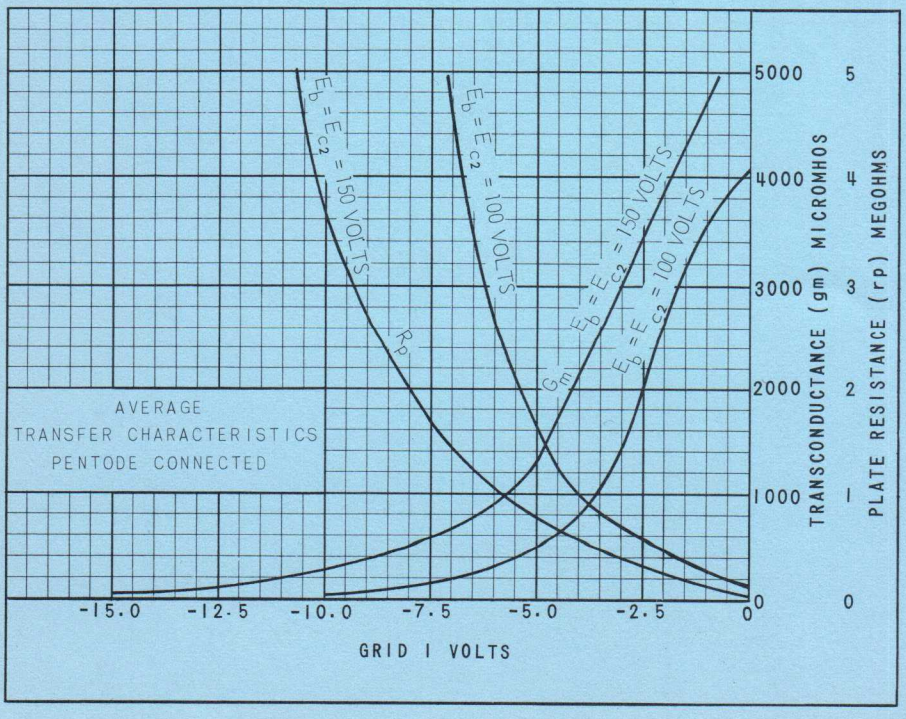

AVERAGE
TRANSFER CHARACTERISTICS
PENTODE CONNECTED
$E_{c_2} = E_b = 150$ VOLTS
I_{c_2}
100
$E_{c_2} = E_b = 150$ VOLTS
100
I_b
-15.0
-12.5
-10.0
-7.5
-5.0
-2.5
0
GRID I VOLTS
25
20
15
10
5
0
MILLIAMPERES
7.5
5.0
2.5
0
MILLIAMPERES

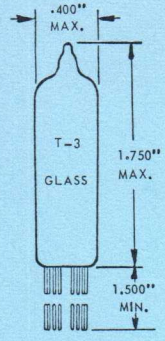

AVERAGE
TRANSFER CHARACTERISTICS
PENTODE CONNECTED
$E_b = E_{c_2} = 150$ VOLTS
R_p
$E_b = E_{c_2} = 100$ VOLTS
G_m
$E_b = E_{c_2} = 150$ VOLTS
$E_b = E_{c_2} = 100$ VOLTS
-15.0
-12.5
-10.0
-7.5
-5.0
-2.5
0
GRID I VOLTS
5000
4000
3000
2000
1000
0
TRANSCONDUCTANCE (gm) MICROMHOS
5
4
3
2
1
0
PLATE RESISTANCE (rp) MEGOHMS

TUNG-SOL

BEAM PENTODE

SUBMINATURE

OUTLINE DRAWING
JEDEC 3-3



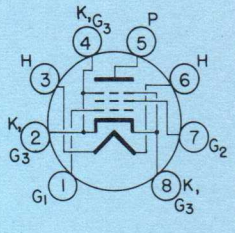
SUBMINIATURE BUTTON
8 FLEXIBLE LEADS
JEDEC E8-10

FOR
GUIDED MISSILE
SERVICE

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION

BASING DIAGRAM
JEDEC 8DL



BOTTOM VIEW

THE 6945 IS A BEAM POWER PENTODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED SPECIFICALLY FOR GUIDED MISSILE SERVICE. THIS TYPE IS CHARACTERIZED BY STABLE PERFORMANCE IN OPERATION AT HIGH ALTITUDES WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK, VIBRATION AND HIGH TEMPERATURE ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES
WITH EXTERNAL SHIELD #318 CONNECTED TO CATHODE

GRID 1 TO PLATE	MAX.	0.13	pf
INPUT		5.0	pf
OUTPUT		5.5	pf

HEATER CHARACTERISTICS AND RATINGS

AVERAGE CHARACTERISTICS	6.3 VOLTS	350	mA
LIMITS OF APPLIED VOLTAGE		5.5 TO 6.9	VOLTS
HEATER CATHODE VOLTAGE:			
HEATER POSITIVE WITH RESPECT TO CATHODE		200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE		200	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

DC PLATE VOLTAGE	250	VOLTS
PEAK-PLATE FORWARD VOLTAGE	360	VOLTS
GRID 2 VOLTAGE	150	VOLTS
DC GRID 1 VOLTAGE		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	55	VOLTS
PLATE DISSIPATION	3.0	WATTS
GRID 2 DISSIPATION	0.33	WATTS
CATHODE CURRENT	40	mADC
GRID 1 CIRCUIT RESISTANCE	0.5	MEGOHM
BULB TEMPERATURE	250	°C

AVERAGE CHARACTERISTICS

	TRIODE CONNECTED	PENTODE CONNECTED	
DC PLATE VOLTAGE	100	100	VOLTS
DC GRID 2 VOLTAGE	100	100	VOLTS
CATHODE BIAS RESISTOR	270	270	OHMS
DC PLATE CURRENT	26	25	mA
DC GRID 2 CURRENT	–	1.5	mA
TRANSCONDUCTANCE	3,700	3,500	μMHOS
AMPLIFICATION FACTOR	5.0		
PLATE RESISTANCE - APPROX.	1,500	20,000	OHMS
DC GRID 1 VOLTAGE FOR $I_b = 35\ \mu A$		−40	VOLTS

CHARACTERISTICS AND TYPICAL OPERATION

CLASS A_1 AMPLIFIER - SINGLE TUBE

	TRIODE CONNECTED		PENTODE CONNECTED	
PLATE VOLTAGE	150	250	150	VOLTS
GRID 2 VOLTAGE	–	–	110	VOLTS
CATHODE RESISTOR	680	2,700	470	OHMS
PEAK AF GRID 1 VOLTAGE	16.3	38.2	10.6	VOLTS
ZERO - SIGNAL PLATE CURRENT	23.8	14.2	21.5	mA
MAX. - SIGNAL PLATE CURRENT	25.3	15.5	20.5	mA
ZERO - SIGNAL GRID 2 CURRENT	–	–	0.8	mA
MAX. - SIGNAL GRID 2 CURRENT	–	–	3.23	mA
MAX. - SIGNAL POWER OUTPUT	0.43	0.94	1.22	WATTS
LOAD RESISTANCE	2,200	6,000	7,000	OHMS
TOTAL HARMONIC DISTORTION	11.0	16.7	11.0	PERCENT

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CHARACTERISTICS AND TYPICAL OPERATION (Cont'd)

PUSH-PULL - TWO TUBES

	CLASS A_1		CLASS AB_2	
PLATE VOLTAGE	150	200	185	VOLTS
GRID 2 VOLTAGE	110	125	110	VOLTS
GRID 1 VOLTAGE	–	–	-15	VOLTS
CATHODE RESISTOR	270	560	–	OHMS
PEAK AF GRID TO GRID VOLTAGE	21.2	39.6	31.2	VOLTS
ZERO-SIGNAL PLATE CURRENT	37.5	27.0	26.7	mA
MAX. - SIGNAL PLATE CURRENT	38.0	31.6	46.0	mA
ZERO - SIGNAL GRID 2 CURRENT	1.35	0.8	0.67	mA
MAX.-SIGNAL GRID 2 CURRENT	4.67	4.30	5.90	mA
MAX. SIGNAL POWER OUTPUT	2.42	3.41	4.76	WATTS
LOAD RESISTANCE - PLATE TO PLATE	12,000	13,000	10,000	OHMS
TOTAL HARMONIC DISTORTION - APPROX.	4.1	4.9	1.02	PERCENT

SPECIAL TESTS AND RATINGS

IMPACT ACCELERATION		
FATIGUE		
FAILURE RATE		
RADIATION: ABSOLUTE MAXIMUM		
TOTAL DOSAGE - NEUTRONS/SA.CM.	10^{16}	NVT
DOSE RATE - NEUTRONS/SQ. CM/SEC	10^{12}	NV
ALTITUDE - ABSOLUTE MAXIMUM	80,000	FT

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TUNG-SOL

TRIODE

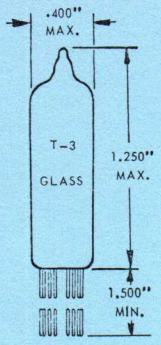
SUBMINIATURE

FOR GUIDED MISSI LE SERVICE

COATED UNIPOTENTIAL CATHODE

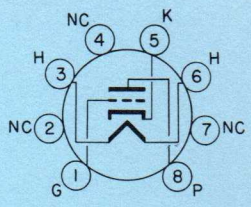
ANY MOUNTING POSITION

OUTLINE DRAWING
JEDEC 3-11



SUBMINIATURE BUTTON
8 FLEXIBLE LEADS
JEDEC E8-10

OUTLINE DRAWING
JEDEC 8DK



BOTTOM VIEW

THE 6946 IS GENERAL PURPOSE MEDIUM-MU TRIODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED SPECIFICALLY FOR GUIDED MISSILE SERVICE. THIS TYPE IS CHARACTERIZED BY STABLE PERFORMANCE IN OPERATION AT HIGH ALTITUDES AND WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK VIBRATION AND HIGH TEMPERATURES ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE	1.0	pf
INPUT	1.6	pf
OUTPUT	0.75	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	175	mA
LIMITS OF APPLIED VOLTAGE		5.5 TO 6.9	VOLTS
HEATER-CATHODE VOLTAGE:			
HEATER POSITIVE WITH RESPECT TO CATHODE		200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE		200	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

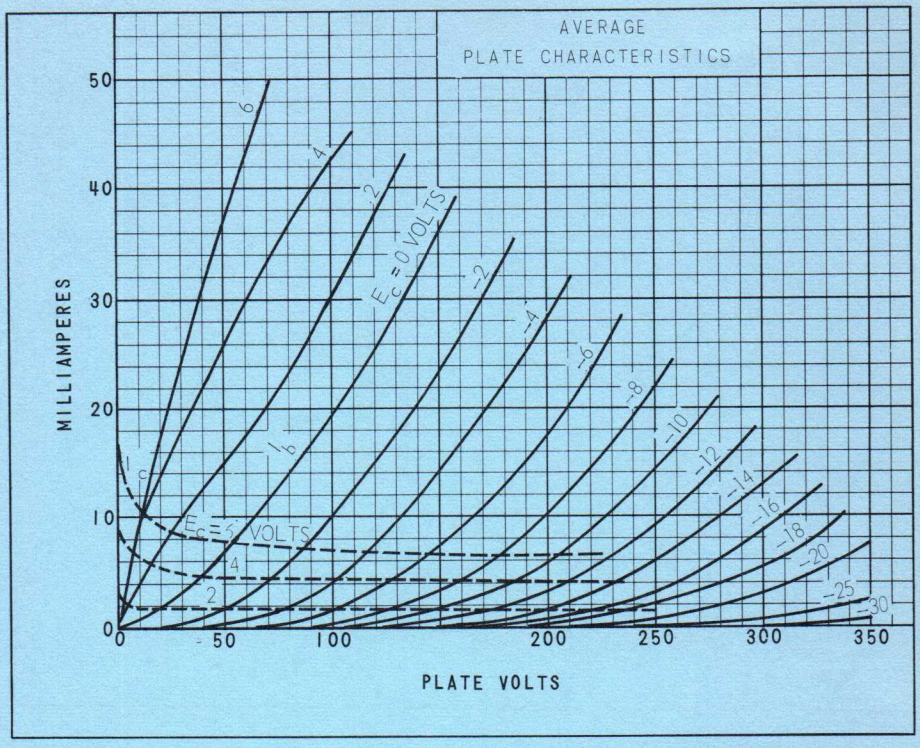
DC PLATE VOLTAGE	250	VOLTS
PEAK-PLATE FORWARD VOLTAGE	360	VOLTS
DC GRID VOLTAGE:		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	55	VOLTS
PLATE DISSIPATION	1.5	WATTS
DC CATHODE CURRENT	15	mA
GRID CIRCUIT RESISTANCE	1.0	MEGOHM
BULB TEMPERATURE	250	°C

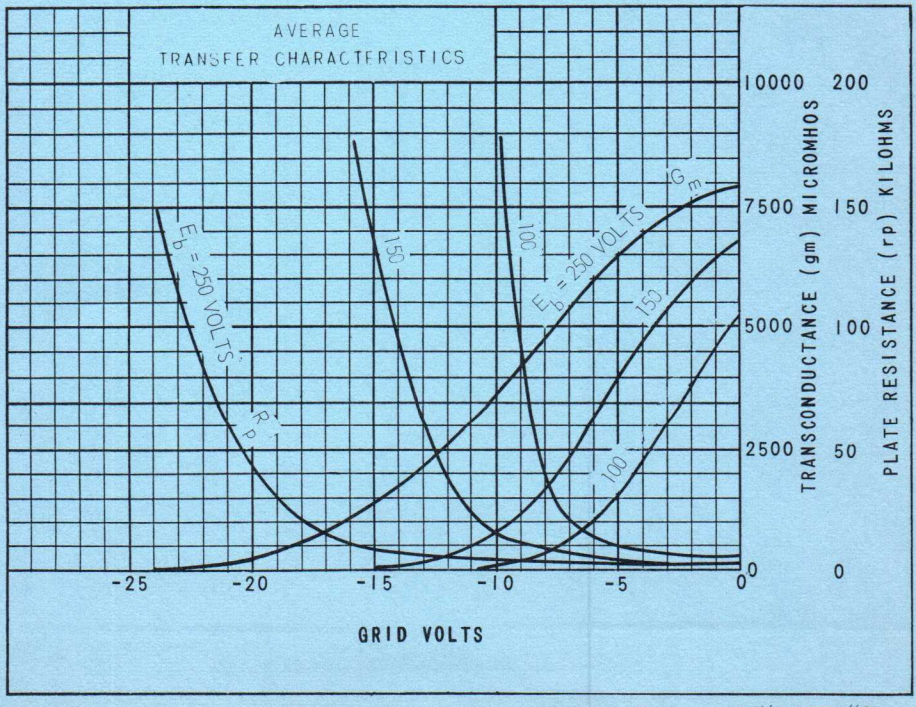
CHARACTERISTICS

DC PLATE VOLTAGE	100	VOLTS
CATHODE RESISTOR	270	OHMS
DC PLATE CURRENT	9.0	mA
AMPLIFICATION FACTOR	16.5	
TRANSCONDUCTANCE	3,800	μMHOS
DC GRID VOLTAGE FOR I_b = 150 μADC MAX.	-11.5	VOLTS
DC GRID VOLTAGE FOR I_b = 5 μADC MIN.	-8.5	VOLTS

SPECIAL TESTS AND RATINGS

IMPACT ACCELERATION		
FATIGUE		
FAILURE RATE		
ALTITUDE-ABSOLUTE MAXIMUM	80,000	FT.
RADIATION--ABSOLUTE MAXIMUM		
TOTAL DOSAGE-NEUTRONS/SQ. CM	10^{16}	NVT
DOSE RATE- NEUTRONS/SQ. CM/SEC	10^{12}	NV





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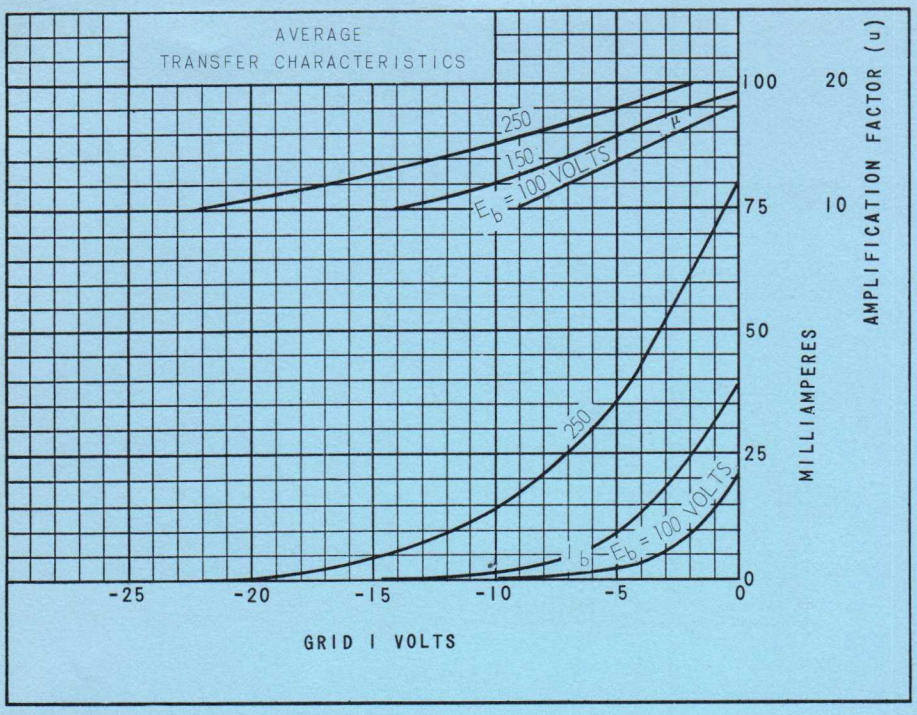

AVERAGE
TRANSFER CHARACTERISTICS
250
150
E_b = 100 VOLTS
μ
250
I_b
E_b = 100 VOLTS
100
75
50
25
0
20
10
MILLIAMPERES
AMPLIFICATION FACTOR (u)
-25
-20
-15
-10
-5
0
GRID I VOLTS

TUNG-SOL

TWIN TRIODE

SUBMINIATURE

FOR

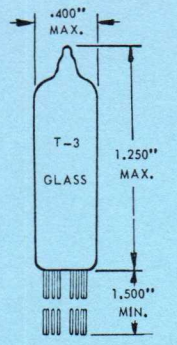
GUIDED MISSILE

SERVICE

COATED UNIPOTENTIAL CATHODE

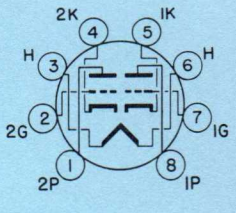
ANY MOUNTING POSITION

OUTLINE DRAWING
JEDEC 3-11



SUBMINIATURE BUTTON
8 FLEXIBLE LEADS
JEDEC E8-10

BASING DIAGRAM
JEDEC 8DG



BOTTOM VIEW

THE 6947 IS A SUBMINIATURE GENERAL PURPOSE MEDIUM-MU TWIN TRIODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED SPECIFICALLY FOR GUIDED MISSILE SERVICE. THIS TYPE IS CHARACTERIZED BY STABLE PERFORMANCE IN OPERATION AT HIGH ALTITUDES AND WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK, VIBRATION AND HIGH TEMPERATURE ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE-EACH SECTION		1.2	pf
INPUT-EACH SECTION		1.6	pf
OUT			
SECTION 1		0.20	pf
SECTION 2		0.25	pf
GRID TO GRID	MAX.	0.013	pf
PLATE TO PLATE	MAX.	0.45	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES-SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	350	mA
LIMITS OF APPLIED VOLTAGE		5.5 TO 6.9	VOLTS
HEATER-CATHODE VOLTAGE			
HEATER POSITIVE WITH RESPECT TO CATHODE		200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE		200	VOLTS

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MAXIMUM RATINGS – EACH SECTION

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

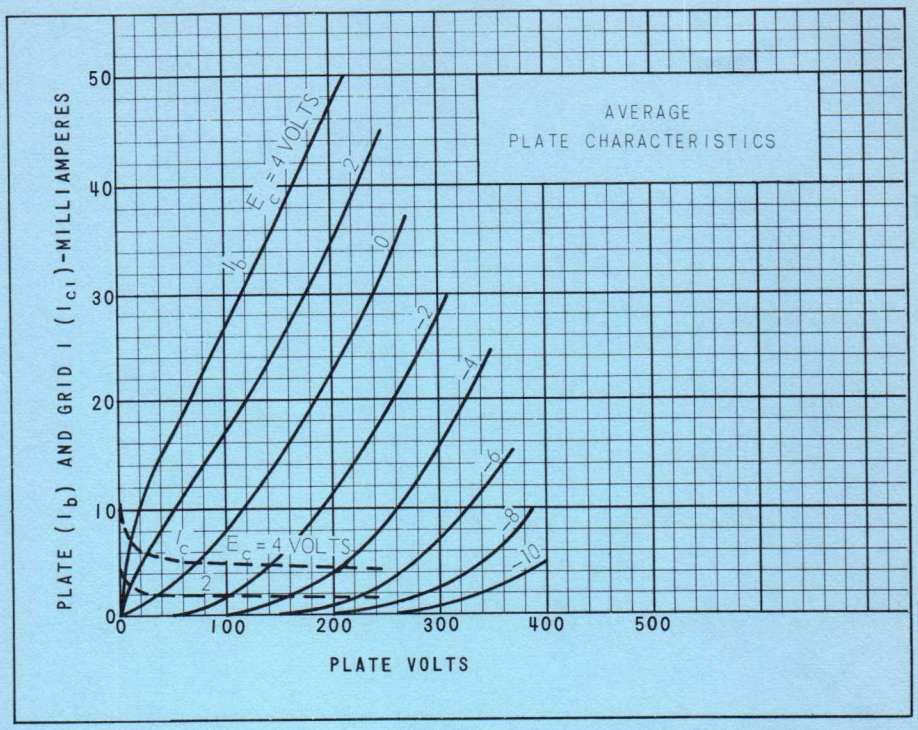
DC PLATE VOLTAGE	250	VOLTS
PEAK – PLATE FORWARD VOLTAGE	360	VOLTS
DC GRID VOLTAGE		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	55	VOLTS
PLATE DISSIPATION	0.75	WATTS
PLATE CURRENT	13	mA
GRID CIRCUIT RESISTANCE	1.0	MEGOHM
BULB TEMPERATURE	250	°C

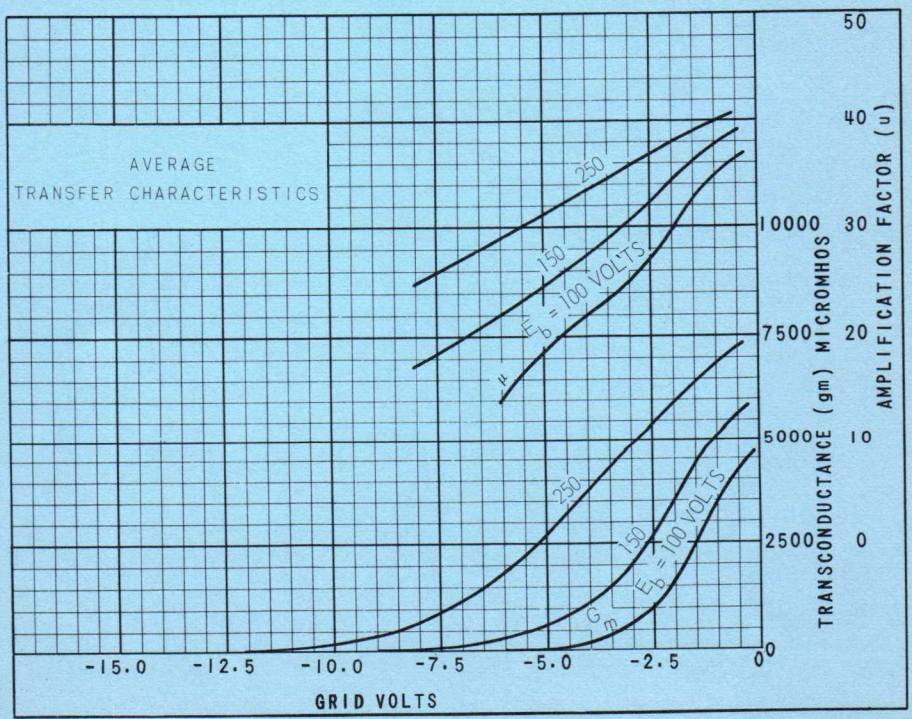
CHARACTERISTICS – EACH SECTION

DC PLATE VOLTAGE	150	VOLTS
CATHODE RESISTOR	270	OHMS
PLATE CURRENT	6.5	mA
AMPLIFICATION FACTOR	35	
TRANSCONDUCTANCE	4,000	μMHOS
GRID VOLTAGE FOR I_b = 50 μADC MAXIMUM	–9.0	VOLTS

SPECIAL TESTS AND RATINGS

IMPACT ACCELERATION		
FATIGUE		
FAILURE RATE		
ALTITUDE – ABSOLUTE MAXIMUM	80,000	FT.
RADIATION – ABSOLUTE MAXIMUM		
TOTAL DOSAGE – NEUTRONS/SQ.CM	10^{16}	NVT
DOSE RATE – NEUTRONS/SQ. CM./SEC.	10^{12}	NV





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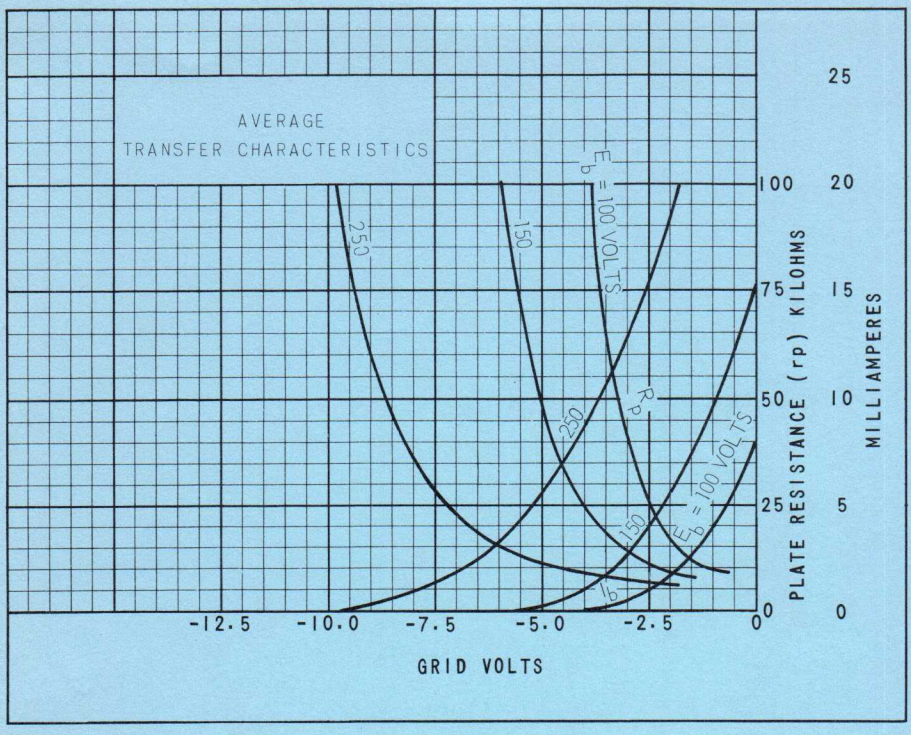
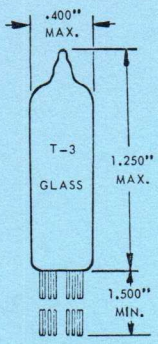

AVERAGE
TRANSFER CHARACTERISTICS
250
150
E_b = 100 VOLTS
R_p
250
150
E_b = 100 VOLTS
-12.5
-10.0
-7.5
-5.0
-2.5
0
GRID VOLTS
100
75
50
25
0
PLATE RESISTANCE (rp) KILOHMS
25
20
15
10
5
0
MILLIAMPERES

TUNG-SOL

TWIN TRIODE

SUBMINIATURE

OUTLINE DRAWING
JFDEC 3-11



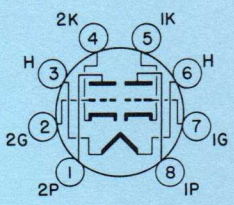
SUBMINIATURE BUTTON
8 FLEXIBLE LEADS
JEDEC E8-10

FOR
GUIDED MISSILE
SERVICE

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION

BASING DIAGRAM
JEDEC 8DG



BOTTOM VIEW

THE 6948 IS A GENERAL PURPOSE HIGH-MU TWIN TRIODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED SPECIFICALLY FOR GUIDED MISSILE SERVICE. THIS TYPE IS CHARACTERIZED BY STABLE PERFORMANCE IN OPERATION AT HIGH ALTITUDES AND WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK, VIBRATION AND HIGH TEMPERATURE ARE ENCOUNTERED.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE – EACH SECTION		0.75	pf
INPUT – EACH SECTION		1.6	pf
OUTPUT			
SECTION 1		0.20	pf
SECTION 2		0.25	pf
GRID TO GRID	MAX.	0.014	pf
PLATE TO PLATE	MAX.	0.86	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	350	mA
LIMITS OF APPLIED VOLTAGE		5.5 TO 6.9	VOLTS
HEATER-CATHODE VOLTAGE:			
HEATER POSITIVE WITH RESPECT TO CATHODE		200	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE		200	VOLTS

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MAXIMUM RATINGS – EACH SECTION

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

DC PLATE VOLTAGE	250	VOLTS
PEAK-PLATE FORWARD VOLTAGE	360	VOLTS
DC GRID VOLTAGE:		
POSITIVE VALUE	0	VOLTS
NEGATIVE VALUE	55	VOLTS
PLATE DISSIPATION	0.5	WATTS
DC PLATE CURRENT	10	mA
GRID CIRCUIT RESISTANCE	1.0	MEGOHM
BULB TEMPERATURE	250	°C

CHARACTERISTICS – EACH SECTION

DC PLATE VOLTAGE	100	VOLTS
CATHODE RESISTOR	1,500	OHMS
DC PLATE CURRENT	0.8	mA
AMPLIFICATION FACTOR	70	
TRANSCONDUCTANCE	1,650	μMHOS
DC GRID VOLTAGE FOR I_b = 50 μADC MAXIMUM	−3.5	VOLTS

SPECIAL TESTS AND RATINGS

IMPACT ACCELERATION		
FATIGUE		
FAILURE RATE		
ALTITUDE– ABSOLUTE MAXIMUM	80,000	FT.
RAD ATION – ABSOLUTE MAXIMUM		
TOTAL DOSAGE– NEUTRONS/SQ. CM	10^{16}	NVT
DOSE RATE – NEUTRONS/SQ. CM/SEC	10^{12}	NV

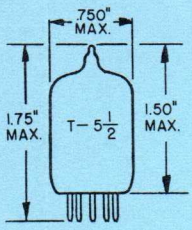
TUNG-SOL

PENTODE

MINIATURE TYPE

RUGGEDIZED FOR MILITARY

AND INDUSTRIAL APPLICATIONS

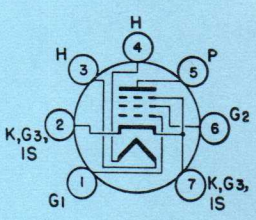


GLASS BULB

MINIATURE BUTTON
7 PIN BASE E7-1
OUTLINE DRAWING
JEDEC 5-1

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 7BD

THE 6968 IS A WIDE-BAND HIGH-FREQUENCY AMPLIFIER IN THE 7 PIN MINIATURE CONSTRUCTION. THE DESIGN OF THE HEATER CATHODE PERMITS INTERMITTENT OPERATION WITH LONG PERIODS OF CUTOFF IN ON-OFF CONTROL APPLICATIONS WITHOUT IMPAIRMENT TO EMISSION. THE ELECTRICAL CHARACTERISTICS OF THE 6968 ARE SIMILAR TO THOSE OF THE 6AK5.

DIRECT INTERELECTRODE CAPACITANCES

WITH SHIELD 316 CONNECTED TO CATHODE

GRID TO PLATE: G1 TO P, MAX.	0.02	pf
INPUT: G1 TO K+H+G2+G3+I.S.	4.0	pf
OUTPUT: P TO K+H+G2+G3+I.S.	2.85	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	175	MA.
HEATER SUPPLY LIMITS:				
VOLTAGE/OPERATION			6.3 ± 0.6	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			135	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			135	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	200	VOLTS
GRID 2 VOLTAGE	155	VOLTS
GRID 1 VOLTAGE, NEGATIVE, DC	50	VOLTS
GRID 1 VOLTAGE, POSITIVE, DC	0	VOLTS
PLATE DISSIPATION	1.65	WATTS
GRID 2 DISSIPATION	0.55	WATT
CATHODE CURRENT, DC	20	MA.
GRID 1 CURRENT, DC	1.0	MA.
GRID 1 CIRCUIT RESISTANCE	0.1	MEGOHM
BULB TEMPERATURE AT HOTTEST POINT	165	°C
ALTITUDE[A]	60000	FEET

[A] INCREASE IN ALTITUDE OVER THIS VALUE MAY REQUIRE A DECREASE IN INSTANTANEOUS VOLTAGES (Ef EXCEPTED)

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

CLASS A AMPLIFIER

	MIN.	AVG.	MAX.	
PLATE VOLTAGE		120		VOLTS
GRID 2 (SCREEN) VOLTAGE		120		VOLTS
GRID 1 (CONTROL-GRID) VOLTAGE		−2.0		VOLTS
TRANSCONDUCTANCE (1)	3800	5000	6200	μMHOS
PLATE CURRENT	5.0	7.5	11	MA.
GRID 2 CURRENT	0.8	2.5	4.0	MA.
GRID 1 VOLTAGE (APPROX.) FOR Ib = 10 μA.	------	−8.5	------	VOLTS
TRANSCONDUCTANCE PERCENTAGE CHANGE WITH Ef = 5.7 V. $\frac{\Delta Gm}{Gm\ (1)} \times 100$			15	PERCENT
CHARACTERISTICS WITH EF=6.3 VOLTS, Eb = Ec2 = 120 VOLTS				
PLATE CURRENT CUTOFF, Ec1 = −10V AND R_L = 0.1 MEG.	------	------	200	μA
PLATE CURRENT CUTOFF, Ec1 = − 5.5 V	5.0	------	200	μA
NEGATIVE GRID 1 CURRENT, Ecc1 = −2.0 V, Rg1 = 0.5 MEG.	0	------	0.1	μA
GRID 1 EMISSION CURRENT Ef = 7.5 V, Ecc1 = −45V, Rg1 = 0.1 MEG.	------	------	−0.5	μA.
TRIODE CONNECTED (GRID 2 TIED TO PLATE)[B]				
PLATE VOLTAGE	------	150	------	VOLTS
MAXIMUM PLATE CURRENT (Ec1 = −15.0 V)	------	------	100	μA
MINIMUM PLATE CURRENT (Ec1 = −7.0 V)	250	------	------	μA.

[B] MEASUREMENT OF CURRENT IN CATHODE CIRCUIT

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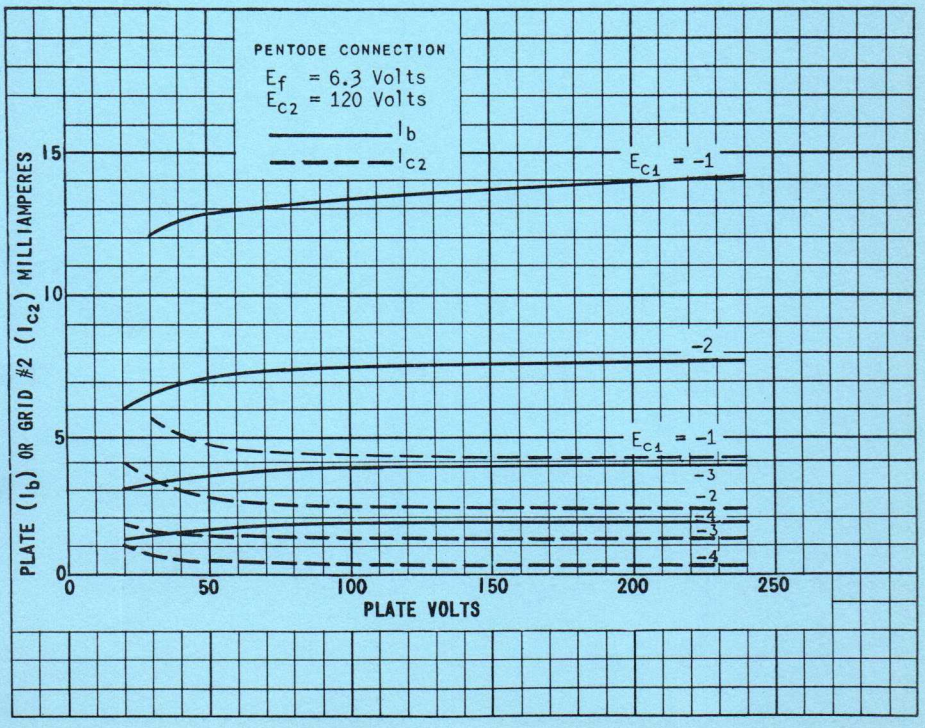
TUNG-SOL

CONTINUED FROM PRECEDING PAGE

SPECIAL TESTS AND RATINGS

VIBRATION NOISE OUTPUT VOLTAGE, RMS (MIL-E-1C 4.9.19.1)
SHOCK RATING
FATIGUE RATING



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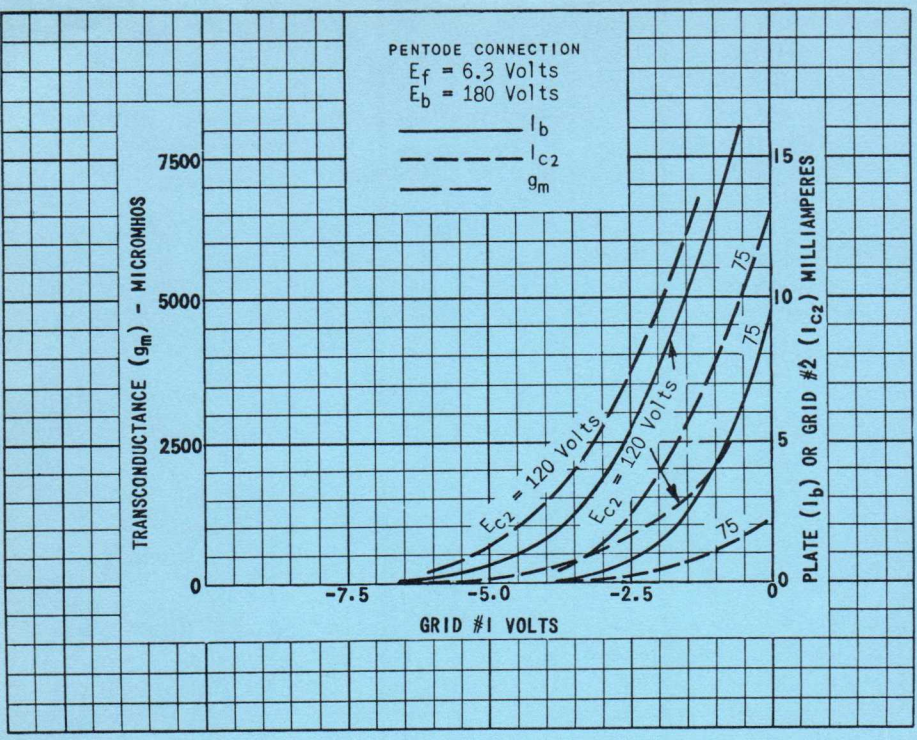
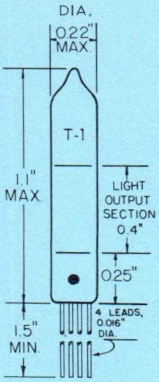

PENTODE CONNECTION
E_f = 6.3 Volts
E_b = 180 Volts
I_b
I_{c2}
g_m
TRANSCONDUCTANCE (g_m) - MICROMHOS
7500
5000
2500
0
PLATE (I_b) OR GRID #2 (I_{c2}) MILLIAMPERES
15
10
5
0
75
75
75
E_{c2} = 120 Volts
E_{c2} = 120 Volts
-7.5
-5.0
-2.5
0
GRID #1 VOLTS

TUNG-SOL

INDICATOR TRIODE
SUBMINIATURE TYPE

FOR

LOW VOLTAGE APPLICATIONS



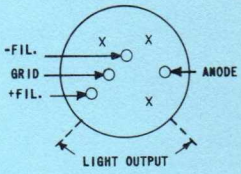
GLASS BULB

DOT INDICATES CENTER LINE OF LIGHT OUTPUT AREA

4 TINNED LEADS
0.016 DIA.

FILAMENTARY CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW

DOT ON LIGHT OUTPUT AXIS
O - LEAD WIRE
X - CLIPPED OFF LEAD

→ THE 6977 IS A FILAMENTARY, HIGH-VACUUM SUBMINIATURE INDICATOR TRIODE. ITS GRID-SHAPED PLATE IS COATED WITH A PHOSPHOR WHICH GIVES A BRIGHT BLUE-GREEN LIGHT PROPORTIONAL TO THE PLATE CURRENT. IT IS DESIGNED FOR APPLICATIONS IN ELECTRONIC COMPUTERS, WHERE ITS SMALL SIZE, LOW ENERGY REQUIREMENTS, HIGH SENSITIVITY AND FREEDOM FROM NOISE MAKE IT VERY USEFUL IN COMBINATION WITH TRANSISTORIZED CIRCUITS. THE TUBE IS CONTROLLED TO MILITARY STANDARDS FOR HIGH RELIABILITY.

DIRECT INTERELECTRODE CAPACITANCES
WITHOUT EXTERNAL SHIELD

GRID TO PLATE	1.8	pf
GRID TO FILAMENT	1.0	pf
PLATE TO FILAMENT	1.1	pf

FILAMENT CHARACTERISTICS AND RATINGS
ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	1.0	VOLTS	30	MA.
SUPPLY			AC OR DC	
LIMITS OF APPLIED FILAMENT VOLTAGE			0.95-1.05	VOLTS

→ INDICATES A CHANGE.

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDRD RS-239

PLATE VOLTAGE	65	VOLTS
POSITIVE GRID SUPPLY VOLTAGE	0	VOLTS
NEGATIVE GRID VOLTAGE	50	VOLTS
PLATE CURRENT	750	μA
GRID CIRCUIT RESISTANCE	1	MEGOHMS
MINIMUM GRID CIRCUIT RESISTANCE	0.1	MEGOHMS

AVERAGE CHARACTERISTICS

FILAMENT: DC, NEGATIVE GROUNDED

PLATE VOLTAGE	50	VOLTS
GRID VOLTAGE	0	
PLATE CURRENT	440	μA
TRANSCONDUCTANCE	450	μMHOS
AMPLIFICATION FACTOR	30	

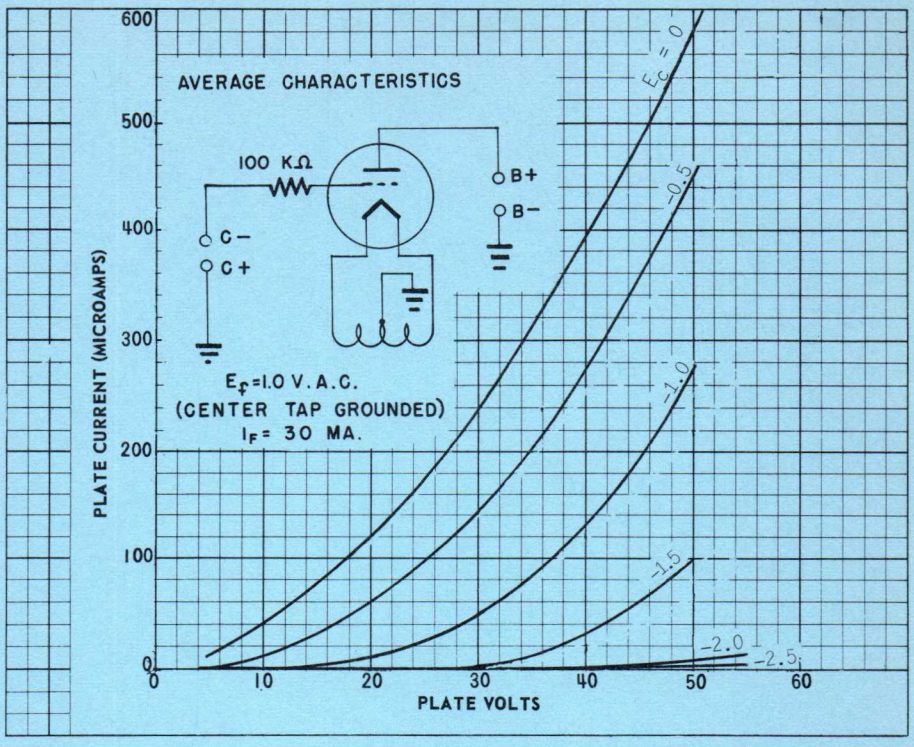
TYPICAL OPERATION

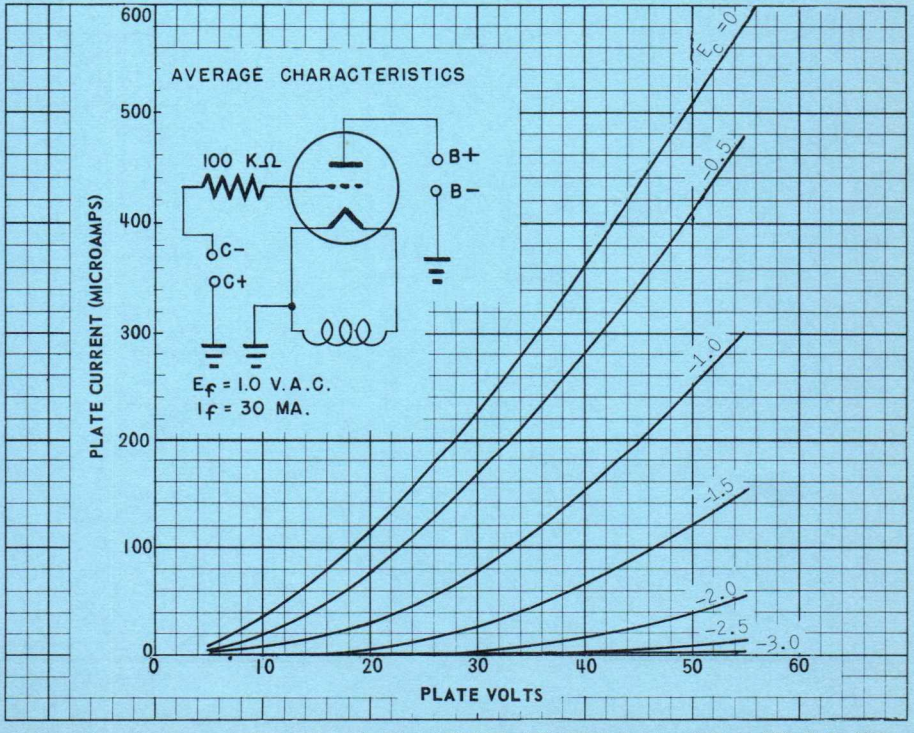
FILAMENT: SUPPLIED FROM TRANSFORMER, CENTER TAP GROUNDED

PLATE VOLTAGE	50	VOLTS
GRID RESISTOR	10C	KOHMS
WITH GRID SUPPLY VOLTAGE 0		
PLATE CURRENT	580	μA
LIGHT OUTPUT	6	mCANDLES
WITH GRID SUPPLY VOLTAGE −3.0 VOLTS		
PLATE CURRENT	<5	μA
LIGHT OUTPUT	NOT VISIBLE	

NOTE:

LIGHT OUTPUT MEASURED BY COMPARISON WITH A TUNGSTEN LAMP OF 2,870 °K COLOR TEMPERATURE USING AN S4 PHOTO DEVICE.





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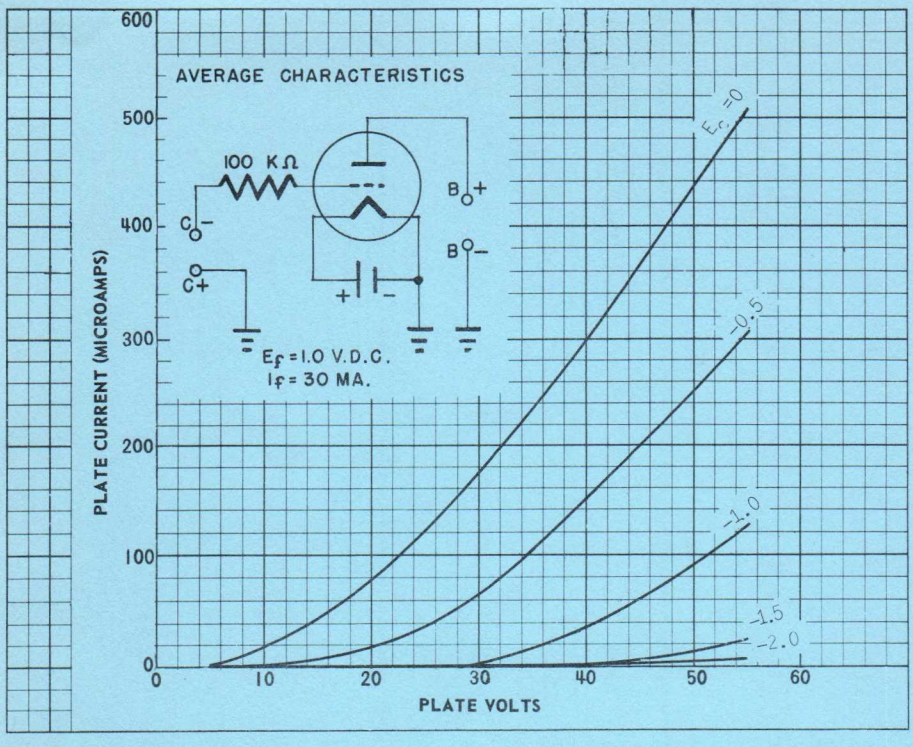
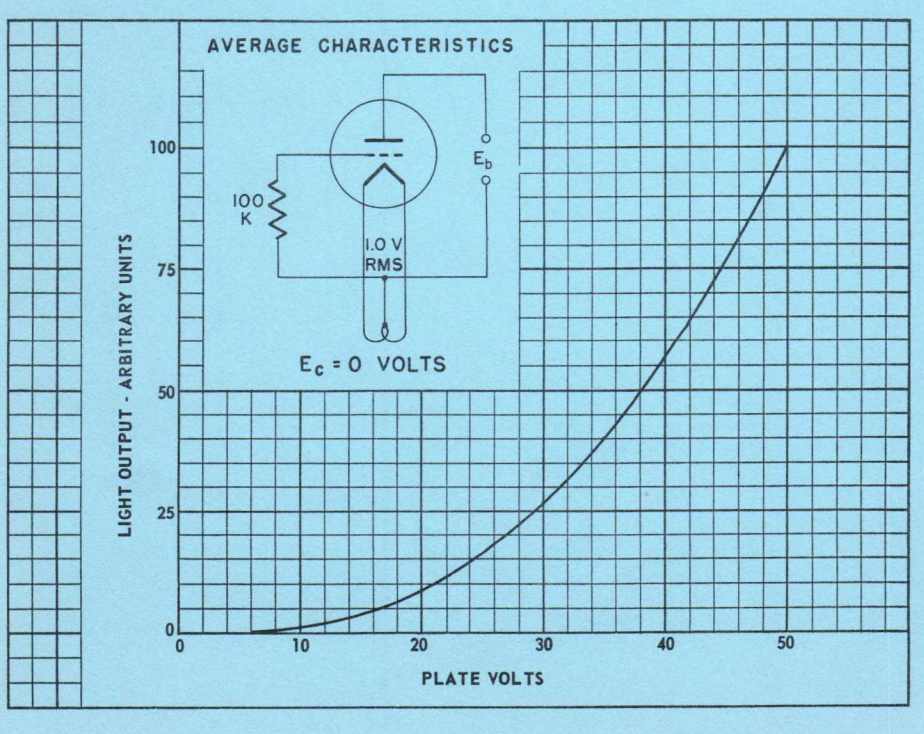
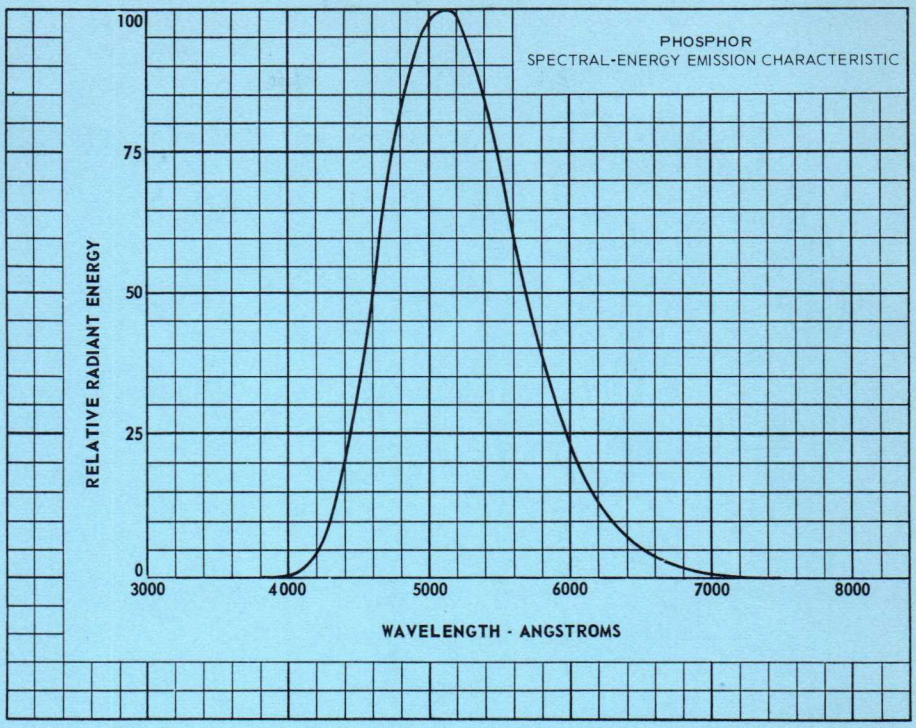
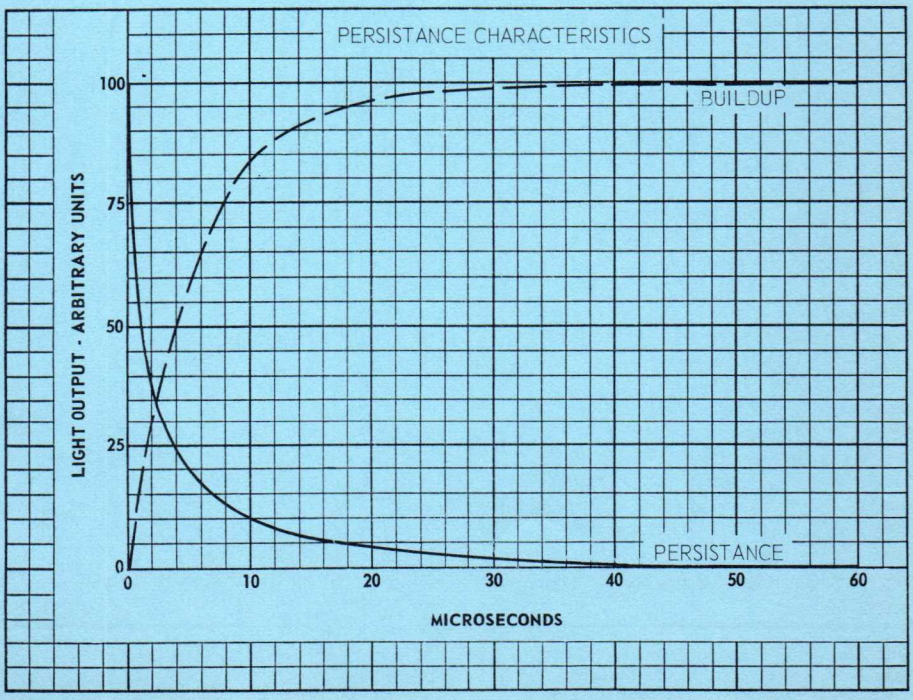

AVERAGE CHARACTERISTICS
100 KΩ
C−
C+
B+
B−
Ef = 1.0 V.D.C.
If = 30 MA.
PLATE CURRENT (MICROAMPS)
PLATE VOLTS
Ec = 0
-0.5
-1.0
-1.5
-2.0
0
100
200
300
400
500
600
10
20
30
40
50
60


AVERAGE CHARACTERISTICS
100 K
Eb
1.0 V RMS
Ec = 0 VOLTS
LIGHT OUTPUT - ARBITRARY UNITS
PLATE VOLTS
0
25
50
75
100
10
20
30
40
50





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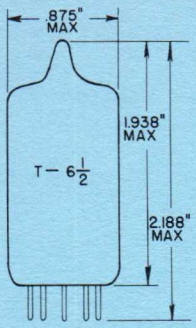
TUNG-SOL



GLASS BULB
SMALL BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2

TWIN TRIODE

MINIATURE TYPE

COATED UNIPOTENTIAL CATHODE

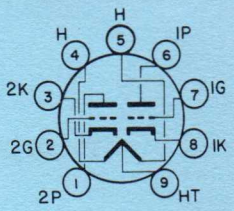
HEATER

SERIES	PARALLEL
12.6 VOLTS	6.3 VOLTS
150 MA.	300 MA.

AC OR DC

FOR 12.6 VOLT OPERATION APPLY HEATER VOLTAGE BETWEEN PINS #4 AND #5. FOR 6.3 VOLT OPERATION APPLY HEATER VOLTAGE BETWEEN PIN #9 AND PINS #4 AND #5 CONNECTED TOGETHER.

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9A

THE 7025 COMBINES TWO COMPLETELY INDEPENDENT HIGH-MU TRIODES IN THE SMALL 9 PIN BUTTON CONSTRUCTION. IT IS INTENDED FOR APPLICATIONS WHERE HIGH VOLTAGE GAIN AND LOW HEATER POWER ARE THE IMPORTANT CONSIDERATION, SUCH AS VOLTAGE AMPLIFIER, PHASE INVERTERS AND MULTIVIBRATORS. LOW NOISE AND LOW HUM IS A SPECIAL FEATURE OF THIS TYPE.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD[A]	WITHOUT SHIELD	
GRID TO PLATE	1.7	1.7	pf
INPUT	1.8	1.6	pf
OUTPUT (SECTION 1)	1.9	0.46	pf
OUTPUT (SECTION 2)	1.9	0.34	pf

[A] WITH EXTERNAL SHIELD #315 CONNECTED TO CATHODE OF SECTION UNDER TEST.

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER VALUES

EACH SECTION

MAXIMUM HEATER–CATHODE VOLTAGE	180	VOLTS
MAXIMUM PLATE VOLTAGE	300	VOLTS
MAXIMUM POSITIVE DC GRID VOLTAGE	0	VOLTS
MAXIMUM NEGATIVE DC GRID VOLTAGE	–50	VOLTS
MAXIMUM PLATE DISSIPATION	1	WATT

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A_1 AMPLIFIER – EACH SECTION

PLATE VOLTAGE	100	250	VOLTS
GRID VOLTAGE	−1	−2	VOLTS
PLATE CURRENT	0.5	1.2	MA.
AMPLIFICATION FACTOR	100	100	
PLATE RESISTANCE	80 000	62 500	OHMS
TRANSCONDUCTANCE	1 250	1 600	μMHOS

ADDITIONAL CHARACTERISTICS

EQUIVALENT NOISE AND HUM VOLTAGE (REFERENCED TO GRID, EACH UNIT):

AVERAGE VALUE 1.8 MICROVOLTS RMS

MEASURED IN "TRUE RMS" UNITS UNDER THE FOLLOWING CONDITIONS: HEATER VOLTAGE (PARALLEL CONNECTION), 6.3 VOLTS AC; CENTER TAP OF HEATER TRANSFORMER GROUNDED; PLATE SUPPLY VOLTAGE, 250 VOLTS DC; PLATE LOAD RESISTOR, 100000 OHMS; CATHODE RESISTOR, 2700 OHMS BYPASSED BY 100-μf CAPACITOR; GRID RESISTOR, 0 OHMS; AND AMPLIFIER COVERING FREQUENCY RANGE BETWEEN 25 & 10000 CPS.

MAXIMUM VALUE 7 MICROVOLTS RMS

MEASURED IN "TRUE RMS" UNITS UNDER THE SAME CONDITIONS AS FOR "AVERAGE VALUE" EXCEPT THAT THE CATHODE RESISTOR IS UNBYPASSED AND THAT THE GRID RESISTOR HAS A VALUE OF 50000 OHMS.

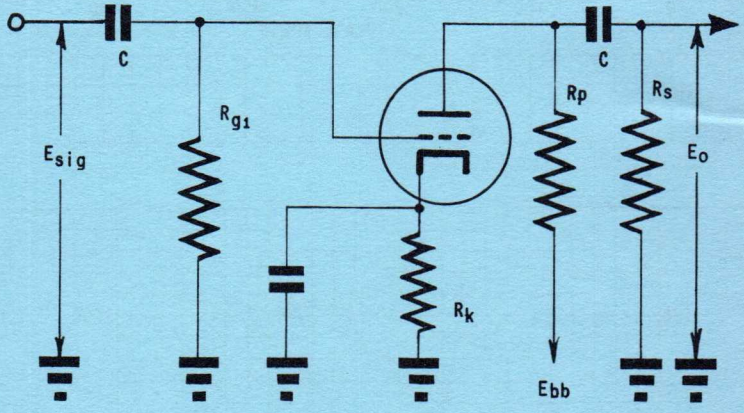
SIMILAR TYPE REFERENCE: 12AX7.

TUNG-SOL

RESISTANCE COUPLED AMPLIFIER

R_p MEG.	R_s MEG.	R_{g1} MEG.	E_{bb} = 90 VOLTS			E_{bb} = 180 VOLTS			E_{bb} = 300 VOLTS		
			R_k	GAIN	E_o	R_k	GAIN	E_o	R_k	GAIN	E_o
0.10	0.10	0.1	1700	31	5.0	1000	40	15	760	43	30
0.10	0.24	0.1	2000	38	6.9	1100	46	20	900	50	40
0.24	0.24	0.1	3500	43	6.5	2000	54	18	1600	58	37
0.24	0.51	0.1	3900	49	8.6	2300	59	24	1800	64	47
0.51	0.51	0.1	7100	50	7.4	4300	62	19	3100	66	39
0.51	1.0	0.1	7800	53	9.1	4800	64	24	3600	69	46
0.24	0.24	10	0	37	3.9	0	53	15	0	62	32
0.24	0.51	10	0	44	5.4	0	60	19	0	67	41
0.51	0.51	10	0	44	5.0	0	61	17	0	69	35
0.51	1.0	10	0	49	6.4	0	66	21	0	71	41

E_o IS MAXIMUM RMS VOLTAGE OUTPUT FOR FIVE PERCENT TOTAL HARMONIC DISTORTION.
GAIN MEASURED AT 2.0 VOLTS RMS OUTPUT.
FOR ZERO-BIAS DATA, GENERATOR IMPEDANCE IS NEGLIGIBLE.



NOTE: COUPLING CAPACITORS (C) SHOULD BE SELECTED TO GIVE DESIRED FREQUENCY RESPONSE. Rk SHOULD BE ADEQUATELY BY-PASSED.

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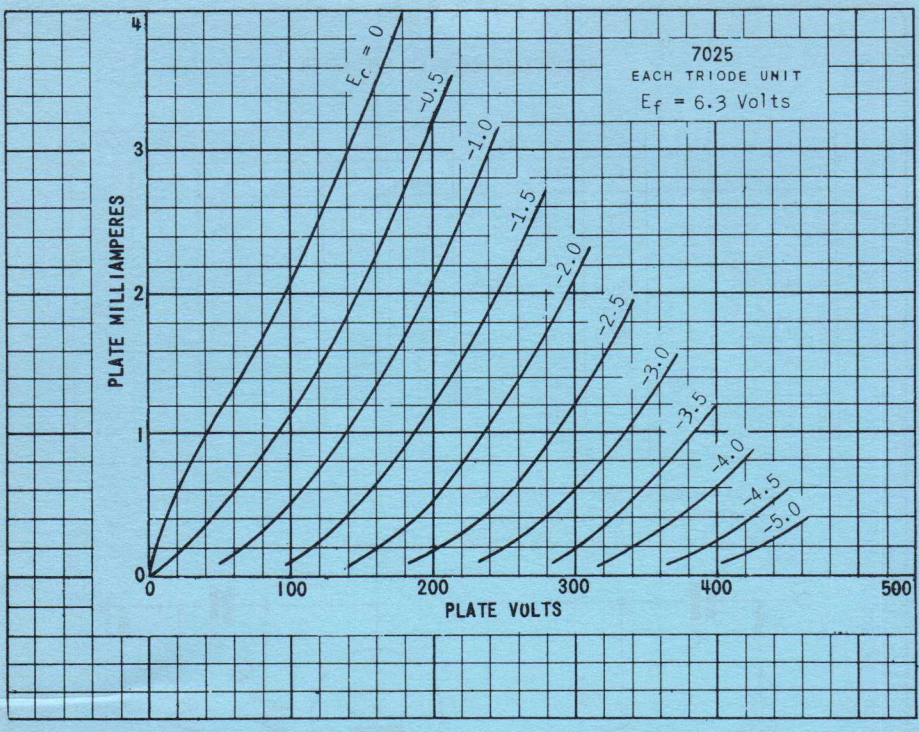
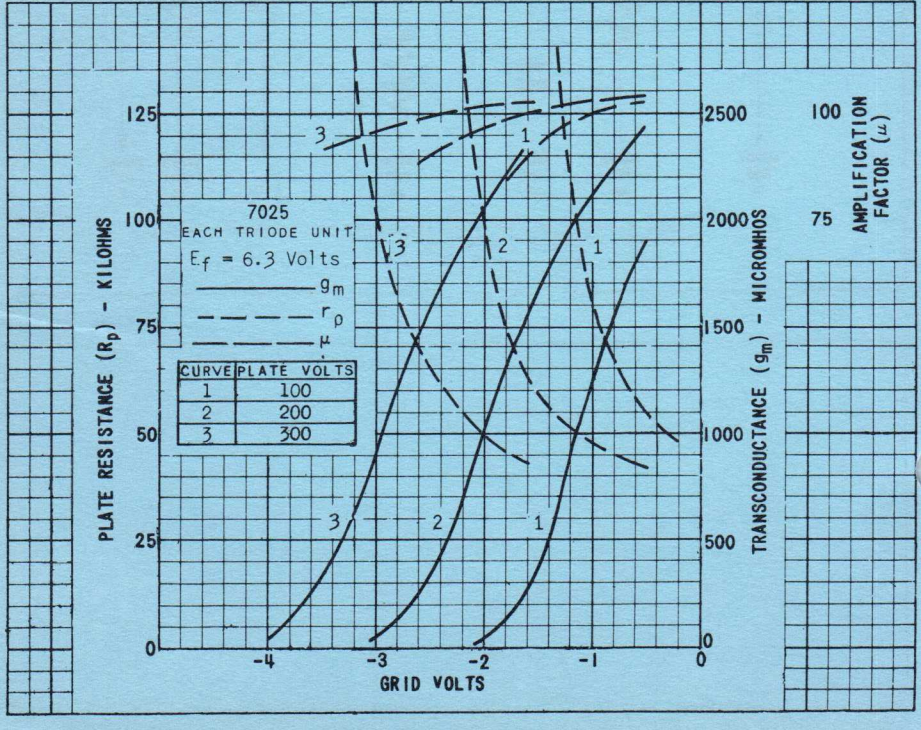
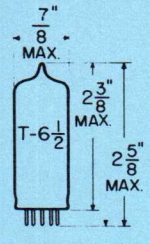

7025
EACH TRIODE UNIT
Ef = 6.3 Volts
Ec = 0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
PLATE MILLIAMPERES
PLATE VOLTS
0
1
2
3
4
0
100
200
300
400
500


7025
EACH TRIODE UNIT
Ef = 6.3 Volts
gm
rp
μ
CURVE | PLATE VOLTS
1 | 100
2 | 200
3 | 300
PLATE RESISTANCE (Rp) - KILOHMS
TRANSCONDUCTANCE (gm) - MICROMHOS
AMPLIFICATION FACTOR (μ)
GRID VOLTS
0
25
50
75
100
125
500
1000
1500
2000
2500
75
100
-4
-3
-2
-1
0

TUNG-SOL

DOUBLE TRIODE

MINIATURE TYPE



SMALL BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-3
GLASS BULB

COATED UNIPOTENTIAL CATHODE

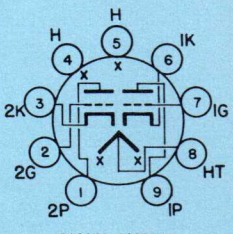
HEATER	SERIES	PARALLEL
	12.6±5% VOLTS	6.3±5% VOLTS
	0.45 AMP	0.90 AMP

AC OR DC

MOUNTING POSITION

PREFERRED: UPRIGHT OR WITH PLATE MAJORS IN A VERTICAL POSITION

PERMISSIBLE.....ANY



BASING DIAGRAM
JEDEC 9H

BOTTOM VIEW

THE 7044 IS A DOUBLE TRIODE DESIGNED FOR USE IN ELECTRONIC COMPUTERS. THE TUBE IS CHARACTERIZED BY HIGH ZERO BIAS PLATE CURRENT AND EXCEPTIONAL FREEDOM FROM THE DEVELOPMENT OF CATHODE INTERFACE.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

	SECTION 1		SECTION 2	
GRID TO PLATE: (G TO P)	6.0		6.0	μμf
INPUT: G TO (H+K)	4.8		4.8	μμf
OUTPUT: P TO (H+K)	0.65		0.55	μμf
GRID #1 TO GRID #2 (1G TO 2G)		0.10		μμf
PLATE #1 TO PLATE #2 (1P TO 2P)		1.4		μμf
HEATER TO CATHODE: (H+K)	6.0		6.0	μμf

RATINGS

INTERPRETED ACCORDING TO DESIGN MAXIMUM SYSTEM

	SERIES	PARALLEL	
HEATER VOLTAGE	12.6±5%	6.3±5%	VOLTS
HEATER CURRENT	0.45	0.90	AMP.
HEATER POWER	5.7	5.7	WATTS
MAXIMUM HEATER CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			
TOTAL DC PLUS PEAK	200		
HEATER POSITIVE WITH RESPECT TO CATHODE[A]			
DC	100		VOLTS
TOTAL DC PLUS PEAK	200		VOLTS
MAXIMUM AVERAGE PLATE VOLTAGE [D]	300		VOLTS
MAXIMUM PEAK PLATE VOLTAGE			
(MEASURED BETWEEN PLATE AND CATHODE)[E]	600		VOLTS

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RATINGS - CONT'D.

INTERPRETED ACCORDING TO DESIGN MAXIMUM SYSTEM

	EACH UNIT [C]		
HEATER VOLTAGE	12.6±5%	6.3±5%	VOLTS
MAXIMUM GRID VOLTAGE:			
NEGATIVE BIAS VALUE DC	100		VOLTS
POSITIVE BIAS VALUE DC	1.0		VOLTS
PEAK NEGATIVE VALUE [E]	300		VOLTS
PEAK POSITIVE VALUE [E]	30		VOLTS
MAXIMUM AVERAGE PLATE DISSIPATION [D]	4.5		WATTS
MAXIMUM AVERAGE TOTAL PLATE DISSIPATION (BOTH UNITS) [D]	8.0		WATTS
MAXIMUM AVERAGE POSITIVE GRID CURRENT [D]	5.0		MA.
MAXIMUM PEAK POSITIVE GRID CURRENT [E]	200		MA.
MAXIMUM AVERAGE CATHODE CURRENT [D]	50		MA.
MAXIMUM PEAK CATHODE CURRENT [E]	400		MA.
MAXIMUM BULB TEMPERATURE (AT HOTTEST POINT ON BULB)	160		°C
MAXIMUM GRID CIRCUIT RESISTANCE			
FIXED BIAS	0.1		MEGOHM
CATHODE BIAS	0.47		MEGOHM

INITIAL CHARACTERISTICS LIMITS

RANGE VALUES FOR EQUIPMENT DESIGN

	MIN.		MAX.	
HEATER VOLTAGE (SERIES)		12.6±5%		VOLTS
HEATER VOLTAGE (PARALLEL)		6.3±5%		VOLTS
HEATER CURRENT (SERIES)		0.45		AMP.
HEATER CURRENT (PARALLEL)		0.90		AMP.
HEATER CURRENT @ Ef= 12.6 VOLTS	410		490	MA.
PLATE CURRENT				
Ef = 12.6 V., Eb = 90 V., Ec ADJUSTED FOR Ic = 250 μA	→ 34		→ 60	MA.
PLATE CURRENT				
Ef = 12.6 V., Eb = 120 V., Ec = − 2 V.	26		45	MA.
REVERSE GRID CURRENT				
Ef = 12.6 V Eb = 120 V Ec = −2 V.	---		1.5	μA
CUTOFF PLATE CURRENT				
Ef = 12.6 V Eb = 150 V., Ec = − 14 V.	---		200	μA
HEATER-CATHODE LEAKAGE AT				
Ef = 12.6 V. AND Ehk = ± 100 V.	---		30	μA
MINIMUM INTERELECTRODE RESISTANCE (EXCEPT HEATER CATHODE)				
GRID TO ALL MEASURED WITH 300 VOLTS, GRID NEGATIVE	50		---	MEGOHMS
PLATE TO ALL MEASURED WITH 500 VOLTS PLATE NEGATIVE	50		---	MEGOHMS
INTERMITTENT LEAKAGE [F]				

→ INDICATES A CHANGE.

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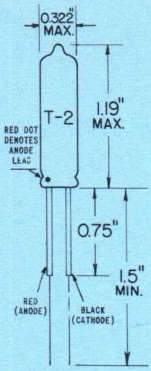
TUNG-SOL

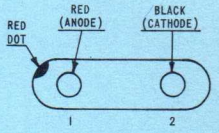
VOLTAGE REGULATOR



GLASS BULB

COLD CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW

FLAT PRESS WITH 2 FLYING LEADS

THE 7099 IS A LOW CURRENT, TWO ELEMENT, INERT-GAS-FILLED, COLD CATHODE, VOLTAGE REGULATOR TUBE. THE TUBE COVERS A RANGE NOT ADEQUATELY HANDLED BY OTHER VR TUBES OR BY ZENER DIODES. IT HAS A MAINTAINING VOLTAGE OF APPROXIMATELY 155 VOLTS OVER A CURRENT RANGE FROM 0.075 TO 0.300 MILLI-AMPERES.

THE 7099 PROVIDES A HIGH DEGREE OF STABILITY AND VOLTAGE REPEATABILITY OVER ITS OPERATING TEMPERATURE RANGE. IT IS ESPECIALLY SUITED FOR SERVICE IN APPLICATIONS WHICH REQUIRE LONG LIFE, AND MINIMUM SIZE AND WEIGHT. ITS FLYING LEADS CAN BE SOLDERED DIRECTLY INTO A CIRCUIT OR CAN BE CLIPPED TO ONE-QUARTER INCH FOR INSERTION IN A STANDARD SUBMINIATURE SOCKET.

ELECTRICAL DATA

CATHODE	COLD

MECHANICAL DATA

MOUNTING POSITION	ANY	
LENGTH — OVERALL	SEE OUTLINE DRAWING	
DIAMETER (MAX.)	0.322	INCH
WEIGHT — APPROXIMATE	0.16	OUNCE
BULB	T-2	
BASE	FLAT PRESS WITH 2 FLYING LEADS	

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

RATINGS
ABSOLUTE VALUES

MAXIMUM DC CATHODE CURRENT	0.300	MA.
MINIMUM DC CATHODE CURRENT	0.075	MA.
BULB TEMPERATURE (MAX.)	100	°C
AMBIENT TEMPERATURE (MIN.)	-55	°C
ALTITUDE (MAX.)	60 000	FEET

CIRCUIT VALUES

SHUNT CAPACITOR (MAX.)	0.1	μf
SERIES RESISTOR	SEE APPLICATION NOTES	

EQUIPMENT DESIGN AND RANGE VALUES

	MIN.	BOGEY	MAX.	
DC ANODE SUPPLY VOLTAGE	225[A]	---	---	VOLTS
ANODE BREAKDOWN VOLTAGE	---	180	200	VOLTS
TUBE VOLTAGE DROP AT 0.075 MA.	152	155.0	---	VOLTS
TUBE VOLTAGE DROP AT 0.3 MA.	---	155.5	162	VOLTS
REGULATION - 0.075 THROUGH 0.150 MA.	---	0.4	2.5	VOLTS
REGULATION - 0.150 THROUGH 0.300 MA.	---	0.6	4.0	VOLTS
LEAKAGE CURRENT AT - 100 VOLTS	---	---	2	μAMP.

[A] IN ORDER TO ASSURE STARTING THROUGHOUT LIFE OF TUBE, NOT LESS THAN THE SPECIFIED SUPPLY VOLTAGE SHOULD BE PROVIDED.

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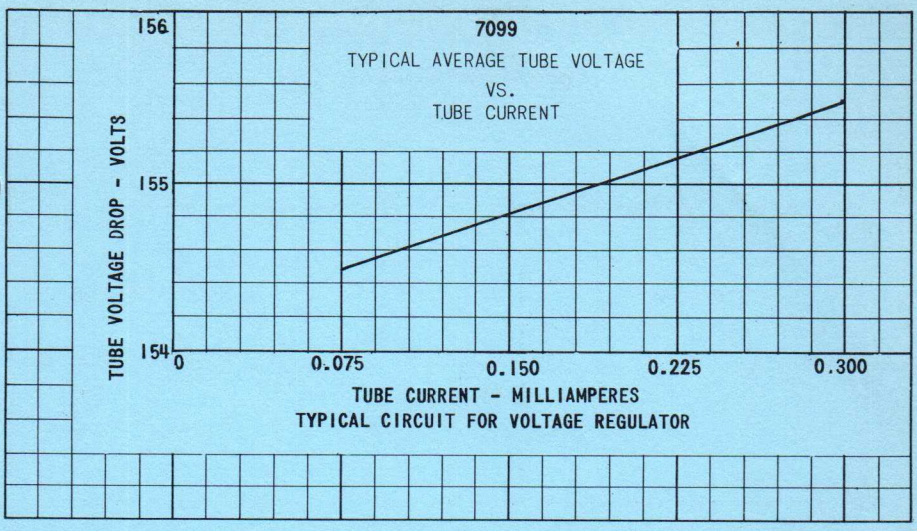

OPERATING NOTES

IN THE OPERATION OF A GLOW TUBE THERE ARE SEVERAL REQUIREMENTS WHICH MUST ALWAYS BE MET. THE FIRST IS THAT THE SUPPLY VOLTAGE MUST ALWAYS BE GREATER THAN THE ANODE BREAKDOWN VOLTAGE AND THE SECOND IS THAT SUFFICIENT RESISTANCE MUST ALWAYS BE PUT IN SERIES WITH THE TUBE IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM AND MAXIMUM VALUES GIVEN IN THE RATINGS.

IN ORDER TO ILLUSTRATE HOW TO CALCULATE THE VALUE OF THE SERIES RESISTANCE A TYPICAL REGULATOR CIRCUIT IS SHOWN IN FIGURE 1.

FROM FIGURE 1 WE SEE THAT E_{BB} IS THE UNREGULATED SUPPLY VOLTAGE, E_L IS THE TUBE VOLTAGE DROP OR THE REGULATED VOLTAGE SUPPLIED TO THE LOAD, R IS THE SERIES LIMITING RESISTOR, R_L IS THE VARIABLE LOAD, I_T IS THE TUBE CURRENT AND I_L IS THE LOAD CURRENT.

WE SEE THAT THE TUBE CURRENT WILL BE A MAXIMUM WHEN THE SUPPLY VOLTAGE IS A MAXIMUM (E_{BB} MAX.); WHEN THE LOAD CURRENT IS A MINIMUM (I_L MIN.); AND WHEN THE TUBE VOLTAGE DROP IS A MINIMUM (E_L MIN.). THEREFORE THE CONDITIONS WHICH DETERMINE THE LOWER LIMIT FOR THE SERIES RESISTANCE R_1 ARE THAT

$$R > \frac{E_{BB\,MAX.} - E_{L\,MIN.}}{I_{T\,MAX.} + I_{L\,MIN.}}$$

IN A LIKE MANNER IT CAN BE SHOWN THAT THE VALUE OF R IN ORDER TO LIMIT THE CURRENT TO THE MINIMUM VALUE REQUIRES THAT

$$R < \frac{E_{BB\,MIN.} - E_{L\,MAX.}}{I_{T\,MIN.} + I_{L\,MAX.}}$$

WHEN THESE VALUES HAVE BEEN COMPUTED, ONE SHOULD CHECK TO SEE IF THERE IS SUFFICIENT STARTING VOLTAGE BY THE FOLLOWING RELATION

$$E_{BB\,MIN.} \frac{R_L}{R + R_L} > E_{STARTING}$$

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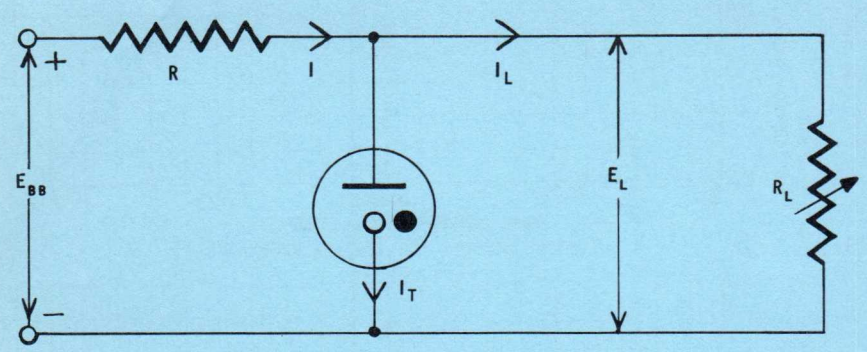


TYPICAL CIRCUIT FOR VOLTAGE REGULATOR

FIGURE 1

WHEN THESE CALCULATIONS HAVE BEEN MADE AND THERE IS INSUFFICIENT STARTING VOLTAGE, A NEW LOAD CURRENT OF LOWER VALUE MUST BE USED AND THE CALCULATIONS REPEATED.

WHERE THE REGULATOR TUBE IS SHUNTED BY A CAPACITOR, THE VALUE OF SUCH CAPACITOR SHOULD BE LIMITED TO 0.1 μf AS A LARGER VALUE MIGHT CAUSE OSCILLATION.

OPERATION OF TWO TUBES IN PARALLEL TO INCREASE THE CURRENT RATING IS NOT RECOMMENDED UNLESS A RESISTANCE OF APPROXIMATELY 100 OHMS IS USED IN SERIES WITH EACH TUBE TO EQUALIZE THE DIVISION OF CURRENT. IT SHOULD BE NOTED THAT PARALLEL OPERATION REDUCES THE REGULATION THAT CAN BE OBTAINED.

HIGHER REGULATED VOLTAGES CAN BE OBTAINED BY CONNECTING TWO TUBES IN SERIES AS SHOWN IN FIGURE 2. HOWEVER, CARE SHOULD BE EXERCISED TO MAKE CERTAIN THAT SUFFICIENT SUPPLY VOLTAGE IS AVAILABLE TO START BOTH TUBES. THIS CAN BE ACCOMPLISHED BY SHUNTING THE LOWER TUBE WITH A HIGH RESISTANCE.

TUNG-SOL

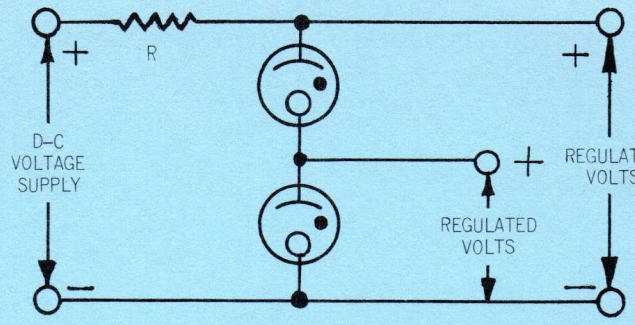
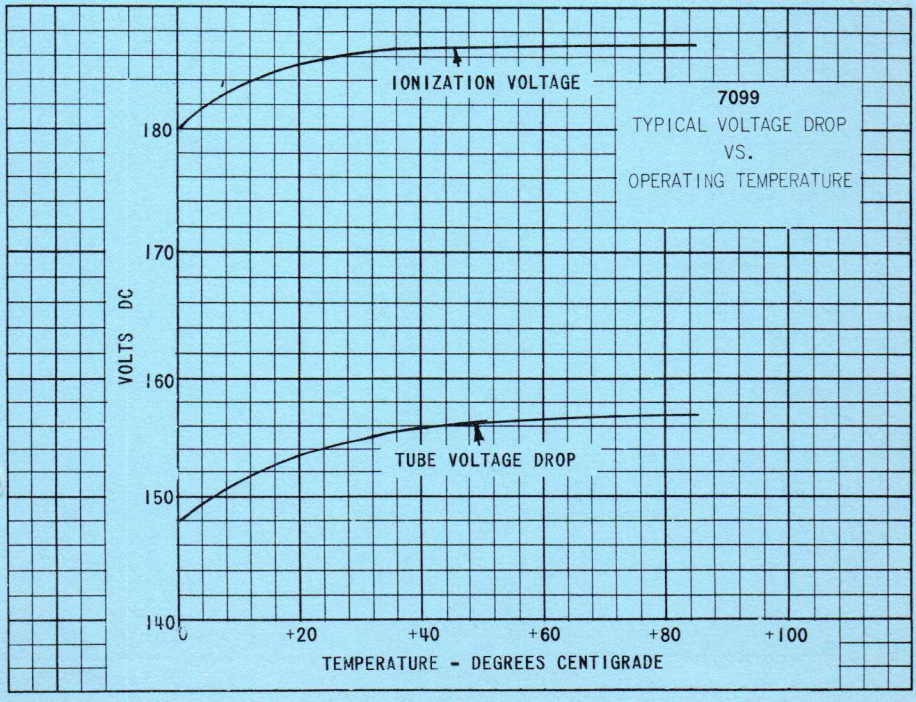


FIGURE 2. OPERATION OF REGULATOR TUBES IN SERIES



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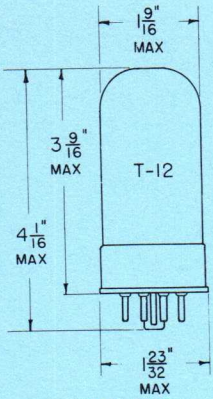
TUNG-SOL

TWIN TRIODE



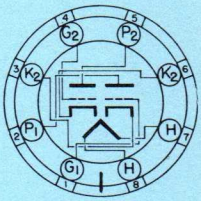
GLASS BULB

HEATER

12.6±5% VOLTS 1.25 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

LARGE WAFER OCTAL WITH METAL SLEEVE

8BD

THE 7105 IS A 12.6 VOLT VERSION OF THE POPULAR RUGGEDIZED RELIABLE TYPE 6080WA. IN A RELIABLE PROGRAM, TUBES ARE HANDLED IN LOTS WITH MANY DESTRUCTIVE TESTS PERFORMED ON RANDOMLY SELECTED SAMPLES. THUS A TUBE MAY PASS ALL REQUIRED TESTS AND YET BE REJECTED IF IT IS FROM AN UNSATISFACTORY LOT.

WITH THE MOUNT SHOCK ISOLATED FROM THE BULB BY NINE METAL SPRING CLIPS, AND BY THE USE OF HEAVY DUTY PARTS, THE TUBE WILL WITHSTAND A SHOCK IMPULSE OF 450G AND A VIBRATION FORCE OF 10G. OTHER FEATURES ARE HIGH ALTITUDE RATINGS, HIGH BULB TEMPERATURE LIMITS, AND LONG LIFE TESTS WITH MANY LIFE TEST END POINTS. PLATE CURRENT AND TRANSCONDUCTANCE ARE HELD TO CLOSE LIMITS TO PROVIDE GREATER BALANCE BETWEEN TUBE SECTIONS. THIS IS ESPECIALLY ADVANTAGEOUS WHEN MANY TUBES ARE TO BE PARALLELED IN REGULATED POWER SUPPLY SERVICE.

THIS TUBE CAN BE USED FOR ANY APPLICATION REQUIRING HIGH PLATE CURRENT AT LOW PLATE VOLTAGES. THE 12.6 VOLT FILAMENT IS PARTICULARLY ADAPTABLE TO MOBILE EQUIPMENT. ITS PRIMARY USE IS IN ELECTRONICALLY REGULATED POWER SUPPLIES.

ELECTRICAL DATA

HEATER VOLTAGE	12.6±5%	VOLTS
HEATER CURRENT (E_f=6.3VOLTS)	1.25	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE (PER SECTION)	7 000	μMHOS
AMPLIFICATION FACTOR	2.0	
INTER ELECTRODE CAPACITIES PER TRIODE SECTION		
GRID TO CATHODE	6.2	μμf
GRID TO PLATE	8.4	μμf
CATHODE TO PLATE	2.2	μμf
HEATER TO CATHODE	6.3	μμf
INTER ELECTRODE CAPACITIES BETWEEN TRIODE SECTIONS		
SECTION 1 GRID TO SECTION 2 GRID	0.5	μμf
SECTION 1 PLATE TO SECTION 2 PLATE	2.2	μμf

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TUNG-SOL

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MECHANICAL DATA

MOUNTING POSITION (IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)	ANY	
BULB	T-12	
BASE	LARGE WAFER OCTAL WITH METAL SLEEVE, 8 PIN, JEDEC #B8-86	
MAXIMUM NET WEIGHT	3	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	450	G
MAXIMUM VIBRATION RATING (D =.08" @ 50 CPS)	10	G

RATINGS
ABSOLUTE VALUES

	MIN.	MAX.	
HEATER VOLTAGE	12.0	13.2	VOLTS
PLATE VOLTAGE (DC)	---	250	VOLTS
GRID VOLTAGE (DC)	---	0	VOLTS
HEATER-CATHODE VOLTAGE (DC)	-300	+300	VOLTS
GRID CURRENT PER GRID	---	5.	MA.
PLATE CURRENT PER PLATE (DC) (IF SEVERAL TUBE SECTIONS ARE TO BE USED IN PARALLEL WITH EACH OTHER, IT IS RECOMMENDED NOT TO EXCEED 100 MA PER PLATE.)	---	125.	MA.
POWER DISSIPATION PER PLATE	---	13	WATTS
ENVELOPE TEMPERATURE	---	230	°C
ALTITUDE FOR FULL RATINGS	---	60 000	FEET
CIRCUIT VALUES:			
GRID CIRCUIT RESISTANCE FOR CATHODE BIAS OPERATION	---	1.0	MEGOHM
GRID CIRCUIT RESISTANCE FOR FIXED BIAS OR COMBINATION FIXED AND CATHODE BIAS OPERATION	---	0.1	MEGOHM

ADDITIONAL TESTS TO INSURE RELIABILITY
RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450 G/MSEC)

FATIGUE; 25 CPS, 0.08" TOTAL DISPLACEMENT, FOR 32 HOURS IN EACH OF THREE MUTUALLY PERPENDICULAR PLANES (2.5G)

POST SHOCK AND FATIGUE LIMITS:

VIBRATION (R_p=2000 Ω, E_c=- 7VDC, TIE 1K TO 2K, 1G TO 2G, 1P TO 2P), GENERATED PLATE VOLTAGE (MAX.)		100	MVAC
HEATER-CATHODE LEAKAGE (E_{hk} =±100 VDC) (MAX.)		50	μADC
CHANGE IN TRANSCONDUCTANCE FROM INITIAL VALUE (MAX.)		10	PERCENT
GRID CURRENT (MAX.)		-3	μA
HEATER CYCLING LIFE TEST (E_f= 15V, E_{hk}=300VDC. DURATIOI OF 2000 CYCLES OF 1 MIN. ON AND 1 MIN. OFF) END POINT (E_{hk}=±100V.) (MAX.)		50	μADC
STABILITY LIFE TEST (1 HR.) END POINT:			
CHANGE IN TRANSCONDUCTANCE FROM INITIAL VALUE (MAX.)		10	PERCENT
SURVIVAL RATE LIFE TEST (100 HRS.) END POINT:			
TRANSCONDUCTANCE (MIN.)		5800	μMHOS
INTERMITTENT LIFE TEST (1000 HRS.) END POINTS:			
GRID CURRENT	MIN. 0	MAX. -10	μADC
TRANSCONDUCTANCE (MIN.)		5500	μMHOS
CHANGE IN TRANSCONDUCTANCE BY REDUCING E_f TO 5.7V. (MAX.)		10	PERCENT
HEATER-CATHODE LEAKAGE E_{hk}=±100VDC. (MAX.)		25	μADC
HEATER CURRENT	MIN. 1.15	MAX. 1.35	AMPS
INSULATION OF ELECTRODES: GRID TO ALL OTHERS AND PLATE TO ALL OTHERS (MIN.)		100	MEGOHM

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RANGE OF VALUES

CONDITIONS: E_f = 12.6V, E_b = 135V, E_c = 0, $R_{k/k}$ = 250 Ω

BOTH SECTIONS OPERATING. EACH SECTION READ SEPARATELY.

INDIVIDUAL PLATE CURRENT (DC)	100	150	MA.
LOT AVERAGE PLATE CURRENT (SAME CONDTIONS)(DC)	115	135	MA.
PLATE CURRENT, DIFFERENCE BETWEEN SECTIONS (DC)	---	25	MA.
INDIVIDUAL SECTION TRANSCONDUCTANCE	6000	8200	μMHOS
LOT AVERAGE TRANSCONDUCTANCE	6600	7400	μMHOS
AMPLIFICATION FACTOR	1.5	2.5	
HEATER CURRENT @ 6.3V.	1.15	1.35	AMP.

SIMILAR TYPE REFERENCE: 6080WA.

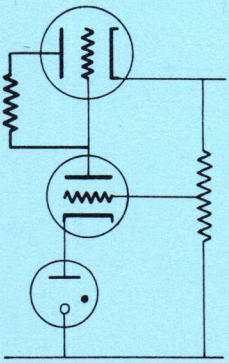

FIGURE 1

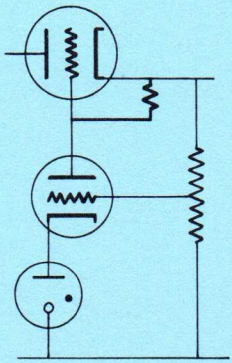

FIGURE 2

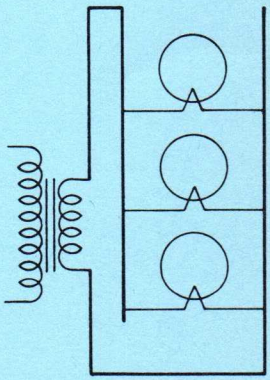

FIGURE 3

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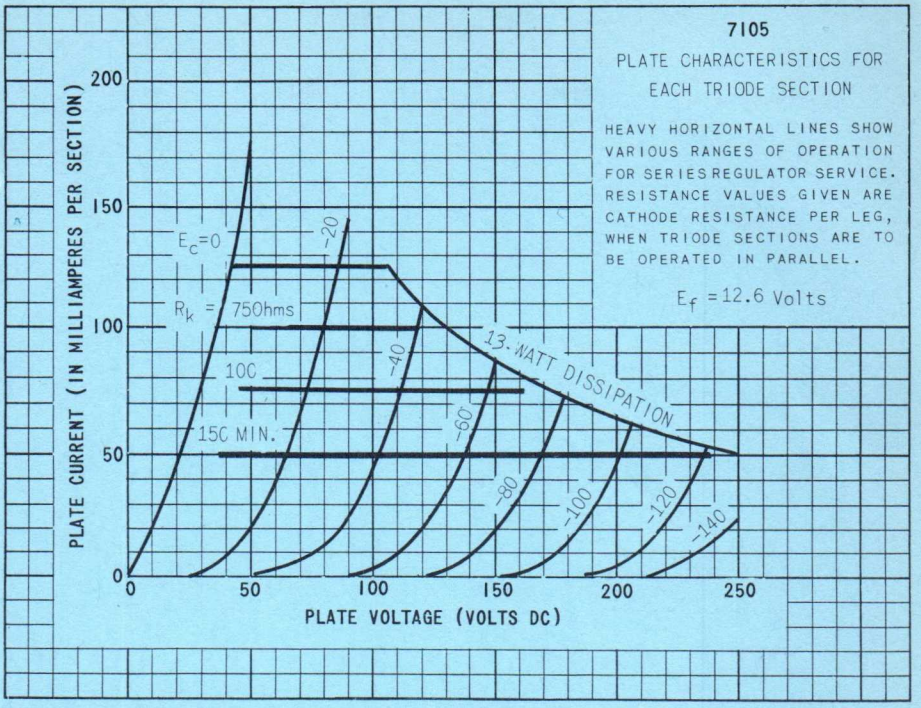
APPLICATION NOTES

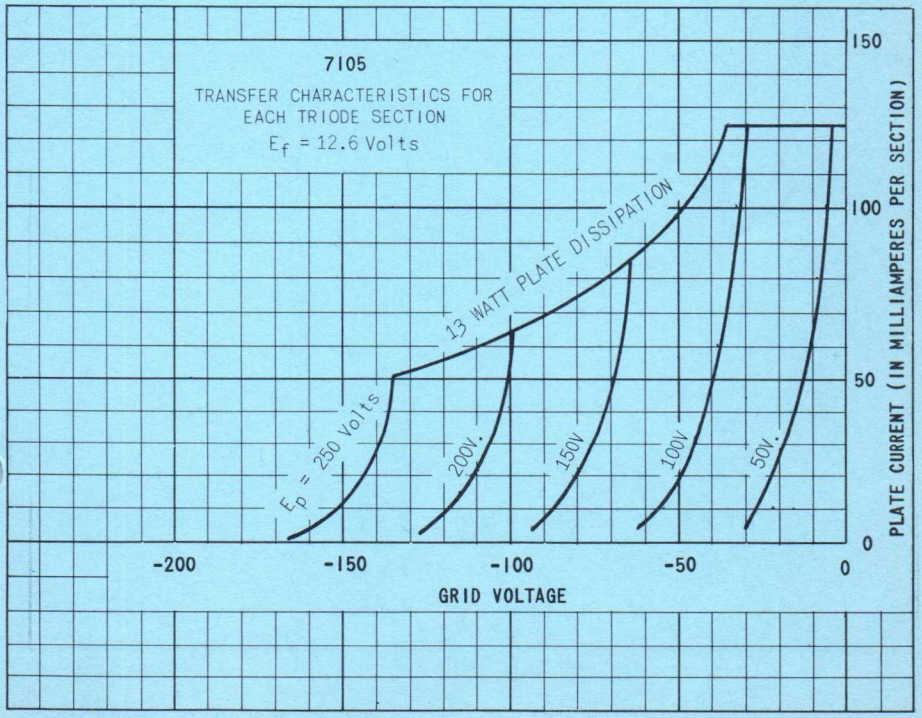
THE 7105 IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS. RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED, USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE RESISTANCE BECAUSE IT PROVIDES MORE BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE THIRD THE VALUE $(\frac{R}{\mu+1})$ OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE THIRD THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (ABOUT ONE WATTS) AND THE ADDITIONAL VOLTAGE (LESS THAN 10 VOLTS) NECESSARY FROM THE UNREGULATED SUPPLY. A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE PASSING TUBE TO WORK WITH HIGHER BIAS AND HENCE WITH GREATER TUBE DROP.

A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASSING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATOR OUTPUT IS LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A TUBE DROP AS POSSIBLE. A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES. SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE DUE TO TUBE AGING.

A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 12.6 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.





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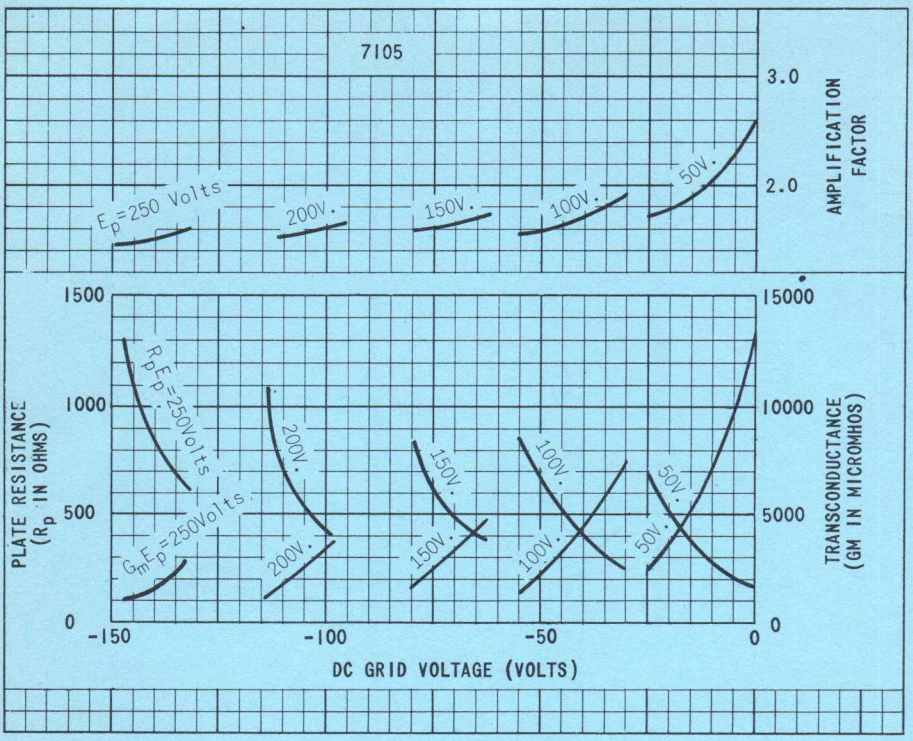
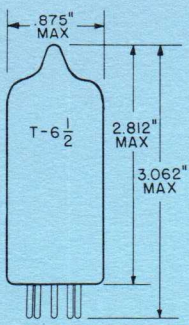

7105
3.0
2.0
AMPLIFICATION FACTOR
E_p=250 Volts
200V.
150V.
100V.
50V.
1500
1000
500
0
PLATE RESISTANCE (R_p IN OHMS)
R_p E_p=250Volts
G_m E_p=250Volts
15000
10000
5000
0
TRANSCONDUCTANCE (GM IN MICROMHOS)
-150
-100
-50
0
DC GRID VOLTAGE (VOLTS)

TUNG-SOL

PENTODE

MINIATURE TYPE



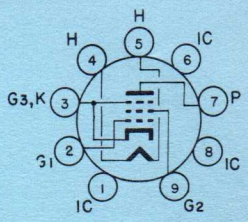
GLASS BULB
OUTLINE DRAWING
JEDEC 6-4

COATED UNIPOTENTIAL CATHODE

HEATER

6.3 VOLTS 760 MA.

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9CV

THE 7189 IS A POWER PENTODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE AS A POWER AMPLIFIER IN HIGH FIDELITY AUDIO EQUIPMENT, INTENDED FOR USE IN AMPLIFIERS OF OVER 20 WATT CAPABILITIES.

DIRECT INTERELECTRODE CAPACITANCES

INPUT CAPACITANCE	10.8	pf
OUTPUT CAPACITANCE	6.5	pf
PLATE TO GRID #1	0.5	pf
GRID #1 TO HEATER	0.25	pf

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

CLASS AB_1 FIXED BIAS AUDIO AMPLIFIER

PENTODE CONNECTION

MAXIMUM PLATE VOLTAGE	400	VOLTS
MAXIMUM PLATE DISSIPATION	12	WATTS
MAXIMUM GRID #2 VOLTAGE	300	VOLTS
MAXIMUM GRID #2 DISSIPATION (ZERO SIGNAL)	2.0	WATTS
MAXIMUM GRID #2 DISSIPATION (MAX. SIGNAL)	4.0	WATTS
MAXIMUM CATHODE CURRENT	65	MA.
MAXIMUM GRID RESISTANCE (FIXED BIAS)	300 000	OHMS
MAXIMUM HEATER TO CATHODE VOLTAGE	100	VOLTS

TYPICAL CHARACTERISTICS

PLATE VOLTAGE	250	VOLTS
GRID #2 VOLTAGE	250	VOLTS
PLATE CURRENT	48	MA.
GRID #2 CURRENT	5.5	MA.
GRID #1 VOLTAGE	-7.3	VOLTS
TRANSCONDUCTANCE	11 300	μMHOS
PLATE RESISTANCE	40 000	OHMS
AMPLIFICATION FACTOR (GRID #1 TO GRID #2)	19.5	

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TYPICAL OPERATION

FIXED BIAS – TWO TUBES – PUSH PULL

PLATE VOLTAGE	400	VOLTS
GRID #2 VOLTAGE	300	VOLTS
GRID #1 VOLTAGE	−15	VOLTS
PLATE TO PLATE LOAD RESISTANCE	8 000	OHMS
PLATE CURRENT (ZERO SIGNAL)	2x7.5	MA.
PLATE CURRENT (MAX. SIGNAL)	2x52.5	MA.
GRID #2 CURRENT (ZERO SIGNAL)	2x0.8	MA.
GRID #2 CURRENT (MAX. SIGNAL)	2x12.5	MA.
INPUT SIGNAL VOLTAGE (RMS)	10.5	VOLTS
POWER OUTPUT	24	WATTS
PERCENT DISTORTION	4.0	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

CLASS AB_1 AUDIO AMPLIFIER

ULTRA-LINEAR AMPLIFIER

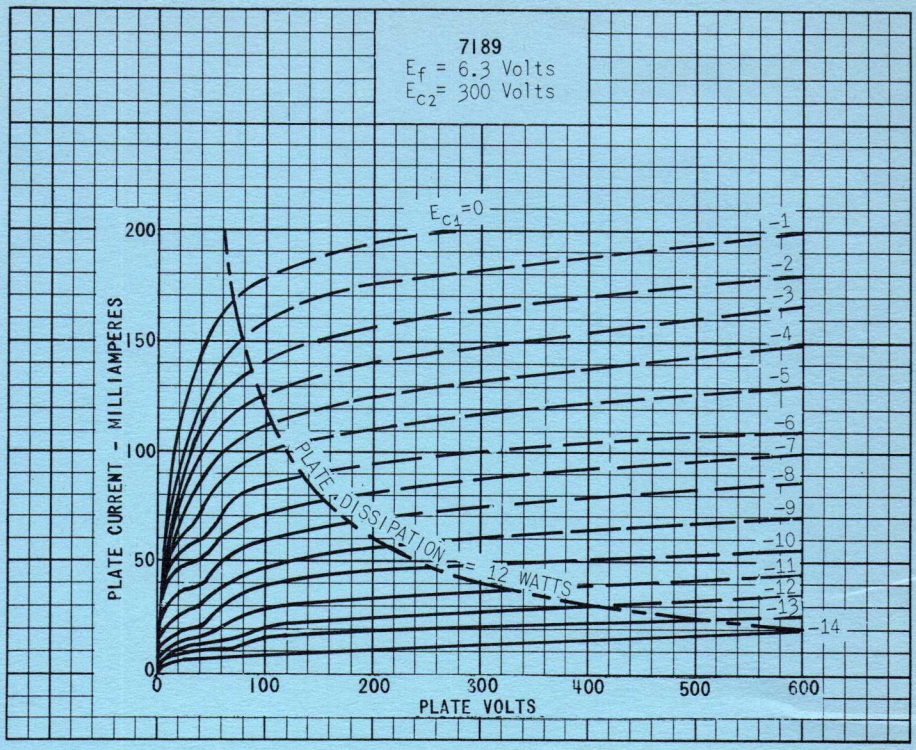
PLATE AND GRID #2 SUPPLY VOLTAGE	375	VOLTS
PLATE DISSIPATION	12	WATTS
GRID #2 DISSIPATION (ZERO SIGNAL)	2	WATTS
GRID #2 INPUT (MAX SIGNAL)	4	WATTS
CATHODE CURRENT	65	MA.
GRID RESISTANCE (CATHODE BIAS)	1	MEGOHM
HEATER TO CATHODE VOLTAGE	100	VOLTS

TYPICAL OPERATION

CATHODE BIAS – TWO TUBES – PUSH PULL

PLATE SUPPLY VOLTAGE	375	VOLTS
GRID #2 SUPPLY VOLTAGE[A]		
COMMON CATHODE RESISTANCE	220	OHMS
PLATE TO PLATE LOAD RESISTANCE	11 000	OHMS
PLATE AND GRID #2 CURRENT (ZERO SIGNAL)	2x35	MA.
PLATE AND GRID #2 CURRENT (MAX. SIGNAL)	2x40.5	MA.
INPUT SIGNAL VOLTAGE, RMS	12.5	VOLTS
POWER OUTPUT	16.5	WATTS
PERCENT DISTORTION	3	PERCENT

[A] SCREEN VOLTAGE IS OBTAINED FROM TAPS LOCATED AT 43% OF THE PLATE WINDING TURNS.



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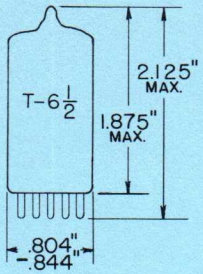
THYRATRON

MINIATURE TYPE

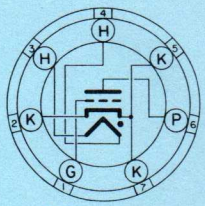


GLASS BULB
HARD

HEATER

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW-
SMALL BUTTON MINIATURE
7 PIN BASE
7FJ

THE 7190 IS A ZERO BIAS MINIATURE HYDROGEN THYRATRON DESIGNED PRIMARILY FOR THE GENERATION OF PULSE VOLTAGES UNDER EXTREME CONDITIONS OF MECHANICAL VIBRATION. THIS TUBE CAN SUPPLY PEAK PULSE POWER OF 10 KILOWATTS AND THEREFORE WILL REPLACE PHYSICALLY LARGER TYPES IN MANY RADAR APPLICATIONS. BECAUSE OF ITS CLOSE ELECTRODE SPACING AND SMALL SIZE, MADE POSSIBLE BY HARD GLASS CONSTRUCTION, THE 7190 IS CAPABLE OF RELATIVELY HIGH PULSE REPETITION RATES.

THE 7190, 7191, AND 7192 DIFFER ONLY IN THEIR ELECTRODE TERMINALS. ALL OF THESE TYPES HAVE FOUND USE IN MISSILE APPLICATIONS. THE 7190, 7191, AND 7192 HAVE BEEN DESIGNED INTO SOME EQUIPMENT UNDER THE CHATHAM DEVELOPMENTAL DESIGNATIONS CH1062, CH1092, AND CH1055 RESPECTIVELY.

ELECTRICAL DATA

	SYMBOL	MIN.	BOGEY	MAX.	
HEATER VOLTAGE (WHEN Ip IS LESS THAN 0.75 Aac, REFER TO RECOMMENDED HEATER VOLTAGE CURVE)	Ef	6.0	6.3	6.6	VOLTS
HEATER CURRENT (WITH BOGIE HEATER VOLTAGE)	If	1.6	1.8	2.0	AMP.
CATHODE HEATING TIME	tk	30			SECONDS
ANODE VOLTAGE DROP (AT RECOMMENDED Ef)	etd	45		125	VOLTS

MECHANICAL DATA

TYPE OF COOLING (HEAT DISSIPATING SHIELDS MAY BE USED. FORCED AIR COOLING IS NOT RECOMMENDED.)	CONVECTION	
ALITITUDE	SEE APPLICATION NOTES	
MOUNTING POSITION	ANY	
MAXIMUM NET WEIGHT	0.5	OUNCES
DIMENSIONS: SEE OUTLINE DRAWINGS	SEE OUTLINE DRAWINGS	
MAXIMUM VIBRATION CONDITIONS	50-2000 CPS @ 15 G	
MAXIMUM SHOCK CONDITIONS (48° HAMMER BLOW IN NAVY FLY WEIGHT, HIGH IMPACT SHOCK MACHINE)	720	G/1MSEC.
MICROSCOPIC INSPECTION PER MIL-E-1775IB (N ORD)	SEE APPLICATION NOTES	

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RATINGS
ABSOLUTE VALUES

	SYMBOL	MIN.	MAX.	
PEAK ANODE VOLTAGE				
INVERSE (NOTE 1)	epx	---	1200	VOLTS
FORWARD	epy	300	1200	VOLTS
CATHODE CURRENT				
PEAK	ib		20.0	AMP.
AVERAGE	Ib		50	MA.
RMS (FOR SQUARE PULSE APPLICATIONS $I_p = \sqrt{I_b \times ib}$)	I_p		1.0	AMP.
DC ANODE VOLTAGE	E_{bb}	300		VOLTS
HEATER–CATHODE VOLTAGE	Ehk	−100	+25	VOLTS
OPERATING FREQUENCY (THIS IS NOT NECESSARILY THE UPPER OPERATING FREQUENCY LIMIT BUT REPRESENTS THE HIGHEST REPETITION RATE EXTENSIVELY LIFE TESTED TO DATE.)	prr		5000	CPS
PEAK GRID VOLTAGE (SEE RECOMMENDED GRID PULSE CONDITIONS.)	egy	175	500	VOLTS
PEAK INVERSE GRID VOLTAGE	egx		150	VOLTS
HEATING FACTOR (epy x ib x prr.)	Pb		1×10^8	
CURRENT RATE OF RISE (NOTE 2)			400	AMP/μSEC.
ANODE DELAY TIME (NOTE 3)	tad		0.6	μSEC.
TIME JITTER (NOTE 4)	tj		0.01	μSEC.
AMBIENT TEMPERATURE	TA	−60	+125	°C

NOTES

[1] IN PULSED OPERATION, THE PEAK INVERSE VOLTAGE, EXCLUSIVE OF A SPIKE OF 0.05 μSEC. MAXIMUM DURATION, SHALL NOT EXCERD 500 VOLTS DURING THE FIRST 25 μSEC, FOLLOWING THE ANODE PULSE.

[2] MEASUREMENT MADE BETWEEN 26% AND 70.7% POINTS.

[3] ANODE DELAY TIME IS DEFINED AS THE TIME INTERVAL BETWEEN THE POINT ON THE RISING PORTION OF THE GRID VOLTAGE PULSE WHICH IS 26 PERCENT OF THE MAXIMUM UNLOADED PULSE AMPLITUDE AND THE POINT WHERE ANODE CONDUCTION TAKES PLACE.

[4] TIME JITTER IS MEASURED AT 50 PERCENT OF THE PULSE AMPLITUDE AFTER THE TUBE HAS BEEN OPERATING FOR AT LEAST 60 SECONDS. THE LIMIT OF 0.01 μSEC. SHOWN IS THE MAXIMUM ALLOWABLE UNDER SPECIFIED UNFAVORABLE OPERATING CONDITIONS. WITH SUFFICIENT GRID DRIVE AND WITH ANODE VOLTAGES OF 600 VOLTS AND ABOVE, JITTER NOT EXCEEDING 0.005 μSEC. CAN BE EASILY ACHIEVED.

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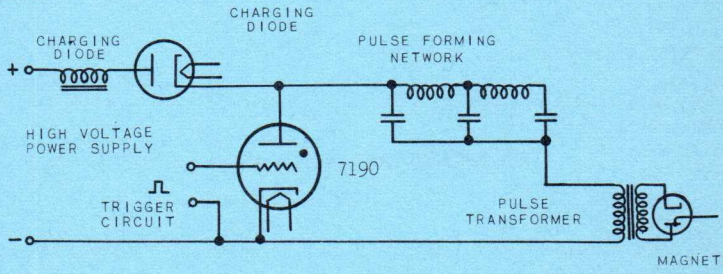
APPLICATION NOTES

THIS FAMILY OF MINIATURE HYDROGEN THYRATRONS IS DESIGNED FOR USE IN LINE TYPE RADAR MODULATORS. A BASIC CIRCUIT FOR SUCH SERVICE IS ILLUSTRATED BELOW. IN SUCH A CIRCUIT, THE HYDROGEN THYRATRON SERVES AS A SWITCH TO RELEASE INTO THE MAGNETRON OR OTHER RADIO FREQUENCY GENERATOR, THE ENERGY STORED IN THE PULSE FORMING NETWORK. THESE TUBES ARE ADMIRABLY SUITED FOR SUCH SERVICE BY THEIR ABILITY TO HOLD OFF RELATIVELY HIGH VOLTAGE, AND TO PASS HIGH PEAK CURRENT WITH RELATIVELY LOW TUBE VOLTAGE DROP. THE TUBES WILL OPERATE OVER A WIDE RANGE OF PULSE REPETITION RATES, PULSE WIDTHS AND PEAK CURRENTS, THUS PROVIDING VERY FLEXIBLE CIRCUIT ELEMENTS. TRIGGERING REQUIREMENTS ARE SIMPLIFIED SINCE THE TUBES OPERATE WITH ZERO BIAS.



THE SMALL SIZE, LIGHT WEIGHT, EXTREME RUGGEDNESS, AND ABILITY TO OPERATE AT HIGH AMBIENT TEMPERATURES, MAKE THESE TUBES PARTICULARLY SUITABLE FOR AIRBORNE USE. THE TUBES CAN BE OPERATED IN ANY POSITION. ALL TUBES ARE TESTED IN ACCORDANCE WITH MIL-E-1775 1B (N ORD), THE MILITARY SPECIFICATION FOR ELECTRON TUBES FOR GUIDED MISSILES. THIS ENTAILS 100% MICROSCOPIC INSPECTION WITH A 10 POWER BINOCULAR MICROSCOPE FOR SUCH ITEMS AS SEALS, LEADS AND SPOT WELDS. SAMPLE TUBES ARE VIBRATED WITH VOLTAGES APPLIED OVER A RANGE OF 50 TO 2000 TO 500CPS AT 15G IN 4 MINUTES.

THE 7190 AND THE 7191 FIT A STANDARD 7 PIN MINIATURE SOCKET. THE TUBE PINS, HOWEVER, ARE STIFF, AND CARE SHOULD BE TAKEN TO HAVE THE SOCKET CLIPS IN PERFECT ALIGNMENT BEFORE ATTEMPTING TO INSERT A TUBE. AS THE TUBE OPERATES AT HIGH TEMPERATURES, A CERAMIC TYPE SOCKET SHOULD BE EMPLOYED. CONNECTIONS TO THE SOCKET SHOULD BE MADE WITH FLEXIBLE LEADS TO PROVIDE FLOATING ACTION FOR THE SOCKET CLIPS. PIN STRAIGHTENERS SHOULD NEVER BE USED ON THESE TUBE TYPES, AS ANY ATTEMPT TO BEND THE PINS WILL RESULT IN CRACKED BUTTON BASES!

THE ANODE CONNECTION ON TYPE 7191 IS A SOLDERING TERMINAL BROUGHT OUT THE TOP OF THE ENVOLOPE. THIS DESIGN PROVIDES A MAXIMUM SPACING BETWEEN THE ANODE LEAD AND THE GRID AND CATHODE PINS TO PREVENT ARC-OVER AT REDUCED AIR PRESSURES. THE 7191 WILL OPERATE FOR SHORT PERIODS AT 80,000 FEET WITHOUT FORCED AIR COOLING. THE NOMINAL ALTITUDE RATING FOR THE 7190 AND 7192 IS 10,000 FEET. HOWEVER, IF PROVISION IS MADE TO PREVENT ARC-OVER BETWEEN PINS, THESE TYPES ALSO WILL OPERATE AT 80,000 FEET. ONE METHOD OF PREVENTING ARC-OVER BETWEEN PINS IS TO POT THE BASE END OF THE TUBE. IF THE ENTIRE ENVELOPE IS TO BE POTTED, HOWEVER, PRECAUTION MUST BE TAKEN TO KEEP BULB TEMPERATURE BELOW 225°C.

TYPE 7192 IS SUPPLIED WITH LONG, FLEXIBLE STRANDED LEAD CONNECTORS THAT MAY BE CRIMPED OR SOLDERED DIRECTLY IN THE CIRCUIT. THE TUBE ITSELF CAN BE SECURED BY ANY SUITABLE MECHANICAL MEANS. ONE SUCH METHOD IS TO HOLD IT IN POSITION WITH A HEAT DISSIPATING CLAMP SUCH AS THE BIRTCHER 6A3.

CATHODE TEMPERATURE IS DETERMINED BY RMS CATHODE CURRENT AS WELL AS BY HEATER POWER. THE BOGEY HEATER VOLTAGE OF 6.3 VOLTS HEREFORE IS APPLICABLE ONLY NEAR FULL OPERATING CONDITIONS. AT LIGHT LOADING IT IS RECOMMENDED TO OPERATE THE HEATER VOLTAGE HIGHER. RECOMMENDED FIGURES FOR VARIOUS OPERATING CONDITIONS ARE SHOWN ON THE CURVES.

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TUNG-SOL

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TYPICAL OPERATION

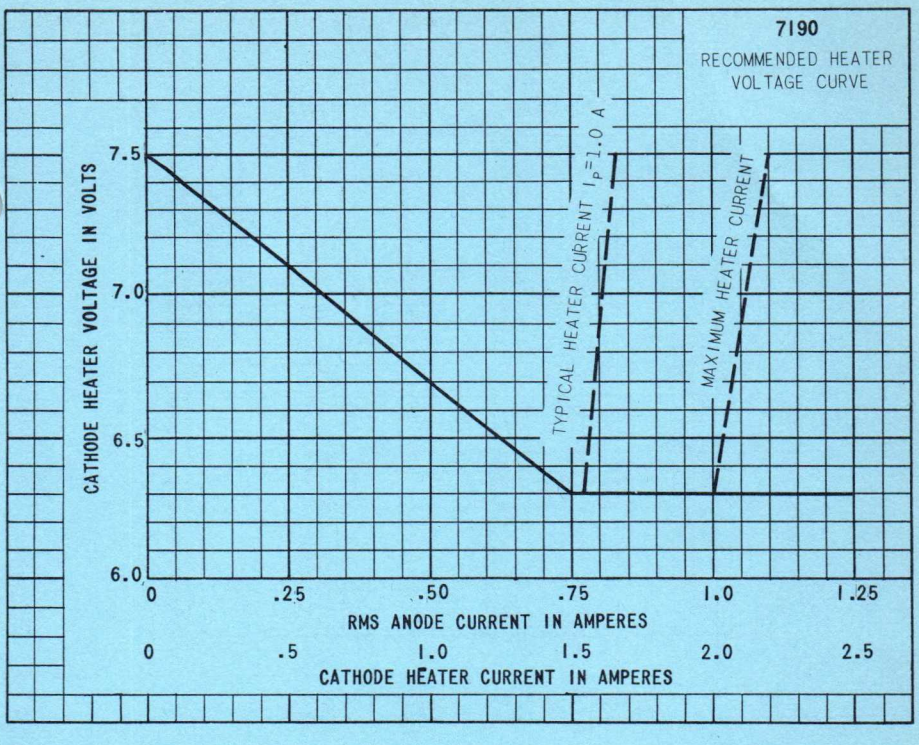
PRR (pps)	ANODE CURRENT PEAK (Amps)	RMS Amps AC	AVG. mAd.c.	Peak Anode Voltage VOLTS	PULSE WIDTH μ sec	GRID μ sec	DRIVE VOLTS
5000	20.0	1.0	50.	1000	0.5	1.0	250
10000	6.6	0.5	37.	316	0.56	2.0	250
33000*	3.5	0.46	60.	350	0.5	BLOCKING OSCILLATOR	200

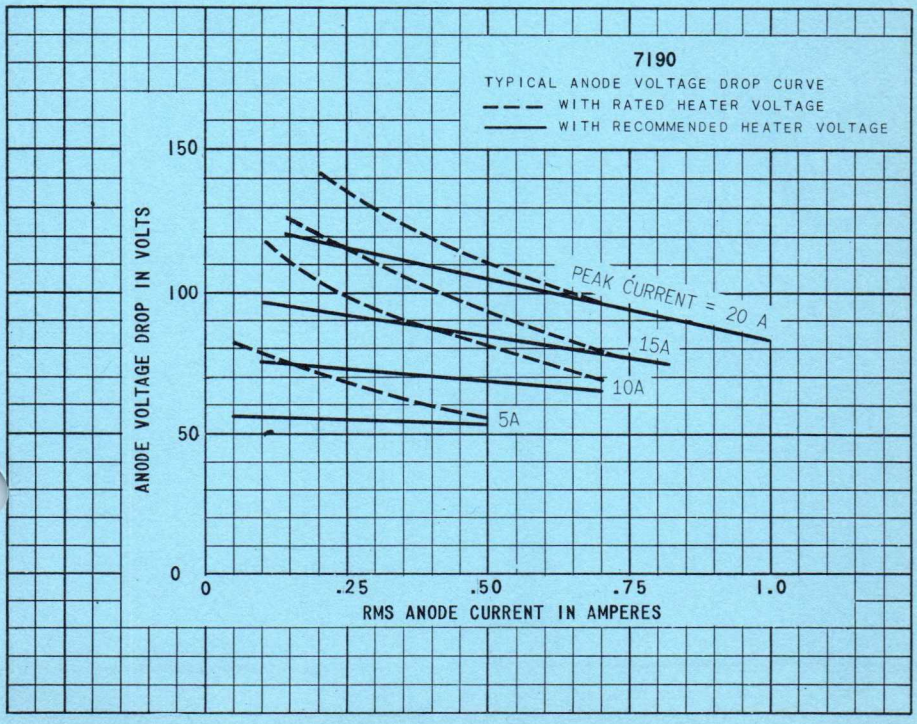
*LIMITED TEST INFORMATION.

RECOMMENDED GRID PULSE VALUES

	MIN.	MAX.	
PEAK VOLTAGE	200	500	VOLTS
DRIVER CIRCUIT IMPEDANCE	200	1000	OHMS
VOLTAGE RATE OF RISE μ SEC.	350		VOLTS

THESE VALUES ARE AS MEASURED AT THE TUBE SOCKET WITH THE THYRATRON REMOVED. THE GRID PULSE WIDTH SHOULD NOT BE LONGER THAN THE ANODE PULSE EXCEPT IN CASES WHERE THE DRIVER CIRCUIT IMPEDANCE IS HIGH. THE MINIMUM PEAK TRIGGER VOLTAGE RECOMMENDED WILL INCREASE WITH DECREASING TRIGGER PULSE WIDTH. HOWEVER, THIS EFFECT IS IMPORTANT ONLY AT PULSE WIDTHS LESS THAN 0.5 MICROSECONDS.





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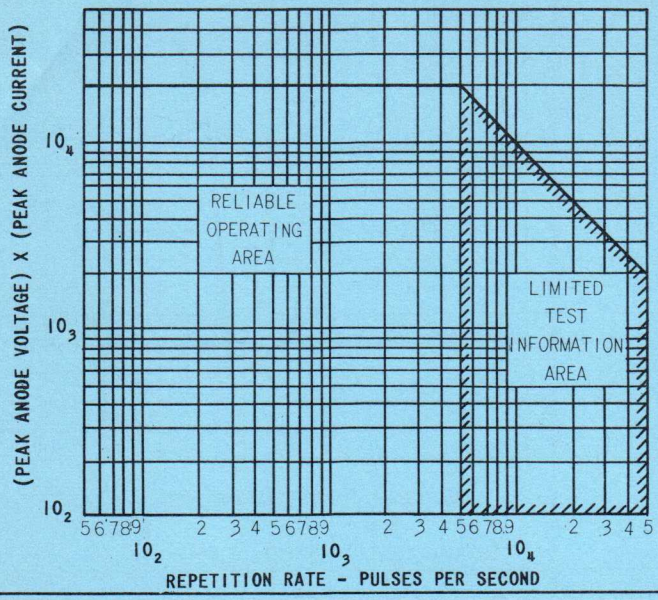
7190

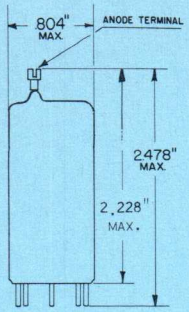
GRAPHICAL REPRESENTATION OF HEAT FACTOR



TUNG-SOL

THYRATRON

MINIATURE TYPE

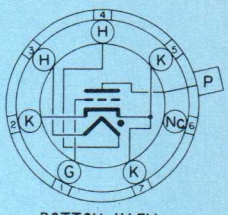


GLASS BULB
HARD

HEATER

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
SMALL BUTTON MINIATURE
7 PIN BASE
7FK

THE 7191 IS A ZERO BIAS MINIATURE HYDROGEN THYRATRON DESIGNED PRIMARILY FOR THE GENERATION OF PULSE VOLTAGES UNDER EXTREME CONDITIONS OF MECHANICAL VIBRATION. THIS TUBE CAN SUPPLY PEAK PULSE POWER OF 10 KILOWATTS AND THEREFORE WILL REPLACE PHYSICALLY LARGER TYPES IN MANY RADAR APPLICATIONS. BECAUSE OF ITS CLOSE ELECTRODE SPACING AND SMALL SIZE, MADE POSSIBLE BY HARD GLASS CONSTRUCTION, THE 7190 IS CAPABLE OF RELATIVELY HIGH PULSE REPETITION RATES.

THE 7190, 7191, AND 7192 DIFFER ONLY IN THEIR ELECTRODE TERMINALS. ALL OF THESE TYPES HAVE FOUND USE IN MISSILE APPLICATIONS. THE 7190, 7191, AND 7192 HAVE BEEN DESIGNED INTO SOME EQUIPMENT UNDER THE CHATHAM DEVELOPMENTAL DESIGNATIONS-CH1062, CH1092, AND CH1055 RESPECTIVELY.

ELECTRICAL DATA

	SYMBOL	MIN.	BOGEY	MAX.	
HEATER VOLTAGE (WHEN Ip IS LESS THAN 0.75 Aac, REFER TO RECOMMENDED HEATER VOLTAGE CURVE)	Ef	6.0	6.3	6.6	VOLTS
HEATER CURRENT (WITH BOGIE HEATER VOLTAGE)	If	1.6	1.8	2.0	AMP.
CATHODE HEATING TIME	tk	30			SECONDS
ANODE VOLTAGE DROP (AT RECOMMENDED Ef)	etd	45		125	VOLTS

MECHANICAL DATA

TYPE OF COOLING (HEAT DISSIPATING SHIELDS MAY BE USED. FORCED AIR COOLING IS NOT RECOMMENDED.)	CONVECTION
ALTITUDE	SEE APPLICATION NOTES
MOUNTING POSITION	ANY
MAXIMUM NET WEIGHT	0.5 OUNCES
DIMENSIONS: SEE OUTLINE DRAWINGS	SEE OUTLINE DRAWINGS
MAXIMUM VIBRATION CONDITIONS	50-2000 CPS @ 15 G
MAXIMUM SHOCK CONDITIONS (48° HAMMER BLOW IN NAVY FLY WEIGHT, HIGH IMPACT SHOCK MACHINE)	720 G/1MSEC.
MICROSCOPIC INSPECTION PER MIL-E-17751B (N ORD)	SEE APPLICATION NOTES

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TUNG-SOL

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RATINGS
ABSOLUTE VALUES

	SYMBOL	MIN.	MAX.	
PEAK ANODE VOLTAGE				
INVERSE (NOTE 1)	epx	---	1200	VOLTS
FORWARD	epy	300	1200	VOLTS
CATHODE CURRENT				
PEAK	ib		20.0	AMP.
AVERAGE	Ib		50	MA.
RMS (FOR SQUARE PULSE APPLICATIONS $I_p = \sqrt{I_b \times ib}$)	I_p		1.0	AMP.
DC ANODE VOLTAGE	E_{bb}	300		VOLTS
HEATER–CATHODE VOLTAGE	Ehk	−100	+25	VOLTS
OPERATING FREQUENCY (THIS IS NOT NECESSARILY THE UPPER OPERATING FREQUENCY LIMIT BUT REPRESENTS THE HIGHEST REPETITION RATE EXTENSIVELY LIFE TESTED TO DATE.)	prr		5000	CPS
PEAK GRID VOLTAGE (SEE RECOMMENDED GRID PULSE CONDITIONS.)	egy	175	500	VOLTS
PEAK INVERSE GRID VOLTAGE	egx		150	VOLTS
HEATING FACTOR (epy X ib X prr.)	Pb		1×10^8	
CURRENT RATE OF RISE (NOTE 2)			400	AMP/μSEC.
ANODE DELAY TIME (NOTE 3)	tad		0.6	μSEC.
TIME JITTER (NOTE 4)	tj		0.01	μSEC.
AMBIENT TEMPERATURE	TA	−60	+125	°C

NOTES

[1] IN PULSED OPERATION, THE PEAK INVERSE VOLTAGE, EXCLUSIVE OF A SPIKE OF 0.05 μSEC. MAXIMUM DURATION, SHALL NOT EXCERD 500 VOLTS DURING THE FIRST 25 μSEC, FOLLOWING THE ANODE PULSE.

[2] MEASUREMENT MADE BETWEEN 26% AND 70.7% POINTS.

[3] ANODE DELAY TIME IS DEFINED AS THE TIME INTERVAL BETWEEN THE POINT ON THE RISING PORTION OF THE GRID VOLTAGE PULSE WHICH IS 26 PERCENT OF THE MAXIMUM UNLOADED PULSE AMPLITUDE AND THE POINT WHERE ANODE CONDUCTION TAKES PLACE.

[4] TIME JITTER IS MEASURED AT 50 PERCENT OF THE PULSE AMPLITUDE AFTER THE TUBE HAS BEEN OPERATING FOR AT LEAST 60 SECONDS. THE LIMIT OF 0.01 μSEC. SHOWN IS THE MAXIMUM ALLOWABLE UNDER SPECIFIED UNFAVORABLE OPERATING CONDITIONS. WITH SUFFICIENT GRID DRIVE AND WITH ANODE VOLTAGES OF 600 VOLTS AND ABOVE, JITTER NOT EXCEEDING 0.005 μSEC. CAN BE EASILY ACHIEVED.

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TUNG-SOL

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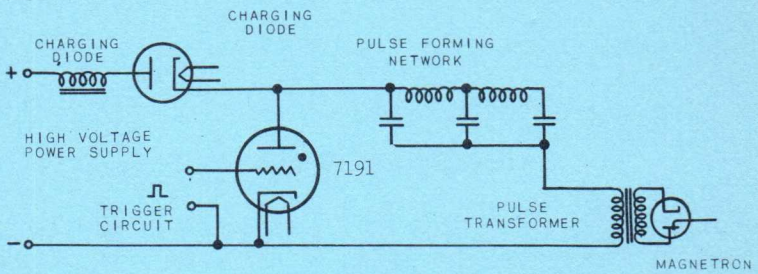
APPLICATION NOTES

THIS FAMILY OF MINIATURE HYDROGEN THYRATRONS IS DESIGNED FOR USE IN LINE TYPE RADAR MODULATORS. A BASIC CIRCUIT FOR SUCH SERVICE IS ILLUSTRATED BELOW. IN SUCH A CIRCUIT, THE HYDROGEN THYRATRON SERVES AS A SWITCH TO RELEASE INTO THE MAGNETRON OR OTHER RADIO FREQUENCY GENERATOR, THE ENERGY STORED IN THE PULSE FORMING NETWORK. THESE TUBES ARE ADMIRABLY SUITED FOR SUCH SERVICE BY THEIR ABILITY TO HOLD OFF RELATIVELY HIGH VOLTAGE, AND TO PASS HIGH PEAK CURRENT WITH RELATIVELY LOW TUBE VOLTAGE DROP. THE TUBES WILL OPERATE OVER A WIDE RANGE OF PULSE REPETITION RATES, PULSE WIDTHS AND PEAK CURRENTS, THUS PROVIDING VERY FLEXIBLE CIRCUIT ELEMENTS. TRIGGERING REQUIREMENTS ARE SIMPLIFIED SINCE THE TUBES OPERATE WITH ZERO BIAS.



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THE 7190 AND THE 7191 FIT A STANDARD 7 PIN MINIATURE SOCKET. THE TUBE PINS, HOWEVER, ARE STIFF, AND CARE SHOULD BE TAKEN TO HAVE THE SOCKET CLIPS IN PERFECT ALIGNMENT BEFORE ATTEMPTING TO INSERT A TUBE. AS THE TUBE OPERATES AT HIGH TEMPERATURES, A CERAMIC TYPE SOCKET SHOULD BE EMPLOYED. CONNECTIONS TO THE SOCKET SHOULD BE MADE WITH FLEXIBLE LEADS TO PROVIDE FLOATING ACTION FOR THE SOCKET CLIPS. PIN STRAIGHTENERS SHOULD NEVER BE USED ON THESE TUBE TYPES, AS ANY ATTEMPT TO BEND THE PINS WILL RESULT IN CRACKED BUTTON BASES!

THE ANODE CONNECTION ON TYPE 7191 IS A SOLDERING TERMINAL BROUGHT OUT THE TOP OF THE ENVOLOPE. THIS DESIGN PROVIDES A MAXIMUM SPACING BETWEEN THE ANODE LEAD AND THE GRID AND CATHODE PINS TO PREVENT ARC-OVER AT REDUCED AIR PRESSURES. THE 7191 WILL OPERATE FOR SHORT PERIODS AT 80,000 FEET WITHOUT FORCED AIR COOLING. THE NOMINAL ALTITUDE RATING FOR THE 7190 AND 7192 IS 10,000 FEET. HOWEVER, IF PROVISION IS MADE TO PREVENT ARC-OVER BETWEEN PINS, THESE TYPES ALSO WILL OPERATE AT 80,000 FEET. ONE METHOD OF PREVENTING ARC-OVER BETWEEN PINS IS TO POT THE BASE END OF THE TUBE. IF THE ENTIRE ENVELOPE IS TO BE POTTED, HOWEVER, PRECAUTION MUST BE TAKEN TO KEEP BULB TEMPERATURE BELOW 225°C.

TYPE 7192 IS SUPPLIED WITH LONG, FLEXIBLE STRANDED LEAD CONNECTORS THAT MAY BE CRIMPED OR SOLDERED DIRECTLY IN THE CIRCUIT. THE TUBE ITSELF CAN BE SECURED BY ANY SUITABLE MECHANICAL MEANS. ONE SUCH METHOD IS TO HOLD IT IN POSITION WITH A HEAT DISSIPATING CLAMP SUCH AS THE BIRTCHER 6A3.

CATHODE TEMPERATURE IS DETERMINED BY RMS CATHODE CURRENT AS WELL AS BY HEATER POWER. THE BOGEY HEATER VOLTAGE OF 6.3 VOLTS HEREFORE IS APPLICABLE ONLY NEAR FULL OPERATING CONDITIONS. AT LIGHT LOADING IT IS RECOMMENDED TO OPERATE THE HEATER VOLTAGE HIGHER. RECOMMENDED FIGURES FOR VARIOUS OPERATING CONDITIONS ARE SHOWN ON THE CURVES.

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TUNG-SOL

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TYPICAL OPERATION

PRR	ANODE CURRENT PEAK	ANODE CURRENT RMS	ANODE CURRENT AVG.	Peak Anode Voltage	PULSE WIDTH	GRID DRIVE	
(pps)	(Amps)	Amps AC	mAd.c.	VOLTS	μ sec	μ sec	VOLTS
5000	20.0	1.0	50.	1000	0.5	1.0	250
10000	6.6	0.5	37.	316	0.56	2.0	250
33000*	3.5	0.46	60.	350	0.5	BLOCKING OSCILLATOR	200

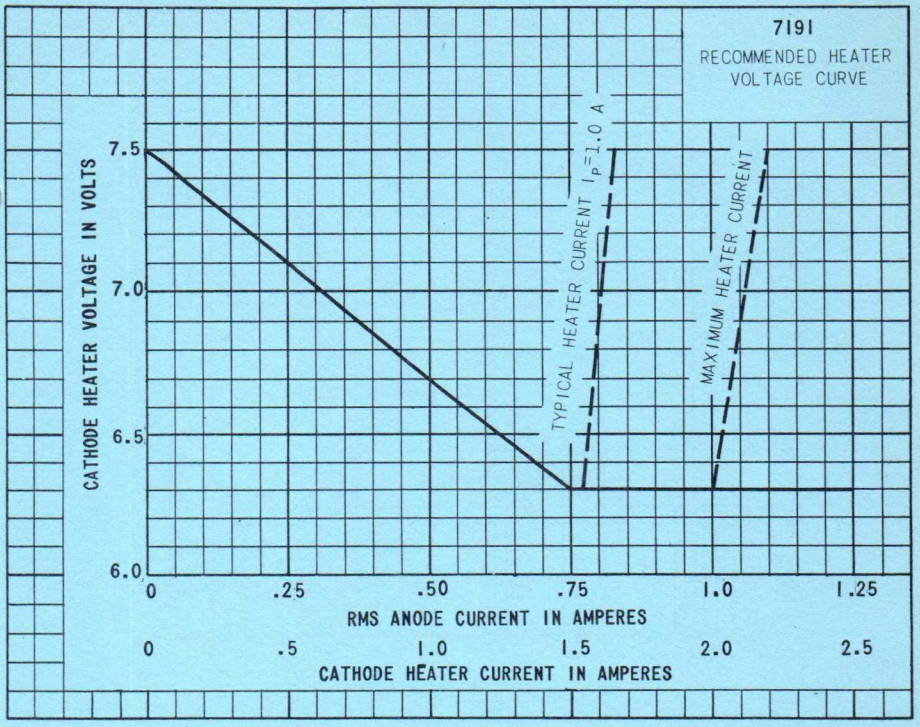
*LIMITED TEST INFORMATION.

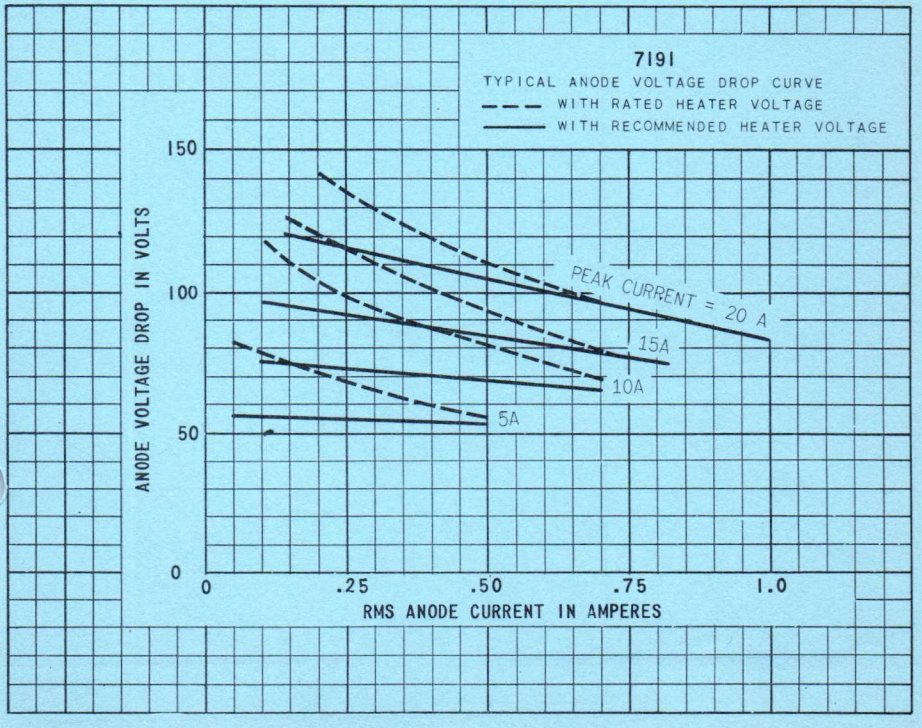
RECOMMENDED GRID PULSE VALUES

	MIN.	MAX.	
PEAK VOLTAGE	200	500	VOLTS
DRIVER CIRCUIT IMPEDANCE	200	1000	OHMS
VOLTAGE RATE OF RISE μ SEC.	350		VOLTS

THESE VALUES ARE AS MEASURED AT THE TUBE SOCKET WITH THE THYRATRON REMOVED. THE GRID PULSE WIDTH SHOULD NOT BE LONGER THAN THE ANODE PULSE EXCEPT IN CASES WHERE THE DRIVER CIRCUIT IMPEDANCE IS HIGH. THE MINIMUM PEAK TRIGGER VOLTAGE RECOMMENDED WILL INCREASE WITH DECREASING TRIGGER PULSE WIDTH. HOWEVER, THIS EFFECT IS IMPORTANT ONLY AT PULSE WIDTHS LESS THAN 0.5 MICROSECONDS.

SIMILAR TYPE REFERENCE: Type 7191 is similar in all respects to type 7190 except that the anode connector is a terminal extending from the top of the bulb. This permits operation at high altitudes in unpressurized equipment as explained in the application notes.





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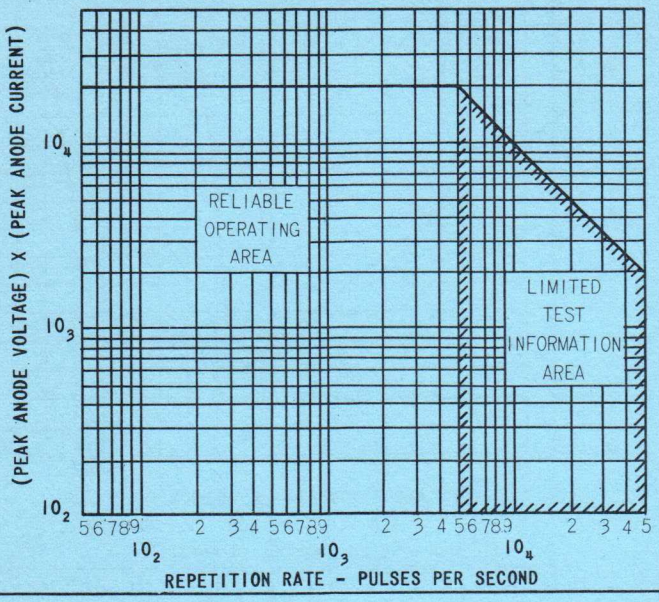
7191

GRAPHICAL REPRESENTATION OF HEAT FACTOR



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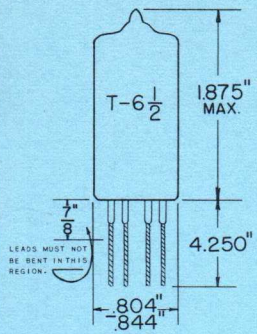


GLASS BULB
HARD

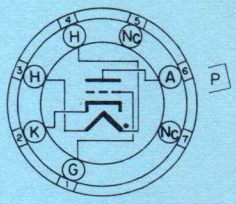
THYRATRON

MINIATURE TYPE

HEATER

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
SMALL BUTTON MINIATURE
7 PIN BASE
7FK

THE 7192 IS A ZERO BIAS MINIATURE HYDROGEN THYRATRON DESIGNED PRIMARILY FOR THE GENERATION OF PULSE VOLTAGES UNDER EXTREME CONDITIONS OF MECHANICAL VIBRATION. THIS TUBE CAN SUPPLY PEAK PULSE POWER OF 10 KILOWATTS AND THEREFORE WILL REPLACE PHYSICALLY LARGER TYPES IN MANY RADAR APPLICATIONS. BECAUSE OF ITS CLOSE ELECTRODE SPACING AND SMALL SIZE, MADE POSSIBLE BY HARD GLASS CONSTRUCTION, THE 7190 IS CAPABLE OF RELATIVELY HIGH PULSE REPETITION RATES.

THE 7190, 7191, AND 7192 DIFFER ONLY IN THEIR ELECTRODE TERMINALS. ALL OF THESE TYPES HAVE FOUND USE IN MISSILE APPLICATIONS. THE 7190, 7191, AND 7192 HAVE BEEN DESIGNED INTO SOME EQUIPMENT UNDER THE CHATHAM DEVELOPMENTAL DESIGNATIONS CH1062, CH1092, AND CH1055 RESPECTIVELY.

ELECTRICAL DATA

	SYMBOL	MIN.	BOGEY	MAX.	
HEATER VOLTAGE (WHEN Ip IS LESS THAN 0.75 Aac, REFER TO RECOMMENDED HEATER VOLTAGE CURVE)	Ef	6.0	6.3	6.6	VOLTS
HEATER CURRENT (WITH BOGIE HEATER VOLTAGE)	If	1.6	1.8	2.0	AMP.
CATHODE HEATING TIME	tk	30			SECONDS
ANODE VOLTAGE DROP (AT RECOMMENDED Ef)	etd	45		125	VOLTS

MECHANICAL DATA

TYPE OF COOLING (HEAT DISSIPATING SHIELDS MAY BE USED. FORCED AIR COOLING IS NOT RECOMMENDED.)	CONVECTION	
ALTITUDE	SEE APPLICATION NOTES	
MOUNTING POSITION	ANY	
MAXIMUM NET WEIGHT	0.5	OUNCES
DIMENSIONS: SEE OUTLINE DRAWINGS	SEE OUTLINE DRAWINGS	
MAXIMUM VIBRATION CONDITIONS	50-2000 CPS @ 15 G	
MAXIMUM SHOCK CONDITIONS (48° HAMMER BLOW IN NAVY FLY WEIGHT, HIGH IMPACT SHOCK MACHINE)	720	G/1MSEC.
MICROSCOPIC INSPECTION PER MIL-E-17751B (N ORD)	SEE APPLICATION NOTES	

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TUNG-SOL

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RATINGS
ABSOLUTE VALUES

	SYMBOL	MIN.	MAX.	
PEAK ANODE VOLTAGE				
INVERSE (NOTE 1)	epx	---	1200	VOLTS
FORWARD	epy	300	1200	VOLTS
CATHODE CURRENT				
PEAK	ib		20.0	AMP.
AVERAGE	Ib		50	MA.
RMS (FOR SQUARE PULSE APPLICATIONS $I_p = \sqrt{I_b \times ib}$)	I_p		1.0	AMP.
DC ANODE VOLTAGE	E_{bb}	300		VOLTS
HEATER–CATHODE VOLTAGE	Ehk	−100	+25	VOLTS
OPERATING FREQUENCY (THIS IS NOT NECESSARILY THE UPPER OPERATING FREQUENCY LIMIT BUT REPRESENTS THE HIGHEST REPETITION RATE EXTENSIVELY LIFE TESTED TO DATE.)	prr		5000	CPS
PEAK GRID VOLTAGE (SEE RECOMMENDED GRID PULSE CONDITIONS.)	egy	175	500	VOLTS
PEAK INVERSE GRID VOLTAGE	egx		150	VOLTS
HEATING FACTOR (epy x ib x prr.)	Pb		1×10^8	
CURRENT RATE OF RISE (NOTE 2)			400	AMP/μSEC.
ANODE DELAY TIME (NOTE 3)	tad		0.6	μSEC.
TIME JITTER (NOTE 4)	tj		0.01	μSEC.
AMBIENT TEMPERATURE	TA	−60	+125	°C

NOTES

[1] IN PULSED OPERATION, THE PEAK INVERSE VOLTAGE, EXCLUSIVE OF A SPIKE OF 0.05 μSEC. MAXIMUM DURATION, SHALL NOT EXCERD 500 VOLTS DURING THE FIRST 25 μSEC, FOLLOWING THE ANODE PULSE.

[2] MEASUREMENT MADE BETWEEN 26% AND 70.7% POINTS.

[3] ANODE DELAY TIME IS DEFINED AS THE TIME INTERVAL BETWEEN THE POINT ON THE RISING PORTION OF THE GRID VOLTAGE PULSE WHICH IS 26 PERCENT OF THE MAXIMUM UNLOADED PULSE AMPLITUDE AND THE POINT WHERE ANODE CONDUCTION TAKES PLACE.

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TUNG-SOL

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APPLICATION NOTES

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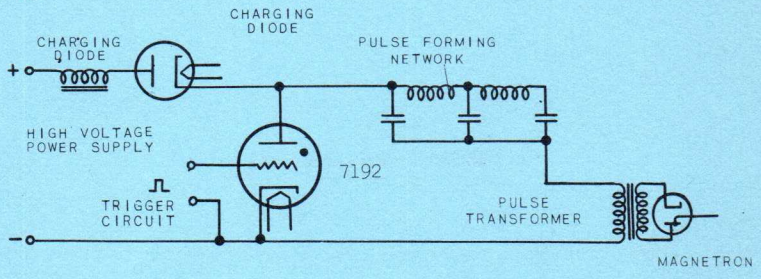

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THE 7190 AND THE 7191 FIT A STANDARD 7 PIN MINIATURE SOCKET. THE TUBE PINS, HOWEVER, ARE STIFF, AND CARE SHOULD BE TAKEN TO HAVE THE SOCKET CLIPS IN PERFECT ALIGNMENT BEFORE ATTEMPTING TO INSERT A TUBE. AS THE TUBE OPERATES AT HIGH TEMPERATURES, A CERAMIC TYPE SOCKET SHOULD BE EMPLOYED. CONNECTIONS TO THE SOCKET SHOULD BE MADE WITH FLEXIBLE LEADS TO PROVIDE FLOATING ACTION FOR THE SOCKET CLIPS. PIN STRAIGHTENERS SHOULD NEVER BE USED ON THESE TUBE TYPES, AS ANY ATTEMPT TO BEND THE PINS WILL RESULT IN CRACKED BUTTON BASES!

THE ANODE CONNECTION ON TYPE 7191 IS A SOLDERING TERMINAL BROUGHT OUT THE TOP OF THE ENVOLOPE. THIS DESIGN PROVIDES A MAXIMUM SPACING BETWEEN THE ANODE LEAD AND THE GRID AND CATHODE PINS TO PREVENT ARC-OVER AT REDUCED AIR PRESSURES. THE 7191 WILL OPERATE FOR SHORT PERIODS AT 80,000 FEET WITHOUT FORCED AIR COOLING. THE NOMINAL ALTITUDE RATING FOR THE 7190 AND 7192 IS 10,000 FEET. HOWEVER, IF PROVISION IS MADE TO PREVENT ARC-OVER BETWEEN PINS, THESE TYPES ALSO WILL OPERATE AT 80,000 FEET. ONE METHOD OF PREVENTING ARC-OVER BETWEEN PINS IS TO POT THE BASE END OF THE TUBE. IF THE ENTIRE ENVELOPE IS TO BE POTTED, HOWEVER, PRECAUTION MUST BE TAKEN TO KEEP BULB TEMPERATURE BELOW 225°C.

TYPE 7192 IS SUPPLIED WITH LONG, FLEXIBLE STRANDED LEAD CONNECTORS THAT MAY BE CRIMPED OR SOLDERED DIRECTLY IN THE CIRCUIT. THE TUBE ITSELF CAN BE SECURED BY ANY SUITABLE MECHANICAL MEANS. ONE SUCH METHOD IS TO HOLD IT IN POSITION WITH A HEAT DISSIPATING CLAMP SUCH AS THE BIRTCHER 6A3.

CATHODE TEMPERATURE IS DETERMINED BY RMS CATHODE CURRENT AS WELL AS BY HEATER POWER. THE BOGEY HEATER VOLTAGE OF 6.3 VOLTS HEREFORE IS APPLICABLE ONLY NEAR FULL OPERATING CONDITIONS. AT LIGHT LOADING IT IS RECOMMENDED TO OPERATE THE HEATER VOLTAGE HIGHER. RECOMMENDED FIGURES FOR VARIOUS OPERATING CONDITIONS ARE SHOWN ON THE CURVES.

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

TYPICAL OPERATION

PRR (pps)	ANODE CURRENT PEAK (Amps)	RMS Amps AC	AVG. mAd.c.	Peak Anode Voltage VOLTS	PULSE WIDTH μ sec	GRID DRIVE μ sec	VOLTS
5000	20.0	1.0	50.	1000	0.5	1.0	250
10000	6.6	0.5	37.	316	0.56	2.0	250
33000*	3.5	0.46	60.	350	0.5	BLOCKING OSCILLATOR	200

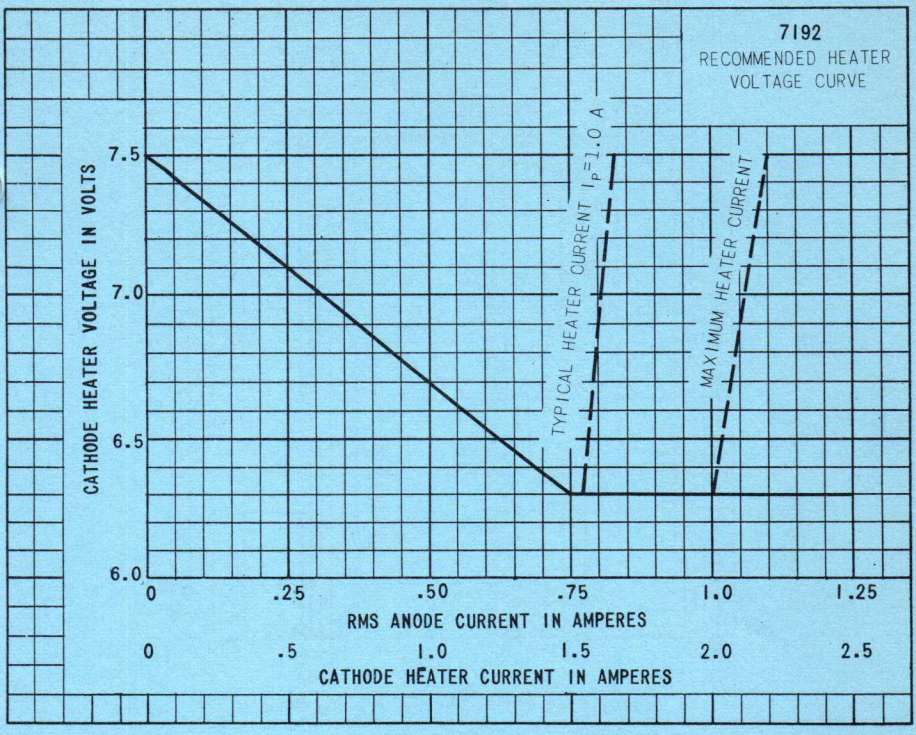
* LIMITED TEST INFORMATION.

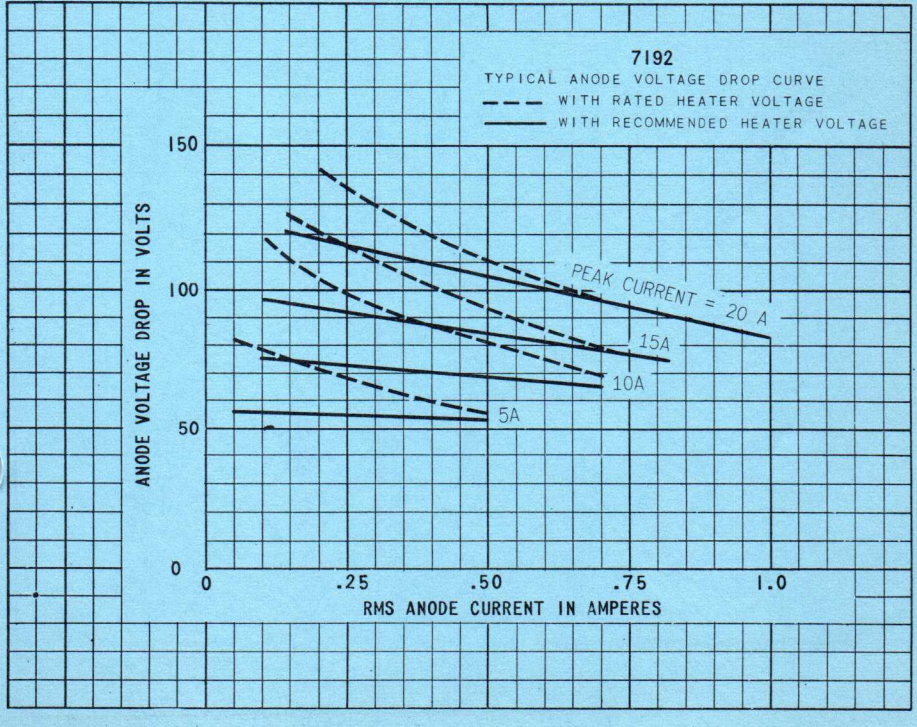
RECOMMENDED GRID PULSE VALUES

	MIN.	MAX.	
PEAK VOLTAGE	200	500	VOLTS
DRIVER CIRCUIT IMPEDANCE	200	1000	OHMS
VOLTAGE RATE OF RISE μ SEC.	350		VOLTS

THESE VALUES ARE AS MEASURED AT THE TUBE SOCKET WITH THE THYRATRON REMOVED. THE GRID PULSE WIDTH SHOULD NOT BE LONGER THAN THE ANODE PULSE EXCEPT IN CASES WHERE THE DRIVER CIRCUIT IMPEDANCE IS HIGH. THE MINIMUM PEAK TRIGGER VOLTAGE RECOMMENDED WILL INCREASE WITH DECREASING TRIGGER PULSE WIDTH. HOWEVER, THIS EFFECT IS IMPORTANT ONLY AT PULSE WIDTHS LESS THAN 0.5 MICROSECONDS.

SIMILAR TYPE REFERENCE: Type 7192 is similar in all respects to type 7190 except that long flexible leads are provided to permit the connection of the tube directly into a circuit without the use of a tube socket. This is discussed in the application notes.





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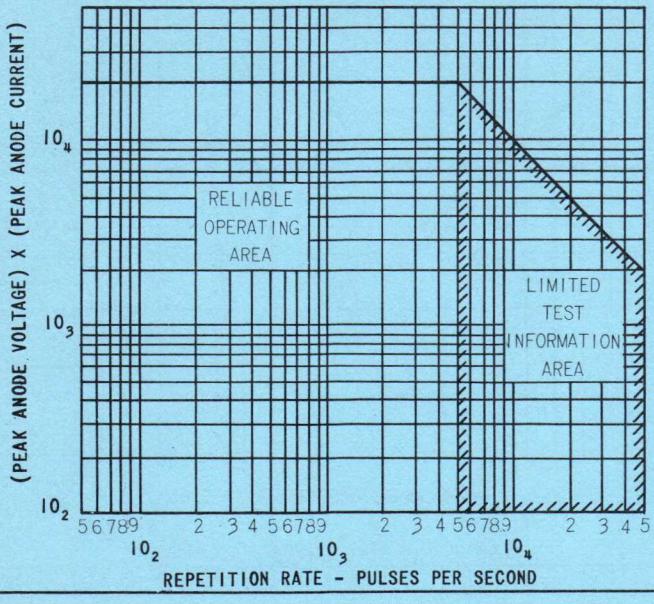
7192
GRAPHICAL REPRESENTATION OF HEAT FACTOR



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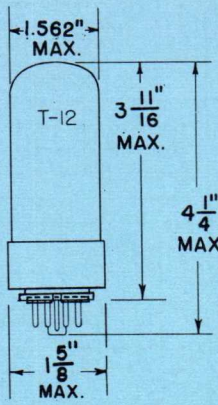
TWIN TRIODE



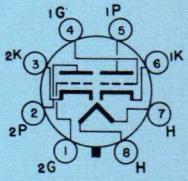
GLASS BULB
SMALL WAFER
8 PIN OCTAL B8-197

COATED UNIPOTENTIAL CATHODE

HEATER NOMINAL

6.3±.3 VOLTS 2.4 AMP.
AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 8BD

THE 7236 IS A LOW MU DOUBLE TRIODE INTENDED FOR LONG LIFE SERVICE AS A POWER AMPLIFIER IN COMPUTER SERVICE. IT HAS THE ABILITY TO PASS LARGE CURRENTS WITH A LOW VOLTAGE DROP.

DIRECT INTERELECTRODE CAPACITANCES
EACH UNIT

INPUT	9.0	μμf
OUTPUT	3.3	μμf
GRID TO PLATE	10.0	μμf
HEATER TO CATHODE	11.0	μμf
PLATE TO PLATE	0.5	μμf

RATINGS
ABSOLUTE MAXIMUM VALUES.

OPTIMUM SERVICE LIFE

HEATER VOLTAGE	6.3±.3	VOLTS
MAXIMUM PLATE VOLTAGE	300	VOLTS
MAXIMUM PLATE CURRENT PER PLATE	190	MA.
MAXIMUM PLATE DISSIPATION PER PLATE	15	WATTS
MAXIMUM GRID RESISTANCE	0.25	MEGOHM
MAXIMUM BULB TEMPERATURE[A]	150	°C
MAXIMUM POSITIVE GRID VOLTAGE	+1	VOLT
MAXIMUM NEGATIVE GRID VOLTAGE	100	VOLTS
MAXIMUM HEATER–CATHODE VOLTAGE	100	VOLTS

[A] FORCED AIR COOLING IS NECESSARY TO OBTAIN THIS BULB TEMPERATURE.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS
EACH TRIODE

HEATER VOLTAGE		6.3±5%		VOLTS
HEATER CURRENT	2.4	2.4	2.4	AMP.
PLATE VOLTAGE	120	60	150	VOLTS
DC GRID VOLTAGE	−14	0	−24	VOLTS
PLATE CURRENT	100	150	60	MA.
AMPLIFICATION FACTOR	4.8	---	---	
TRANSCONDUCTANCE	12 500	---	---	μMHOS
I_b (AT E_{c1} =−65 V.) (MAX.)	----	---	100	μA.

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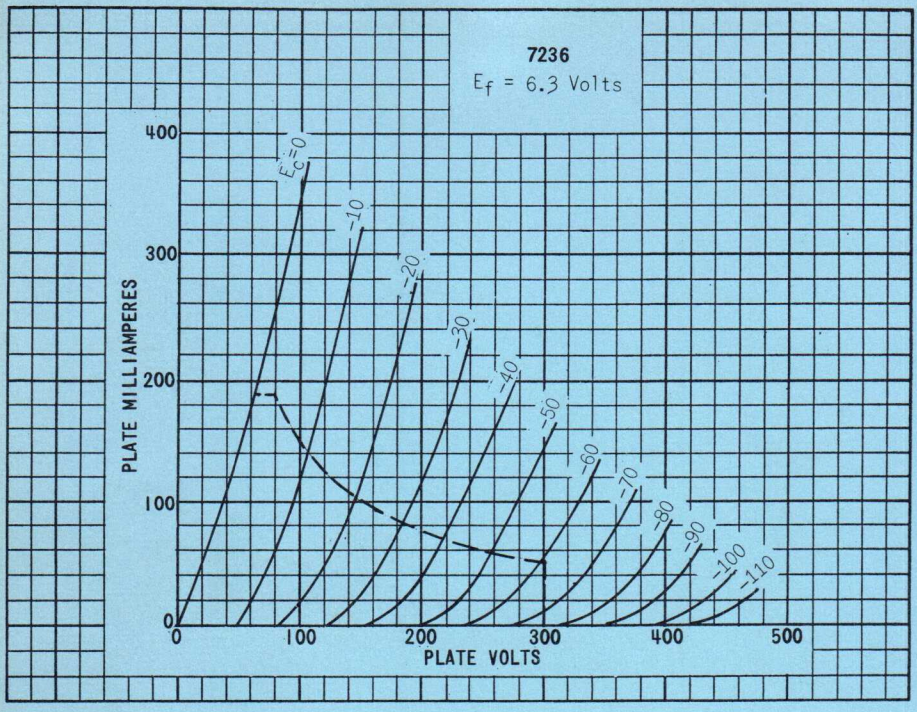
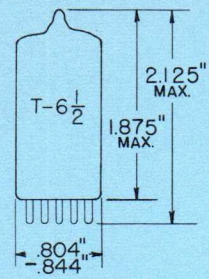

7236
E_f = 6.3 Volts
PLATE MILLIAMPERES
400
300
200
100
0
E_c=0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0
100
200
300
400
500
PLATE VOLTS

TUNG-SOL

THYRATRON

MINIATURE TYPE

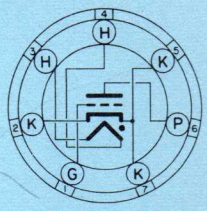


GLASS BULB
HARD

HEATER

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW
SMALL BUTTON MINIATURE
7 PIN BASE
7FJ

THE 7240 IS A ZERO BIAS MINIATURE HYDROGEN THYRATRON DESIGNED PRIMARILY FOR THE GENERATION OF PULSE VOLTAGES UNDER EXTREME CONDITIONS OF MECHANICAL VIBRATION. THIS TUBE CAN SUPPLY PEAK PULSE POWER OF 10 KILOWATTS AND THEREFORE WILL REPLACE PHYSICALLY LARGER TYPES IN MANY RADAR APPLICATIONS. BECAUSE OF ITS CLOSE ELECTRODE SPACING AND SMALL SIZE, MADE POSSIBLE BY HARD GLASS CONSTRUCTION, THE 7240 IS CAPABLE OF RELATIVELY HIGH PULSE REPETITION RATES. IN ADDITION ITS 28 VOLT HEATER MAKES IT PARTICULARLY SUITABLE FOR USE WITH AIRBORNE AND MISSILE POWER SUPPLIES. THE 7240 HAS BEEN DESIGNED INTO SOME EQUIPMENT UNDER THE DEVELOPMENTAL DESIGNATION CH-1046.

ELECTRICAL DATA

	SYMBOL	MIN.	BOGEY	MAX.	
HEATER VOLTAGE (WHEN Ip IS LESS THAN 0.75 Aac, REFER TO RECOMMENDED HEATER VOLTAGE CURVE)	Ef	26.6	28.0	29.4	VOLTS
HEATER CURRENT (WITH BOGIE HEATER VOLTAGE)	If	0.37	0.42	0.46	AMP
CATHODE HEATING TIME	tk	30			SECONDS
ANODE VOLTAGE DROP (AT RECOMMENDED Ef)	etd	45		125	VOLTS

MECHANICAL DATA

TYPE OF COOLING (HEAT DISSIPATING SHIELDS MAY BE USED. FORCED AIR COOLING IS NOT RECOMMENDED.)	CONVECTION
ALTITUDE	SEE APPLICATION NOTES
MOUNTING POSITION	ANY
MAXIMUM NET WEIGHT	0.5 OUNCES
DIMENSIONS	SEE OUTLINE DRAWINGS
MAXIMUM VIBRATION CONDITIONS	50-2000 CPS @ 15 G
MAXIMUM SHOCK CONDITIONS (48° HAMMER BLOW IN NAVY FLY WEIGHT, HIGH IMPACT SHOCK MACHINE)	720 G/1MSEC.
MICROSCOPIC INSPECTION PER MIL-E-1775IB (N ORD)	SEE APPLICATION NOTES

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RATINGS
ABSOLUTE VALUES

	SYMBOL	MIN.	MAX.	
PEAK ANODE VOLTAGE				
INVERSE (NOTE 1)	epx	---	1200	VOLTS
FORWARD	epy	300	1200	VOLTS
CATHODE CURRENT				
PEAK	ib		20.0	AMP.
AVERAGE	Ib		50	MA.
RMS (FOR SQUARE PULSE APPLICATIONS $I_p = \sqrt{I_b \times ib}$)	I_p		1.0	AMP.
DC ANODE VOLTAGE	E_{bb}	300		VOLTS
HEATER-CATHODE VOLTAGE	Ehk	-100	+25	VOLTS
OPERATING FREQUENCY (THIS IS NOT NECESSARILY THE UPPER OPERATING FREQUENCY LIMIT BUT REPRESENTS THE HIGHEST REPETITION RATE EXTENSIVELY LIFE TESTED TO DATE.)	prr		5000	CPS
PEAK GRID VOLTAGE (SEE RECOMMENDED GRID PULSE CONDITIONS.)	egy	175	500	VOLTS
PEAK INVERSE GRID VOLTAGE	egx		150	VOLTS
HEATING FACTOR (epy X ib X prr.)	Pb		1×10^8	
CURRENT RATE OF RISE (NOTE 2)			400	AMP/μSEC.
ANODE DELAY TIME (NOTE 3)	tad		0.6	μSEC.
TIME JITTER (NOTE 4)	tj		.005	μSEC.
AMBIENT TEMPERATURE	TA	-60	+125	°C

NOTES

[1] IN PULSED OPERATION, THE PEAK INVERSE VOLTAGE, EXCLUSIVE OF A SPIKE OF 0.05 μSEC. MAXIMUM DURATION, SHALL NOT EXCERD 500 VOLTS DURING THE FIRST 25 μSEC, FOLLOWING THE ANODE PULSE.

[2] MEASUREMENT MADE BETWEEN 26% AND 70.7% POINTS.

[3] ANODE DELAY TIME IS DEFINED AS THE TIME INTERVAL BETWEEN THE POINT ON THE RISING PORTION OF THE GRID VOLTAGE PULSE WHICH IS 26 PERCENT OF THE MAXIMUM UNLOADED PULSE AMPLITUDE AND THE POINT WHERE ANODE CONDUCTION TAKES PLACE.

[4] TIME JITTER IS MEASURED AT 50 PERCENT OF THE PULSE AMPLITUDE AFTER THE TUBE HAS BEEN OPERATING FOR AT LEAST 60 SECONDS. THE LIMIT OF 0.01 μSEC. SHOWN IS THE MAXIMUM ALLOWABLE UNDER SPECIFIED UNFAVORABLE OPERATING CONDITIONS. WITH SUFFICIENT GRID DRIVE AND WITH ANODE VOLTAGES OF 600 VOLTS AND ABOVE, JITTER NOT EXCEEDING 0.005 μSEC. CAN BE EASILY ACHIEVED.

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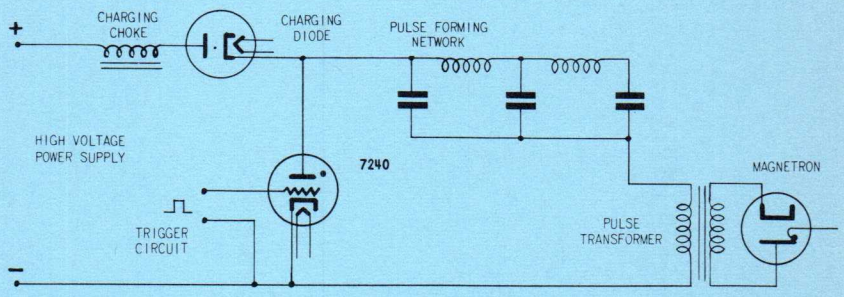
APPLICATION NOTES

THIS MINIATURE HYDROGEN THYRATRON IS DESIGNED PRIMARILY FOR USE IN LINE TYPE RADAR MODULATORS. A BASIC CIRCUIT FOR SUCH SERVICE IS ILLUSTRATED BELOW. IN SUCH A CIRCUIT, THE HYDROGEN THYRATRON SERVES AS A SWITCH TO RELEASE INTO THE MAGNETRON OR OTHER RADIO FREQUENCY GENERATOR, THE ENERGY STORED IN THE PULSE FORMING NETWORK. THIS TUBE IS ADMIRABLY SUITED FOR SUCH SERVICE BY ITS ABILITY TO HOLD OFF RELATIVELY HIGH VOLTAGE, AND TO PASS HIGH PEAK CURRENT WITH RELATIVELY LOW TUBE VOLTAGE DROP. THE TUBE WILL OPERATE OVER A WIDE RANGE OF PULSE REPETITION RATES, PULSE WIDTHS AND PEAK CURRENTS, THUS PROVIDING A VERY FLEXIBLE CIRCUIT ELEMENT. TRIGGERING REQUIREMENTS ARE SIMPLIFIED SINCE THE TUBE OPERATES WITH ZERO BIAS.



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THE 7240 FITS A STANDARD 7 PIN MINIATURE SOCKET. THE TUBE PINS, HOWEVER, ARE STIFF, AND CARE SHOULD BE TAKEN TO HAVE THE SOCKET CLIPS IN PERFECT ALIGNMENT BEFORE ATTEMPTING TO INSERT A TUBE. AS THE TUBE OPERATES AT HIGH TEMPERATURES, A CERAMIC TYPE SOCKET SHOULD BE EMPLOYED. CONNECTIONS TO THE SOCKET SHOULD BE MADE WITH FLEXIBLE LEADS TO PROVIDE FLOATING ACTION FOR THE SOCKET CLIPS. PIN STRAIGHTENERS SHOULD NEVER BE USED ON THIS TUBE TYPE, AS ANY ATTEMPT TO BEND THE PINS WILL RESULT IN CRACKED BUTTON BASES.

THE NOMINAL ALTITUDE RATING FOR THE 7240 IS 10,000 FEET. HOWEVER, IF PROVISION IS MADE TO PREVENT ARC-OVER BETWEEN PINS, THIS TYPE WILL OPERATE AT 80,000 FEET. ONE METHOD OF PREVENTING ARC-OVER BETWEEN PINS IS TO POT THE BASE END OF THE TUBE. IF THE ENTIRE ENVELOPE IS TO BE POTTED, HOWEVER, PRECAUTION MUST BE TAKEN TO KEEP BULB TEMPERATURE BELOW 225°C.

CATHODE TEMPERATURE IS DETERMINED BY RMS CATHODE CURRENT AS WELL AS BY HEATER POWER. THE BOGEY HEATER VOLTAGE OF 28.0 VOLTS THEREFORE IS APPLICABLE ONLY NEAR FULL OPERATING CONDITIONS. AT LIGHT LOADING IT IS RECOMMENDED TO OPERATE THE HEATER VOLTAGE HIGHER. RECOMMENDED FIGURES FOR VARIOUS OPERATING CONDITIONS ARE SHOWN ON THE CURVES.

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TYPICAL OPERATION

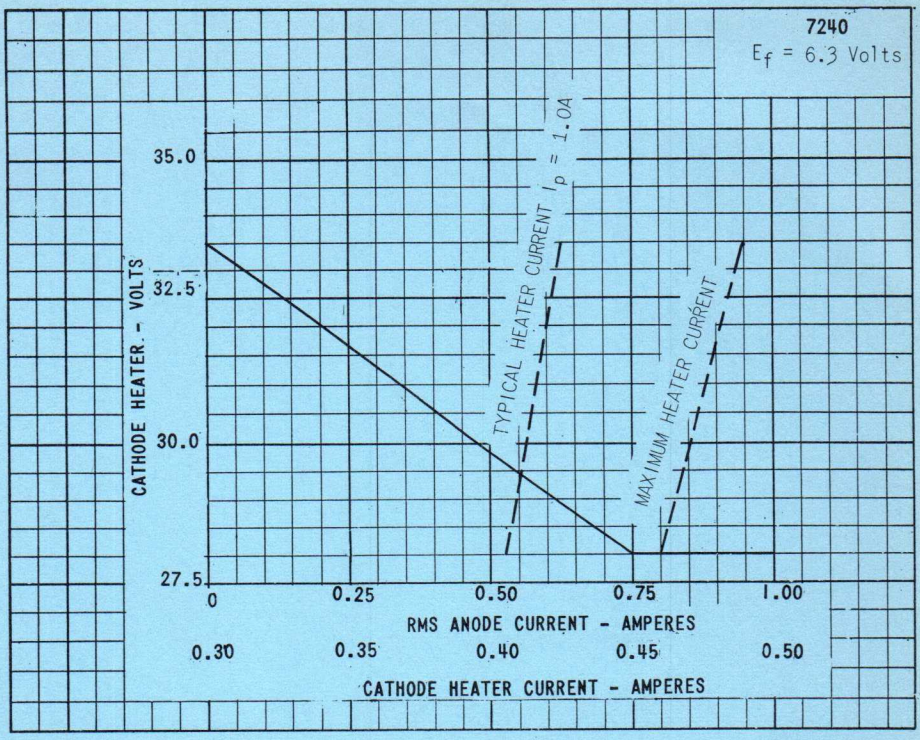
PRR	ANODE CURRENT			PEAK ANODE VOLTAGE	PULSE WIDTH	GRID DRIVE	
	PEAK	RMS	AVG.				
(pps)	(Amps)	Amps AC	mAd.c.	VOLTS	μ sec	μ sec	VOLTS
5000	20.0	1.0	50.	1000	0.5	1.0	250
10000	6.6	0.5	37.	316	0.56	2.0	250
33000*	3.5	0.46	60.	350	0.5	BLOCKING OSCILLATOR	200

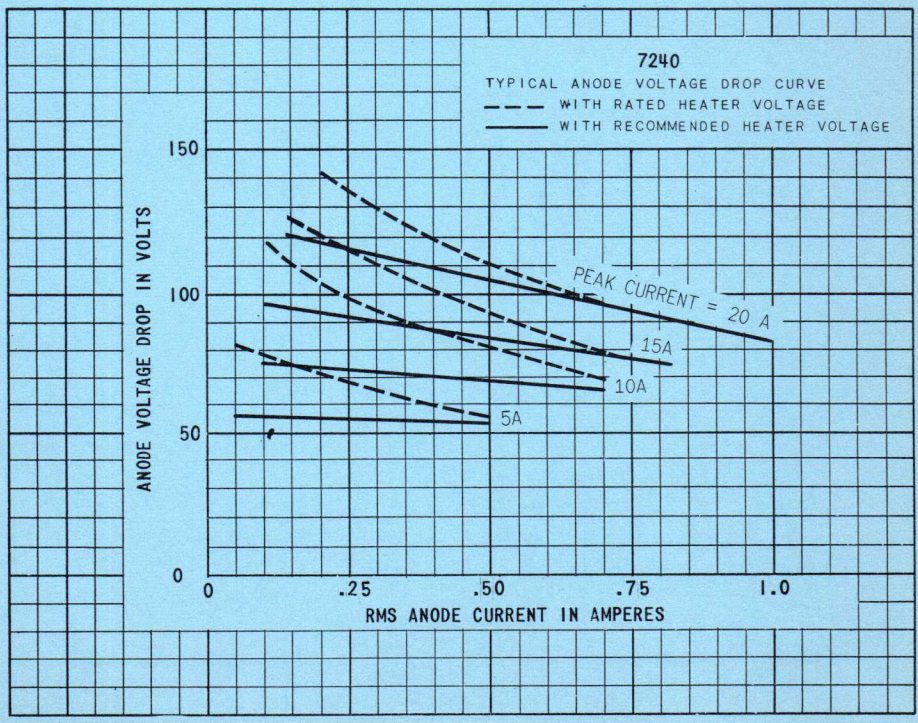
*LIMITED TEST INFORMATION.

RECOMMENDED GRID PULSE VALUES

	MIN.	MAX.	
PEAK VOLTAGE	200	500	VOLTS
DRIVER CIRCUIT IMPEDANCE	200	1000	OHMS
VOLTAGE RATE OF RISE PER μSEC.	350		VOLTS

THESE VALUES ARE AS MEASURED AT THE TUBE SOCKET WITH THE THYRATRON REMOVED. THE GRID PULSE WIDTH SHOULD NOT BE LONGER THAN THE ANODE PULSE EXCEPT IN CASES WHERE THE DRIVER CIRCUIT IMPEDANCE IS HIGH. THE MINIMUM PEAK TRIGGER VOLTAGE RECOMMENDED WILL INCREASE WITH DECREASING TRIGGER PULSE WIDTH. HOWEVER, THIS EFFECT IS IMPORTANT ONLY AT PULSE WIDTHS LESS THAN 0.5 MICROSECONDS.





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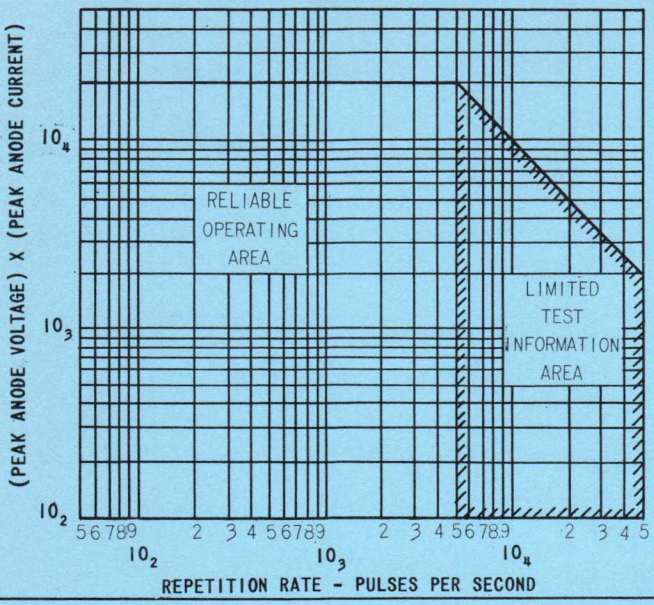
7240

GRAPHICAL REPRESENTATION OF HEAT FACTOR



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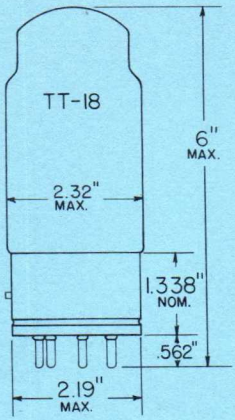
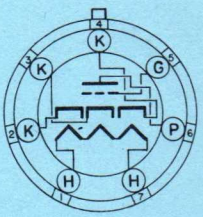
TRIODE



GLASS BULB

HEATER
6.3±10% VOLTS 7.5 AMP.
AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

GIANT WITH
CERAMIC INSERT
7 PIN BASE

THE 7241 IS A LONG LIFE, HIGH POWER TRIODE DEVELOPED ESPECIALLY FOR USE AS A PASSING TUBE IN THE SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINSIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 7241 ADEQUATELY MEETS THESE REQUIREMENTS. ONE TYPE 7241 CAN PASS MORE THAN ONE AMPERE AT 100 WATTS PLATE DISSIPATION.

THE 7241 FEATURES ONE LARGE ZIRCONIUM COATED GRAPHITE ANODE, WITH THREE SEPARATE GRID-CATHODES STRUCTURES. THIS ANODE, WHILE LIGHTER IN WEIGHT THAN SIMILAR METAL ANODES, REMAINS WARP FREE DURING LIFE AND PROVIDES ONE OF THE BEST GAS "GETTERING" MEANS KNOWN. THE ANODE IS SUPPORTED BY CERAMIC INSULATORS. THE USE OF THESE INSULATORS AND THE HARD GLASS ENVELOPE PERMIT THE TUBE TO BE OUTGASSED AT HIGH TEMPERATURES DURING THE MANUFACTURING EXHAUST PROCESS. THIS ALLOWS THE TUBE TO BE RUN AT HIGH TEMPERATURES DURING OPERATION, WITHOUT THE EVOLUTION OF HARMFUL GAS FROM THE TUBE PARTS.

MASSIVE CATHODES PROVIDE ADEQUATE EMISSION CURRENT RESERVE. GOLD PLATED MOLYBDENUM WIRES ARE EMPLOYED IN THE RUGGED GRID STRUCTURE. THE TUBE MOUNT IS BUILT ON A RUGGED BUTTON STEM, AND IS SUPPORTED FROM THE BULB BY MEANS OF FLEXIBLE METAL VIBRATION SNUBBERS.

IN MANY CIRCUITS, ONE 7241 CAN REPLACE FOUR TYPE 6080WA OR 6AS7G REGULATOR TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OR POWER, SEVERAL 7241 TUBES CAN BE PARALLELED AS EXPLAINED IN THE APPLICATION NOTES.

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ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (E_f= 6.3 V.)	7.5	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE	40 000	μMHOS
AMPLIFICATION FACTOR	2.7	
PLATE RESISTANCE	67	OHMS

MECHANICAL DATA

MOUNTING POSITION	ANY	
(IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)		
BULB	TT 18	NONEX
BASE	GIANT 7 PIN WITH CERAMIC INSERT, JETEC #A7-17	
SOCKET	E.F. JOHNSON #122-237 OR EQUIVALENT	
AVERAGE NET WEIGHT	6.0	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	450	G
MAXIMUM VIBRATION RATING (10 TO 25 CPS)	2.5	G

RATINGS
ABSOLUTE VALUES

TOTAL PLATE DISSIPATION	---	100	WATTS
TOTAL PLATE CURRENT DC	---	1.2	AMP.
IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE			
CURRENT PER CATHODE (DC)	---	400	MA.
PLATE VOLTAGE (DC)	0	400	VOLTS
HEATER-CATHODE VOLTAGE (DC)	-300	+300	VOLTS
GRID VOLTAGE (DC)	-300	0	VOLTS
GRID CURRENT PER GRID	---	0	MA.
HEATER VOLTAGE	5.7	6.9	VOLTS
ENVELOPE TEMPERATURE	---	300	°C
ALTITUDE FOR FULL RATINGS	---	10,000	FEET
IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FT.			
CIRCUIT VALUES			
TOTAL GRID CIRCUIT RESISTANCE IN REGULATED SERVICE OR WITH FIXED BIAS	500	50,000	OHMS
TOTAL GRID CIRCUIT RESISTANCE WITH CATHODE BIAS ONLY	500	200,000	OHMS
RESISTANCE PER GRID LEG WHEN TUBES ARE PARALLELED	500	---	OHMS

CATHODE RESISTANCE: MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 27 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.

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TUNG-SOL

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ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450G/MSEC)

LIFE TEST: 1000 HOURS UNDER PLATE CURRENT TEST CONDITIONS

POST SHOCK AND LIFE TEST END POINTS:

PLATE CURRENT (MIN.)	450	MA
TRANSCONDUCTANCE (MIN.)	27 000	μMHO
HK LEAKAGE (MAX.)	150	μA
GRID CURRENT (MAX.)	-12	μA

RANGE OF VALUES

CONDITIONS: E_f = 6.3V, E_b = 190V.
E_c = 0, $R_{k/k}$ = 200 Ω, R_g = 500Ω
READINGS TAKEN AFTER 5 MINUTES POWER PRE-HEATING.

TOTAL PLATE CURRENT	495	600	MA,DC
AMPLIFICATION FACTOR	2.0	3.4	
TRANSCONDUCTANCE	33 000	48 000	μMHOS
HEATER CURRENT PER TUBE	7.12	7.88	AMP.

CONDITIONS: E_f = 6.3V, E_b = 200V.
E_c = -100V, R_k = 0

CURRENT PER CATHODE	0	10	MA.

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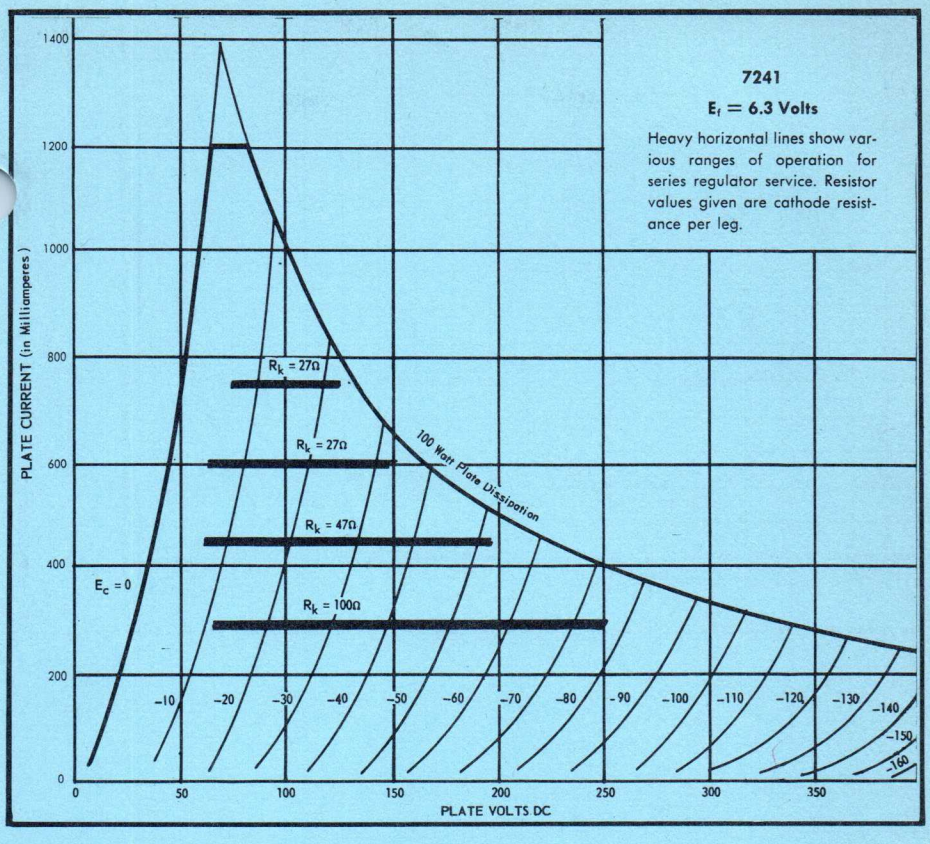
APPLICATION NOTES

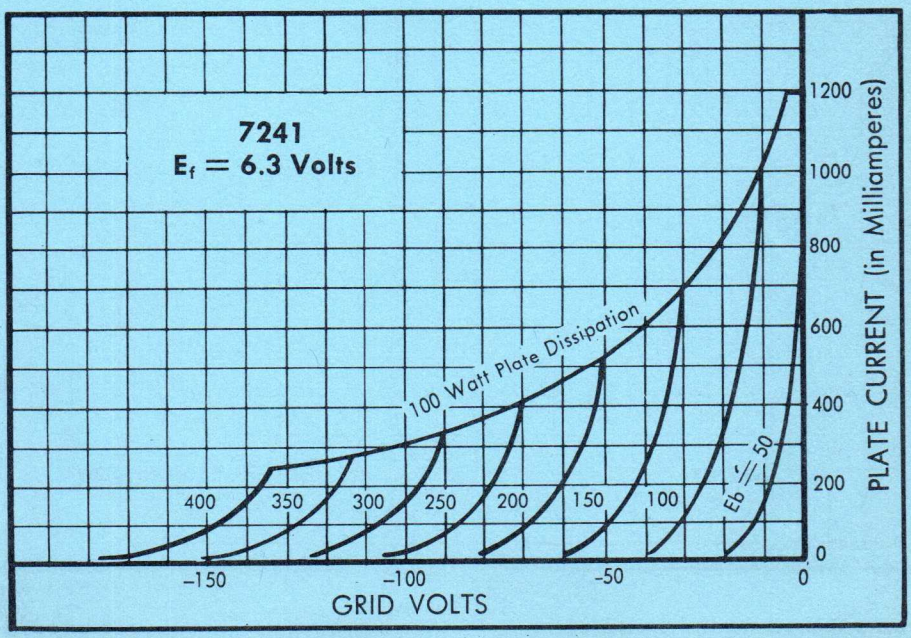
THE 7241 IS WIDELY USED AS A "PASSING" TUBE OR SERIES REGULATOR IN CONTROLLED POWER SUPPLIES BECAUSE OF ITS HIGH TRANSCONDUCTANCE AT RELATIVELY LOW PLATE VOLTAGES. TO PROVIDE THE DESIRED OUTPUT CURRENT, MANY TRIODE SECTIONS CAN BE PARALLELED. IF TUBE SECTIONS ARE TO BE PARALLELED, HOWEVER, THE DESIGNER IS STRONGLY URGED TO USE SUFFICIENT RESISTANCE IN EACH CATHODE LEG TO EQUALIZE CURRENT DIVISION AMONG THE TRIODE SECTIONS. RECOMMENDED VALUES FOR VARIOUS OPERATING CURRENTS ARE SHOWN ON THE PLATE CHARACTERISTICS CURVE. IF THE OUTPUT CURRENT OF THE SUPPLY IS NOT FIXED, USE THE RESISTANCE INDICATED FOR THE LOWEST CURRENT THAT APPROACHES THE MAXIMUM PLATE DISSIPATION LINE. CATHODE RESISTANCE IS SUPERIOR TO ANODE RESISTANCE BECAUSE IT PROVIDES MORE BIAS ON THE SECTIONS TAKING GREATER PLATE CURRENT. A CATHODE RESISTOR NEED BE ONLY ONE FOURTH THE VALUE $(\frac{R}{u+1})$ OF A PLATE RESISTOR, AND THEREFORE WILL DISSIPATE ONLY ONE FOURTH THE POWER. IN ANY CASE, THE ONLY LOSSES INCURRED IN USING A RESISTOR IS THE INSERTION LOSS OF THE RESISTOR ITSELF (ABOUT TWO WATTS) AND THE ADDITIONAL VOLTAGE (LESS THAN 10 VOLTS) NECESSARY FROM THE UNREGULATED SUPPLY. A CATHODE RESISTOR ADDS A SMALL ADDITIONAL LOSS BY CAUSING THE PASSING TUBE TO WORK WITH HIGHER BIAS AND HENCE WITH GREATER TUBE DROP.

A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASSING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATOR OUTPUT IS LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A TUBE DROP AS POSSIBLE. A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES. SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE DUE TO TUBE AGING.

A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 6.3 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.





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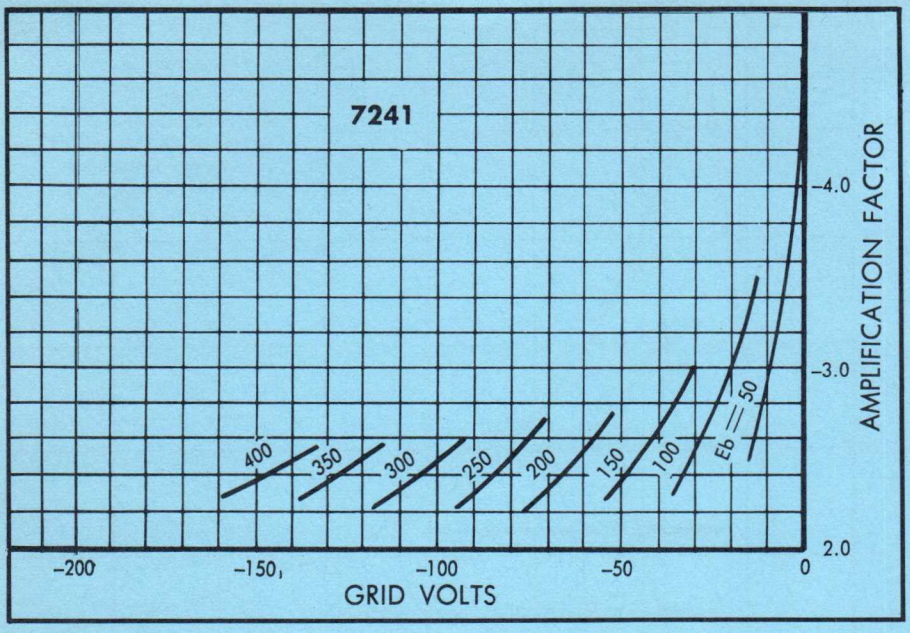
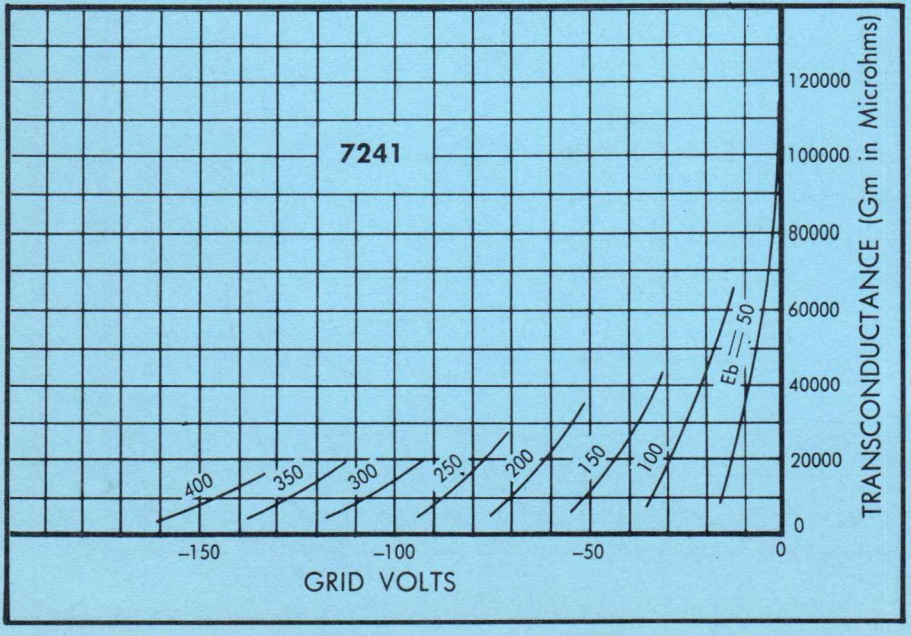
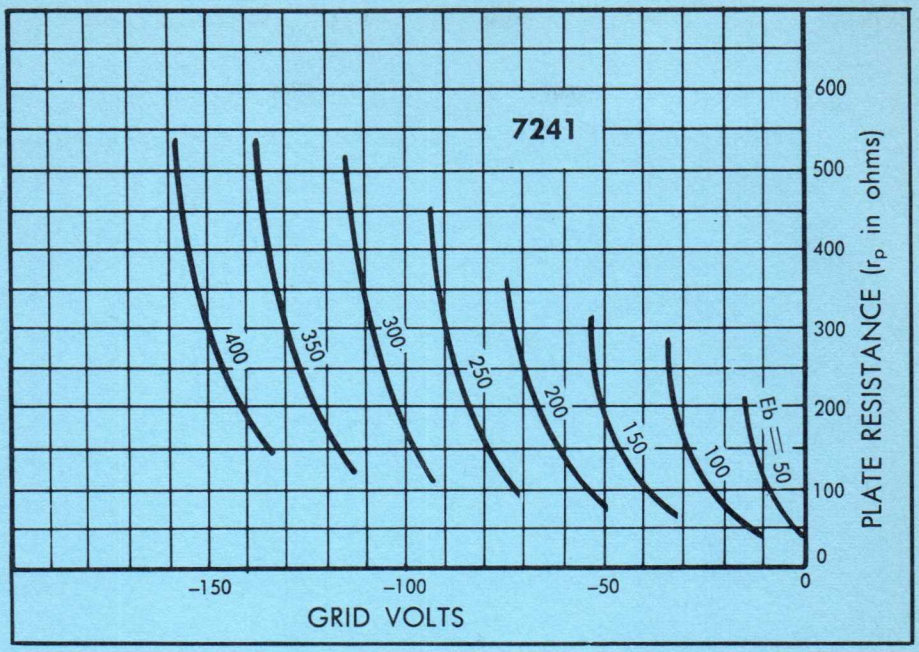

7241
AMPLIFICATION FACTOR
-4.0
-3.0
2.0
400
350
300
250
200
150
100
Eb = 50
-200
-150
-100
-50
0
GRID VOLTS


7241
TRANSCONDUCTANCE (Gm in Microhms)
120000
100000
80000
60000
40000
20000
0
400
350
300
250
200
150
100
Eb = 50
-150
-100
-50
0
GRID VOLTS



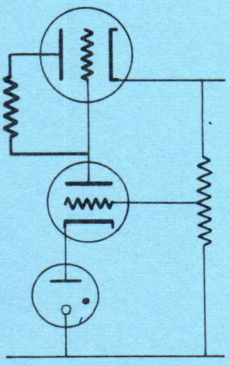


FIGURE 1

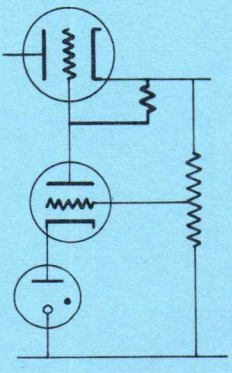


FIGURE 2

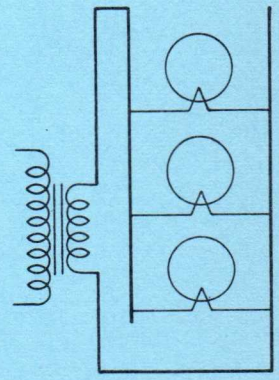


FIGURE 3

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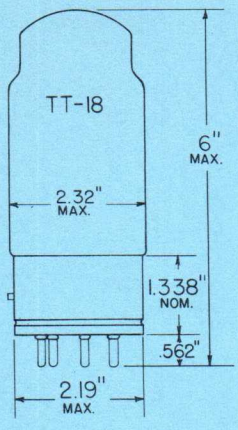
TUNG-SOL

TRIODE



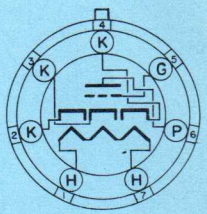
GLASS BULB

HEATER

6.3±10% VOLTS 7.5 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

GIANT WITH CERAMIC INSERT 7 PIN BASE

THE 7242 IS A LONG LIFE, HIGH POWER TRIODE DEVELOPED ESPECIALLY FOR USE AS A PASSING TUBE IN SERIES REGULATED POWER SUPPLIES. FOR THIS SERVICE, A TUBE MUST BE ABLE TO PASS LARGE CURRENTS OVER A WIDE VOLTAGE RANGE AND STILL EXHIBIT A LOW INTRINSIC VOLTAGE DROP WHEN OPERATED "WIDE OPEN". THE 7242 NOT ONLY MEETS THESE REQUIREMENTS BUT POSSESSES THE ADDITIONAL ADVANTAGE OF REQUIRING LITTLE GRID VOLTAGE SWING TO CONTROL THESE CURRENTS. THIS PERMITS THE USE OF SIMPLER CONTROL AMPLIFIER CIRCUITS IN THE REGULATED SUPPLY.

THE 7242 FEATURES ONE LARGE ZIRCONIUM COATED GRAPHITE ANODE, WITH THREE SEPARATE GRID-CATHODES STRUCTURES. THIS ANODE, WHILE LIGHTER IN WEIGHT THAN SIMILAR METAL ANODES, REMAINS WARP FREE DURING LIFE AND PROVIDES ONE OF THE BEST GAS "GETTERING" MEANS KNOWN. THE ANODE IS SUPPORTED BY CERAMIC INSULATORS. THE USE OF THESE INSULATORS AND THE HARD GLASS ENVELOPE PERMIT THE TUBE TO BE OUTGASSED AT HIGH TEMPERATURES DURING THE MANUFACTURING EXHAUST PROCESS. THIS ALLOWS THE TUBE TO BE RUN AT HIGH TEMPERATURES DURING OPERATION, WITHOUT THE EVOLUTION OF HARMFUL GAS FROM THE TUBE PARTS.

MASSIVE CATHODES PROVIDE ADEQUATE EMISSION CURRENT RESERVE. GOLD PLATED MOLYBDENUM WIRES ARE EMPLOYED IN THE RUGGED GRID STRUCTURE. THE TUBE MOUNT IS BUILT ON A RUGGED BUTTON STEM, AND IS SUPPORTED FROM THE BULB BY MEANS OF FLEXIBLE METAL VIBRATION SNUBBERS.

IN MANY CIRCUITS, ONE 7242 CAN REPLACE FOUR TYPE 5998 REGULATOR TUBES. FOR EVEN HIGHER LEVELS OF CURRENT OR POWER, SEVERAL 7242 TUBES CAN BE PARALLELED AS EXPLAINED IN THE APPLICATION NOTES.

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ELECTRICAL DATA

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT (E_f = 6.3 V.)	7.5	AMP.
MINIMUM CATHODE HEATING TIME	30	SECONDS
TRANSCONDUCTANCE	111,000	μMHOS
AMPLIFICATION FACTOR	9.0	
PLATE RESISTANCE	82	OHMS

MECHANICAL DATA

MOUNTING POSITION	ANY	
(IF TUBE IS TO BE MOUNTED IN A HORIZONTAL POSITION IT IS RECOMMENDED THAT IT BE MOUNTED SO THAT THE BASE LUG KEY BE EITHER DIRECTLY UP OR DIRECTLY DOWN)		
BULB	TT 18	NONEX
BASE	GIANT 7 PIN WITH CERAMIC INSERT, JETEC #A7-17	
SOCKET	E.F. JOHNSON #122-237 OR EQUIVALENT	
AVERAGE NET WEIGHT	6.0	OUNCES
MAXIMUM SHOCK RATING (NAVY HI IMPACT SHOCK MACHINE)	450	G
MAXIMUM VIBRATION RATING (10 TO 25 CPS)	2.5	G

RATINGS
ABSOLUTE VALUES

TOTAL PLATE DISSIPATION	---	100	WATTS
TOTAL PLATE CURRENT DC	---	0.9	AMP.
IF TUBE VOLTAGE DROP IS TO BE SWUNG MORE THAN 6 VOLTS, THIS CURRENT CANNOT BE REALIZED. SEE PLATE CHARACTERISTICS CURVE			
CURRENT PER CATHODE (DC)	---	300	MA.
PLATE VOLTAGE (DC)	0	400	VOLTS
HEATER-CATHODE VOLTAGE (DC)	-300	+300	VOLTS
GRID VOLTAGE (DC)	-300	0	VOLTS
GRID CURRENT PER GRID	---	0	MA.
HEATER VOLTAGE	5.7	6.9	VOLTS
ENVELOPE TEMPERATURE	---	300	°C
ALTITUDE FOR FULL RATINGS	---	10,000	FEET
IF COOLING IS PROVIDED TO KEEP BULB TEMPERATURE WITHIN RATINGS, ALTITUDE RATING CAN BE EXTENDED TO 60,000 FT.			
CIRCUIT VALUES			
TOTAL GRID CIRCUIT RESISTANCE IN REGULATED SERVICE OR WITH FIXED BIAS	500	50,000	OHMS
TOTAL GRID CIRCUIT RESISTANCE WITH CATHODE BIAS ONLY	500	200,000	OHMS
RESISTANCE PER GRID LEG WHEN TUBES ARE PARALLELED	500	---	OHMS

CATHODE RESISTANCE: MINIMUM CATHODE RESISTANCE PER CATHODE LEG SHALL BE 27 OHMS OR THAT RESISTANCE NECESSARY TO PROVIDE 10% OF THE GRID BIAS VOLTAGE, WHICHEVER IS GREATER.

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TUNG-SOL

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ADDITIONAL TESTS TO INSURE RELIABILITY

RANDOMLY SELECTED SAMPLES ARE SUBJECTED TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450G/MSEC)

LIFE TEST: 1000 HOURS UNDER PLATE CURRENT TEST CONDITIONS (R_g = .05 MEG.)

POST SHOCK AND LIFE TEST END POINTS:

PLATE CURRENT (MIN.)	390	MA
TRANSCONDUCTANCE (MIN.)	70,000	μMHO
HK LEAKAGE (MAX.)	150	μA
GRID CURRENT (MAX.)	-12	μA

RANGE OF VALUES

CONDITIONS: E_c = 6.3V, E_b = 100V.
E_c = -4, R_g = 500 Ω
READINGS TAKEN AFTER 2 MINUTES PREHEATING UNDER CONDITIONS OF E_f = 6.3, E_{bb} = 190 V, E_c = 0, R_k = 6.3 OHMS.

TOTAL PLATE CURRENT	420	690	MA,DC
AMPLIFICATION FACTOR	7.0	11.0	
TRANSCONDUCTANCE	87,000	135,000	μMHOS
HEATER CURRENT PER TUBE	7.12	7.88	AMP.

CONDITIONS: E_f = 6.3V, E_b = 400 V.
E_c = -75 V, R_k = 0

CURRENT PER CATHODE	0	10	MA.

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APPLICATION NOTES

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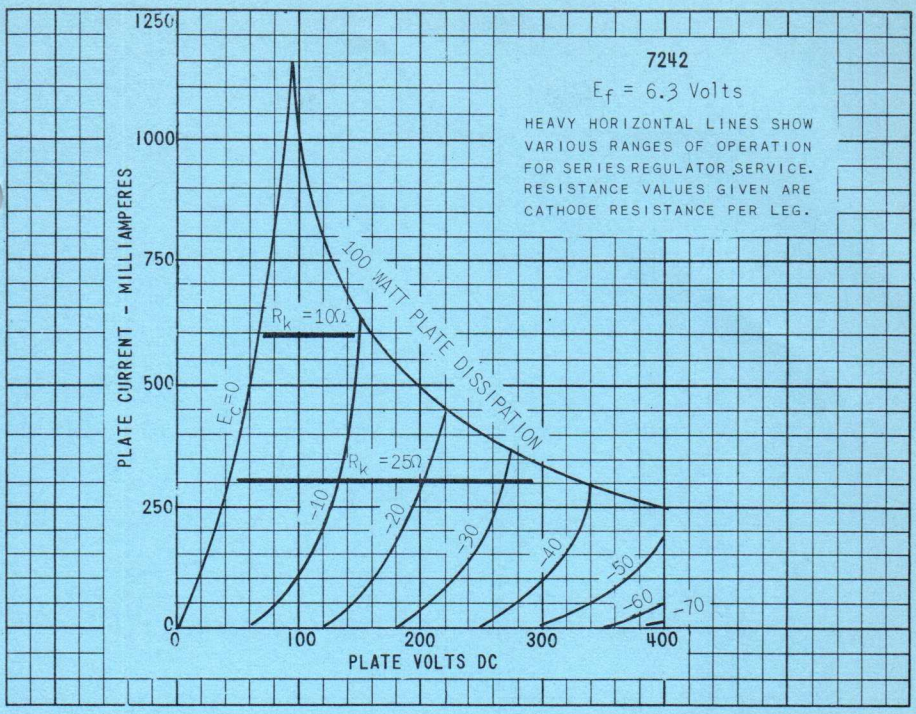
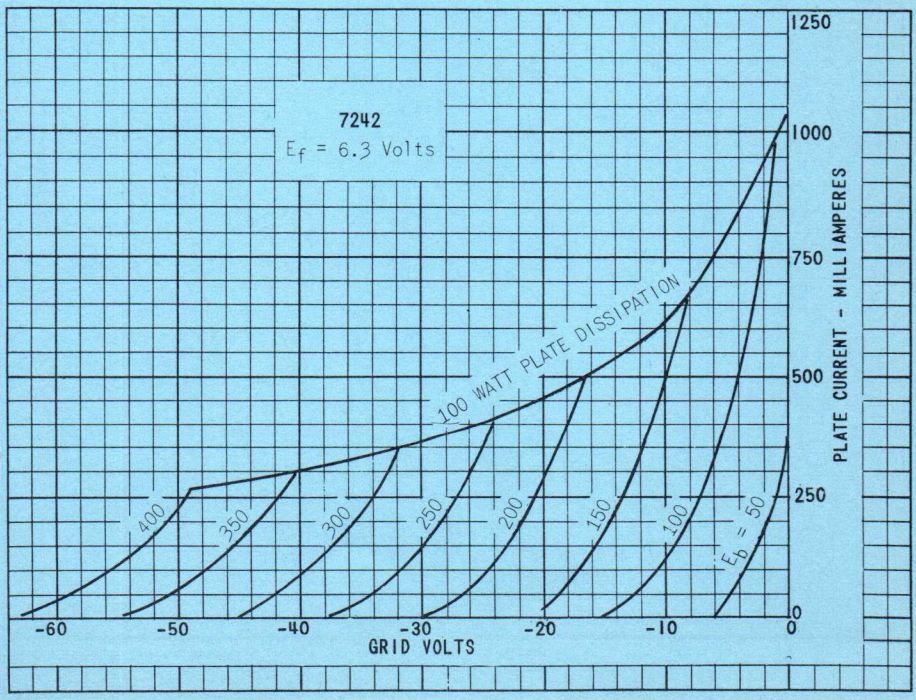
A THIRTY SECOND CATHODE WARMUP TIME IS RECOMMENDED BEFORE THE PLATE VOLTAGE IS APPLIED. THIS IS ESPECIALLY NECESSARY IN CIRCUITS WHERE THE AMPLIFIER TUBE PLATE RESISTOR IS RETURNED TO THE PLATE SIDE OF THE PASSING TUBE, AS ILLUSTRATED IN THE SIMPLIFIED CIRCUIT IN FIGURE 1. IN THIS CASE DURING WARMUP THE AMPLIFIER TUBE DRAWS LITTLE CURRENT, THERE IS LITTLE IR DROP ACROSS THE RESISTOR, AND THE GRID OF THE PASSING TUBE IS EFFECTIVELY, TIED TO THE PLATE. THE PLATE WILL ATTEMPT TO DRAW EXCESSIVE CURRENT FROM THE PASSING TUBE'S CATHODE AND MAY SERIOUSLY IMPAIR TUBE LIFE. THE CIRCUIT IN FIGURE 2 IS PREFERABLE FROM THE CONSIDERATION OF THE SAFETY OF THE PASSING TUBE BOTH DURING WARMUP AND IN THE EVENT OF TROUBLE IN THE AMPLIFIER CIRCUIT OR IF THE AMPLIFIER TUBE IS REMOVED FROM ITS SOCKET. IT HAS THE ADDITIONAL ADVANTAGE OF PROVIDING A CONSTANT VOLTAGE FOR THE AMPLIFIER CIRCUIT. HOWEVER, IF THE REGULATOR OUTPUT IS LOW (BELOW 250 VOLTS) IT WILL BE NECESSARY TO PROVIDE ADDITIONAL NEGATIVE VOLTAGE FOR THE REFERENCE TUBE CIRCUIT. ALSO, IF THE REGULATED OUTPUT VOLTAGE IS TO BE VARIABLE, IT MAY BE NECESSARY TO FOLLOW FIGURE 1.

PASSING TUBE OPERATION CONDITIONS SHOULD BE CHOSEN TO PROVIDE AS LOW A TUBE DROP AS POSSIBLE. A SAFETY MARGIN OF AT LEAST 5 VOLTS FROM THE ZERO BIAS LINE SHOULD BE ALLOWED HOWEVER, FOR VARIATIONS OF INDIVIDUAL TUBES. SUFFICIENT BIAS EXCURSION SHOULD BE ALLOWED FOR OVERCOMING RIPPLE. THE AMPLIFIER CIRCUIT SHOULD BE ABLE TO COUNTERACT THE EFFECT OF UNBALANCE DUE TO TUBE AGING.

A GRID RESISTOR SHOULD BE USED FOR EACH TRIODE SECTION. THIS SHOULD BE ENOUGH TO PREVENT PARASITIC OSCILLATION BUT NOT LARGE ENOUGH TO PREVENT LOSS OF CONTROL DUE TO A SMALL AMOUNT OF "GAS" GRID CURRENT. A VALUE OF GRID RESISTANCE THAT MEETS BOTH THESE CONDITIONS IS 1,000 OHMS. HEATER VOLTAGE SHOULD BE KEPT AS CLOSE AS POSSIBLE TO 6.3 VOLTS AS MEASURED ON THE TUBE PINS. WHEN CONNECTING MANY HIGH DRAIN TUBE HEATERS ACROSS A SINGLE TRANSFORMER, BUS BARS FEEDING FROM "ALTERNATE ENDS" (FIGURE 3) SHOULD BE USED WITH A STRANDED PAIR FEEDING INDIVIDUAL SOCKETS.





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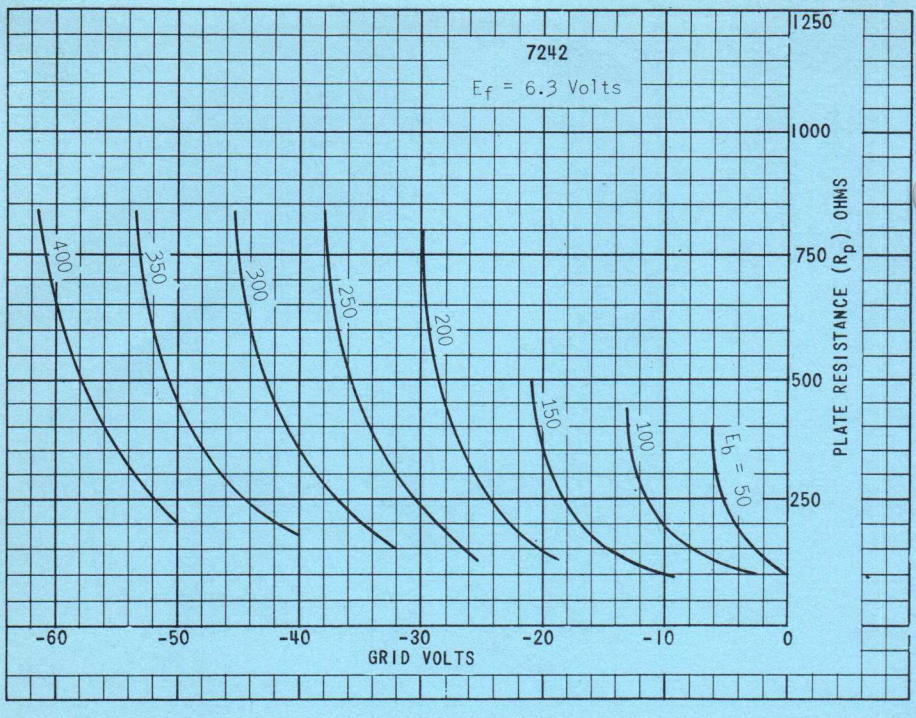
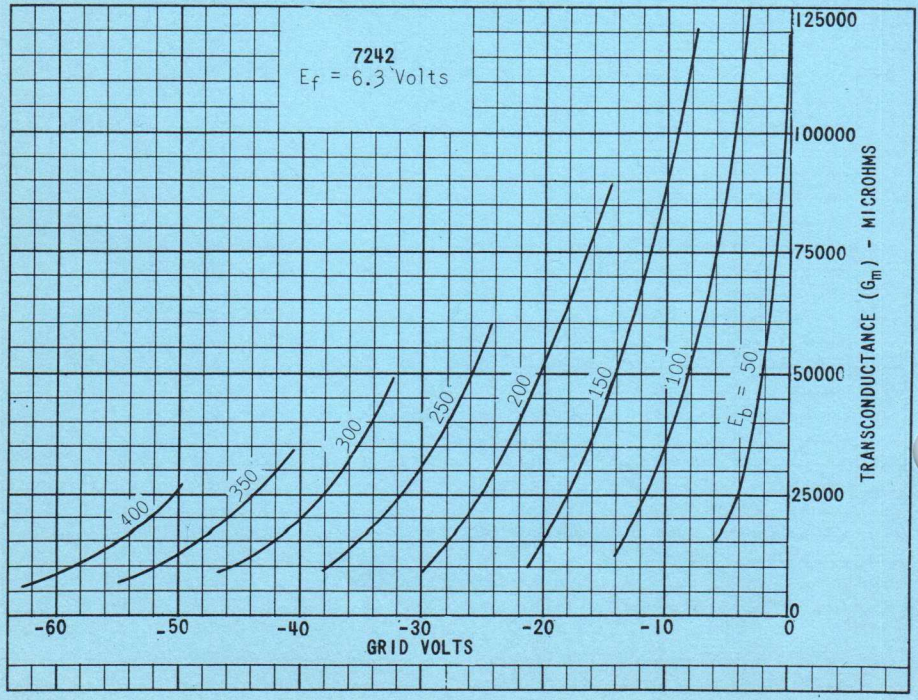
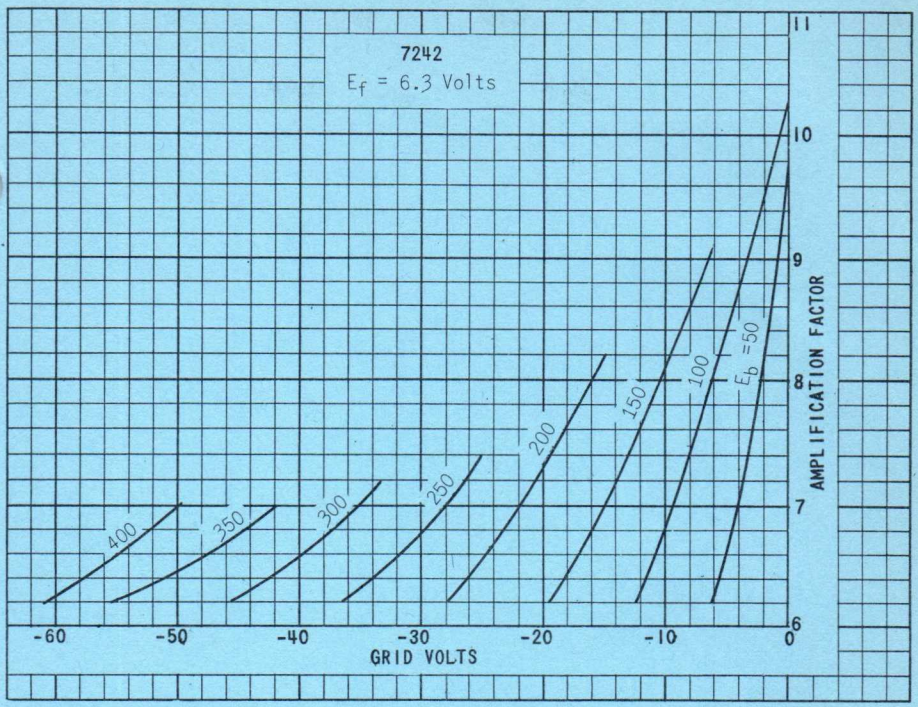

7242
E_f = 6.3 Volts
1250
1000
750
500
250
PLATE RESISTANCE (R_p) OHMS
400
350
300
250
200
150
100
E_b = 50
-60
-50
-40
-30
-20
-10
0
GRID VOLTS


7242
E_f = 6.3 Volts
125000
100000
75000
50000
25000
0
TRANSCONDUCTANCE (G_m) - MICROHMS
400
350
300
250
200
150
100
E_b = 50
-60
-50
-40
-30
-20
-10
0
GRID VOLTS



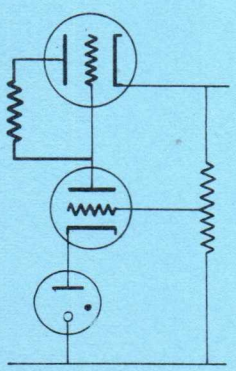


FIGURE 1

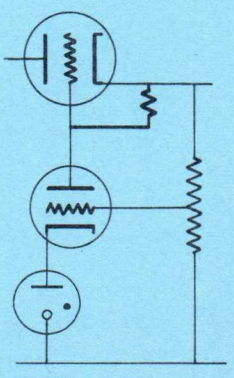


FIGURE 2

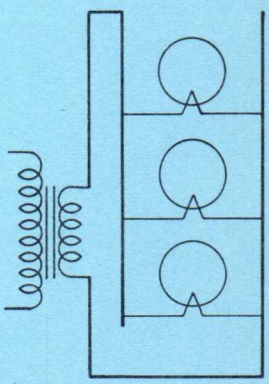


FIGURE 3

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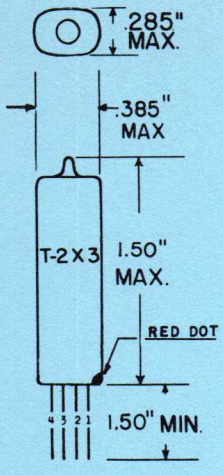
TUNG-SOL

TRIODE

SUBMINIATURE



GLASS BULB

RED DOT IS ADJACENT TO LEAD 1 IN LINE BASE OUTLINE DRAWING

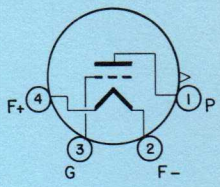
JEDEC 2-1

FOR APPLICATIONS REQUIRING

ECONOMY OF SPACE, WEIGHT

AND BATTERY DRAIN

ANY MOUNTING POSITION



BASE: — NONE

0.016" TINNED FLEXIBLE LEADS

0.048" CENTER-TO-CENTER

THE 7246 IS A 500 MEGACYCLE, FILAMENT TYPE TRIODE IN THE 4 PIN SUBMINIATURE CONSTRUCTION. IT IS DESIGNED FOR USE AS A HIGH FREQUENCY OSCILLATOR, CLASS C AMPLIFIER, SUPERREGENERATIVE DETECTOR, FREQUENCY MULTIPLIER OR MIXER. THE FLEXIBLE TERMINAL LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO THE TERMINALS OF CIRCUIT COMPONENTS. STANDARD SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE LEADS TO A SUITABLE LENGTH.

DIRECT INTERELECTRODE CAPACITANCES

	WITHOUT SHIELD	
GRID TO PLATE	1.5	pf
INPUT	1.6	pf
OUTPUT	1.9	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	1.25 VOLTS	150	MA.
HEATER SUPPLY LIMITS: FILAMENT OPERATION		1.25±.15	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	150	VOLTS
PLATE CURRENT	7.5	MA.
GRID CURRENT	1.2	MA.
GRID VOLTAGE	-30	VOLTS
PLATE DISSIPATION	0.7	WATTS

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TUNG-SOL

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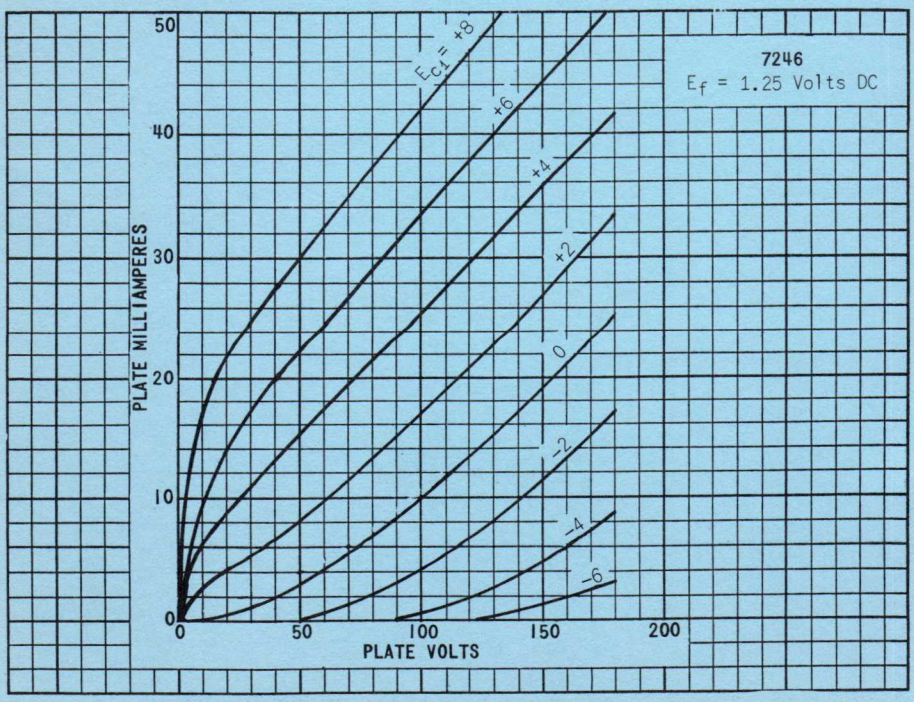
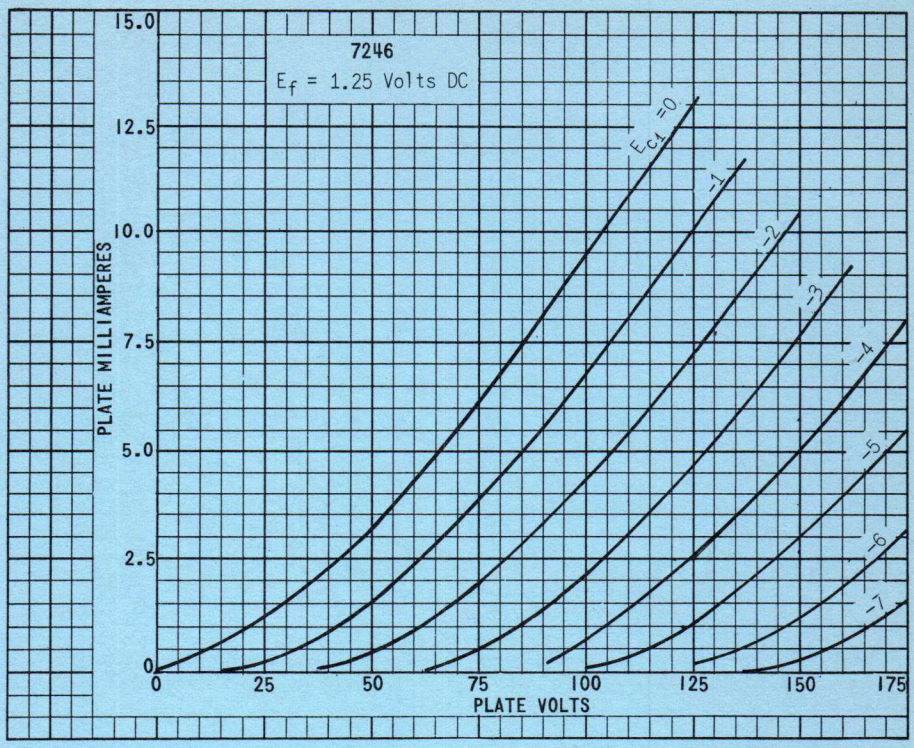
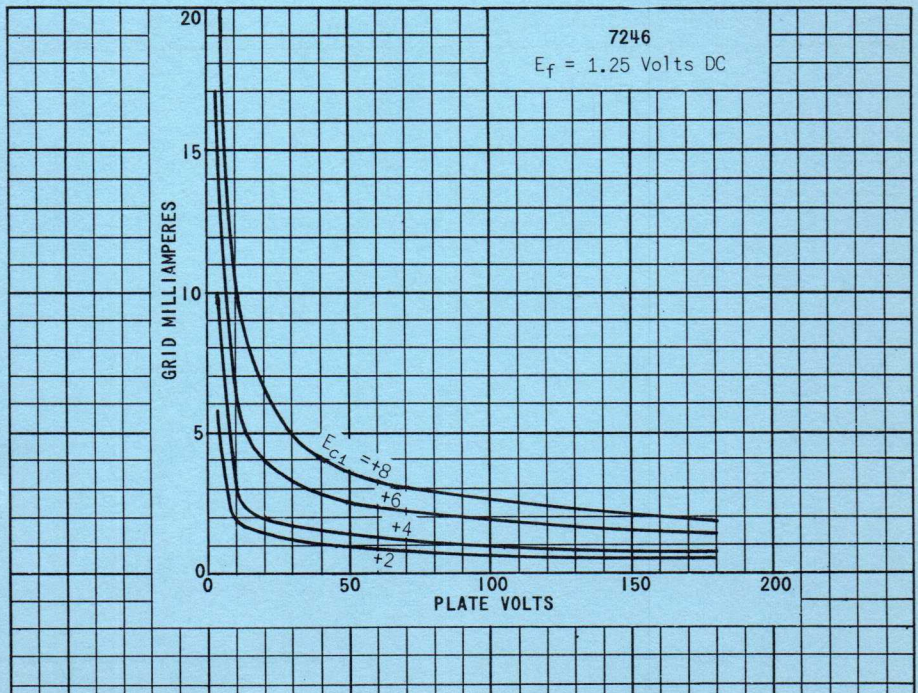
TYPICAL OPERATING CHARACTERISTICS

CLASS A_1 AMPLIFIER

PLATE VOLTAGE	105	VOLTS
GRID VOLTAGE	-2.5	VOLTS
TRANSCONDUCTANCE	2700	μMHOS
AMPLIFICATION FACTOR	22	
PLATE CURRENT	4.5	MA.







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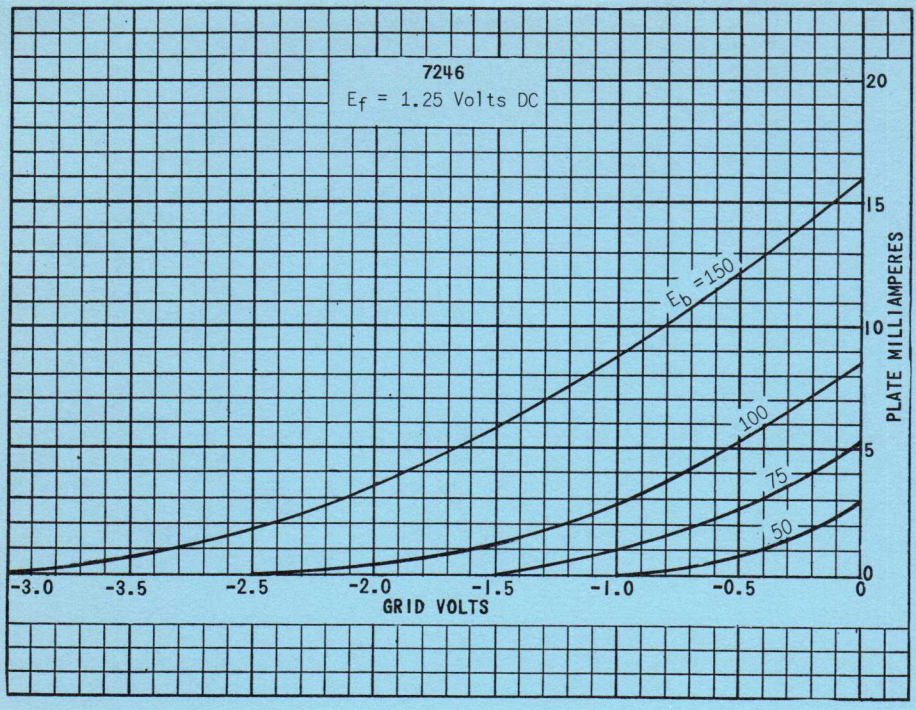
7246
E_f = 1.25 Volts DC
E_b =150
100
75
50
20
15
10
5
0
PLATE MILLIAMPERES
-3.0
-3.5
-2.5
-2.0
-1.5
-1.0
-0.5
0
GRID VOLTS

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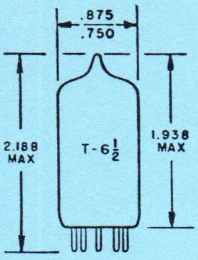
TRIODE-PENTODE

MINIATURE TYPE



GLASS BULB
SMALL BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2

SHARP CUTOFF PENTODE AND

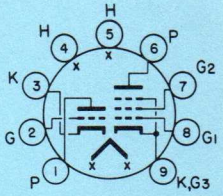
MEDIUM MU TRIODE

FOR

MOBILE APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9DA

THE 7258 CONTAINS A MEDIUM MU TRIODE AND A SHARP CUTOFF PENTODE IN THE 9 PIN MINIATURE CONSTRUCTION. THE TRIODE SECTION MAY BE USED AS A LOW FREQUENCY OSCILLATOR OR GENERAL PURPOSE AMPLIFIER. THE PENTODE SECTION AS AN RF, IF, OR REACTANCE TUBE. IT IS DESIGNED FOR USE OVER A WIDE RANGE OF HEATER VOLTAGES NORMALLY ENCOUNTERED IN MOBILE APPLICATIONS. EXCEPT FOR HEATER CHARACTERISTICS, TYPE 7258 IS SIMILAR TO TYPE 6AN8.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

PENTODE			
GRID 1 TO PLATE: G1 TO P	MAX.	0.04	pf
INPUT: G1 TO (H + KP + G2 + G3 + I.S.)		7.0	pf
OUTPUT: P TO (H + KP + G2 + G3 + I.S.)		2.4	pf
TRIODE			
GRID TO PLATE: G TO P		1.5	pf
INPUT: G TO (H + KT + KP + I.S.)		2.0	pf
OUTPUT: P TO (H + KT + KP + I.S.)		1.5	pf
COUPLING			
TRIODE GRID TO PENTODE PLATE	MAX.	0.02	pf
PENTODE GRID TO TRIODE PLATE	MAX.	0.02	pf
PENTODE PLATE TO TRIODE PLATE	MAX.	0.15	pf

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HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	13.5	VOLTS	210	MA.
LIMITS OF APPLIED VOLTAGE			13.5±1.5	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE			200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE				
DC			100	VOLTS
TOTAL DC AND PEAK			200	VOLTS

MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

	TRIODE SECTION	PENTODE SECTION	
PLATE VOLTAGE	330	330	VOLTS
GRID 2 SUPPLY VOLTAGE		330	VOLTS
GRID 2 VOLTAGE		See Rating Chart	
POSITIVE GRID 1 VOLTAGE	0	0	VOLTS
PLATE DISSIPATION	2.8	2.3	WATTS
GRID 2 DISSIPATION		0.55	WATTS
GRID 1 CIRCUIT RESISTANCE			
FIXED BIAS	0.5	0.25	MEGOHM
CATHODE BIAS	1.0	1.0	MEGOHM

AVERAGE CHARACTERISTICS

	TRIODE SECTION	PENTODE SECTION	
PLATE VOLTAGE	150	125	VOLTS
GRID 2 VOLTAGE	-----	125	VOLTS
GRID 1 VOLTAGE	-3		VOLTS
CATHODE BIAS RESISTOR		56	OHMS
PLATE CURRENT	15	12	MA.
GRID 2 CURRENT	-----	3.8	MA.
TRANSCONDUCTANCE	4,500	7,800	μMHOS
AMPLIFICATION FACTOR	21		
PLATE RESISTANCE (APPROX.)	4,700	170,000	OHMS
GRID 1 VOLTAGE FOR Ib = 20 μA. (APPROX.)	-17	-6	VOLTS
PLATE CURRENT AT Ec1 =-3 VDC, Rk = 0		1.6	MA.

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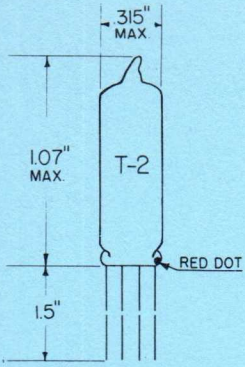
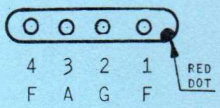
THYRATRON

SELF INDICATING*



GLASS BULB



BOTTOM VIEW

0.016" TINNED
FLEXIBLE LEADS
0.048" CENTER TO CENTER

THE 7323 IS A SUBMINIATURE THYRATRON WITH NEGATIVE CONTROL GRID CHARACTERISTICS. THE GASEOUS GLOW IT EXHIBITS WHILE CONDUCTING IS SEVERAL TIMES BRIGHTER THAN AN NE-2 GLOW LAMP (BOTH DEVICES AT MAXIMUM RATINGS) AND MAKES THE USE OF AUXILIARY READOUT DEVICES UNNECESSARY. IT MAY BE VIEWED EITHER "END ON" OR FROM THE SIDE.

BECAUSE OF ITS SMALL SIZE, LOW OPERATING VOLTAGES, MINUTE TRIGGERING REQUIREMENTS AND LOW FILAMENT POWER, THE 7323 IS PARTICULARLY SUITED FOR USE IN TRANSISTOR CIRCUITS. THE TERMINAL LEADS MAY BE SOLDERED DIRECTLY INTO A CIRCUIT OR MAY BE CLIPPED FOR INSERTION IN AN IN-LINE SUBMINIATURE SOCKET.

THE 7323 REPLACES TYPE CK1050 IN ALL APPLICATIONS.

ELECTRICAL DATA

FILAMENT VOLTAGE	1.25±10%	VAC
FILAMENT CURRENT	280.	MA.
ANODE VOLTAGE DROP @ 3 MA.	18	VDC

MECHANICAL DATA

MOUNTING POSITION	ANY	
BULB	T-2	
DIAMETER (MAX.)	0.315	INCHES
LENGTH (WITHOUT LEADS) (MAX.)	1.07	INCHES
CONNECTIONS	FLEXIBLE LEADS	
WEIGHT (APPROX.)	0.06	OUNCES

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* INDICATES AN ADDITION.

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TUNG-SOL

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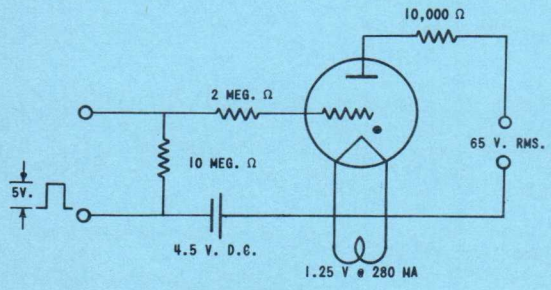
RATINGS
ABSOLUTE VALUES

ANODE SUPPLY VOLTAGE (RMS) (MAX.)	80	VAC
CATHODE CURRENT (MAX.)	3	MADC
PRECONDUCTION GRID (TRANSFER) CURRENT @ E_b = 75 VOLTS RMS (MAX.)	0.5	μADC

TYPICAL OPERATING CONDITIONS

ANODE SUPPLY VOLTAGE (RMS)	65	VAC
ANODE CIRCUIT RESISTANCE	10,000	OHMS
ANODE CURRENT	2	MADC
GRID BIAS VOLTAGE	-4.5	VDC
GRID SERIES RESISTANCE	2	MEGOHMS



PULSE OPERATED RELAY

APPLICATION NOTES

IT IS OFTEN NECESSARY TO PROVIDE A RELAY DEVICE TO OPERATE AT LOW LEVEL, LOW VOLTAGE, SHORT DURATION PULSES SUCH AS ARE FOUND IN TRANSISTOR CIRCUITS. THE 7323 SELF INDICATING THYRATRON PERFORMS THIS FUNCTION AS WELL AS PROVIDING AN ADEQUATE, VISUAL READOUT INDICATOR. ALTHOUGH NOT AS BRILLIANT AN INDICATOR AS COMPARABLE COLD CATHODE THYRATRONS, THE 7323 OPERATING AT 3 MILLIAMPERES IS MANY TIMES BRIGHTER THAN AN NE-2 NEON GLOW LAMP. THE EFFICIENT FILAMENT CONSUMES ONLY ABOUT ONE THIRD WATT OF HEATER POWER.

AS WITH ANY GAS TUBE, ONCE THE TUBE CONDUCTS, THE TUBE VOLTAGE DROP REMAINS VIRTUALLY CONSTANT AND THE CURRENT THROUGH THE TUBE IS LIMITED BY THE CIRCUIT RESISTANCE. THE GRID CIRCUIT SHOULD CONTAIN A 1,000 OHM SERIES RESISTANCE IF THE SOURCE RESISTANCE IS LOWER THAN THIS FIGURE.

THE 7323 IS NORMALLY MOUNTED BEHIND A PANEL CUT OUT FOR EITHER END-ON OR SIDE VIEWING. A SUBMINIATURE HEAT DISSIPATING TYPE OF TUBE CLAMP PROVIDES BOTH A CONVENIENT MEANS OF MOUNTING AS WELL AS SHIELDING TO MINIMIZE THE THE EFFECT OF HAND CAPACITY OR ELECTRICAL FIELDS.

THE 7323 CAN BE OPERATED FROM EITHER AN A.C. OR D.C. ANODE SUPPLY VOLTAGE. IF DC OPERATED, IT IS NECESSARY TO BREAK THE ANODE CIRCUIT (EITHER BY A MECHANICAL SWITCH OR NEGATIVE PULSE) TO RESTORE CONTROL AFTER THE TUBE HAS FIRED. THIS IS PARTICULARLY ADVANTAGEOUS IN THE "HOLD UNTIL RESET" TYPE OF APPLICATION.

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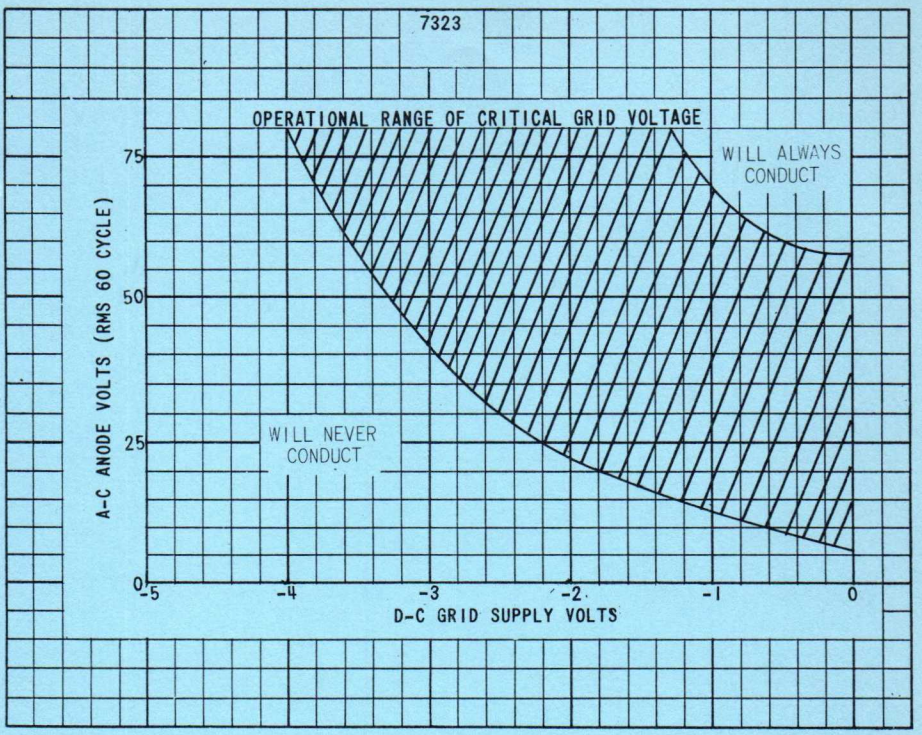

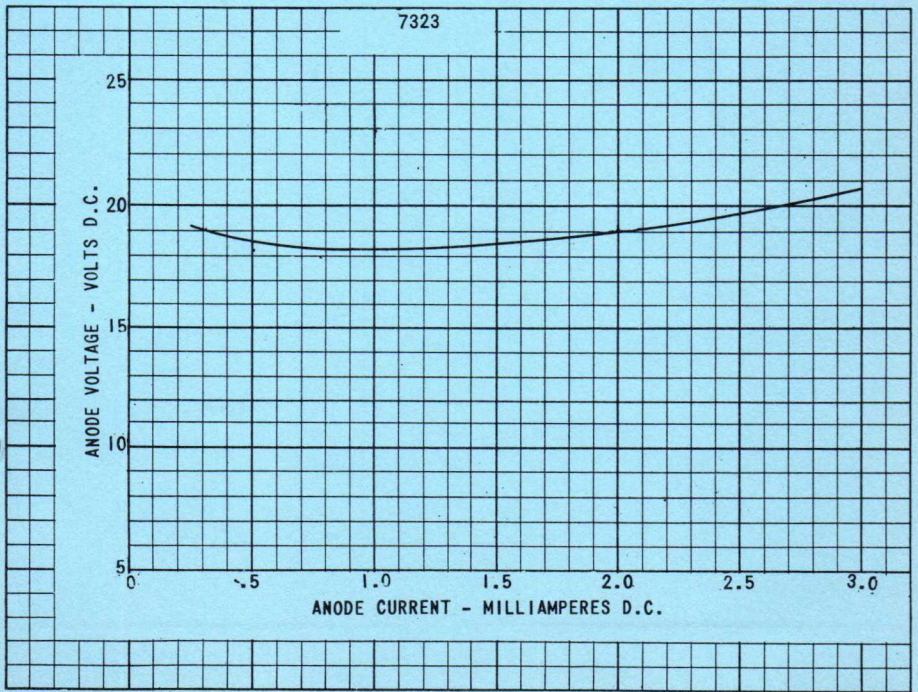

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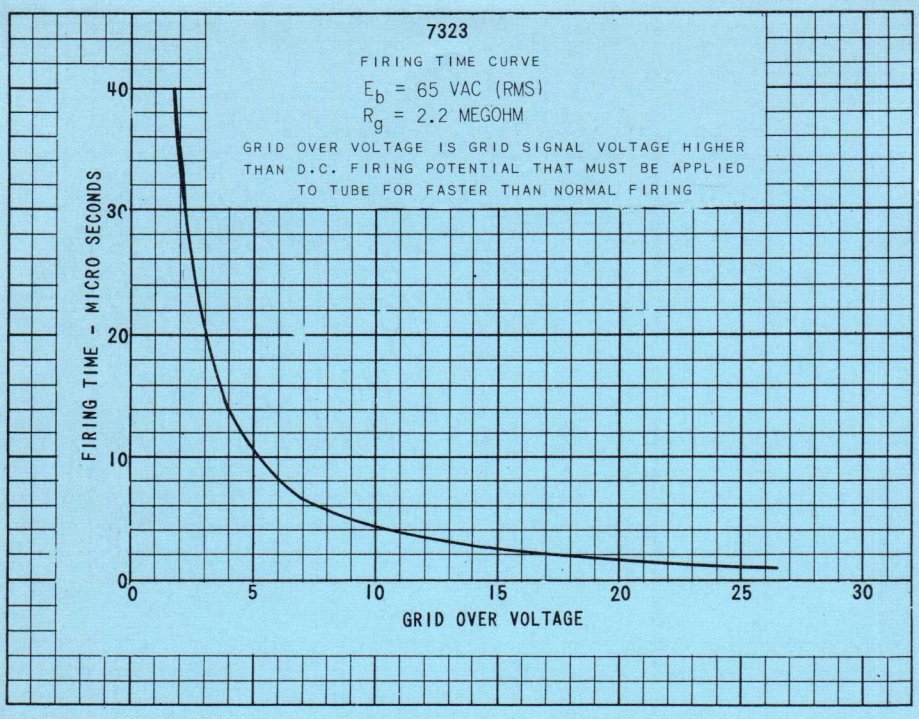
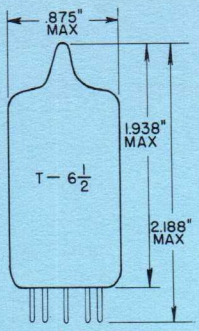

7323
FIRING TIME CURVE
E_b = 65 VAC (RMS)
R_g = 2.2 MEGOHM
GRID OVER VOLTAGE IS GRID SIGNAL VOLTAGE HIGHER THAN D.C. FIRING POTENTIAL THAT MUST BE APPLIED TO TUBE FOR FASTER THAN NORMAL FIRING
FIRING TIME - MICRO SECONDS
40
30
20
10
0
0
5
10
15
20
25
30
GRID OVER VOLTAGE

TUNG-SOL



GLASS BULB
MINIATURE BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2

DOUBLE TRIODE

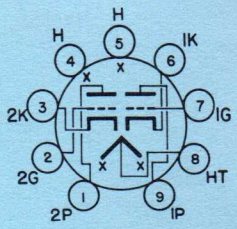
MINIATURE TYPE

COATED UNIPOTENTIAL CATHODE

HEATER

SERIES	PARALLEL
40±5% VOLTS	20±5% VOLTS
130 MA.	260 MA.

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9H

THE 7370 IS A GENERAL PURPOSE MEDIUM MU DOUBLE TRIODE USING THE 9 PIN BUTTON ALL GLASS CONSTRUCTION. EACH TRIODE IS ELECTRICALLY INDEPENDENT ALTHOUGH THE TWO HEATERS HAVE A COMMON CONNECTION. THE TUBE IS CHARACTERIZED BY HIGH PERVEANCE AND HIGH EMISSION CAPABILITIES. WITH THE EXCEPTION OF THE HEATER VOLTAGE AND CURRENT THE TUBE IS IDENTICAL TO THE 5687.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

EACH TRIODE UNIT

GRID TO PLATE: (G TO P)	4.0	pf
GRID TO CATHODE: (G TO K+H)	4.0	pf
PLATE TO CATHODE: (P TO K+H)		
SECTION #1	0.6	pf
SECTION #2	0.5	pf
HEATER TO CATHODE: (H TO K)	5.0	pf
PLATE TO PLATE: (1P TO 2P) (APPROX.)	0.75	pf
GRID TO GRID: (1G TO 2G) (APPROX.)	0.025	pf

RATINGS

ABSOLUTE MAXIMUM VALUES

	SERIES		PARALLEL	
HEATER VOLTAGE[A]	40±5%		20±5%	VOLTS
MAXIMUM PLATE VOLTAGE		330		VOLTS
MAXIMUM INVERSE PLATE VOLTAGE		1000		VOLTS
MAXIMUM PLATE DISSIPATION (EACH UNIT)		4.75		WATTS
MAXIMUM TOTAL PLATE DISSIPATION (BOTH UNITS)		8.5		WATTS
MAXIMUM BULB TEMPERATURE (AT ANY PART OF ENVELOPE)		230		°C
MAXIMUM DC GRID CURRENT (EACH UNIT)		6		MA.
MAXIMUM EXTERNAL GRID CIRCUIT RESISTANCE (EACH UNIT)		1		MEGOHM
MAXIMUM DC CATHODE CURRENT (EACH SECTION)		65		MA.
MAXIMUM HEATER–CATHODE VOLTAGE		100		VOLTS

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CLASS A_1 AMPLIFIER – EACH UNIT

PLATE VOLTAGE	120	180	250	VOLTS
GRID VOLTAGE	−2	−7	−12.5	VOLTS
PLATE CURRENT	36.0	23.0	12.0	MA.
PLATE RESISTANCE (APPROX.)	1560	2000	3000	OHMS
TRANSCONDUCTANCE	11500	8500	5400	μMHOS
AMPLIFICATION FACTOR	18.0	17.0	16.0	
GRID VOLTAGE FOR I_b = 100 μA (APPROX.)	−9.0	−14.0	−19.0	VOLTS

[A] THE EQUIPMENT DESIGNER SHOULD SO DESIGN THE EQUIPMENT SO THAT THE HEATER IS OPERATED AT THE BOGIE VALUE. HEATER SUPPLY VARIATION SHOULD BE RESTRICTED SO AS TO REMAIN WITHIN THE SPECIFIED TOLERANCES.

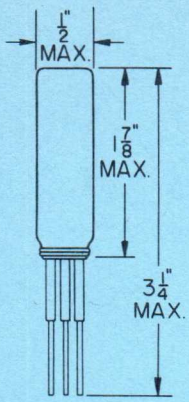
TUNG-SOL

THYRATRON

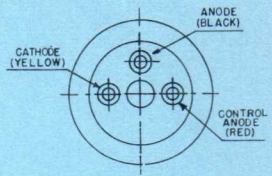
SELF INDICATING*

COLD CATHODE

ANY MOUNTING POSITION



GLASS VIEW



BOTTOM VIEW

COLORS INDICATED FOR TUBE LEADS ARE THE COLORS OF THE INSULATION SLEEVES.

THE 7400 IS A SMALL, LIGHT WEIGHT, COLD CATHODE THYRATRON FOR RELAY SERVICE. WHEN THE TUBE IS CONDUCTING, THE DISK SHAPED CATHODE GLOWS BRIGHTLY WITH THE CHARACTERISTIC NEON COLOR. THE TUBE IS DESIGNED FOR END ON VIEWING.

THE 7400 HAS "REFERENCE TUBE" CONSTRUCTION AND PROCESSING TO KEEP ITS FIRING CHARACTERISTICS CONSTANT DURING LIFE. THIS FEATURE, COUPLED WITH THE LOW LEVEL OF TRIGGER PULSE VOLTAGE, MAKES THE 7400 PARTICULARLY ADAPTABLE TO TRANSISTOR CIRCUITS.

THIS TUBE TYPE WAS DESIGNED INTO SOME CIRCUITS UNDER THE ORIGINAL DEVELOPMENT TYPE DESIGNATION, CH1116.

ELECTRICAL DATA
(TYPICAL VALUES)

ANODE VOLTAGE DROP @ 1 MA.	102	VDC
ANODE VOLTAGE DROP @ 10 MA.	117	VDC
GRID VOLTAGE DROP @ 1 MA.	88	VDC
ANODE IONIZATION VOLTAGE	210	VOLTS
GRID IONIZATION VOLTAGE	109	VOLTS
MINIMUM ANODE CURRENT FOR BRIGHT READ OUT INDICATION	250	μAMPS

MECHANICAL DATA

MOUNTING POSITION	ANY	
BULB	FLAT END VIAL	
DIAMETER (MAX.)	0.50	INCHES
LENGTH (WITHOUT LEADS) (MAX.)	1.88	INCHES
CONNECTIONS	COLOR CODED FLEXIBLE LEADS	
WEIGHT (APPROX.)	0.17	OZ.

* INDICATES AN ADDITION.

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TUNG-SOL

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RATINGS
ABSOLUTE VALUES

POSITIVE ANODE VOLTAGE (MAX.)	180	VDC
NEGATIVE ANODE VOLTAGE (WITHOUT DISCHARGE TO A POSITIVE GRID) (MAX.)	100	VDC
POSITIVE GRID BIAS VOLTAGE (WITHOUT GRID IONIZATION) (MAX.)	102	VDC
TRANSFER CURRENT @ E_b = 150 VDC (MAX.)	15	μAMPS
CATHODE CURRENT (MAX.)	12	MA DC

TYPICAL OPERATING CONDITIONS

ANODE SUPPLY VOLTAGE	150	VDC
ANODE CIRCUIT RESISTANCE	5,000	OHMS
ANODE CURRENT	7	MA.
POSITIVE GRID BIAS	102	VDC
GRID TRIGGER SIGNAL	5	VOLTS
GRID TRANSFER CURRENT	7	μAMPS
CURRENT AMPLIFICATION	1,000	

TUNG-SOL

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APPLICATION NOTES

IT IS OFTEN NECESSARY TO PROVIDE A RELAY DEVICE FOR CIRCUITRY OPERATING * AT LOW POWER LEVEL, LOW VOLTAGE PULSES. THE 7400 SELF INDICATING THYRATRON PERFORMS THIS CIRCUIT FUNCTION AS WELL AS PROVIDING A BRILLIANT, VISUAL READOUT INDICATOR. NO HEATER POWER IS REQUIRED FOR ITS OPERATION.

THE 7400 THYRATRON CONTAINS A CATHODE, A TRIGGER GRID AND AN ANODE WITHIN A GASEOUS ATMOSPHERE. IF AN INCREASING POSITIVE VOLTAGE IS APPLIED TO THE GRID, A MINUTE PRE-IONIZATION CURRENT WILL FLOW UNTIL THE CRITICAL GRID CURRENT OF ABOUT SEVEN MICROAMPERES IS REACHED. AT THIS POINT THE REGION BETWEEN THE GRID AND CATHODE "BREAKS DOWN" OR IONIZES. IF THE APPLIED ANODE VOLTAGE IS EQUAL TO OR GREATER THAN THE GRID VOLTAGE, THE GLOW WILL THEN TRANSFER TO THE CATHODE-ANODE REGION. THUS, A VERY LOW ENERGY SIGNAL IN THE GRID CIRCUIT CAN CONTROL MUCH HIGHER ENERGY IN THE ANODE CIRCUIT. IF, IN THIS ILLUSTRATION AN ANODE CURRENT OF 7 MILLIAMPERES WERE TO FLOW; THE TUBE HAS PROVIDED CURRENT AMPLIFICATION OF 1,000.

AS WITH ANY GAS TUBE, ONCE THE TUBE CONDUCTS, THE TUBE VOLTAGE DROP REMAINS VIRTUALLY CONSTANT AND THE CURRENT THROUGH THE TUBE IS LIMITED BY THE CIRCUIT RESISTANCE. IN THE ANODE CIRCUIT THIS MAY BE THE RESISTANCE OF THE LOAD ITSELF, OR, THE LOAD PLUS ADDITIONAL LIMITING RESISTANCE. THE GRID CIRCUIT SHOULD CONTAIN A 5,000 OHM SERIES RESISTANCE IF THE SOURCE RESISTANCE IS LOWER THAN THIS FIGURE. IF THE GRID CIRCUIT RESISTANCE IS ABOVE 10 MEGOHMS, HOWEVER, IT MAY BE NECESSARY TO CONNECT A SMALL CAPACITANCE BETWEEN THE GRID AND CATHODE. THIS IS TO STORE ENOUGH ENERGY TO INSURE GRID IONIZATION.

RADIOACTIVE DOSING IS USED TO ELIMINATE ANY CHANGE OF FIRING CHARACTERISTICS DUE TO ILLUMINATION. THE MAGNITUDE OF ACTIVITY IS NOT GREAT ENOUGH TO INSTITUTE A PERSONAL HAZARD. HOWEVER, PERSONS ARE CAUTIONED NOT TO HANDLE BROKEN TUBES TO AVOID GETTING THE ACTIVE MATERIAL DIRECTLY INTO THE BLOODSTREAM THROUGH CUTS. IF A PERSON CUTS HIMSELF ON A BROKEN TUBE THE CUT SHOULD BE CLEANSED IMMEDIATELY. AN OPEN CUT CAN BE CLEANSED BY HOLDING IT IN RUNNING WATER.

THE 7400 IS DESIGNED FOR END ON VIEWING AND WILL PROVIDE A BRILLIANT SURFACE GLOW PATTERN WHEN CONDUCTING ONLY A FRACTION OF A MILLIAMPERE. THE TUBE IS NORMALLY MOUNTED BEHIND A METAL PANEL WITH THE FLAT END OF THE BULB FLUSH WITH THE PANEL SURFACE. IF IT IS NOT SO MOUNTED, THE BULB SIDES SHOULD BE SHIELDED (eg: COPPER MESH) TO PREVENT HAND CAPACITY OR STRONG ELECTRIC FIELDS FROM ALTERING FIRING POTENTIALS. A HEAT DISSIPATING TYPE OF TUBE CLAMP PROVIDES A CONVENIENT METHOD OF TUBE MOUNTING THAT REQUIRES NO FURTHER SHIELDING.

TYPICAL CIRCUIT CONFIGURATIONS ARE ILLUSTRATED ABOVE. AS WITH ANY THYRATRON CIRCUIT, ONCE THE TUBE CONDUCTS, THE GRID WILL NOT REGAIN CONTROL UNTIL THE ANODE VOLTAGE FALLS LOW ENOUGH TO EXTINGUISH THE CATHODE-ANODE GLOW. THIS IS USUALLY ACCOMPLISHED BY BREAKING THE ANODE CIRCUIT. HOWEVER, IT CAN ALSO BE DONE UNDER D.C. OPERATION, BY CAUSING THE ANODE CURRENT TO FLOW IN SAW TOOTH STEPS. THE SAW TOOTH IS GENERATED BY RUNNING THE TUBE AS A RELAXATION OSCILLATOR BY INSERTING SUFFICIENT CAPACITY BETWEEN THE CATHODE AND ANODE. FIGURE 3 ILLUSTRATES AN APPLICATION OF THIS IDEA. THE 7400 WILL ALSO REGAIN GRID CONTROL ON EACH CYCLE IF IT IS RUN FROM HALF WAVE RECTIFIED A.C. FIGURE 4 ILLUSTRATES AN APPLICATION OF THE TUBE ON A.C. OPERATION OF THE TUBE ON A.C. WITHOUT THE SERIES DIODE IS NOT RECOMMENDED.

*INDICATES AN ADDITION.

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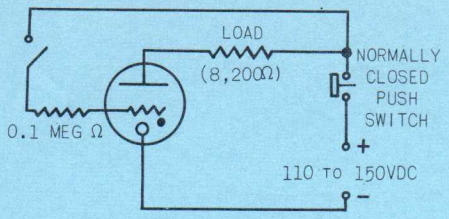
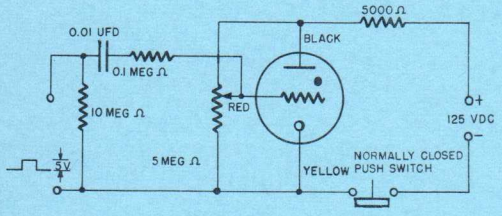
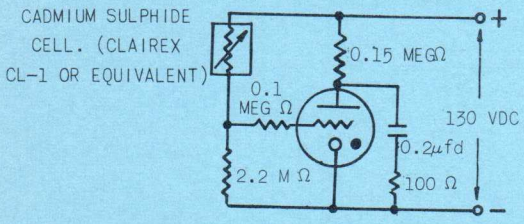


7400 USED AS A MECHANICALLY OPERATED RELAY

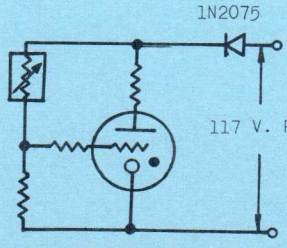
FIG. 1





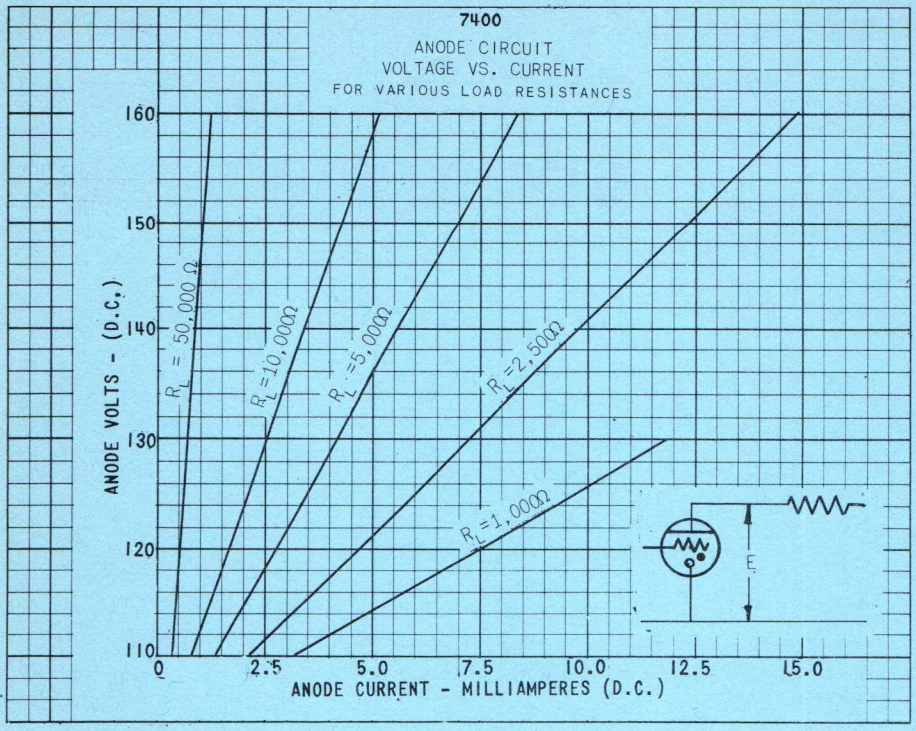
7400 ACTING AS A RELAY FOR A CADMIUM SULPHIDE PHOTO CELL

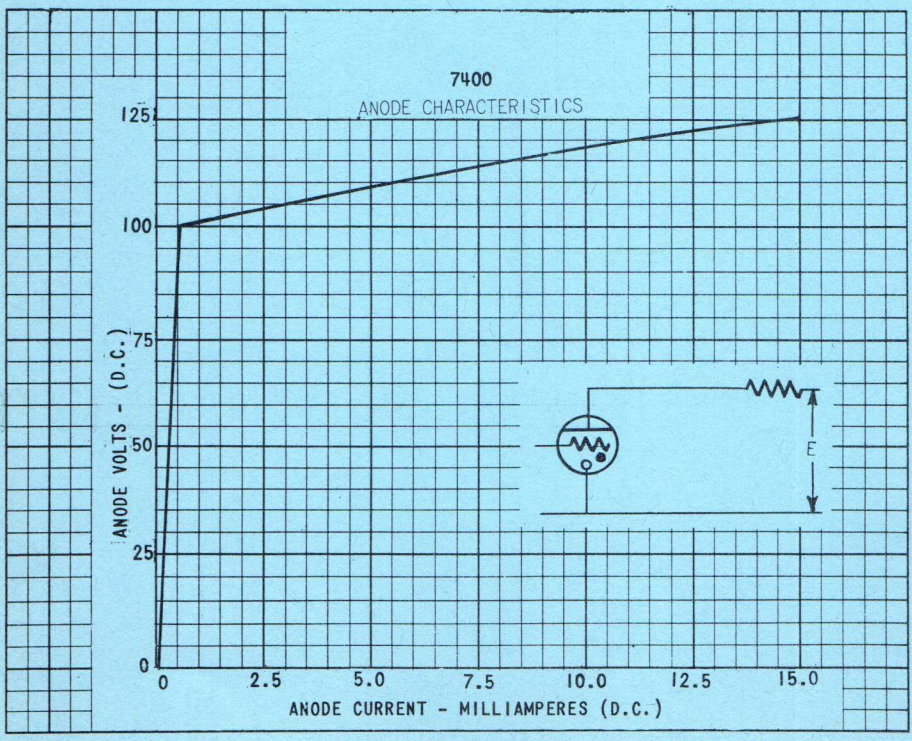
FIG. 3

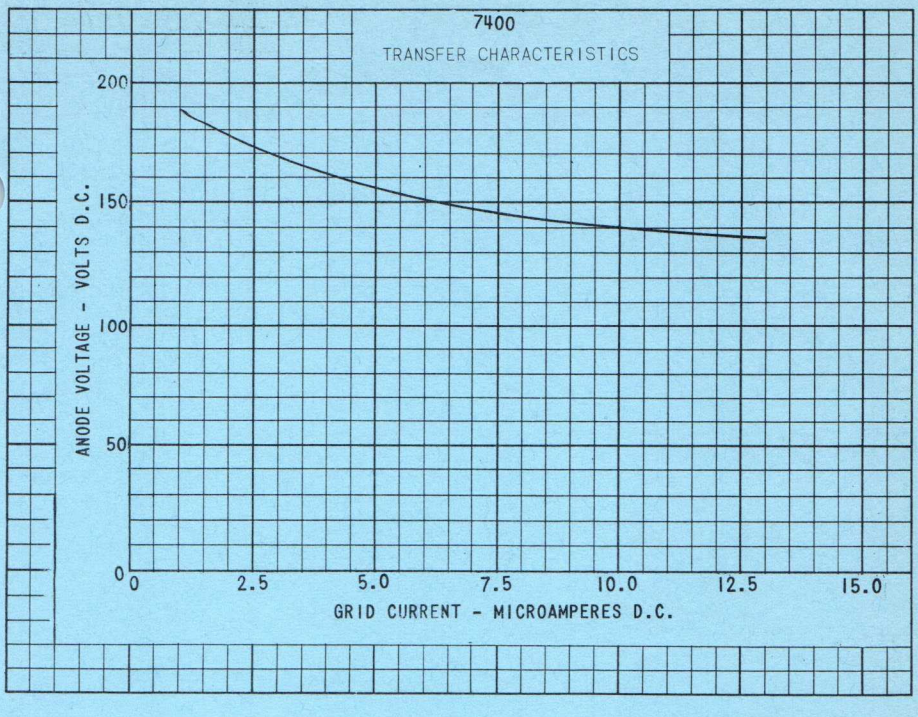


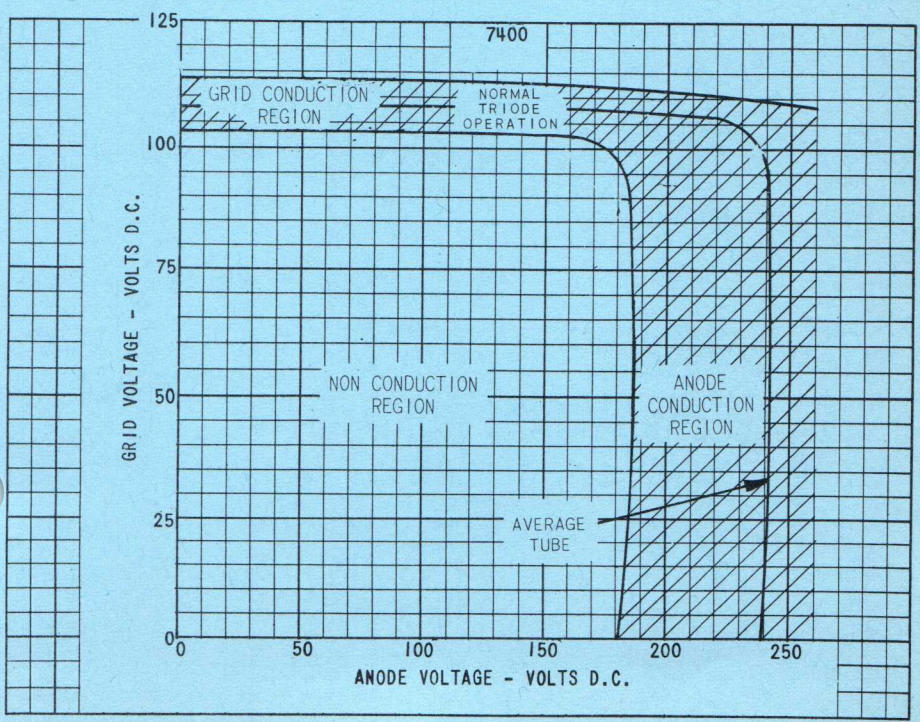
SAME AS FIGURE 3 BUT OPERATED FROM A.C. LINE

FIG. 4


7400
ANODE CIRCUIT
VOLTAGE VS. CURRENT
FOR VARIOUS LOAD RESISTANCES
ANODE VOLTS - (D.C.)
160
150
140
130
120
110
R_L = 50,000 Ω
R_L =10,000Ω
R_L =5,000Ω
R_L =2,500Ω
R_L =1,000Ω
E
0
2.5
5.0
7.5
10.0
12.5
15.0
ANODE CURRENT - MILLIAMPERES (D.C.)


7400
ANODE CHARACTERISTICS
ANODE VOLTS - (D.C.)
125
100
75
50
25
0
E
0
2.5
5.0
7.5
10.0
12.5
15.0
ANODE CURRENT - MILLIAMPERES (D.C.)





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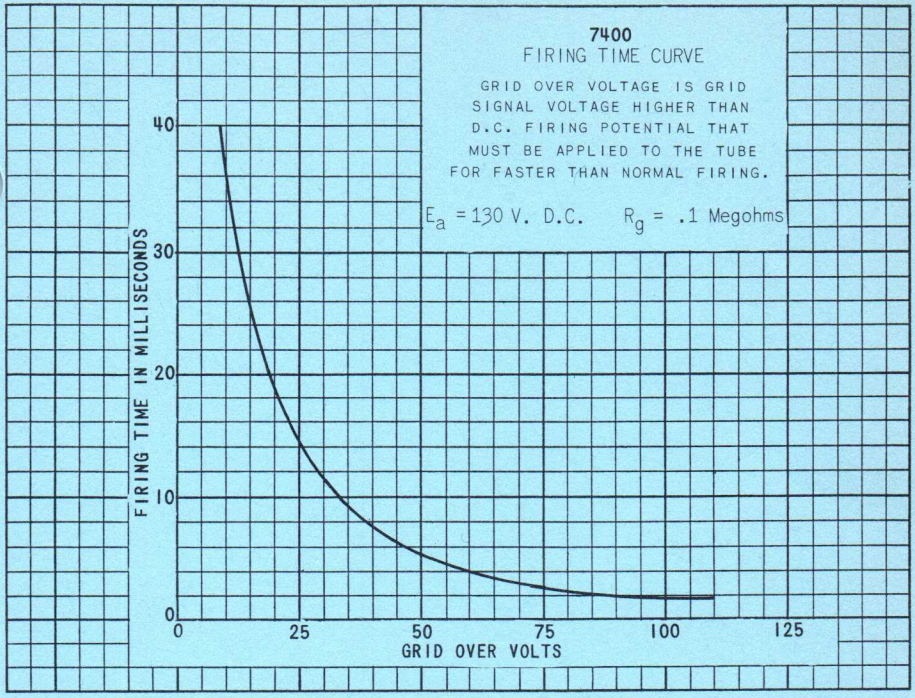

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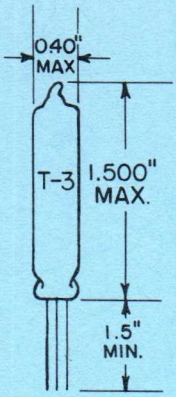
TUNG-SOL

THYRATRON

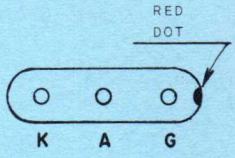
SELF INDICATING*

COLD CATHODE

ANY MOUNTING POSITION



GLASS VIEW



BOTTOM VIEW
0.016" TINNED
FLEXIBLE LEADS
0.100" CENTER TO CENTER

THE 7401 IS A SUBMINIATURE, LIGHTWEIGHT, COLD CATHODE THYRATRON FOR RELAY SERVICE. WHEN THE TUBE IS CONDUCTING, THE DISK SHAPED CATHODE GLOWS BRIGHTLY WITH THE CHARACTERISTIC NEON COLOR. THE TUBE IS DESIGNED FOR END ON VIEWING IN SMALL APACES.

THE 7401 HAS "REFERENCE TUBE" CONSTRUCTION AND PROCESSING TO KEEP ITS FIRING CHARACTERISTICS CONSTANT DURING LIFE. THIS FEATURE, COUPLED WITH THE LOW LEVEL OF TRIGGER PULSE VOLTAGE, MAKES THE 7401 PARTICULARLY ADAPTABLE TO TRANSISTOR CIRCUITS.

THIS TUBE TYPE WAS DESIGNED INTO SOME CIRCUITS UNDER THE ORIGINAL DEVELOPMENT TYPE DESIGNATION, CH1125.

ELECTRICAL DATA
(TYPICAL VALUES)

ANODE VOLTAGE DROP @ 1 MA.	105	VDC
ANODE VOLTAGE DROP @ 8 MA.	115	VDC
GRID VOLTAGE DROP	87	VDC
ANODE IONIZATION VOLTAGE	200	VOLTS
GRID IONIZATION VOLTAGE	107	VOLTS
MINIMUM ANODE CURRENT FOR BRIGHT READ OUT INDICATION	250	μAMPS

MECHANICAL DATA

MOUNTING POSITION	ANY	
BULB	T-3	
DIAMETER (MAX.)	0.40	INCHES
LENGTH (WITHOUT LEADS) (NOM.)	1.50	INCHES
CONNECTIONS	FLEXIBLE LEADS	
WEIGHT (APPROX.)	0.11	OZ.

* INDICATES AN ADDITION.

CONTINUED ON FOLLWING PAGE

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

RATINGS
ABSOLUTE VALUES

POSITIVE ANODE VOLTAGE (MAX.)	180	VDC
NEGATIVE ANODE VOLTAGE (WITHOUT DISCHARGE TO A POSITIVE GRID) (MAX.)	100	VDC
POSITIVE GRID BIAS VOLTAGE (WITHOUT GRID IONIZATION) (MAX.)	102	VDC
TRANSFER CURRENT @ E_b = 150 VDC (MAX.)	15	μAMPS
CATHODE CURRENT (MAX.)	8	MA DC

TYPICAL OPERATING CONDITIONS

ANODE SUPPLY VOLTAGE	150	VDC
ANODE CIRCUIT RESISTANCE	5,000	OHMS
ANODE CURRENT	7	MA.
POSITIVE GRID BIAS	102	VDC
GRID TRIGGER SIGNAL	5	VOLTS
GRID TRANSFER CURRENT	7	μAMPS
CURRENT AMPLIFICATION	1,400	

TUNG-SOL

CONTINUED FROM PRECEDING PAGE

APPLICATION NOTES

IT IS OFTEN NECESSARY TO PROVIDE A RELAY DEVICE FOR CIRCUITRY OPERATING AT LOW POWER LEVEL, LOW VOLTAGE PULSES. THE 7401 SELF INDICATING THYRATRON PERFORMS THIS CIRCUIT FUNCTION AS WELL AS PROVIDING A BRILLIANT, VISUAL READOUT INDICATOR. NO HEATER POWER IS REQUIRED FOR ITS OPERATION. *

THE 7401 THYRATRON CONTAINS A CATHODE, A TRIGGER GRID AND AN ANODE WITHIN A GASEOUS ATMOSPHERE. IF AN INCREASING POSITIVE VOLTAGE IS APPLIED TO THE GRID, A MINUTE PRE-IONIZATION CURRENT WILL FLOW UNTIL THE CRITICAL GRID CURRENT OF ABOUT FIVE MICROAMPERES IS REACHED. AT THIS POINT THE REGION BETWEEN THE GRID AND CATHODE "BREAKS DOWN" OR IONIZES. IF THE APPLIED ANODE VOLTAGE IS EQUAL TO OR GREATER THAN THE GRID VOLTAGE, THE GLOW WILL THEN TRANSFER TO THE CATHODE-ANODE REGION. THUS, A VERY LOW ENERGY SIGNAL IN THE GRID CIRCUIT CAN CONTROL MUCH HIGHER ENERGY IN THE ANODE CIRCUIT. IF, IN THIS ILLUSTRATION AN ANODE CURRENT OF 7 MILLIAMPERES WERE TO FLOW; THE TUBE HAS PROVIDED CURRENT AMPLIFICATION OF 1,400.

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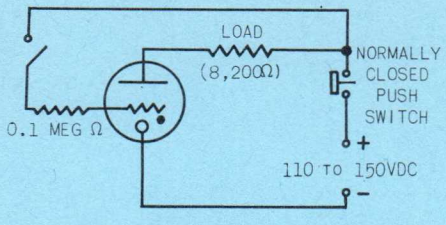
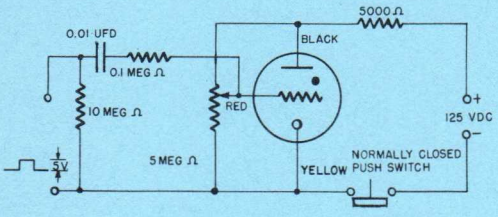
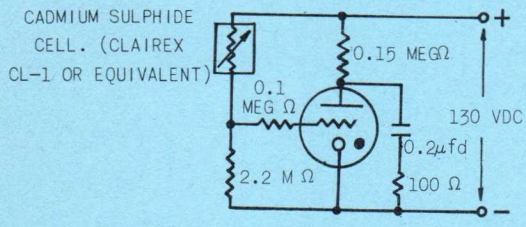


7401 USED AS A MECHANICALLY OPERATED RELAY

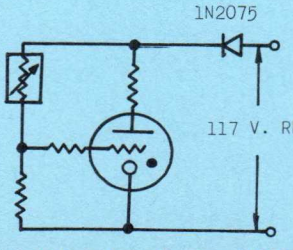
FIG. 1





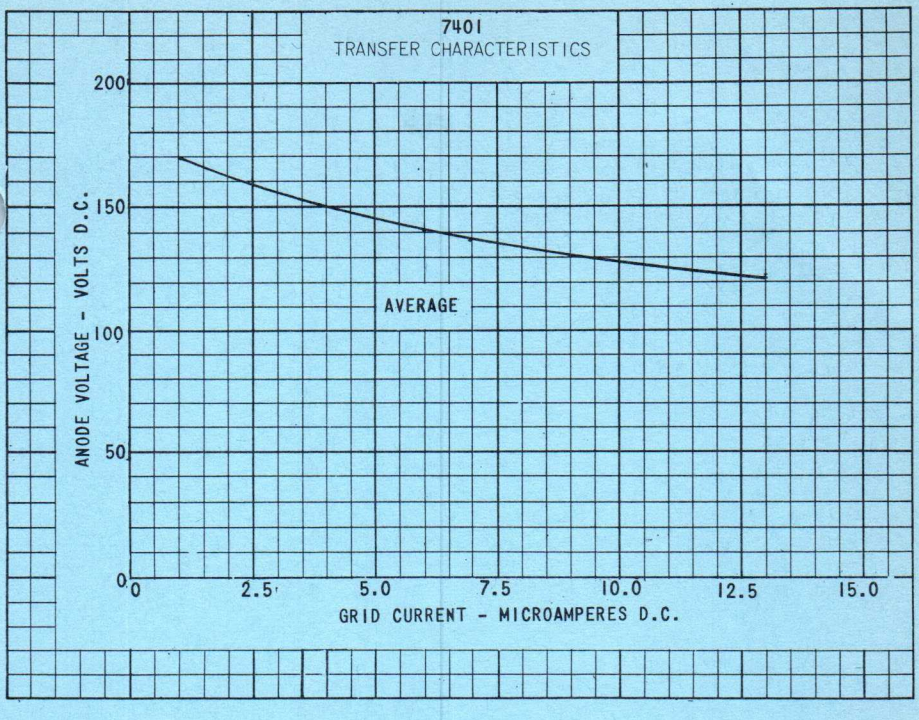
7401 ACTING AS A RELAY FOR A CADMIUM SULPHIDE PHOTO CELL

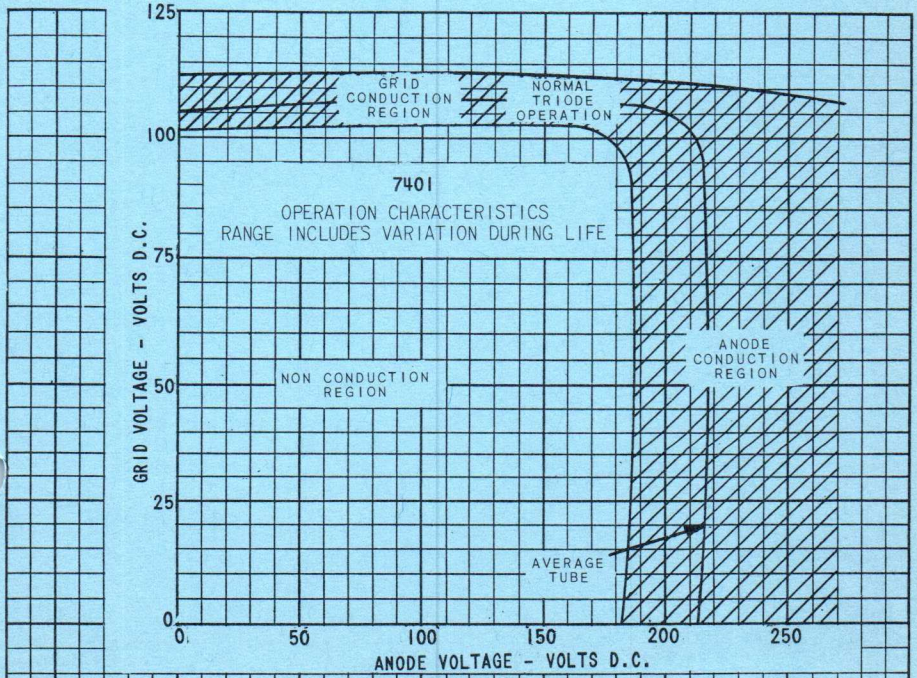
FIG. 3



SAME AS FIGURE 3 BUT OPERATED FROM A.C. LINE

FIG. 4





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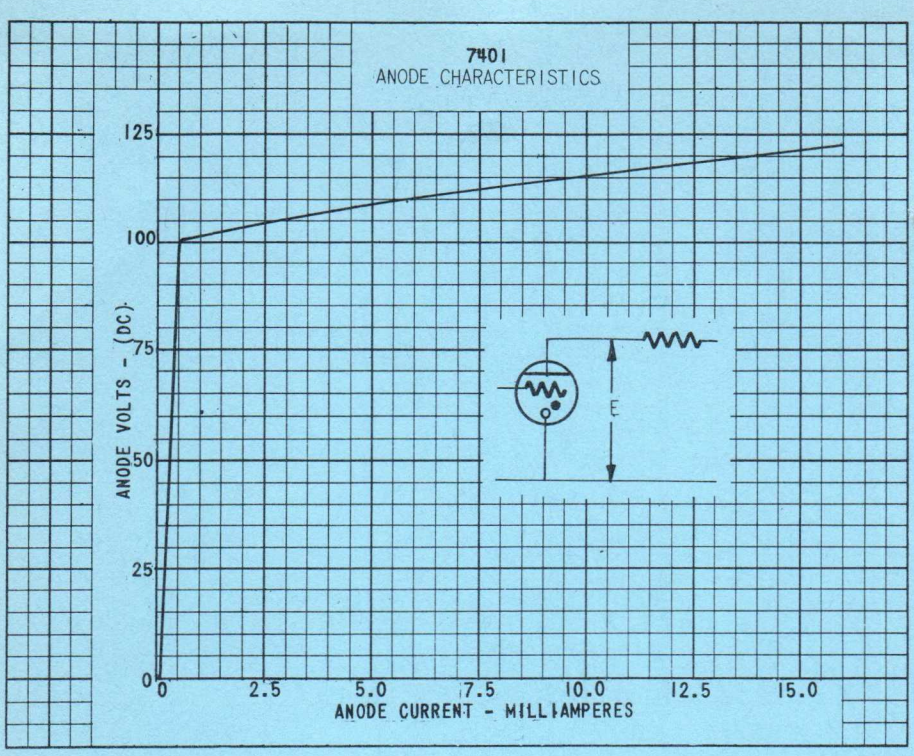
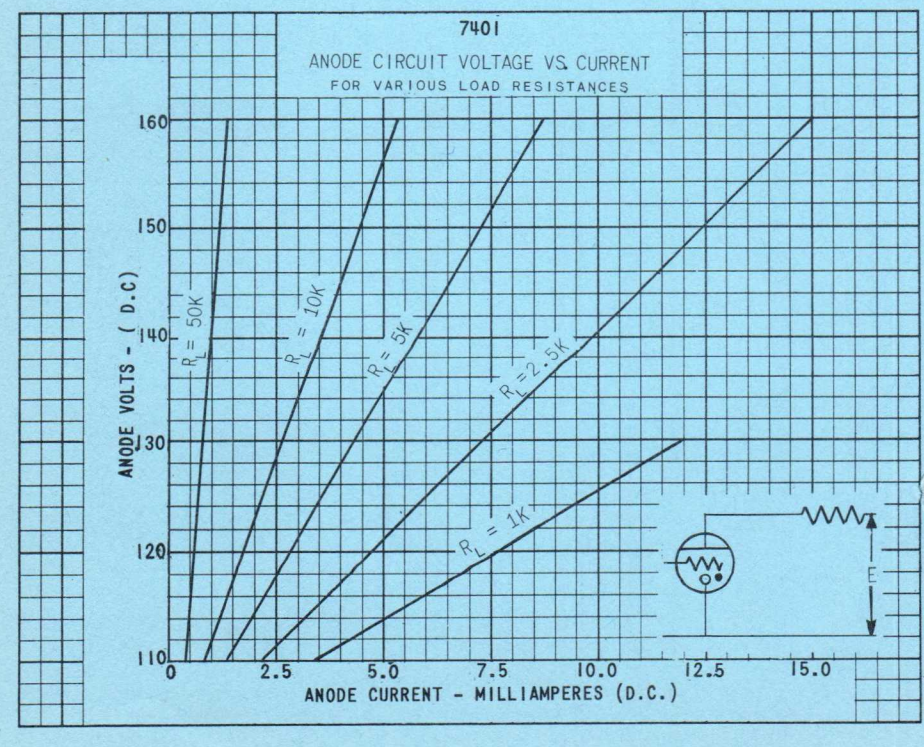
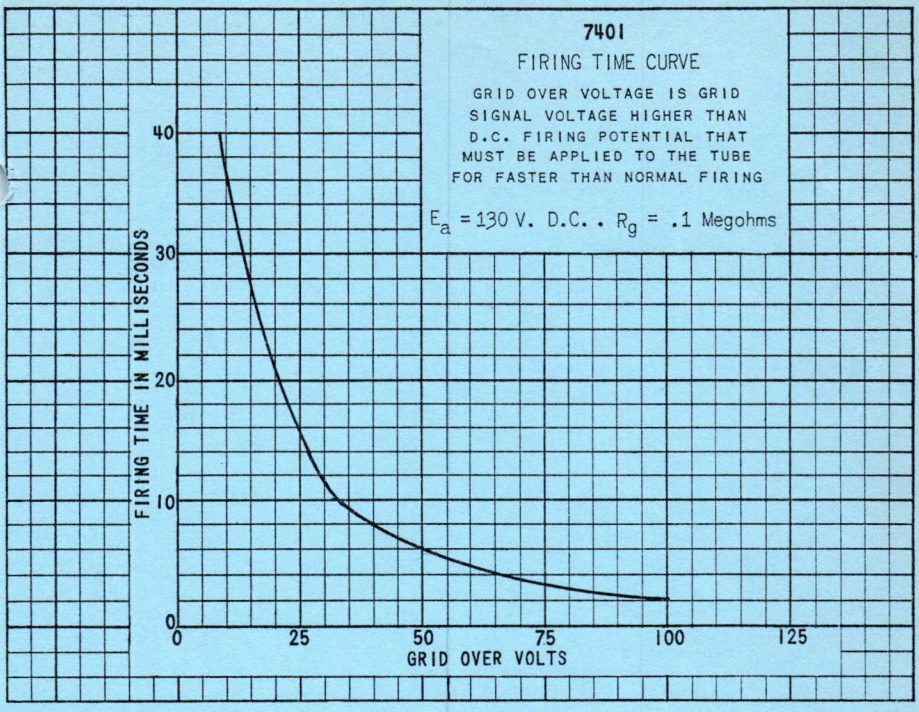

7401
ANODE CHARACTERISTICS
ANODE VOLTS - (DC)
125
100
75
50
25
0
0
2.5
5.0
7.5
10.0
12.5
15.0
ANODE CURRENT - MILLIAMPERES
E


7401
ANODE CIRCUIT VOLTAGE VS. CURRENT
FOR VARIOUS LOAD RESISTANCES
ANODE VOLTS - (D.C)
160
150
140
130
120
110
0
2.5
5.0
7.5
10.0
12.5
15.0
ANODE CURRENT - MILLIAMPERES (D.C.)
RL = 50K
RL = 10K
RL = 5K
RL = 2.5K
RL = 1K
E



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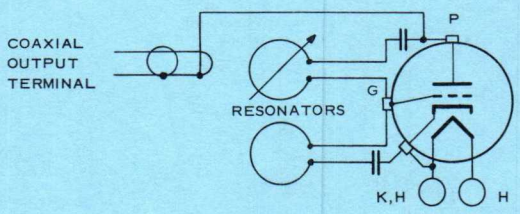
TUNG-SOL

TRIODE OSCILLATOR

THE 7533 IS AN INTEGRAL-CAVITY OSCILLATOR ASSEMBLY DESIGNED FOR TRANSMITTING SERVICE IN BATTERY POWERED RADIOSONDES OPERATING NEAR 1680 MC/S. IT INCORPORATES A PENCIL TRIODE WITH UNUSUALLY LOW HEATER POWER BATTERY DRAIN, RELATIVELY HIGH PLATE CIRCUIT EFFICIENCY, LOW FREQUENCY DRIFT AND A WEIGHT OF ONLY 0.8 OUNCES. THE OUTPUT FREQUENCY CAN BE ADJUSTED BETWEEN 1660 AND 1700 MC/S BY MEANS OF 2 ADJUSTMENT SCREWS POSITIONED IN THE PLATE RESONATOR. THE CATHODE RESONATOR IS PRE-TUNED FOR UNIFORM POWER OUTPUT OVER THE TUNEABLE FREQUENCY RANGE. THE COAXIAL TERMINAL IS LOOP COUPLED TO THE PLATE RESONATOR.

MECHANICAL DATA

TERMINAL CONNECTIONS



H: HEATER
K: CATHODE
G: GRID
P: PLATE

PHYSICAL DIMENSIONS — SEE OUTLINE AND NOTES

ELECTRICAL DATA

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.0	VOLTS	160	MA.
LIMITS OF APPLIED VOLTAGE			5.2 TO 6.6	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

FOR ALTITUDES UP TO 100,000 FEET

DC PLATE-TO-GRID VOLTAGE	130	VOLTS
PLATE DISSIPATION	3.6	WATTS
PLATE INPUT	4	WATTS
DC PLATE CURRENT	34	MA.
DC GRID CURRENT	8	MA.
AMBIENT TEMPERATURE	−55 TO +75	°C

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TUNG-SOL

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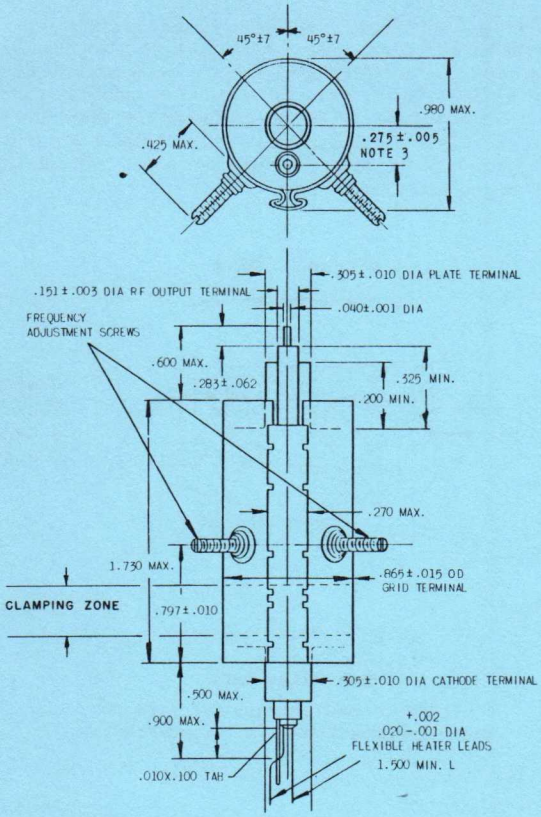
OUTLINE



DIMENSIONS IN INCHES

NOTES:

1. THE AXES OF THE INNER AND OUTER CONDUCTORS OF THE COAXIAL OUTPUT TERMINAL COINCIDE WITHIN 0.010".

2. THE END OF THE INSULATOR IN THE COAXIAL OUTPUT TERMINAL ALIGNS WITH THE EDGE OF THE OUTER CONDUCTOR (0.151" ± 0.003" DIAMETER) WITHIN 0.005"

3. DISTANCE BETWEEN CENTER LINE OF PLATE TERMINAL AND CENTER LINE OF INNER CONDUCTOR (0.040" ± 0.001" DIAMETER).

CONTINUED ON FOLLOWING PAGE

TUNG-SOL

CONTINUED FROM PRECEDING PAGE

OPERATION AS CLASS C OSCILLATOR

OPERATING FREQUENCY	1680	MC/S
CHARACTERISTICS IMPEDANCE OF COAXIAL OUTPUT TERMINAL (APPROX.)	50	Ω
DC PLATE SUPPLY VOLTAGE	117	VOLTS
GRID RESISTOR - ADJUSTED FOR STATED PLATE CURRENT AVG. VALUE	1500	Ω
DC PLATE CURRENT	27	MA.
DC GRID CURRENT	4.5	MA.
USEFUL POWER OUTPUT (APPROX.)	575	MW.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	MIN.	MAX.	
TUNING RANGE	1660	1700	MC/S
LOAD ADJUSTED FOR VOLTAGE STANDING WAVE RATIO		1.1	
HEATER CURRENT AT Ef = 5.2 V.	135	157	MA.
GRID RESISTOR - SEE NOTE	1300	2400	Ω
USEFUL POWER OUTPUT AT Ef = 5.2 V., Ebb = 95 V.	250	------	MW.

SPECIAL TESTS AND PERFORMANCE DATA

CONTROLLED ON A SAMPLING BASIS

LOW-PRESSURE VOLTAGE BREAKDOWN TEST

HIGH-FREQUENCY VIBRATION TEST

MILITARY SPECIFICATIONS SHORTS AND CONTINUITY TEST PERFORMED ON ALL DEVICES

TEMPERATURE-FREQUENCY PERFORMANCE

5 HOUR RADIOSONDE LIFE PERFORMANCE TEST

NOTE:

ADJUSTED TO GIVE PLATE CURRENT AS CLOSE AS POSSIBLE, BUT NOT EXCEEDING 33 MA. OPERATE WITH Ef = 6.6 V., Ebb = 117 V., PLATE LOAD RESISTANCE OF 50 Ω, FREQUENCY ADJUSTED TO 1660 +3, −1 MC/S.

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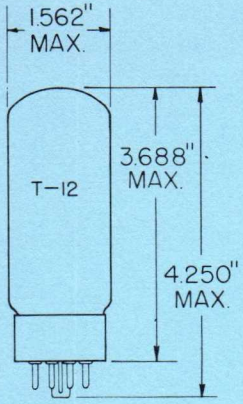
TUNG-SOL

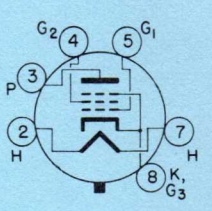
BEAM-POWER PENTODE



GLASS BULB
SHORT MEDIUM SHELL
6 PIN OCTAL 86-248
LOW LOSS MATERIAL
OUTLINE DRAWING
JEDEC 12-15

COATED UNIPOTENTIAL CATHODE

AUDIO-FREQUENCY POWER AMPLIFIER



BOTTOM VIEW

BASING DIAGRAM
JEDEC 7AC

THE 7581 IS A BEAM-POWER PENTODE PRIMARILY DESIGNED FOR USE IN AUDIO-FREQUENCY POWER-AMPLIFIER APPLICATIONS. THE TUBE IS A DIRECT REPLACEMENT FOR THE 6L6GC, BUT FEATURES ADDITIONAL CONTROLLED ZERO-BIAS CHARACTERISTICS AND A LOW-LOSS BASE.

DIRECT INTERELECTRODE CAPACITANCES - APPROX.

WITHOUT EXTERNAL SHIELD

GRID #1 TO PLATE	0.6	pf
INPUT	10	pf
OUTPUT	6.5	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	900	MA.
HEATER SUPPLY LIMITS:			
VOLTAGE OPERATION		6.3±0.6	VOLTS
HEATER-CATHODE VOLTAGE, MAX.			
HEATER POSITIVE WITH RESPECT TO CATHODE	200⊕	200●	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE	200⊕	200●	VOLTS

⊕PENTODE CONNECTION.

●TRIODE CONNECTION.

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MAXIMUM RATINGS

→ DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

	PENTODE CONNECTION	TRIODE[A] CONNECTION	
PLATE VOLTAGE	500	450	VOLTS
SCREEN VOLTAGE	450[B]	---	VOLTS
PLATE DISSIPATION	30	---	WATTS
SCREEN DISSIPATION	5.0	---	WATTS
GRID #1 CIRCUIT RESISTANCE:			
WITH FIXED BIAS	0.1	0.1	MEGOHMS
WITH CATHODE BIAS	0.5	0.5	MEGOHMS

TYPICAL OPERATING CHARACTERISTICS

AVERAGE CHARACTERISTICS

PLATE VOLTAGE	70	250	VOLTS
SCREEN VOLTAGE	300	250	VOLTS
GRID #1 VOLTAGE	0[C]	-14	VOLTS
PEAK AF GRID #1 VOLTAGE	---	14	VOLTS
PLATE RESISTANCE, APPROX.	---	22500	OHMS
TRANSCONDUCTANCE	---	6000	MICROMHOS
PLATE CURRENT	210	72	MA.
SCREEN CURRENT	25	5.0	MA.

CLASS A_1 AMPLIFIER - TRIODE CONNECTION[A]

PLATE VOLTAGE	250	VOLTS
GRID #1 VOLTAGE	-20	VOLTS
PEAK AF GRID #1 VOLTAGE	20	VOLTS
AMPLIFICATION FACTOR	8	
PLATE RESISTANCE, APPROX.	1700	OHMS
TRANSCONDUCTANCE	4700	MICROMHOS
ZERO-SIGNAL PLATE CURRENT	40	MA.
MAXIMUM-SIGNAL PLATE CURRENT	44	MA.
LOAD RESISTANCE	5000	OHMS
TOTAL HARMONIC DISTORTION, APPROX.	5	PERCENT
MAXIMUM-SIGNAL POWER OUTPUT	1.4	WATTS

CLASS A_1 AMPLIFIER - PENTODE CONNECTION

PLATE VOLTAGE	250	300	350	VOLTS
SCREEN VOLTAGE	250	200	250	VOLTS
GRID #1 VOLTAGE	-14	-12.5	-18	VOLTS
PEAK AF GRID #1 VOLTAGE	14	12.5	18	VOLTS
PLATE RESISTANCE, APPROX.	22500	35000	33000	OHMS
TRANSCONDUCATANCE	6000	5300	5200	MICROMHOS
ZERO-SIGNAL PLATE CURRENT	72	48	54	MA.
MAX.-SIGNAL PLATE CURRENT	79	55	66	MA.
ZERO-SIGNAL SCREEN CURRENT	5.0	2.5	2.5	MA.
MAX.-SIGNAL SCREEN CURRENT	7.3	4.7	7.0	MA.
LOAD RESISTANCE	2500	4500	4200	OHMS
TOTAL HARMONIC DISTORTION, APPROX.	10	11	15	PERCENT
MAX.-SIGNAL POWER OUTPUT	6.5	6.5	10.8	WATTS

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→ INDICATES A CHANGE.

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TYPICAL OPERATING CHARACTERISTICS - CONT'D.

PUSH-PULL CLASS A_1 AMPLIFIER - VALUES FOR TWO TUBES

PLATE VOLTAGE	250	270	VOLTS
SCREEN VOLTAGE	250	270	VOLTS
GRID #1 VOLTAGE	-16	-17.5	VOLTS
PEAK AF GRID-TO-GRID VOLTAGE	32	35	VOLTS
ZERO-SIGNAL PLATE CURRENT	120	134	MA.
MAX.-SIGNAL PLATE CURRENT	140	155	MA.
ZERO-SIGNAL SCREEN CURRENT	10	11	MA.
MAX.-SIGNAL SCREEN CURRENT	16	17	MA.
EFFECTIVE LOAD RESISTANCE, PLATE-TO-PLATE	5000	5000	OHMS
TOTAL HARMONIC DISTORTION	2	2	PERCENT
MAX.-SIGNAL POWER OUTPUT	14.5	17.5	WATTS

PUSH-PULL CLASS AB_1 AMPLIFIER - VALUES FOR TWO TUBES

PLATE VOLTAGE	360	360	450	VOLTS
SCREEN VOLTAGE	270	270	400	VOLTS
GRID #1 VOLTAGE	-22.5	-22.5	-37	VOLTS
PEAK AF GRID-TO-GRID VOLTAGE	45	45	70	VOLTS
ZERO-SIGNAL PLATE CURRENT	88	88	116	MA.
MAX.-SIGNAL PLATE CURRENT	132	140	210	MA.
ZERO-SIGNAL SCREEN CURRENT	5.0	5.0	5.6	MA.
MAX.-SIGNAL SCREEN CURRENT	15	11	22	MA.
EFFECTIVE LOAD RESISTANCE, PLATE-TO-PLATE	6600	3800	5600	OHMS
TOTAL HARMONIC DISTORTION	2	2	1.8	PERCENT
MAX.-SIGNAL POWER OUTPUT	26.5	18	55	WATTS

PUSH-PULL CLASS AB_2 AMPLIFIER - VALUES FOR TWO TUBES

PLATE VOLTAGE	360	360	VOLTS
SCREEN VOLTAGE	225	270	VOLTS
GRID #1 VOLTAGE	-18	-22.5	VOLTS
PEAK AF GRID-TO-GRID VOLTAGE	52	72	VOLTS
ZERO-SIGNAL PLATE CURRENT	78	88	MA.
MAX.-SIGNAL PLATE CURRENT	142	205	MA.
ZERO-SIGNAL SCREEN CURRENT	3.5	5.0	MA.
MAX.-SIGNAL SCREEN CURRENT	11	16	MA.
EFFECTIVE LOAD RESISTANCE, PLATE TO PLATE	6000	3800	OHMS
TOTAL HARMONIC DISTORTION	2	2	PERCENT
MAX.-SIGNAL POWER OUTPUT	31	47	WATTS

DESIGN-MAXIMUM RATINGS ARE LIMITING VALUES OF OPERATING AND ENVIRONMENTAL CONDITIONS APPLICABLE TO A BOGEY ELECTRON DEVICE OF A SPECIFIED TYPE AS DEFINED BY ITS PUBLISHED DATA, AND SHOULD NOT BE EXCEEDED UNDER THE WORST PROBABLE CONDITIONS. THE DEVICE MANUFACTURER CHOOSES THESE VALUES TO PROVIDE ACCEPTABLE SERVICEABILITY OF THE DEVICE, TAKING RESPONSIBILITY FOR THE EFFECTS OF CHANGES IN OPERATING CONDITIONS DUE TO VARIATIONS IN DEVICE CHARACTERISTICS. THE EQUIPMENT MANUFACTURER SHOULD DESIGN SO THAT INITIALLY AND THROUGHOUT LIFE NO DESIGN-MAXIMUM VALUE FOR THE INTENDED SERVICE IS EXCEEDED WITH A BOGEY DEVICE UNDER THE WORST PROBABLE OPERATING CONDITIONS WITH RESPECT TO SUPPLY-VOLTAGE VARIATION, EQUIPMENT COMPONENT VARIATION, EQUIPMENT CONTROL ADJUSTMENT, LOAD VARIATION, SIGNAL VARIATION, AND ENVIRONMENTAL CONDITIONS.

[A] WITH SCREEN CONNECTED TO PLATE.

[B] THE MAXIMUM SCREEN VOLTAGE RATING IS 500 VOLTS IN PUSH-PULL CIRCUITS WHERE THE SCREEN OF EACH TUBE IS CONNECTED TO A TAP ON THE PLATE WINDING OF THE OUTPUT TRANSFORMER.

[C] APPLIED FOR SHORT INTERVAL (TWO SECONDS MAXIMUM) SO AS NOT TO DAMAGE TUBE.

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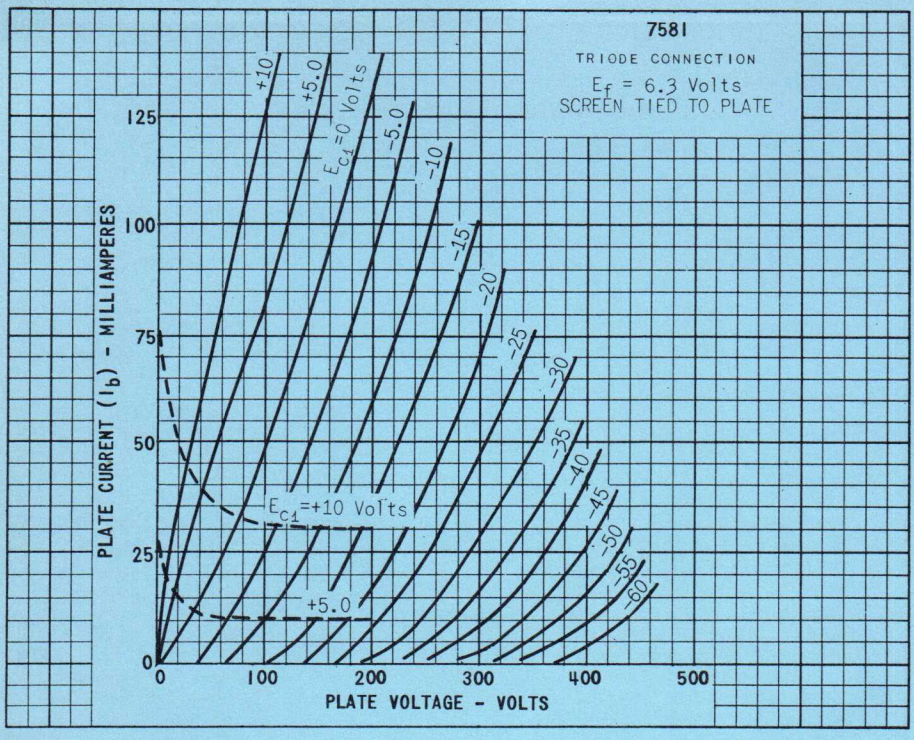
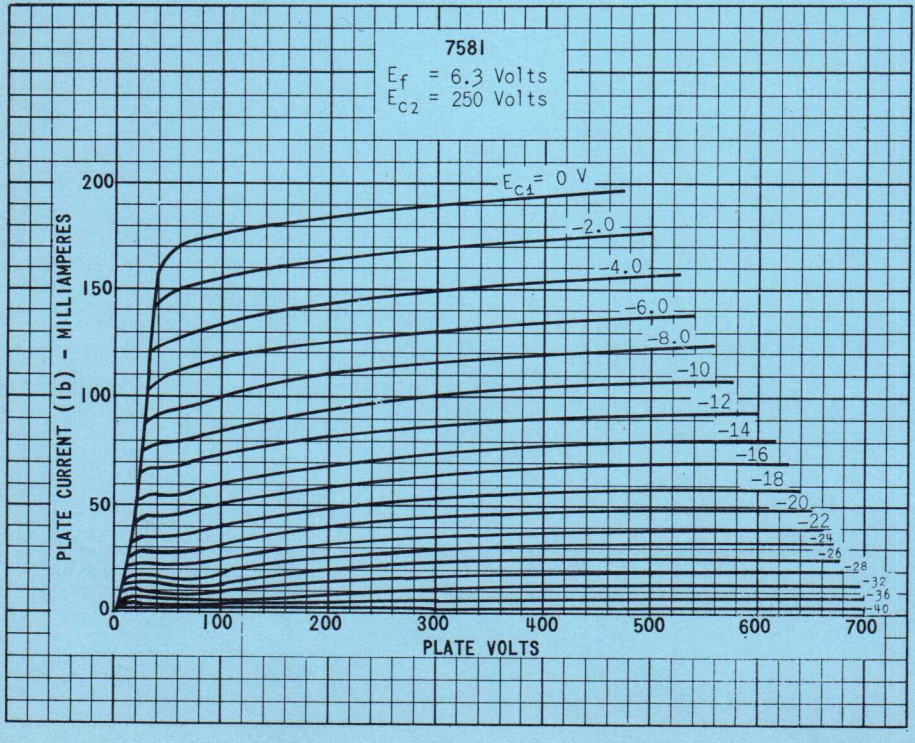
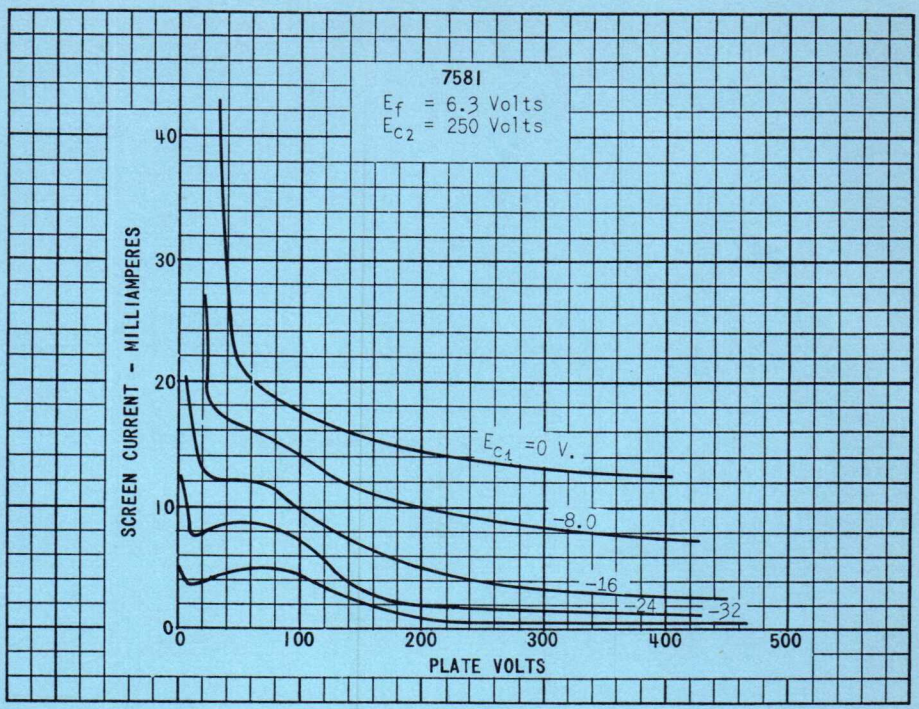
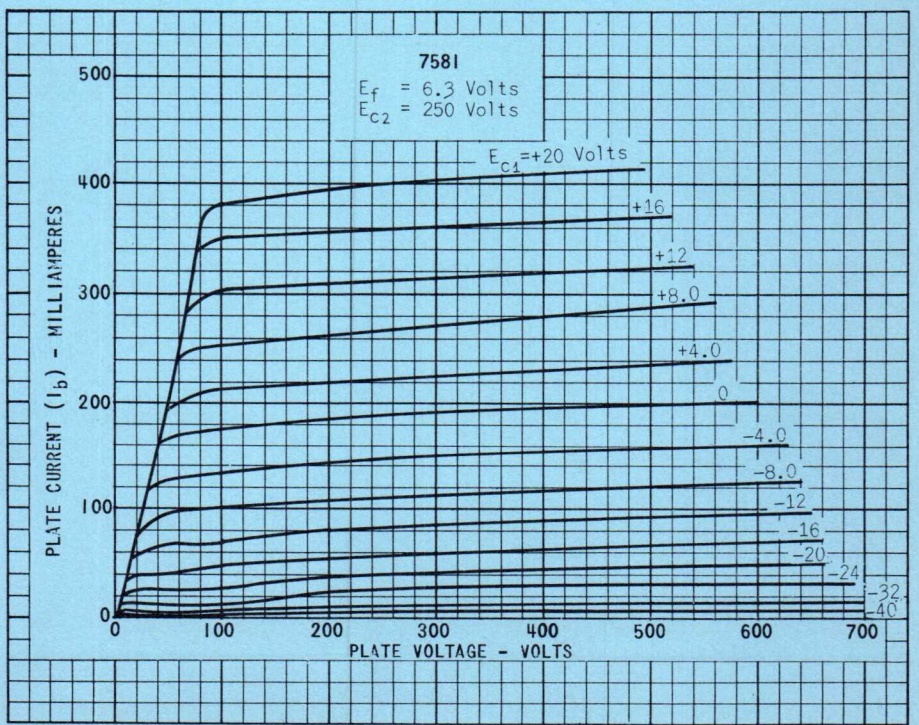

7581
TRIODE CONNECTION
E_f = 6.3 Volts
SCREEN TIED TO PLATE
PLATE CURRENT (I_b) - MILLIAMPERES
PLATE VOLTAGE - VOLTS
E_{C1}=0 Volts
E_{C1}=+10 Volts
+10
+5.0
-5.0
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
0
25
50
75
100
125
0
100
200
300
400
500


7581
E_f = 6.3 Volts
E_{C2} = 250 Volts
PLATE CURRENT (Ib) - MILLIAMPERES
PLATE VOLTS
E_{C1}= 0 V
-2.0
-4.0
-6.0
-8.0
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-32
-36
-40
0
50
100
150
200
0
100
200
300
400
500
600
700





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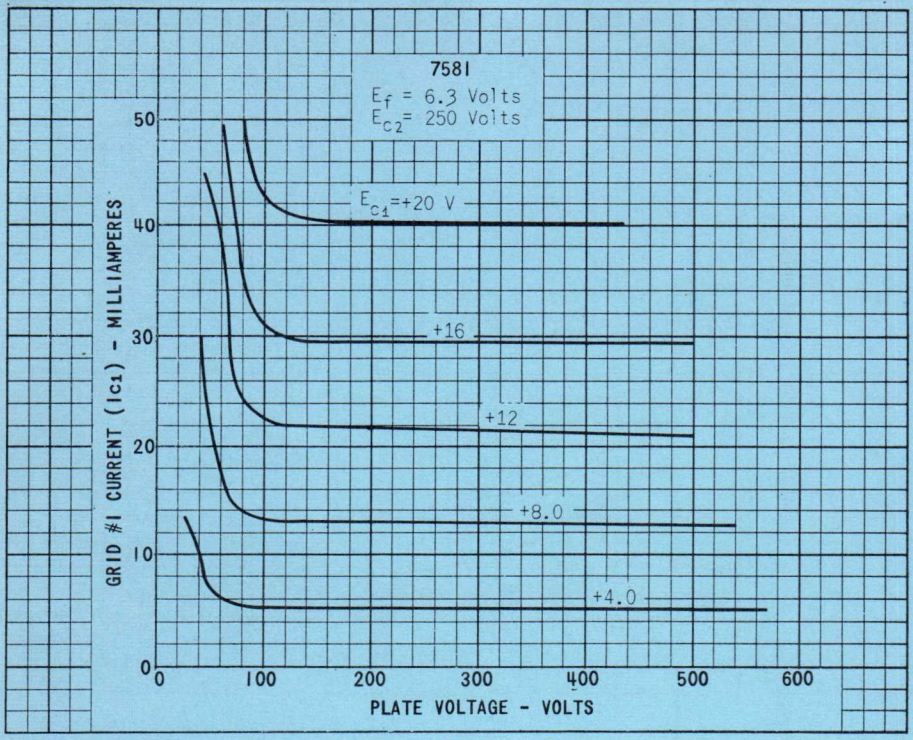
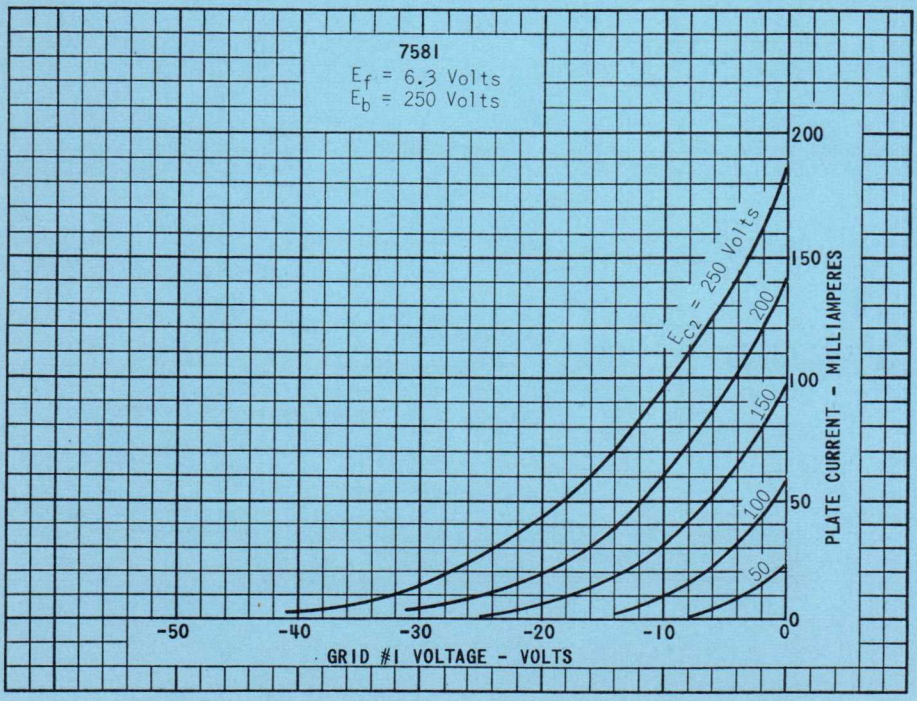
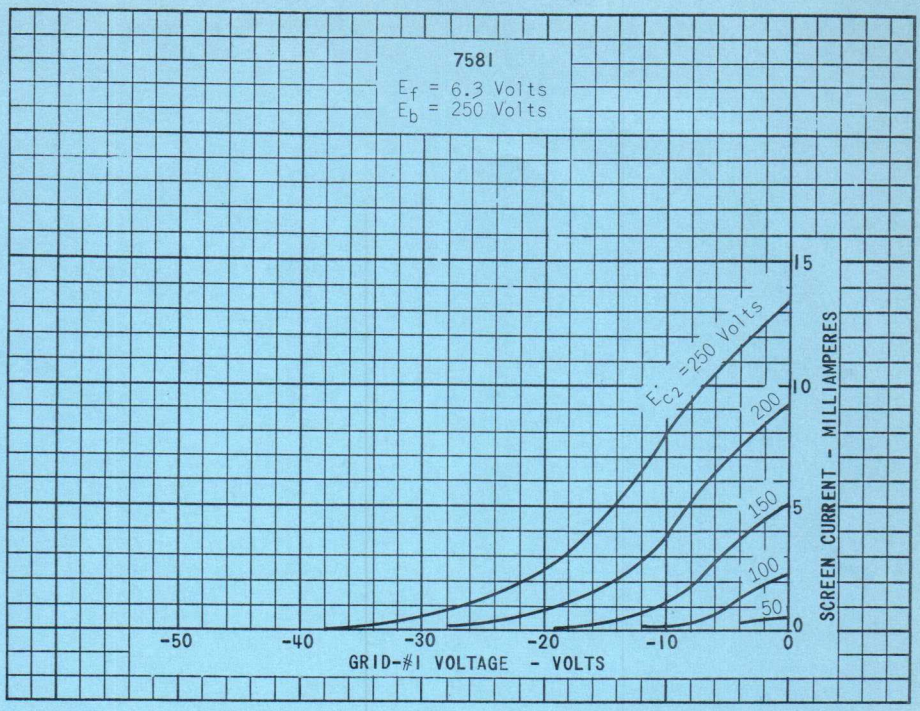
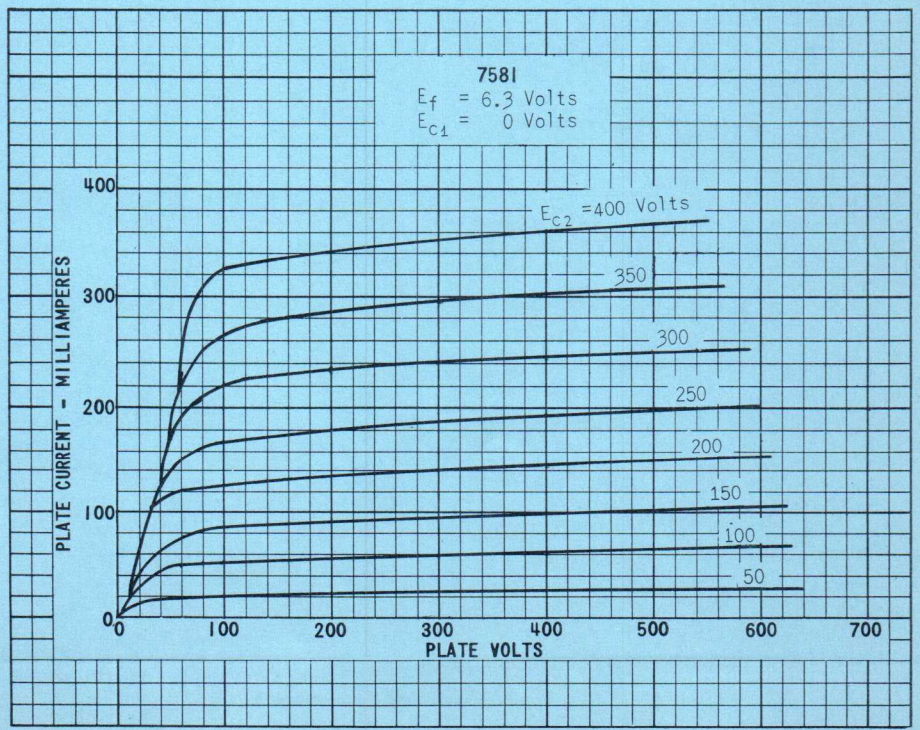

7581
E_f = 6.3 Volts
E_{c2} = 250 Volts
E_{c1}=+20 V
+16
+12
+8.0
+4.0
GRID #1 CURRENT (I_{c1}) - MILLIAMPERES
0
10
20
30
40
50
0
100
200
300
400
500
600
PLATE VOLTAGE - VOLTS


7581
E_f = 6.3 Volts
E_b = 250 Volts
E_{c2} = 250 Volts
200
150
100
50
PLATE CURRENT - MILLIAMPERES
0
50
100
150
200
-50
-40
-30
-20
-10
0
GRID #1 VOLTAGE - VOLTS





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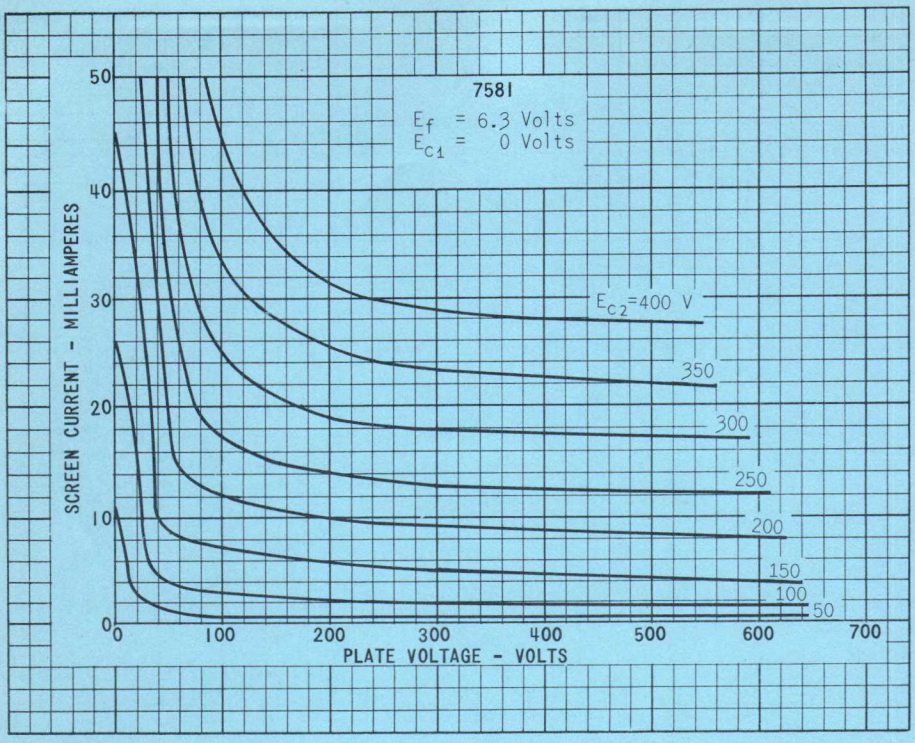
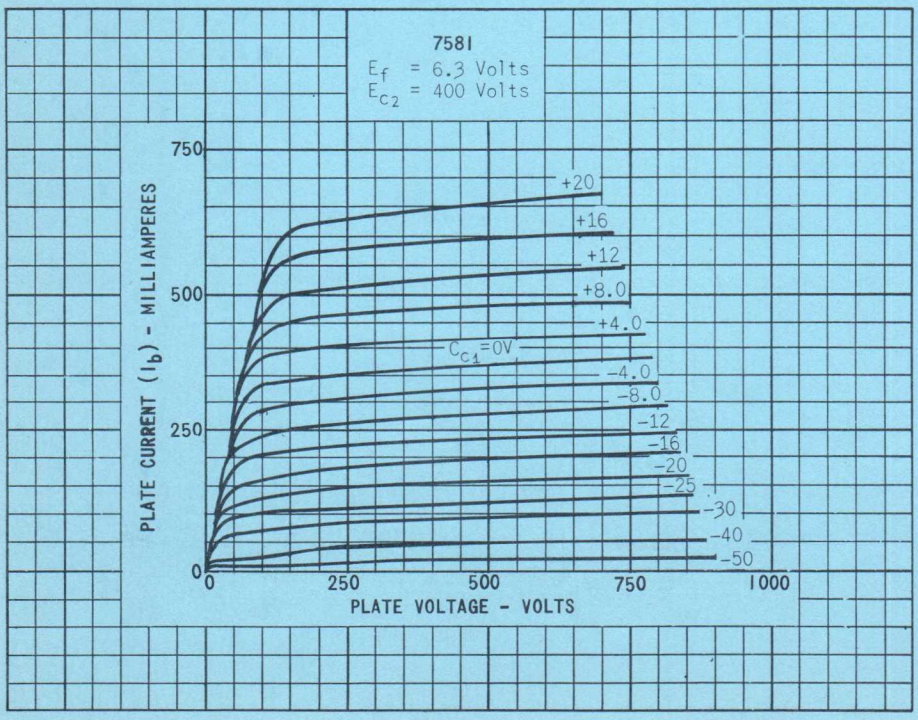
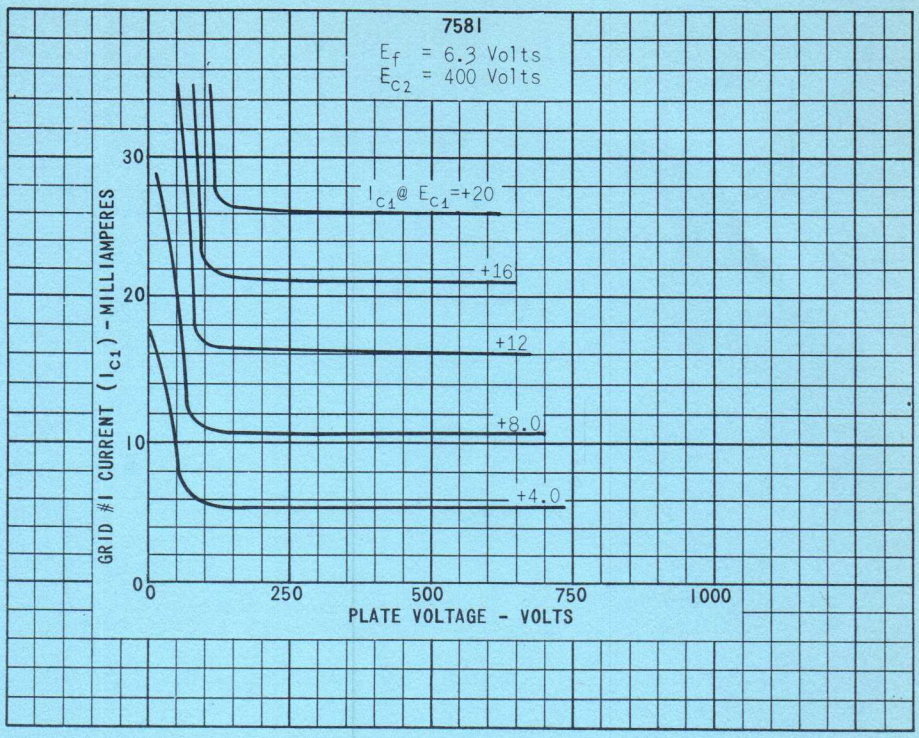
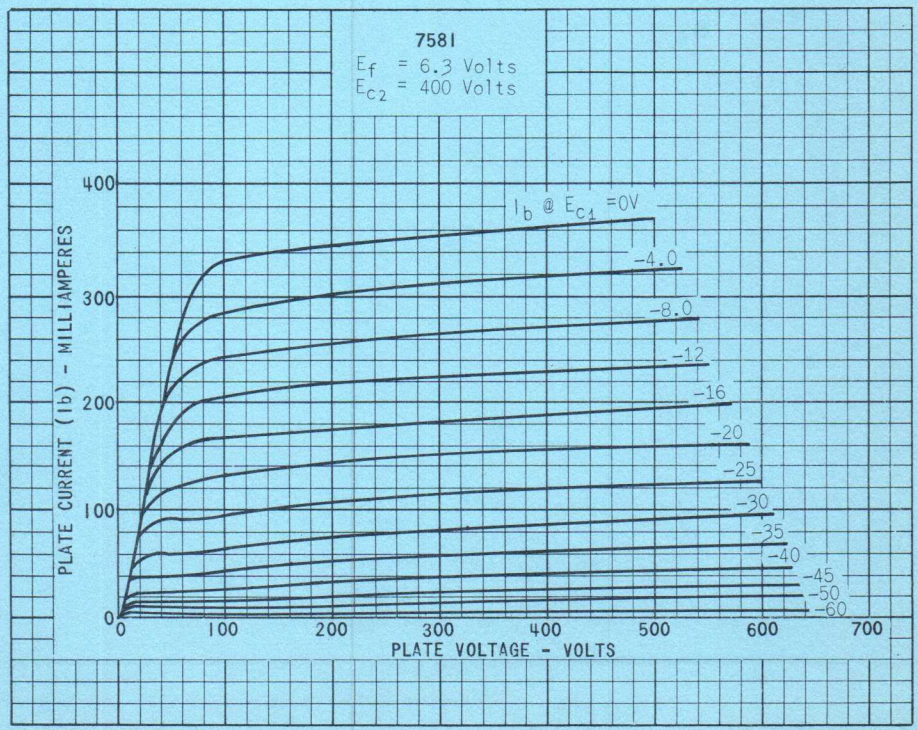

7581
E_f = 6.3 Volts
E_{c1} = 0 Volts
SCREEN CURRENT - MILLIAMPERES
PLATE VOLTAGE - VOLTS
E_{c2}=400 V
350
300
250
200
150
100
50
0
10
20
30
40
50
0
100
200
300
400
500
600
700


7581
E_f = 6.3 Volts
E_{c2} = 400 Volts
PLATE CURRENT (I_b) - MILLIAMPERES
PLATE VOLTAGE - VOLTS
+20
+16
+12
+8.0
+4.0
C_{c1}=0V
-4.0
-8.0
-12
-16
-20
-25
-30
-40
-50
0
250
500
750
1000





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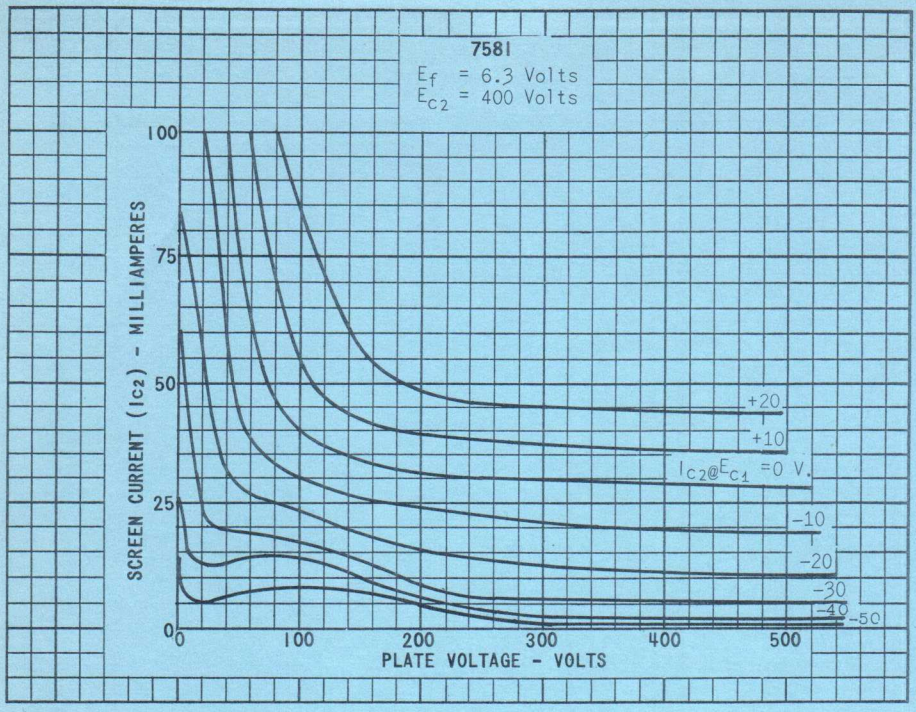
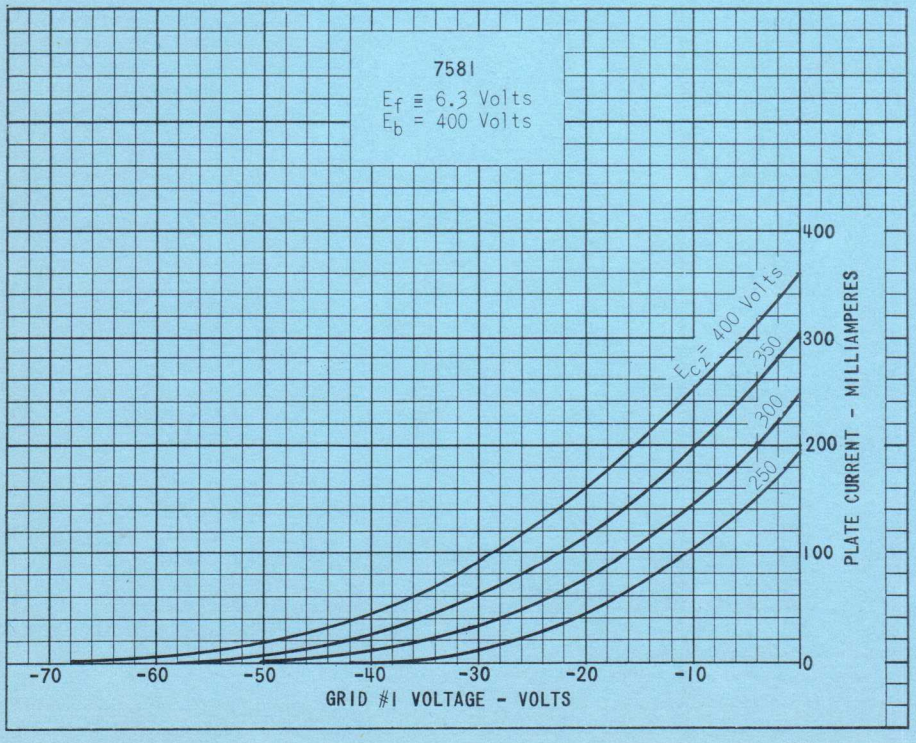
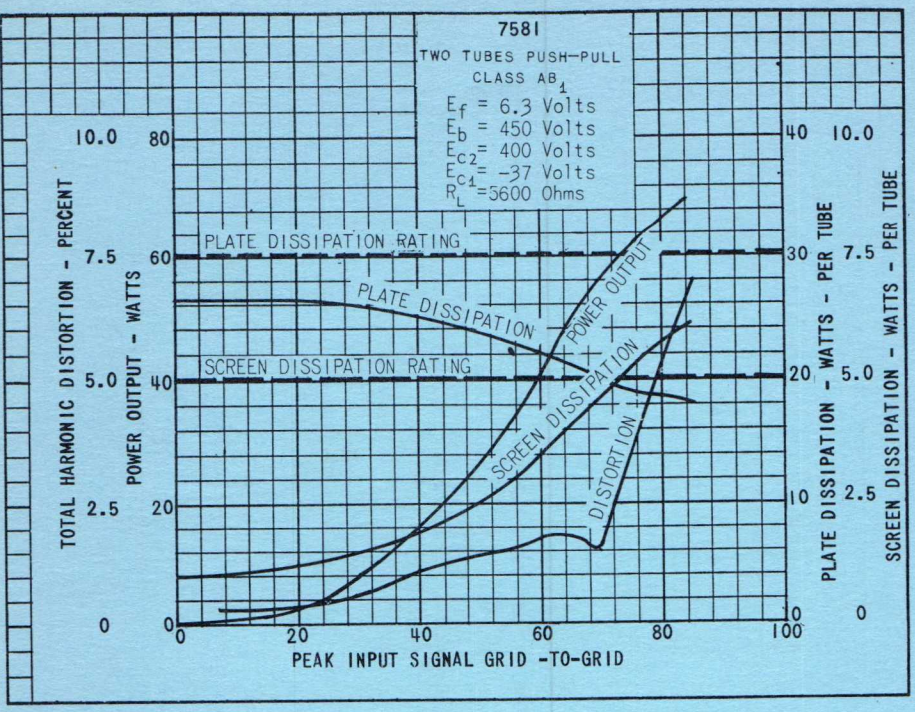
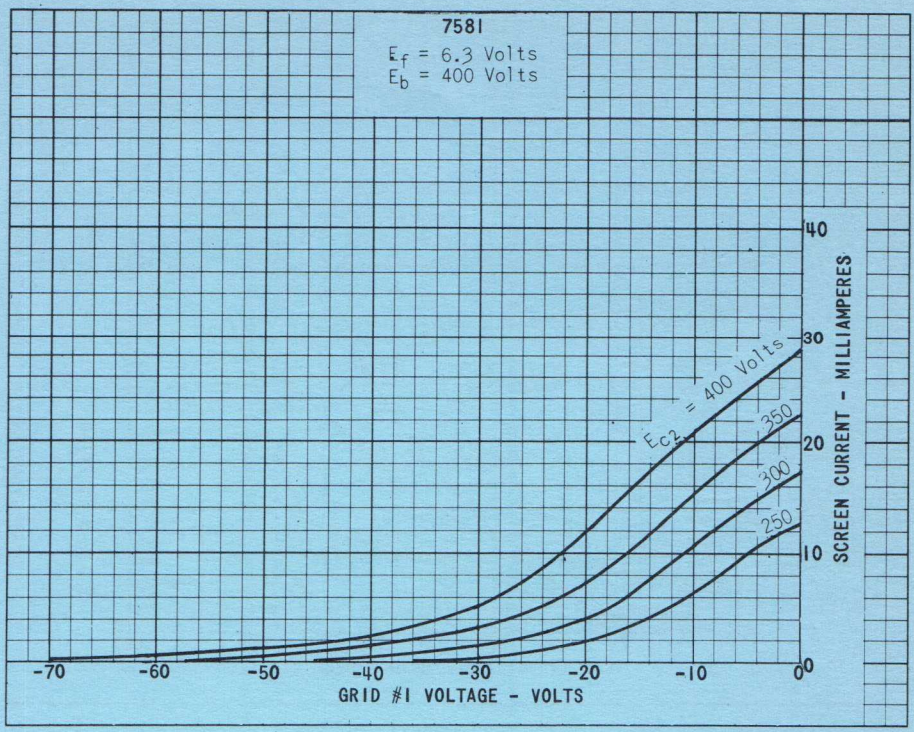
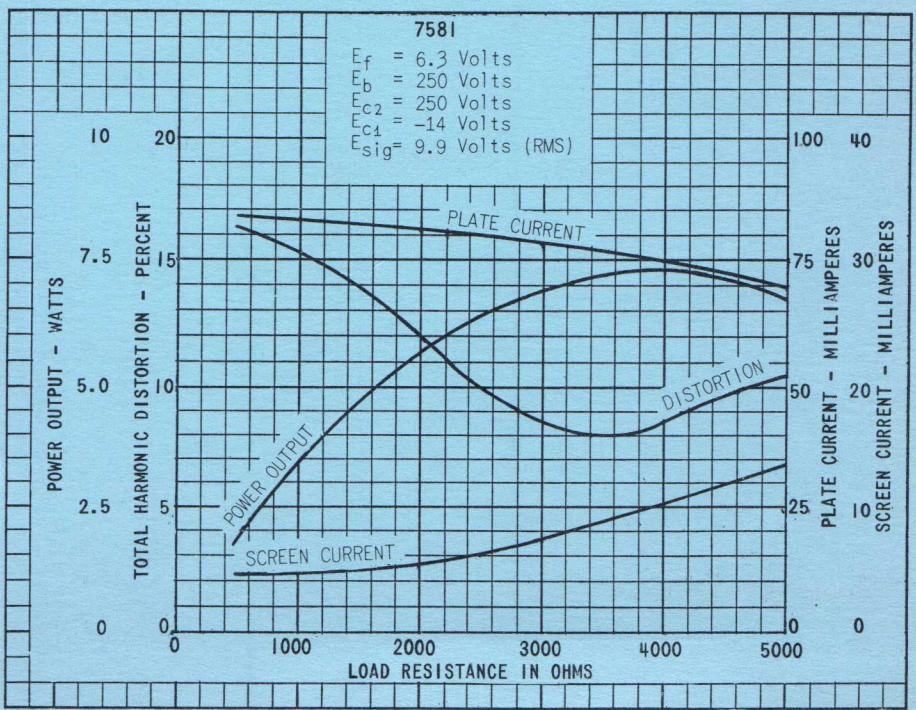

7581
E_f = 6.3 Volts
E_{c2} = 400 Volts
SCREEN CURRENT (I_{c2}) - MILLIAMPERES
100
75
50
25
0
0
100
200
300
400
500
PLATE VOLTAGE - VOLTS
+20
+10
I_{c2}@E_{c1} =0 V.
-10
-20
-30
-40
-50


7581
E_f = 6.3 Volts
E_b = 400 Volts
PLATE CURRENT - MILLIAMPERES
400
300
200
100
0
E_{c2} = 400 Volts
350
300
250
-70
-60
-50
-40
-30
-20
-10
GRID #1 VOLTAGE - VOLTS


7581
TWO TUBES PUSH-PULL
CLASS AB1
Ef = 6.3 Volts
Eb = 450 Volts
Ec2 = 400 Volts
Ec1 = -37 Volts
RL = 5600 Ohms
PLATE DISSIPATION RATING
SCREEN DISSIPATION RATING
PLATE DISSIPATION
POWER OUTPUT
SCREEN DISSIPATION
DISTORTION
TOTAL HARMONIC DISTORTION - PERCENT
POWER OUTPUT - WATTS
PLATE DISSIPATION - WATTS - PER TUBE
SCREEN DISSIPATION - WATTS - PER TUBE
PEAK INPUT SIGNAL GRID -TO-GRID
0
20
40
60
80
100
10.0
7.5
5.0
2.5
0





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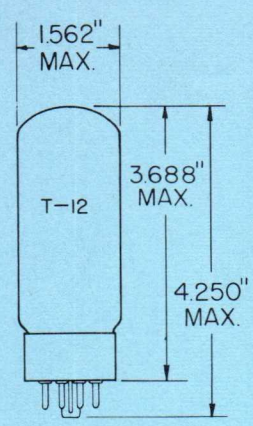
TUNG-SOL

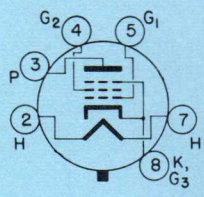
BEAM-POWER PENTODE



GLASS BULB
SHORT MEDIUM SHELL
6 PIN OCTAL B6-148
LOW LOSS MATERIAL
OUTLINE DRAWING
JEDEC 12-15

COATED UNIPOTENTIAL CATHODE

AUDIO-FREQUENCY POWER AMPLIFIER



BOTTOM VIEW

BASING DIAGRAM
JEDEC 7AC

THE 7581A IS A BEAM-POWER PENTODE PRIMARILY DESIGNED FOR USE IN AUDIO-FREQUENCY POWER-AMPLIFIER APPLICATIONS. THE 7581A IS UNILATERALLY INTERCHANGEABLE WITH THE 7581 AND THE 6L6GC.

DIRECT INTERELECTRODE CAPACITANCES - APPROX.

WITHOUT EXTERNAL SHIELD

GRID #1 TO PLATE	0.6	pf
INPUT	10	pf
OUTPUT	6.5	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	900	MA.
HEATER SUPPLY LIMITS:			
VOLTAGE OPERATION		6.3±0.6	VOLTS
HEATER-CATHODE VOLTAGE, MAX.			
HEATER POSITIVE WITH RESPECT TO CATHODE	200⊕	200●	VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE	200⊕	200●	VOLTS

⊕PENTODE CONNECTION.

●TRIODE CONNECTION.

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MAXIMUM RATINGS

→ DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

	PENTODE CONNECTION	TRIODE CONNECTION[A]	
PLATE VOLTAGE	500	450	VOLTS
SCREEN VOLTAGE	450[B]	---	VOLTS
PLATE DISSIPATION	35	35	WATTS
SCREEN DISSIPATION	5.0	---	WATTS
GRID #1 CIRCUIT RESISTANCE:			
WITH FIXED BIAS	0.1	0.1	MEGOHMS
WITH CATHODE BIAS	0.5	0.5	MEGOHMS

TYPICAL OPERATING CHARACTERISTICS

AVERAGE CHARACTERISTICS

PLATE VOLTAGE	70	250	**VOLTS**
SCREEN VOLTAGE	300	250	**VOLTS**
GRID #1 VOLTAGE	0[C]	-14	**VOLTS**
PLATE RESISTANCE, APPROX.	---	22500	OHMS
TRANSCONDUCTANCE	---	6000	MICROMHOS
PLATE CURRENT	210	72	MA.
SCREEN CURRENT	25	5.0	MA.

CLASS A_1 AMPLIFIER - TRIODE CONNECTION[A]

PLATE VOLTAGE	250	VOLTS
GRID #1 VOLTAGE	-20	VOLTS
PEAK AF GRID #1 VOLTAGE	20	VOLTS
AMPLIFICATION FACTOR	8	
PLATE RESISTANCE, APPROX.	1700	OHMS
TRANSCONDUCTANCE	4700	MICROMHOS
ZERO-SIGNAL PLATE CURRENT	40	MA.
MAXIMUM-SIGNAL PLATE CURRENT	44	MA.
LOAD RESISTANCE	5000	OHMS
TOTAL HARMONIC DISTORTION, APPROX.	5	PERCENT
MAXIMUM-SIGNAL POWER OUTPUT	1.4	WATTS

CLASS A_1 AMPLIFIER - PENTODE CONNECTION

PLATE VOLTAGE	250	300	350	VOLTS
SCREEN VOLTAGE	250	200	250	VOLTS
GRID #1 VOLTAGE	-14	-12.5	-18	VOLTS
PEAK AF GRID #1 VOLTAGE	14	12.5	18	VOLTS
PLATE RESISTANCE, APPROX.	22500	35000	33000	OHMS
TRANSCONDUCATANCE	6000	5300	5200	MICROMHOS
ZERO-SIGNAL PLATE CURRENT	72	48	54	MA.
MAX.-SIGNAL PLATE CURRENT	79	55	66	MA.
ZERO-SIGNAL SCREEN CURRENT	5.0	2.5	2.5	MA.
MAX.-SIGNAL SCREEN CURRENT	7.3	4.7	7.0	MA.
LOAD RESISTANCE	2500	4500	4200	OHMS
TOTAL HARMONIC DISTORTION, APPROX.	10	11	15	PERCENT
MAX.-SIGNAL POWER OUTPUT	6.5	6.5	10.8	WATTS

CONTINUED ON FOLLOWING PAGE

→ INDICATES A CHANGE.

CONTINUED FROM PRECEDING PAGE

TYPICAL OPERATING CHARACTERISTICS - CONT'D.

PUSH-PULL CLASS A_1 AMPLIFIER - VALUES FOR TWO TUBES

PLATE VOLTAGE	250	270	VOLTS
SCREEN VOLTAGE	250	270	VOLTS
GRID #1 VOLTAGE	-16	-17.5	VOLTS
PEAK AF GRID-TO-GRID VOLTAGE	32	35	VOLTS
ZERO-SIGNAL PLATE CURRENT	120	134	MA.
MAX.-SIGNAL PLATE CURRENT	140	155	MA.
ZERO-SIGNAL SCREEN CURRENT	10	11	MA.
MAX.-SIGNAL SCREEN CURRENT	16	17	MA.
EFFECTIVE LOAD RESISTANCE, PLATE-TO-PLATE	5000	5000	OHMS
TOTAL HARMONIC DISTORTION	2	2	PERCENT
MAX.-SIGNAL POWER OUTPUT	14.5	17.5	WATTS

PUSH-PULL CLASS AB_1 AMPLIFIER - VALUES FOR TWO TUBES

PLATE VOLTAGE	360	360	450	VOLTS
SCREEN VOLTAGE	270	270	400	VOLTS
GRID #1 VOLTAGE	-22.5	-22.5	-37	VOLTS
PEAK AF GRID-TO-GRID VOLTAGE	45	45	70	VOLTS
ZERO-SIGNAL PLATE CURRENT	88	88	116	MA.
MAX.-SIGNAL PLATE CURRENT	132	140	210	MA.
ZERO-SIGNAL SCREEN CURRENT	5.0	5.0	5.6	MA.
MAX.-SIGNAL SCREEN CURRENT	15	11	22	MA.
EFFECTIVE LOAD RESISTANCE, PLATE-TO-PLATE	6600	3800	5600	OHMS
TOTAL HARMONIC DISTORTION	2	2	1.8	PERCENT
MAX.-SIGNAL POWER OUTPUT	26.5	18	55	WATTS

PUSH-PULL CLASS AB_2 AMPLIFIER - VALUES FOR TWO TUBES

PLATE VOLTAGE	360	360	VOLTS
SCREEN VOLTAGE	225	270	VOLTS
GRID #1 VOLTAGE	-18	-22.5	VOLTS
PEAK AF GRID-TO-GRID VOLTAGE	52	72	VOLTS
ZERO-SIGNAL PLATE CURRENT	78	88	MA.
MAX.-SIGNAL PLATE CURRENT	142	205	MA.
ZERO-SIGNAL SCREEN CURRENT	3.5	5.0	MA.
MAX.-SIGNAL SCREEN CURRENT	11	16	MA.
EFFECTIVE LOAD RESISTANCE, PLATE TO PLATE	6000	3800	OHMS
TOTAL HARMONIC DISTORTION	2	2	PERCENT
MAX.-SIGNAL POWER OUTPUT	31	47	WATTS

DESIGN-MAXIMUM RATINGS ARE LIMITING VALUES OF OPERATING AND ENVIRONMENTAL CONDITIONS APPLICABLE TO A BOGEY ELECTRON DEVICE OF A SPECIFIED TYPE AS DEFINED BY ITS PUBLISHED DATA, AND SHOULD NOT BE EXCEEDED UNDER THE WORST PROBABLE CONDITIONS. THE DEVICE MANUFACTURER CHOOSES THESE VALUES TO PROVIDE ACCEPTABLE SERVICEABILITY OF THE DEVICE, TAKING RESPONSIBILITY FOR THE EFFECTS OF CHANGES IN OPERATING CONDITIONS DUE TO VARIATIONS IN DEVICE CHARACTERISTICS. THE EQUIPMENT MANUFACTURER SHOULD DESIGN SO THAT INITIALLY AND THROUGHOUT LIFE NO DESIGN-MAXIMUM VALUE FOR THE INTENDED SERVICE IS EXCEEDED WITH A BOGEY DEVICE UNDER THE WORST PROBABLE OPERATING CONDITIONS WITH RESPECT TO SUPPLY-VOLTAGE VARIATION, EQUIPMENT COMPONENT VARIATION, EQUIPMENT CONTROL ADJUSTMENT, LOAD VARIATION, SIGNAL VARIATION, AND ENVIRONMENTAL CONDITIONS.

[A] WITH SCREEN CONNECTED TO PLATE.

[B] THE MAXIMUM SCREEN VOLTAGE RATING IS 500 VOLTS IN PUSH-PULL CIRCUITS WHERE THE SCREEN OF EACH TUBE IS CONNECTED TO A TAP ON THE PLATE WINDING OF THE OUTPUT TRANSFORMER.

[C] APPLIED FOR SHORT INTERVAL (TWO SECONDS MAXIMUM) SO AS NOT TO DAMAGE TUBE.

CONTINUED ON FOLLOWING.

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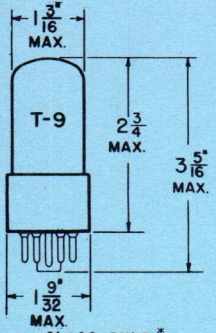
TUNG-SOL

PENTODE



GLASS BULB *

INTERMEDIATE SHELL
7 PIN OCTAL B7-233
WITH BARRIERS
OR
INTERMEDIATE SHELL
8 PIN OCTAL B8-142
WITH BARRIERS
OR
INTERMEDIATE SHELL
7 PIN OCTAL B7-238

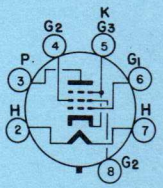
COATED UNIPOTENTIAL CATHODE

HEATER

6.3 VOLTS 0.80 AMP.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

THE 7591 IS A BEAM POWER PENTODE DESIGNED FOR USE AS AN AUDIO FREQUENCY POWER OUTPUT TUBE. IT HAS HIGH POWER SENSITIVITY AND HIGH EFFICIENCY AND IS ESPECIALLY DESIGNED FOR APPLICATIONS WHERE HIGH POWER OUTPUT IS REQUIRED.

DIRECT INTERELECTRODE CAPACITANCES

GRID TO PLATE	.25	μμf
INPUT: G1 TO (H+K+G2+G3)	10.0	μμf
OUTPUT: P TO (H+K+G2+G3	5.0	μμf

RATINGS

INTERPRETED ACCORDING TO DESIGN MAXIMUM SYSTEM

HEATER VOLTAGE	6.3	VOLTS
MAXIMUM PLATE VOLTAGE	550	VOLTS
MAXIMUM SCREEN VOLTAGE	440	VOLTS
MAXIMUM PLATE DISSIPATION	19.0	WATTS
MAXIMUM SCREEN DISSIPATION[A]	3.3	WATTS
MAXIMUM CATHODE CURRENT	85	MA.
MAXIMUM GRID #1 CIRCUIT RESISTANCE:		
WITH FIXED BIAS	0.3	MEGOHMS
WITH CATHODE BIAS	1.0	MEGOHMS
MAXIMUM HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
TOTAL DC AND PEAK	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE		
DC	100	VOLTS
TOTAL DC AND PEAK	200	VOLTS

*INDICATES AN ADDITION.

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TYPICAL OPERATION

CLASS A_1 AMPLIFIER

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.80	AMP.
PLATE VOLTAGE	300	VOLTS
SCREEN VOLTAGE	300	VOLTS
GRID #1 VOLTAGE	−10	VOLTS
PEAK AF GRID VOLTAGE	10.0	VOLTS
PLATE CURRENT (ZERO SIGNAL)	60	MA.
PLATE CURRENT (MAX. SIGNAL)	75	MA.
SCREEN CURRENT (ZERO SIGNAL)	8.0	MA.
SCREEN CURRENT (MAX. SIGNAL)	15.0	MA.
TRANSCONDUCTANCE	10 200	μMHOS
PLATE RESISTANCE	29 000	OHMS
TRIODE AMPLIFICATION FACTOR	16.8	
LOAD RESISTANCE	3000	OHMS
POWER OUTPUT	11	WATTS
TOTAL HARMONIC DISTORTION	13	PERCENT

PUSH-PULL CLASS AB_1 - PENTODE CONNECTION

VALUES FOR TWO TUBES

	FIXED BIAS					CATHODE BIAS	
PLATE SUPPLY VOLTAGE	300	350	400	450	450	450	VOLTS
SCREEN SUPPLY VOLTAGE	300	350	350	350	400	400	VOLTS
GRID #1 VOLTAGE	−12.5	−15.5	−16.0	−16.5	−21		VOLTS
COMMON CATHODE RESISTOR						200	OHMS
PEAK AF GRID TO GRID VOLTAGE	25	31	32	33	42	28	VOLTS
ZERO SIGNAL PLATE CURRENT	86	92	85	77	66	82	MA.
MAX. SIGNAL PLATE CURRENT	116	130	143	153	144	94	MA.
ZERO SIGNAL SCREEN CURRENT	12.6	13.0	11.0	9.6	9.4	11.5	MA.
MAX. SIGNAL SCREEN CURRENT	26.0	28.6	27.0	27.0	30.0	22	MA.
EFFECTIVE LOAD, PLATE TO PLATE	6600	6600	6600	6600	6600	9000	OHMS
TOTAL HARMONIC DISTORTION	2.5	2.0	1.5	1.5	1.5	2.0	PERCENT
MAXIMUM SIGNAL POWER OUTPUT	23	30	37	43	45	28	WATTS

PUSH-PULL CLASS AB_1 - ULTRA-LINEAR[B] OPERATION

VALUES FOR TWO TUBES

	FIXED BIAS	CATHODE BIAS	
PLATE SUPPLY VOLTAGE	400	425	VOLTS
GRID #1 VOLTAGE	−20.5		VOLTS
CATHODE RESISTOR (COMMON TO TWO TUBES)		185	OHMS
PEAK AF GRID TO GRID VOLTAGE	41	42	VOLTS
ZERO SIGNAL PLATE CURRENT	80	88	MA.
MAXIMUM SIGNAL PLATE CURRENT	138	104	MA.
ZERO SIGNAL SCREEN CURRENT	11.5	13.0	MA.
MAXIMUM SIGNAL SCREEN CURRENT	26.4	17.5	MA.
EFFECTIVE LOAD, PLATE TO PLATE	6600	6600	OHMS
TOTAL HARMONIC DISTORTION	1.0	2.0	PERCENT
MAXIMUM SIGNAL POWER OUTPUT	32	26	WATTS

A. SCREEN DISIPATION MAY BE PERMITTED TO REACH 6 WATTS DURING THE PERIODS OF MAXIMUM INPUT OF SPEECH AND MUSIC SIGNALS. FOR EFFICIENT OPERATION OF THE SCREEN, THE TWO SCREEN CONNECTIONS, PINS 4 AND 8 SHOULD BE EXTERNALLY TIED TOGETHER.

B. SCREEN TAPPED AT 40% OF PRIMARY TURNS.

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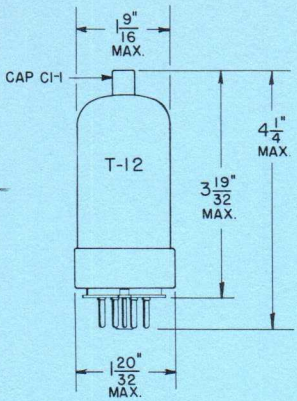
PENTODE



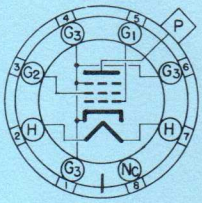
GLASS BULB

UNIPOTENTIAL CATHODE

HEATER

6.3±10% VOLTS 1.6 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW

8 PIN OCTAL
WITH
BARRIERS
STEPPED SLEEVE
7CK

THE 7607 IS A BEAM POWER PENTODE INTENDED FOR SERVICE AS A CLASS C RF POWER AMPLIFIER AND OSCILLATOR AND AS A LINEAR AMPLIFIER IN SINGLE SIDE BAND AMPLIFIERS AND TRANSMITTERS..

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID #1 TO PLATE (MAX.)	0.28	μμf
INPUT (G1 TO ALL)	15	μμf
OUTPUT (P TO ALL)	8.5	μμf

RATINGS

INTERPRETED ACCORDING TO ABSLUTE MAXIMUM SYSTEM

HEATER VOLTAGE	6.3±10%	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE PEAK	300	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE DC	100	VOLTS
TOTAL DC AND PEAK	200	VOLTS

TYPICAL CHARACTERISTICS

HEATER VOLTAGE	6.3±10%	VOLTS
HEATER CURRENT	1.6	AMP.
PLATE VOLTAGE	300	VOLTS
GRID #2 VOLTAGE	225	VOLTS
GRID #1 VOLTAGE	-17	VOLTS
PLATE CURRENT	80	MA.
GRID #2 CURRENT	6.0	MA.
TRANSCONDUCTANCE	8000	μMHOS
TRIODE AMPLIFICATION FACTOR	8.0	
PLATE RESISTANCE	40	KOHMS
GRID #1 VOLTAGE FOR 1 MA PLATE CURRENT	-35	VOLTS

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RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR -CLASS C TELEGRAPHY

MAXIMUM RATINGS
(ABSOLUTE VALUES)

	CCS	ICAS	
DC PLATE VOLTAGE	600	900	VOLTS
DC GRID #2 VOLTAGE	400	450	VOLTS
DC GRID VOLTAGE	-300	-350	VOLTS
DC PLATE CURRENT	150	175	MA.
DC GRID #1 CURRENT	12	12	MA.
PLATE INPUT	85	115	WATTS
PLATE DISSIPATION	23	28	WATTS
GRID #2 DISSIPATION	4	6	WATTS
COMBINED PLATE AND GRID #2 DISSIPATION	25	32	WATTS
MAXIMUM BULB TEMPERATURE	220	245	°C.

TYPICAL OPERATION
CLASS C RADIO FREQUENCY AMPLIFIER

	CCS	ICAS	
DC PLATE VOLTAGE	600	800	VOLTS
DC GRID #2 VOLTAGE	200	220	VOLTS
DC GRID VOLTAGE	-50	-50	VOLTS
PEAK R.F. GRID VOLTAGE	70	70	VOLTS
DC PLATE CURRENT	123	137	MA.
DC GRID #2 CURRENT	11	12.5	MA.
DC GRID #1 CURRENT	10	10	MA.
DRIVING POWER	0.65	0.65	WATTS
POWER OUTPUT	54	84	WATTS
GRID RESISTANCE	5,000	5,000	OHMS

RADIO FREQUENCY LINEAR POWER AMPLIFIER CLASS AB_1
(one tube)

MAXIMUM RATINGS
(ABSOLUTE VALUES)

DC PLATE VOLTAGE	900	VOLTS
DC GRID #2 VOLTAGE	450	VOLTS
DC PLATE CURRENT	175	MA.
PLATE DISSIPATION	28	WATTS
GRID #2 DISSIPATION	6	WATTS
COMBINED PLATE AND GRID #2 DISSIPATION	32	WATTS

TYPICAL OPERATION
CLASS AB_1 RADIO FREQUENCY LINEAR AMPLIFIER
(ONE TUBE)

DC PLATE VOLTAGE	600	800	VOLTS
DC SCREEN VOLTAGE	310	310	VOLTS
DC GRID #1 VOLTAGE	-39	-39	VOLTS
ZERO SIGNAL DC PLATE CURRENT	20	20	MA.
SINGLE TONE R.F. GRID VOLTAGE (PEAK)	39	39	VOLTS
SINGLE TONE D.C. PLATE CURRENT	120	120	MA.
SINGLE TONE D.C. GRID #2 CURRENT	12.5	12	MA.
SINGLE TONE D.C. GRID #1 CURRENT	0	0	
SINGLE TONE PLATE POWER INPUT	72	96	WATTS
SINGLE TONE POWER OUTPUT	50	68	WATTS
TWO TONE AVERAGE D.C. GRID #2 CURRENT	5	5	MA.
TWO TONE AVERAGE D.C. PLATE CURRENT	75	76	MA.

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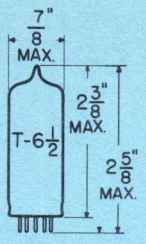
TRIODE

MINIATURE TYPE



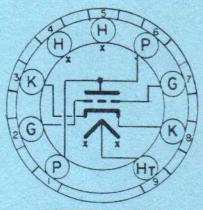
GLASS BULB

UNIPOTENTIAL CATHODE

HEATER

PARALLEL	SERIES
6.3±0.3 VOLTS	12.6±0.6 VOLTS
.45 AMP.	.225 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW

MINIATURE BUTTON
9 PIN BASE
9MX

THE 7719 IS A SINGLE INDIRECTLY HEATED HIGH PERVEANCE TRIODE INTENDED FOR COMPUTER APPLICATIONS. THE CATHODE MATERIAL IS CHOSEN TO MINIMIZE THE DEVELOPMENT OF INTERFACE IMPEDANCE.

DIRECT INTERELECTRODE CAPACITANCES – APPROX.

WITHOUT EXTERNAL SHIELD

INPUT	6.5	μμf
OUTPUT	1.0	μμf
GRID TO PLATE	5.5	μμf

RATINGS

INTERPRETED ACCORDING TO DESIGN MAXIMUM SYSTEM[A]

HEATER VOLTAGE (SERIES)	12.6±0.6	VOLTS
HEATER VOLTAGE (PARALLEL)	6.3±0.3	VOLTS
MAXIMUM PLATE VOLTAGE	330	VOLTS
MAXIMUM PLATE DISSIPATION	6.0	WATTS
MAXIMUM DC CATHODE CURRENT	40	MA.
MAXIMUM HEATER–CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
TOTAL DC AND PEAK	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE		
DC	100	VOLTS
TOTAL DC AND PEAK	200	VOLTS
MAXIMUM BULB TEMPERATURE	175	°C

AVERAGE CHARACTERISTICS

CLASS A_1 AMPLIFIER

HEATER VOLTAGE	6.3±0.3	12.6±0.6	VOLTS
HEATER CURRENT	.45[B]	.225[C]	AMP.
PLATE VOLTAGE	300		VOLTS
GRID VOLTAGE	−10.5		VOLTS
PLATE CURRENT	4		MA.
AMPLIFICATION FACTOR	25		
TRANSCONDUCTANCE	3500		μMHOS
PLATE RESISTANCE	7100		OHMS
GRID VOLTAGE FOR PLATE CURRENT OF 50μA (APPROX.)	−15		VOLTS

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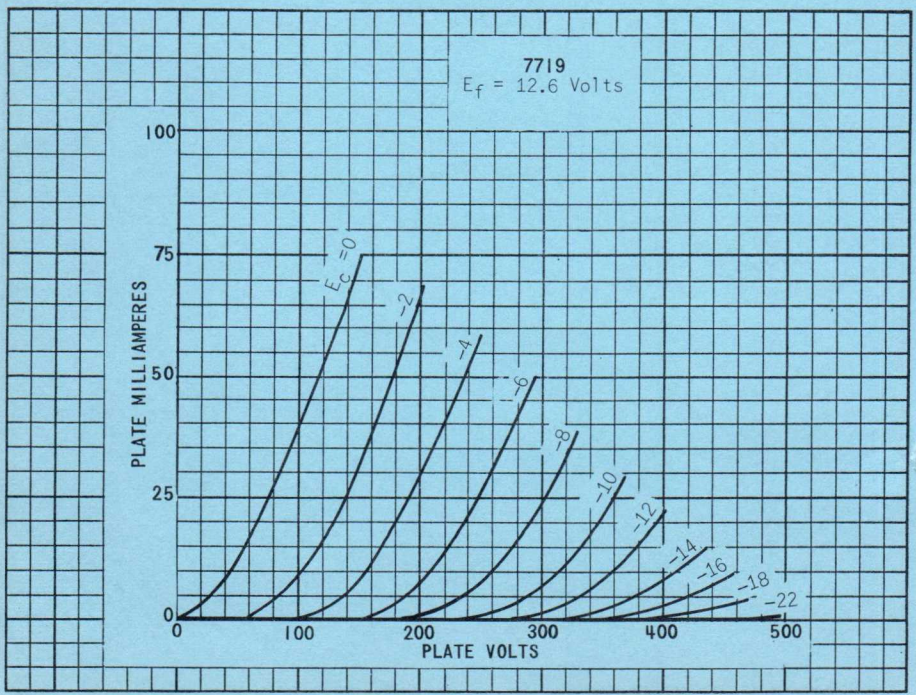
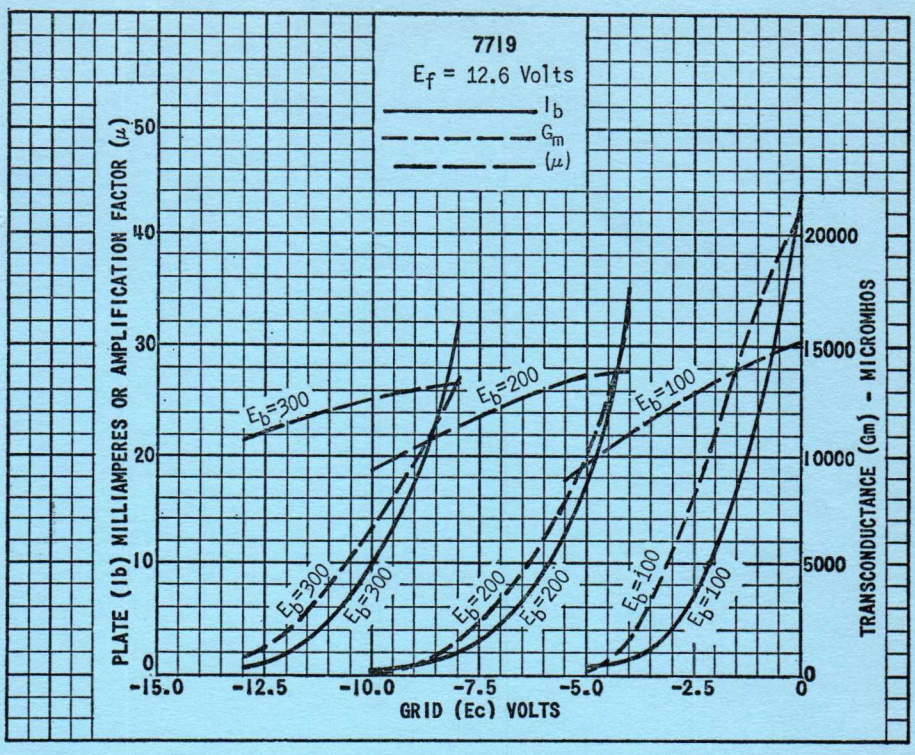
[A] DESIGN-MAXIMUM RATINGS ARE LIMITING VALUES OF OPERATING AND ENVIRONMENTAL CONDITIONS APPLICABLE TO A BOGEY ELECTRON DEVICE OF A SPECIFIED TYPE AS DEFINED BY ITS PUBLISHED DATA, AND SHOULD NOT BE EXCEEDED UNDER THE WORST PROBABLE CONDITIONS. THE DEVICE MANUFACTURER CHOOSES THESE VALUES TO PROVIDE ACCEPTABLE SERVICEABILITY OF THE DEVICE, TAKING RESPONSIBILITY FOR THE EFFECTS OF CHANGES IN OPERATING CONDITIONS DUE TO VARIATIONS IN DEVICE CHARACTERISTICS. THE EQUIPMENT MANUFACTURER SHOULD DESIGN SO THAT INITIALLY AND THROUGHOUT LIFE NO DESIGN-MAXIMUM VALUE FOR THE INTENDED SERVICE IS EXCEEDED WITH A BOGEY DEVICE UNDER THE WORST PROBABLE OPERATING CONDITIONS WITH RESPECT TO SUPPLY-VOLTAGE VARIATION, EQUIPMENT COMPONENT VARIATION, EQUIPMENT CONTROL ADJUSTMENT, LOAD VARIATION, SIGNAL VARIATION, AND ENVIRONMENTAL CONDITIONS.

[B] MEASURED AT 6.3 VOLTS.

[C] MEASURED AT 12.6 VOLTS.





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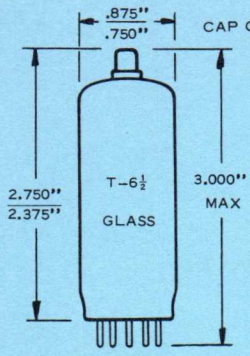
BEAM PENTODE

MINIATURE TYPE

OUTLINE DRAWING

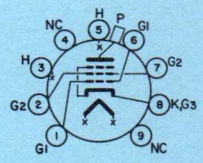


BUTTON 9 PIN MINIATURE
BASE E9-1
GOLD PLATED PINS

FOR
PULSE AND HIGH VOLTAGE
REGULATOR SERVICE

TUNGSTEN HEATER
ANY MOUNTING POSITION

BASING DIAGRAM
JEDEC 9NE



BOTTOM VIEW

THE 7757 IS A HIGH PERVEANCE BEAM POWER AMPLIFIER IN THE 9 PIN MINIATURE HARD GLASS CONSTRUCTION. IT IS DESIGNED FOR HIGH VOLTAGE PULSE MODULATOR AND DEFLECTION AMPLIFIER USE IN AIRCRAFT, MILITARY AND INDUSTRIAL APPLICATIONS WHERE RELIABLE OPERATIONS AT HIGH VOLTAGES DURING SHOCK AND VIBRATION, AND FREEDOM FROM INTERNAL ARCING ARE IMPORTANT.

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	600	mA
LIMITS OF APPLIED VOLTAGE		6.3 ± 0.3	VOLTS
HEATER-CATHODE VOLTAGE			
HEATER NEGATIVE WITH RESPECT TO CATHODE		450	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE		450	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES – SEE EIA STANDARD RS-239

DC PLATE VOLTAGE	3,000	VOLTS
DC GRID 2 VOLTAGE	700	VOLTS
PLATE DISSIPATION	14	WATTS
GRID 2 DISSIPATION	3	WATTS
DC CATHODE CURRENT	75	mA
PEAK CATHODE CURRENT –PULSE	2	AMPS
GRID RESISTANCE	0.1	MEGOHM
AVERAGE CATHODE WARM-UP TIME	45	SECONDS

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TYPICAL OPERATION CONDITIONS AND CHARACTERISTICS

PLATE VOLTAGE	250	VOLTS
GRID 2 VOLTS	250	VOLTS
GRID 1 VOLTS	−12.5	VOLTS
PLATE CURRENT	45	mA
GRID 2 CURRENT	3.5	mA
TRANSCONDUCTANCE	4,100	μMHOS

TYPICAL OPERATING CONDITIONS – PULSE ⊕

⊕ SEE RATING CHART

PLATE VOLTAGE	750	VOLTS
GRID 2 VOLTAGE	325	VOLTS
GRID 1 BIAS VOLTAGE	−100	VOLTS
PULSE VOLTAGE – e_{gk}	+100	VOLTS
PULSE PLATE CURRENT	.75	AMP.

SPECIAL TESTS AND RATINGS

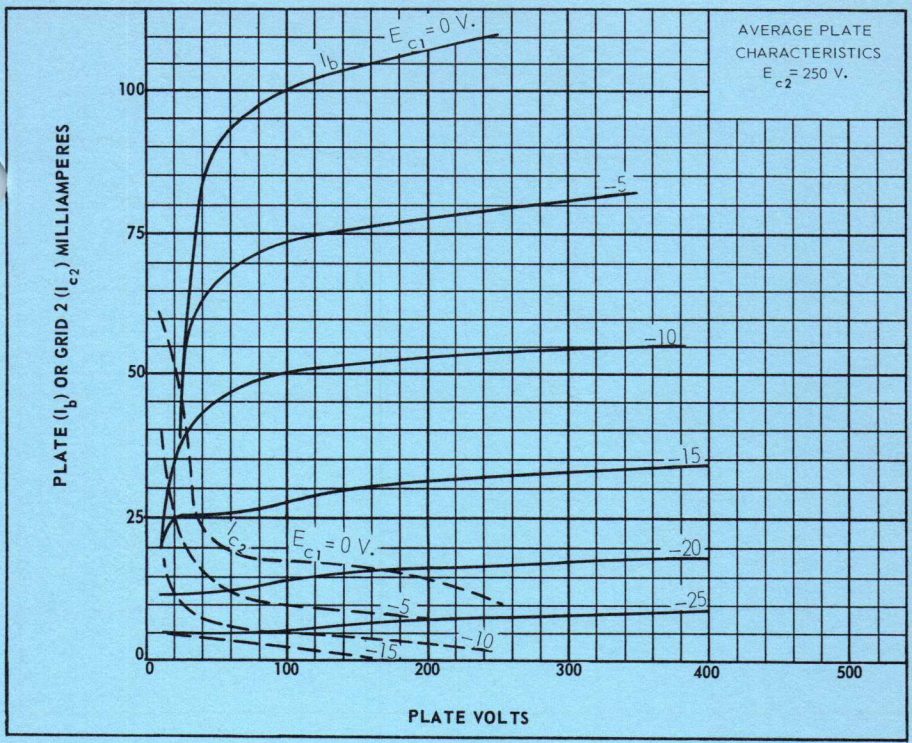
ALTITUDE	70,000	FT.
BULB TEMPERATURE	300	°C
IMPACT SHOCK	500	G
VIBRATIONAL ACCELATION	50	G
HEATER CYCLING LIFE		
LIFE		
FATIGUE		
GLASS STRAIN		

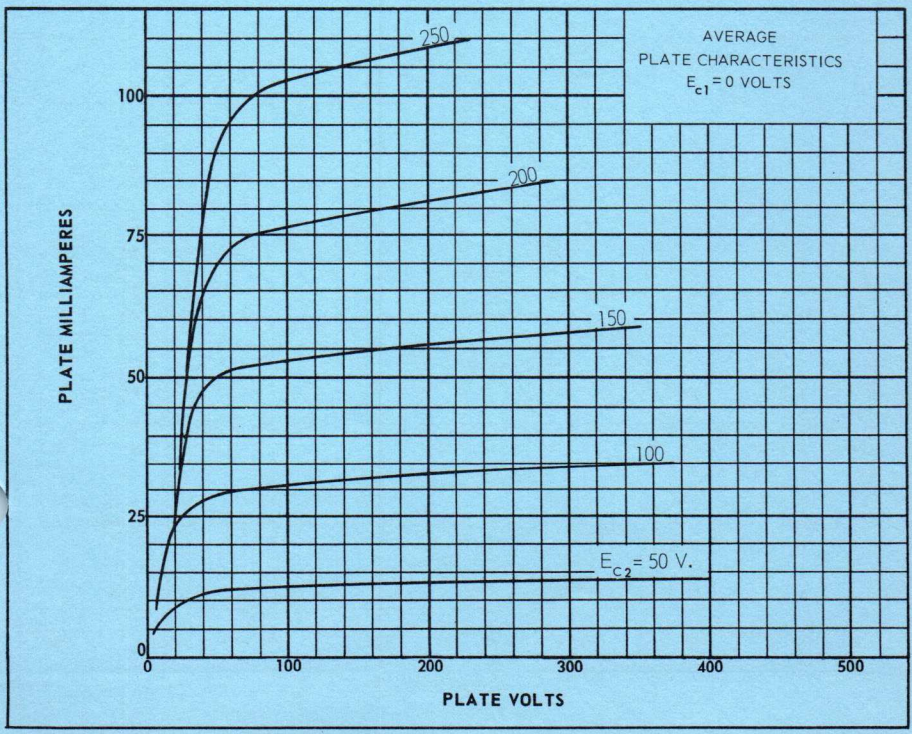
APPLICATION NOTES

SPECIAL ATTENTION SHOULD BE GIVEN TO THE TEMPERATURES AT WHICH THE TUBES ARE TO BE OPERATED. RELIABILITY WILL BE SERIOUSLY IMPAIRED IF MAXIMUM BULB TEMPERATURE IS EXCEEDED. THE LIFE EXPECTANCY WILL BE REDUCED IF CONDITIONS OTHER THAN THOSE SPECIFIED FOR LIFE TEST ARE IMPOSED ON THE TUBE AND WILL BE REDUCED APPRECIABLY IF ABSOLUTE MAXIMUM RATINGS ARE EXCEEDED. BOTH RELIABILITY AND PERFORMANCE WILL BE JEOPARDIZED IF FILAMENT VOLTAGE RATINGS ARE EXCEEDED. LIFE AND RELIABILITY OF PERFORMANCE ARE DIRECTLY RELATED TO THE DEGREE THAT REGULATION OF THE HEATER VOLTAGE IS MAINTAINED AT ITS CENTER RATED VALUE.

THIS TUBE IS CONSTRUCTED USING NONEX GLASS AND THUS CAN WITHSTAND HIGHER AMBIENT TEMPERATURES IN OPERATION. HOWEVER, THE BULB TEMPERATURE SHOULD NEVER EXCEED 300°C AT ITS HOTTEST POINT AND COOLING SHOULD BE EMPLOYED IF NECESSITATED BY THE ADDITIVE EFFECTS OF OPERATION AT HIGH ALTITUDES AND HIGH DISSIPATION SIMULTANEOUSLY OR BY OTHER SOURCES OF HEAT IN THE EQUIPMENT.

THE PLATE VOLTAGE RATING AND HIGH-PERVEANCE OF THE 7757 MAKE IT READILY ADAPTABLE TO VARIED PULSE APPLICATIONS. IN ORDER TO INSURE MAXIMUM RELIABILITY IN PULSE SERVICE THE PEAK CATHODE CURRENT SHOULD NOT EXCEED THE VALUE SHOWN IN PULSE RATING CHART FOR THE REQUIRED DUTY FACTOR.





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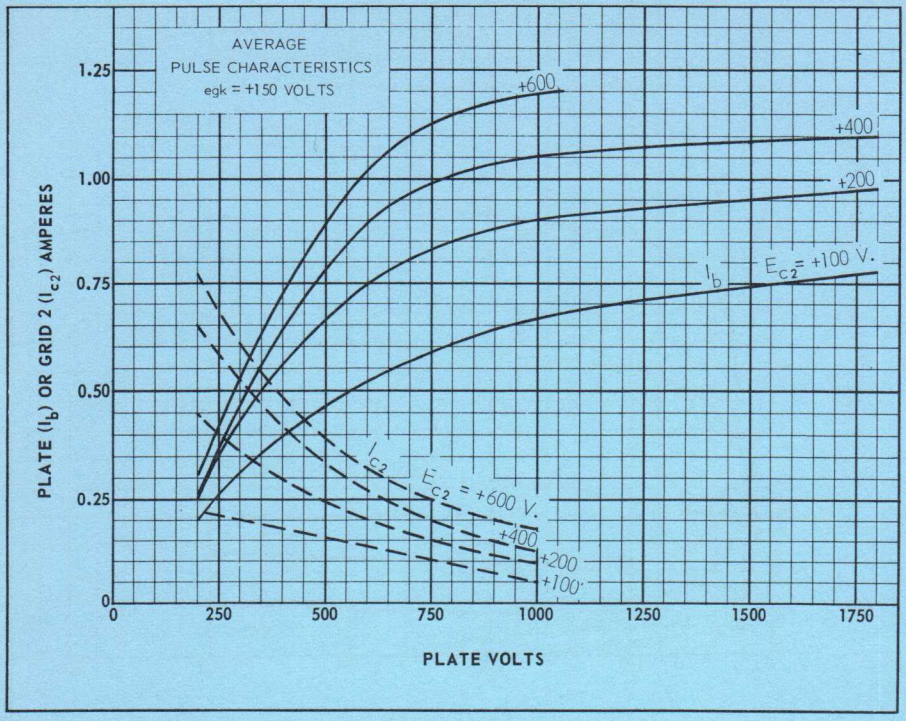
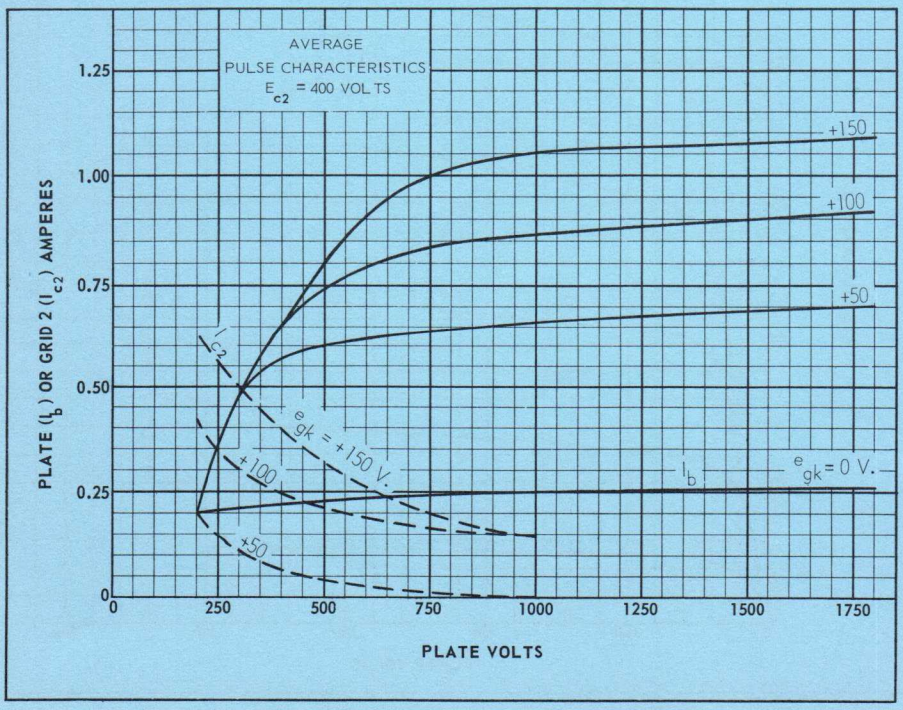
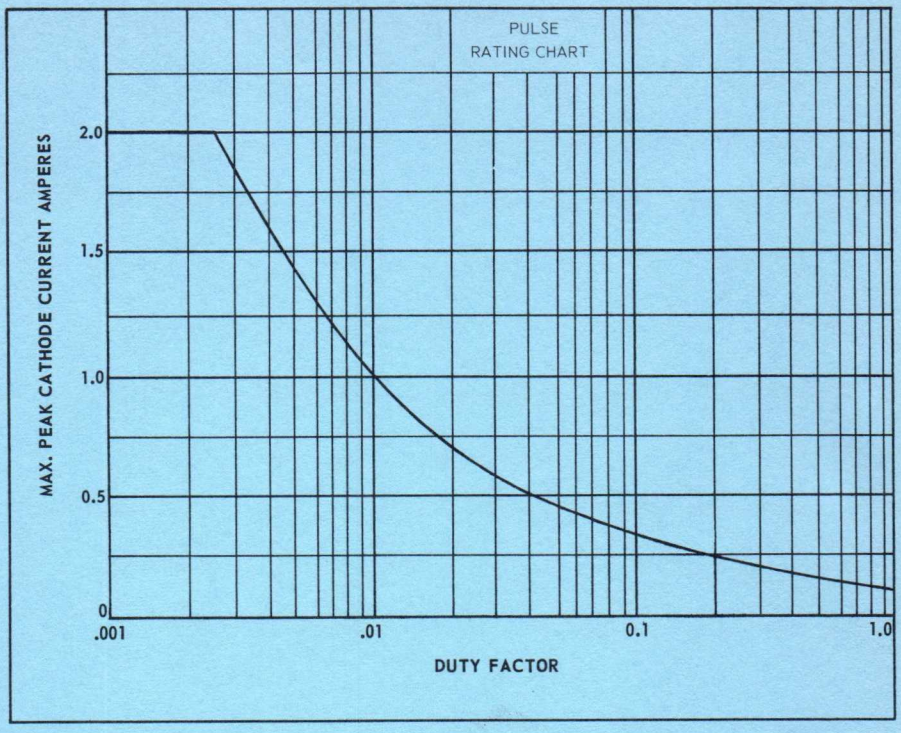
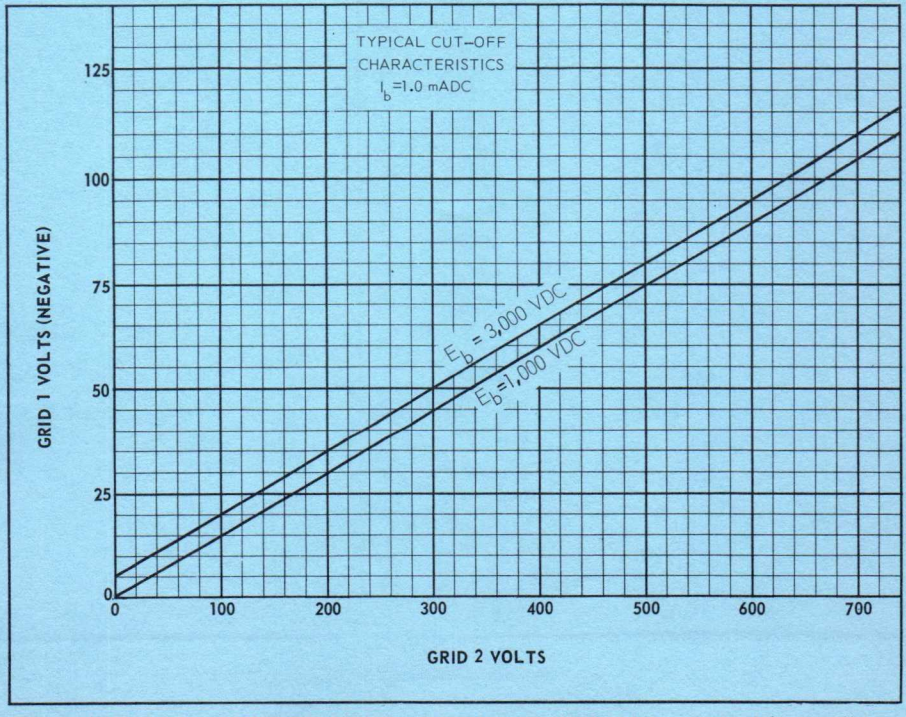

AVERAGE
PULSE CHARACTERISTICS
egk = +150 VOLTS
PLATE (I_b) OR GRID 2 (I_{c2}) AMPERES
1.25
1.00
0.75
0.50
0.25
0
+600
+400
+200
I_b
E_{c2} = +100 V.
I_{c2}
E_{c2} = +600 V.
+400
+200
+100
0
250
500
750
1000
1250
1500
1750
PLATE VOLTS


AVERAGE
PULSE CHARACTERISTICS
E_{c2} = 400 VOLTS
PLATE (I_b) OR GRID 2 (I_{c2}) AMPERES
1.25
1.00
0.75
0.50
0.25
0
+150
+100
+50
I_{c2}
e_{gk} = +150 V.
+100
+50
I_b
e_{gk} = 0 V.
0
250
500
750
1000
1250
1500
1750
PLATE VOLTS





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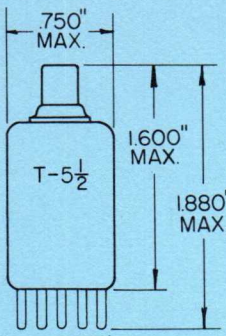
TUNG-SOL

ELECTROMETER TETRODE

MINIATURE TYPE



GLASS BULB

7 PIN MINIATURE

OUTLINE DRAWING
JEDEC E7-1

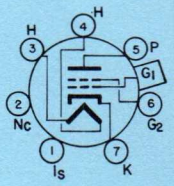
COATED UNIPOTENTIAL CATHODE

HEATER

2.5 VOLTS .200 AMPS.

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 7GE

THE 7851 IS A SCREEN GRID TETRODE ELECTROMETER TUBE. ITS HIGH TRIODE MU, WHICH DISTINGUISHES IT FROM CONVENTIONAL ELECTROMETER TUBES, MAKES IT PARTICULARLY USEFUL AS AN EXTREMELY HIGH GAIN CURRENT AMPLIFIER IN APPLICATIONS WHEREIN THE INPUT SIGNAL IS IN THE ORDER OF MICRO-MICRO-AMPERES. CAREFUL SHIELDING FROM LIGHT AS WELL AS ELECTROMAGNETIC FIELDS MUST BE OBSERVED, AS WITH ALL ELECTROMETER TUBES.

DIRECT INTERELECTRIC CAPACITANCES

(APPROX.)

WITHOUT EXTERNAL SHIELD

GRID TO PLATE: G1 TO P	0.19	pf
INPUT: G1 TO (H+K+G2,S)	2.6	pf
OUTPUT: P TO (H+K+G2,S)	1.8	pf

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM[A]

HEATER VOLTAGE	2.5	VOLTS
MAXIMUM PLATE VOLTAGE	12	VOLTS
MAXIMUM GRID #2 VOLTAGE	12	VOLTS
MAXIMUM NEGATIVE GRID #1 VOLTAGE	-12	VOLTS
MAXIMUM POSITIVE GRID #1 VOLTAGE	0	VOLTS
MAXIMUM GRID #1 CURRENT -(SEE BELOW)		
MAXIMUM HEATER-CATHODE VOLTAGE	±16	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

PLATE SUPPLY VOLTAGE	11.0	VOLTS
GRID #2 VOLTAGE	11.0	VOLTS
GRID #1 VOLTAGE APPLIED	-2.2	VOLTS
PLATE CURRENT	16	μAMPS
TRANSCONDUCTANCE	40	μMHOS
PLATE RESISTANCE - APPROX.	1.7	MEGOHMS
TRIODE AMPLIFICATION FACTOR	5	
GRID CURRENT - MAXIMUM	10×10^{-13}	AMPS.

[A] REFER TO EIA STANDARD RS-239.

WITH HIGH INPUT IMPEDANCES, CHARACTERISTICS VARY GREATLY WITH HEATER VOLTAGE; THE DEGREE OF STABILITY OBTAINED DEPENDS LARGELY UPON THE DEGREE OF REGULATION OF HEATER VOLTAGE OR CURRENT.

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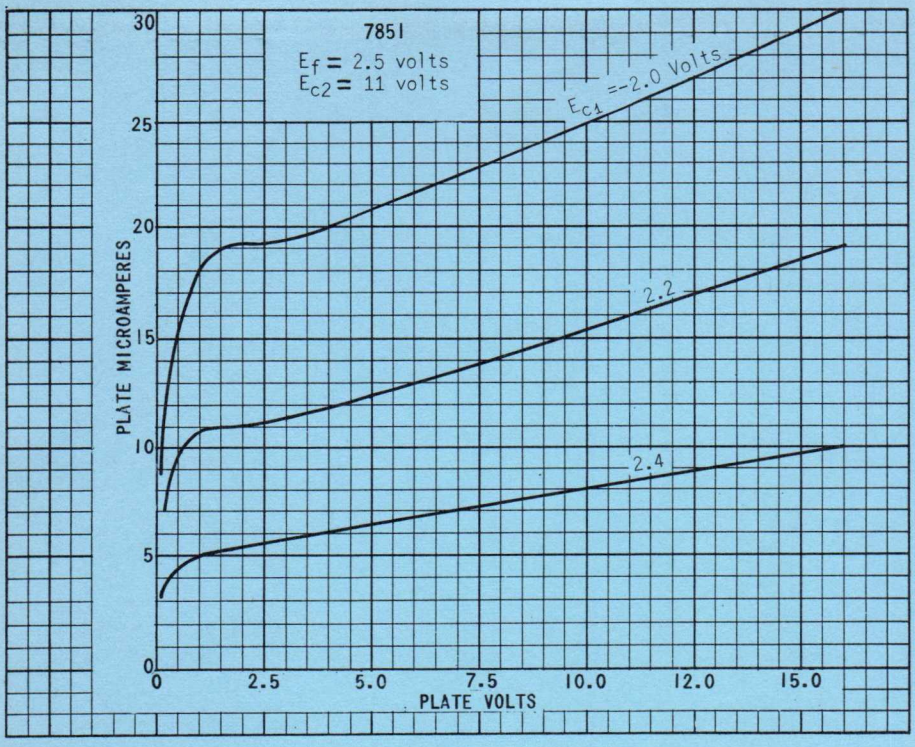
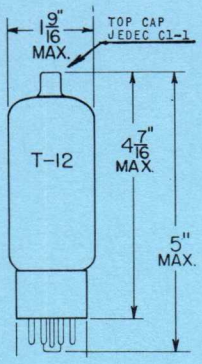

7851
E_f = 2.5 volts
E_{c2} = 11 volts
E_{c1} =-2.0 Volts
2.2
2.4
PLATE MICROAMPERES
PLATE VOLTS
0
5
10
15
20
25
30
0
2.5
5.0
7.5
10.0
12.0
15.0

TUNG-SOL

BEAM POWER PENTODE



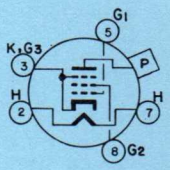
GLASS BULB

OUTLINE DRAWING
JEDEC 12-21
BASE JEDEC B5-123

COATED UNIPOTENTIAL CATHODE

HEATER

6.3±0.6 VOLTS 2.5 AMP.



BOTTOM VIEW

BASING DIAGRAM
JEDEC 58T

THE 7867 IS A BEAM POWER PENTODE DESIGNED WITH HIGH POWER SENSITIVITY AND HIGH EFFICIENCY FOR SERVICE IN AUDIO OUTPUT STAGES. IT IS CAPABLE OF HANDLING HIGH POWER AT A VERY LOW HARMONIC DISTORTION LEVEL.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID #1 TO PLATE (APPROX.)	1.1	pf
INPUT	22	pf
OUTPUT	8.5	pf

RATINGS

INTERPRETED ACCORDING TO DESIGN MAXIMUM SYSTEM[B]

HEATER VOLTAGE[A]	6.3±0.6	VOLTS
MAXIMUM PLATE VOLTAGE	700	VOLTS
MAXIMUM GRID #2 VOLTAGE	175	VOLTS
MAXIMUM PLATE DISSIPATION	24	WATTS
MAXIMUM GRID #2 DISSIPATION	3.6	WATTS
MAXIMUM CATHODE CURRENT—AVERAGE	220	MA.
MAXIMUM GRID #1 CIRCUIT RESISTANCE	0.5	MEGOHM
MAXIMUM BULB TEMPERATURE (HOTTEST POINT)	225	°C
MAXIMUM HEATER—CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
TOTAL DC AND PEAK	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE		
DC	100	VOLTS
TOTAL DC AND PEAK	200	VOLTS

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TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

AUDIO SERVICE

CLASS A_1 AMPLIFIER – SINGLE TUBE

PLATE VOLTAGE[C]	250	VOLTS
GRID #2 CURRENT[C]	90	VOLTS
CATHODE RESISTOR	120	OHMS
PEAK GRID #1 SIGNAL	10	VOLTS
ZERO SIGNAL PLATE CURRENT	80	MA.
MAX. SIGNAL PLATE CURRENT	81	MA.
ZERO SIGNAL GRID #2 CURRENT	1	MA.
MAX. SIGNAL GRID #2 CURRENT	6	MA.
PLATE RESISTANCE	12,000	OHMS
TRANSCONDUCTANCE	10,000	μMHOS
LOAD RESISTANCE	3,000	OHMS
TOTAL HARMONIC DISTORTION	10	PERCENT
MAX. SIGNAL POWER OUTPUT	7.5	WATTS

PUSH-PULL AMPLIFIER

VALUES FOR TWO TUBES

CLASS OF OPERATION	A_1	AB_1	AB_1	
PLATE VOLTAGE[C]	250	250	450	VOLTS
GRID #2 VOLTAGE[C]	90	150	150	VOLTS
CATHODE RESISTOR	60	200	---	OHMS
GRID #1 VOLTAGE	---	---	-35	VOLTS
PEAK GRID #1 TO GRID #1 SIGNAL	19.5	47	69	VOLTS
ZERO SIGNAL PLATE CURRENT	160	114	58	MA.
MAX. SIGNAL PLATE CURRENT	166	128	210	MA.
ZERO SIGNAL GRID #2 CURRENT	2	2	1.4	MA.
MAX. SIGNAL GRID #2 CURRENT	10.5	17	36	MA.
LOAD RESISTANCE (PLATE TO PLATE)	5000	6000	5000	OHMS
TOTAL HARMONIC DISTORTION	1.4	3.0	5.5	PERCENT
MAX. SIGNAL POWER OUTPUT	16	28	65	WATTS

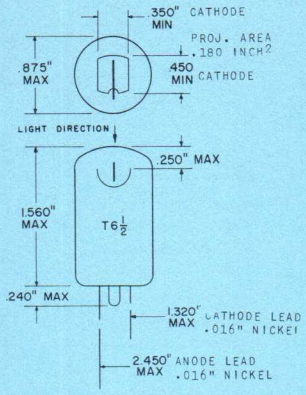
[A] THE EQUIPMENT DESIGNER SHALL SO DESIGN THE EQUIPMENT THAT THE HEATER VOLTAGE IS CENTERED AT THE SPECIFIED BOGEY VALUE. HEATER SUPPLY VARIATIONS SHALL BE RESTRICTED TO MAINTAIN HEATER VOLTAGE WITHIN THE SPECIFIED TOLERANCE.

[B] DESIGN-MAXIMUM RATINGS ARE LIMITING VALUES OF OPERATING AND ENVIRONMENTAL CONDITIONS APPLICABLE TO A BOGEY ELECTRON DEVICE OF A SPECIFIED TYPE AS DEFINED BY ITS PUBLISHED DATA, AND SHOULD NOT BE EXCEEDED UNDER THE WORST PROBABLE CONDITIONS. THE DEVICE MANUFACTURER CHOOSES THESE VALUES TO PROVIDE ACCEPTABLE SERVICEABILITY OF THE DEVICE, TAKING RESPONSIBILITY FOR THE EFFECTS OF CHANGES IN OPERATING CONDITIONS DUE TO VARIATIONS IN DEVICE CHARACTERISTICS. THE EQUIPMENT MANUFACTURER SHOULD DESIGN SO THAT INITIALLY AND THROUGHOUT LIFE NO DESIGN-MAXIMUM VALUE FOR THE INTENDED SERVICE IS EXCEEDED WITH A BOGEY DEVICE UNDER THE WORST PROBABLE OPERATING CONDITIONS WITH RESPECT TO SUPPLY-VOLTAGE VARIATION, EQUIPMENT COMPONENT VARIATION, EQUIPMENT CONTROL ADJUSTMENT, LOAD VARIATION, SIGNAL VARIATION, AND ENVIRONMENTAL CONDITIONS.

[C] SPECIFIED VOLTAGE IS WITH RESPECT TO GROUND.

TUNG-SOL

VACUUM PHOTO DIODE



CYLINDRICAL CATHODE

ANY MOUNTING POSITION

BASE
NONE
FLYING LEADS

THE 8049 IS A CESIUM-ANTIMONY TYPE HEAD-ON PHOTO DIODE. IT IS DESIGNED FOR OPERATION AT LOW LIGHT LEVELS AND AT LOW APPLIED VOLTAGES. ITS CURRENT-VOLTAGE CHARACTERISTICS SHOW SATURATION AT VERY LOW KNEE VOLTAGES. THIS PERMITS THE TUBE TO BE USED DIRECTLY WITH EITHER ELECTRON TUBES OR SEMICONDUCTOR DEVICES. CATHODE AND ANODE CONNECTIONS ARE THROUGH FLYING LEADS AT THE BOTTOM.

GENERAL

SPECTRAL RESPONSE	S4	
WAVELENGTH OF MAXIMUM RESPONSE	4000±500	ANGSTROMS
DIRECT INTERELECTRODE CAPACITANCE	1.3	pf

RATINGS

→ ABSOLUTE MAXIMUM

→ MAXIMUM ANODE SUPPLY VOLTAGE (DC OR PEAK AC)	→ 30	VOLTS
MAXIMUM PEAK CATHODE CURRENT	20	μAMP
MAXIMUM PEAK CATHODE CURRENT DENSITY	125	μAMP/IN²
MAXIMUM AVERAGE CATHODE CURRENT	5	μAMP
MAXIMUM AMBIENT TEMPERATURE	75	°C

CHARACTERISTICS

	MIN.	AVG.	MAX.	
DARK CURRENT AT 25 VOLTS, 27°C	---	---	50	PAMP
LUMINOUS SENSITIVITY	15	30	60	μA/LUMEN

→ INDICATES A CHANGE.

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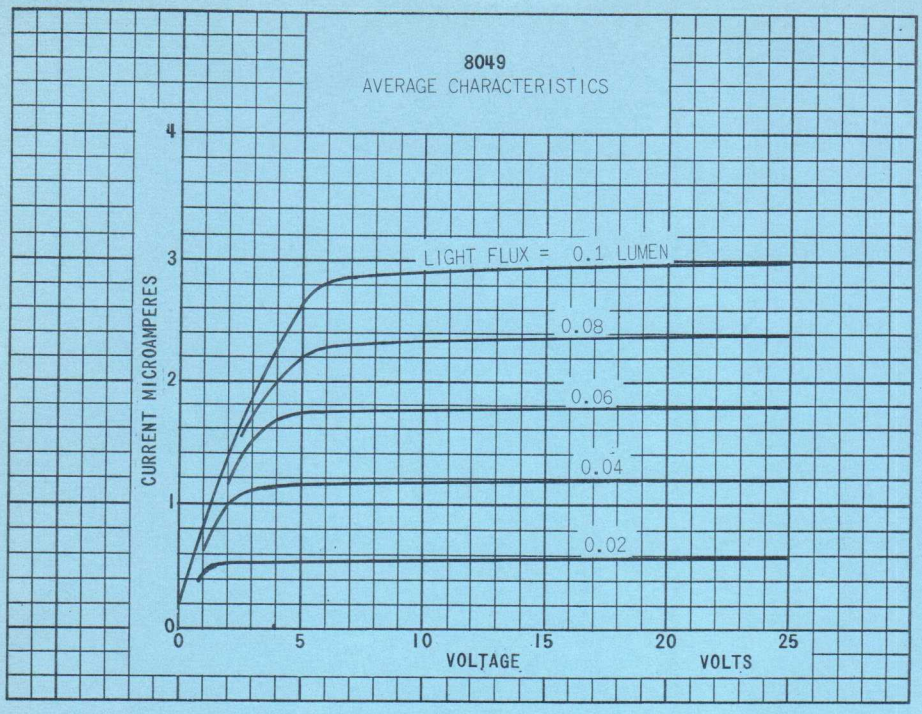
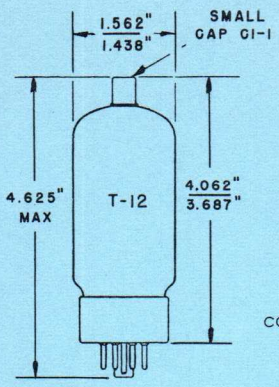

8049
AVERAGE CHARACTERISTICS
CURRENT MICROAMPERES
4
3
2
1
0
LIGHT FLUX = 0.1 LUMEN
0.08
0.06
0.04
0.02
0
5
10
15
20
25
VOLTAGE
VOLTS

TUNG-SOL

PENTODE



GLASS BULB
SHORT MEDIUM-SHELL
5 PIN OCTAL
B5-123 OR B5-149
OUTLINE DRAWING
JEDEC 12-20

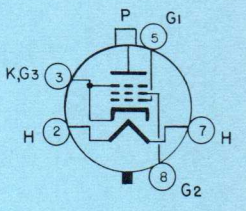
BEAM PENTODE

SERIES REGULATOR IN
HIGH VOLTAGE POWER

SUPPLY APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 8LC

THE 8068 IS A BEAM PENTODE DESIGNED FOR USE AS A SERIES REGULATOR IN HIGH-VOLTAGE POWER SUPPLIES.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE	0.6	pf
INPUT: G TO (H + K + G2 + G3)	10.0	pf
OUTPUT: P TO (H + K + G2 + G3)	5.5	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3	VOLTS	900	MA.
LIMITS OF APPLIED VOLTAGE - AC OR DC			6.3 ± 0.6	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE			± 200	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES - SEE EIA STANDARD RS-239

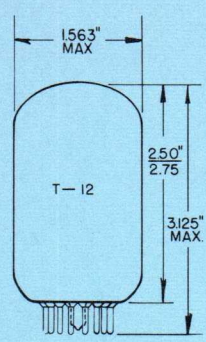
PLATE VOLTAGE	3500	VOLTS
GRID 2 VOLTAGE	250	VOLTS
PLATE DISSIPATION	35	WATTS
GRID 2 DISSIPATION	1.0	WATTS
DC CATHODE CURRENT	100	MA.
GRID 1 CIRCUIT RESISTANCE	0.1	MEGOHMS

AVERAGE CHARACTERISTICS

PLATE VOLTAGE	3500	600	VOLTS
GRID 2 VOLTAGE	100	125	VOLTS
GRID 1 VOLTAGE	-30	-7.5	VOLTS
PLATE CURRENT	1.0	36	MA.
GRID 2 CURRENT	-----	1.0	MA.
TRANSCONDUCTANCE	-----	5200	μMHOS
PLATE RESISTANCE, APPROX.	-----	54,500	OHMS

TUNG-SOL

PENTODE



GLASS BULB

BUTTON
12 PIN BASE E12-74
OUTLINE DRAWING
JEDEC 12-57

BEAM POWER VHF PENTODE

COMPACTRON

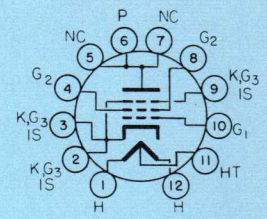
FOR

RF POWER AMPLIFIER

AND OSCILLATOR APPLICATIONS

ANY MOUNTING POSITION

COATED UNIPOTENTIAL CATHODE



BOTTOM VIEW

BASING DIAGRAM
JEDEC 12DT

PINS 5, 6 & 7 MUST BE USED IN PARALLEL

THE 8149 IS A BEAM POWER AMPLIFIER PENTODE IN THE SINGLE-ENDED T-12 COMPACTRON DESIGN. IT IS INTENDED FOR USE AS AN RF POWER AMPLIFIER AND OSCILLATOR AT FREQUENCIES UP TO 175 MEGACYCLES, WITH A MAXIMUM PLATE DISSIPATION RATING OF 35 WATTS UNDER ICAS CONDITIONS. IT FEATURES A CENTER-TAPPED HEATER SO IT MAY BE OPERATED FROM EITHER A 3-CELL OR A 6-CELL STORAGE BATTERY SYSTEM.
A SIMILAR TUBE IN A DOUBLE-ENDED DESIGN IS REGISTERED AS TYPE 8150.

→ DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID 1 TO PLATE: G1 TO P	0.35	pf
INPUT: G1 TO (H+K+G2+G3+I.S.)	13.0	pf
OUTPUT: P TO (H+K+G2+G3+I.S.)	6.0	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

SUPPLY CONNECTED TO PINS	1 & 12	11 & 1+12	
AVERAGE VALUES - VOLTAGE	13.0	6.5	VOLTS
- CURRENT	0.60	1.20	AMPS.
LIMITS OF APPLIED HEATER VOLTAGE	11.0 - 15.0	5.5 - 7.5	VOLTS
MIXIMUM HEATER-CATHODE VOLTAGE EITHER POLARITY	135		VOLTS

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

AVERAGE STATIC CHARACTERISTICS

PLATE VOLTAGE	200	VOLTS
GRID 2 VOLTAGE	200	VOLTS
PLATE CURRENT	100	MA.
TRANSCONDUCTANCE	7500	μMHOS
AMPLIFICATION FACTOR, TRIODE CONNECTED	4.5	

MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

RF POWER AMPLIFIER AND OSCILLATOR - CLASS C TELEGRAPHY

RF POWER AMPLIFIER - CLASS C TELEPHONY

ICAS INTERMITTENT COMMERCIAL AND AMATEUR SERVICE

FOR FREQUENCIES UP TO	175	60	MC
PLATE VOLTAGE -DC	450	750	VOLTS
GRID 2 VOLTAGE	250	250	VOLTS
GRID 1 VOLTAGE - DC	-150	150	VOLTS
CATHODE CURRENT-DC	→ 220	→ 220	MA.
PLATE DISSIPATION	35	35	WATTS
GRID 2 DISSIPATION	3.3	3.3	WATTS
BULB TEMPERATURE	240		°C

→ TYPICAL OPERATION

CLASS C AMPLIFIER AT 175 MC/S

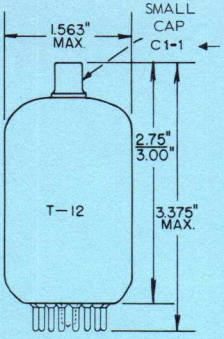
PLATE VOLTAGE	380	VOLTS
GRID 2 SUPPLY VOLTAGE	380	VOLTS
GRID 2 DROPPING RESISTOR	10	KOHMS
GRID 1 VOLTAGE	-78	VOLTS
FROM GRID 1 RESISTOR	27	KOHMS
ADDITIONAL FIXED BIAS	-24	VOLTS
PEAK RF GRID 1 VOLTAGE	120	VOLTS
PLATE CURRENT	180	MA.
GRID 2 CURRENT	12	MA.
GRID 1 CURRENT	2.0	MA.
DRIVING POWER - APPROX.	2	WATTS
POWER OUTPUT	40	WATTS

→ INDICATES A CHANGE.

TUNG-SOL

PENTODE

COMPACTRON



GLASS BULB

BUTTON
12 PIN BASE E12-74
OUTLINE DRAWING
JEDEC 12-86

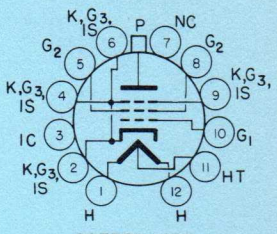
BEAM POWER VHF PENTODE

FOR

RF POWER AMPLIFIER

AND OSCILLATOR APPLICATIONS

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 12DU

THE 8150 IS A BEAM POWER AMPLIFIER PENTODE IN THE DOUBLE-ENDED T-12 COMPACTRON DESIGN. IT IS INTENDED FOR USE AS AN RF POWER AMPLIFIER AND OSCILLATOR AT FREQUENCIES UP TO 175 MEGACYCLES, WITH A MAXIMUM PLATE DISSIPATION RATING OF 35 WATTS UNDER ICAS CONDITIONS. IT FEATURES A CENTER-TAPPED HEATER SO IT MAY BE OPERATED FROM EITHER A 3-CELL OR A 6-CELL STORAGE BATTERY SYSTEM. THE 8150 IS SIMILAR TO THE SINGLE-ENDED TYPE 8149.

→ DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID 1 TO PLATE: G1 TO P	0.2	pf
INPUT: G1 TO (H+K+G2+G3+I.S.)	13.0	pf
OUTPUT: P TO (H+K+G2+G3+I.S.)	6.5	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

SUPPLY CONNECTED TO PINS	1 & 12	11 & 1+12	
AVERAGE VALUES - VOLTAGE	13.0	6.5	VOLTS
- CURRENT	0.60	1.20	AMPS.
LIMITS OF APPLIED HEATER VOLTAGE	11.0 - 15.0	5.5 - 7.5	VOLTS
MIXIMUM HEATER-CATHODE VOLTAGE EITHER POLARITY	135		VOLTS

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TUNG-SOL

CONTINUED FROM PRECEDING PAGE

AVERAGE STATIC CHARACTERISTICS

PLATE VOLTAGE	200	VOLTS
GRID 2 VOLTAGE	200	VOLTS
PLATE CURRENT	100	MA.
TRANSCONDUCTANCE	7500	μMHOS
AMPLIFICATION FACTOR, TRIODE CONNECTED	4.5	

MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

RF POWER AMPLIFIER AND OSCILLATOR - CLASS C TELEGRAPHY

RF POWER AMPLIFIER - CLASS C TELEPHONY

ICAS INTERMITTENT COMMERCIAL AND AMATEUR SERVICE

FOR FREQUENCIES UP TO	175	60	MC
PLATE VOLTAGE -DC	450	750	VOLTS
GRID 2 VOLTAGE	250	250	VOLTS
GRID 1 VOLTAGE - DC	-150	150	VOLTS
CATHODE CURRENT-DC	→ 220	→ 220	MA.
PLATE DISSIPATION	35	35	WATTS
GRID 2 DISSIPATION	3.3	3.3	WATTS
BULB TEMPERATURE	240		°C

→ TYPICAL OPERATION

CLASS C AMPLIFIER AT 175 MC/S

PLATE VOLTAGE	380	VOLTS
GRID 2 SUPPLY VOLTAGE	380	VOLTS
GRID 2 DROPPING RESISTOR	10	KOHMS
GRID 1 VOLTAGE	-78	VOLTS
FROM GRID 1 RESISTOR	27	KOHMS
ADDITIONAL FIXED BIAS	-24	VOLTS
PEAK RF GRID 1 VOLTAGE	120	VOLTS
PLATE CURRENT	180	MA.
GRID 2 CURRENT	12	MA.
GRID 1 CURRENT	2.0	MA.
DRIVING POWER - APPROX.	2	WATTS
POWER OUTPUT	40	WATTS

→ INDICATES A CHANGE.

TUNG-SOL

CONTINUED FROM FOLLOWING PAGE

LINEAR RF POWER AMPLIFIER, CLASS AB_1

SINGLE-SIDEBAND SUPPRESSED-CARRIER SERVICE

MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

FOR FREQUENCIES UP TO 60 M. C.

INTERMITTENT COMMERCIAL AND AMATEUR SERVICE

PLATE VOLTAGE - DC	750	VOLTS
GRID NO. 2 VOLTAGE - DC	250	VOLTS
GRID NO. 1 VOLTAGE - DC	-150	VOLTS
PLATE CURRENT - DC AT PEAK OF ENVELOPE	220	MA.
PLATE DISSIPATION	35	WATTS
GRID NO. 2 DISSIPATION	3.3	WATTS
BULB TEMPERATURE	240	° C
MAXIMUM GRID NO. 1 CIRCUIT RESISTANCE	30,000	OHMS

TYPICAL OPERATION

WITH TWO-TONE MODULATION

FREQUENCY	30	MC/S
DC PLATE VOLTAGE	750	VOLTS
DC GRID NO. 2 VOLTAGE (A)	215	VOLTS
DC GRID NO. 1 VOLTAGE (B)	-41	VOLTS
ZERO SIGNAL DC PLATE CURRENT	25	MA.
ZERO SIGNAL DC GRID NO. 2 CURRENT	0.3	MA.
EFFECTIVE R.F. LOAD RESISTANCE	3,200	OHMS
MAXIMUM SIGNAL PEAK R.F. GRID VOLTAGE (C)	41	VOLTS
DC PLATE CURRENT AT PEAK OF ENVELOPE	125	MA.
DC PLATE CURRENT - AVERAGE	86	MA.
DC GRID NO. 2 CURRENT AT PEAK OF ENVELOPE	8.5	MA.
DC GRID NO. 2 CURRENT - AVERAGE	4.5	MA.
DC GRID NO. 1 CURRENT - AVERAGE (D)	0.02	MA.
POWER OUTPUT AT PEAK OF ENVELOPE	61	WATTS
POWER OUTPUT - AVERAGE	30.5	WATTS
3rd ORDER INTERMODULATION PRODUCTS (E)	-24	db
5th ORDER INTERMODULATION PRODUCTS (E)	-37	db

(A) PREFERABLY OBTAINED FROM A WELL REGULATED SOURCE SUCH AS TWO OB2 VOLTAGE REGULATOR TUBES CONNECTED IN SERIES.

(B) PREFERABLY OBTAINED FROM A SEPARATE, WELL REGULATED SOURCE. ADJUST FOR 25 MA. PLATE CURRENT WITH NO SIGNAL.

(C) THE PEAK SIGNAL VOLTAGE SHOULD BE EQUAL TO THE DC GRID VOLTAGE.

(D) THIS VALUE IS THE APPROXIMATE GRID NO.1 CURRENT DUE TO INITIAL ELECTRON VELOCITY EFFECTS WHEN THE GRID IS DRIVEN TO ZERO VOLTS AT MAXIMUM SIGNAL.

(E) REFERENCED TO EITHER OF THE TWO TONES AND WITHOUT THE USE OF FEEDBACK TO IMPROVE LINEARITY.

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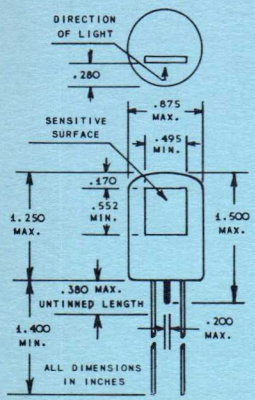
TUNG-SOL

PHOTOCONDUCTIVE CELL



FOR LIGHT CONTROLLED RELAY OPERATIONS

2 FLEXIBLE LEADS TINNED DIA. .018"±.003"

ANY MOUNTING POSITION

THE 8217 IS A SIDE ILLUMINATED CADMIUM SULPHIDE PHOTOCONDUCTIVE NON-POLARIZED CELL, HERMETICALLY SEALED IN A GLASS ENVELOPE WITH TWO FLEXIBLE DUMET LEADS. THIS CELL WAS DESIGNED FOR STREET LIGHT CONTROLLER SERVICE AND FOR OTHER LIGHT CONTROLLED RELAY OPERATIONS.

GENERAL

SPECTRAL RESPONSE (SEE FIGURE 1)	S15	
WAVELENGTH OF MAXIMUM RESPONSE	5800±500	ANGSTROM UNITS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

APPLIED VOLTAGE (DC OR PEAK AC)	300	VOLTS
CURRENT[A]	20	MA.
POWER DISSIPATION[A]	SEE FIGURE 3	
AT 25°C	400	MW.
AT 70°C	170	MW
AMBIENT TEMPERATURE RANGE	-40 TO +70	°C

[A] WITH UNIFORM ILLUMINATION OF SENSITIVE SURFACE.

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TUNG-SOL

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CHARACTERISTICS

AT 25°C AMBIENT TEMPERATURE

VOLTAGE–CURRENT CHARACTERISTICS — SEE FIGURE #4

	MIN.	AVG.	MAX.	
LIGHT RESISTANCE [B]	5	7	10	KOHMS
DARK RESISTANCE [C]	1	---	---	MEGOHMS
RISE TIME	SEE FIGURE #5			
DECAY TIME	SEE FIGURE #6			

[B] MEASURED WITH 10 FOOT-CANDLES ILLUMINATION OF 2870°K COLOR TEMPERATURE.

[C] MEASURED 20 SECONDS AFTER REMOVAL OF 10 FOOT-CANDLES ILLUMINATION.

FIGURE 1 - AVERAGE SPECTRAL RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

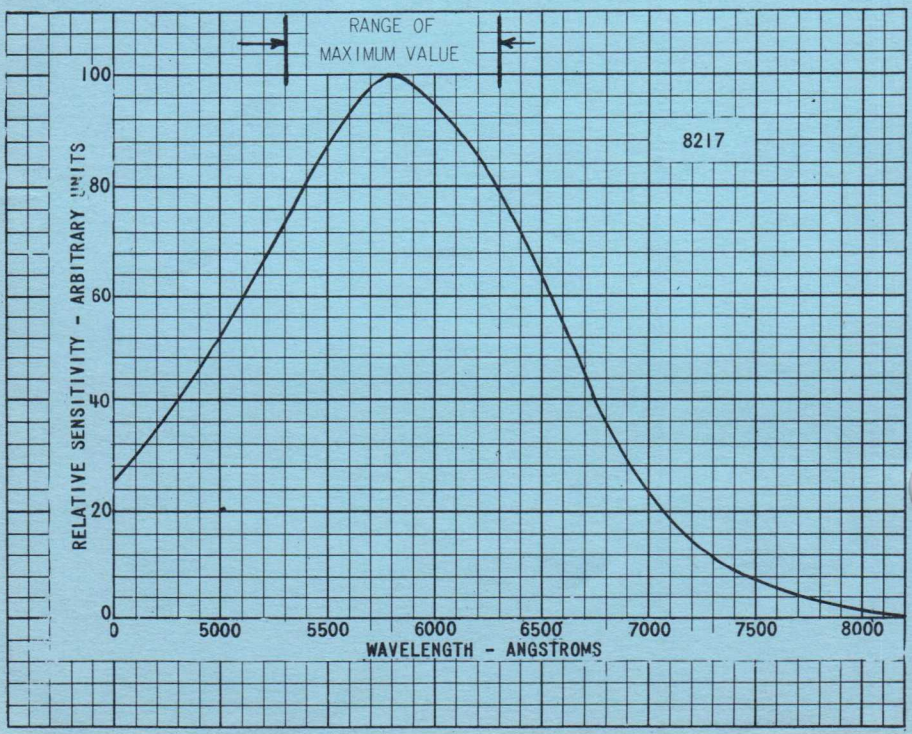

FIGURE 3 - POWER DISSIPATION RATING CHART

RATINGS APPLY WHEN SENSITIVE SURFACE IS UNIFORMLY ILLUMINATED WITH 10 FOOT-CANDLES.

DERATING IS NECESSARY FOR NON-UNIFORM ILLUMINATION.

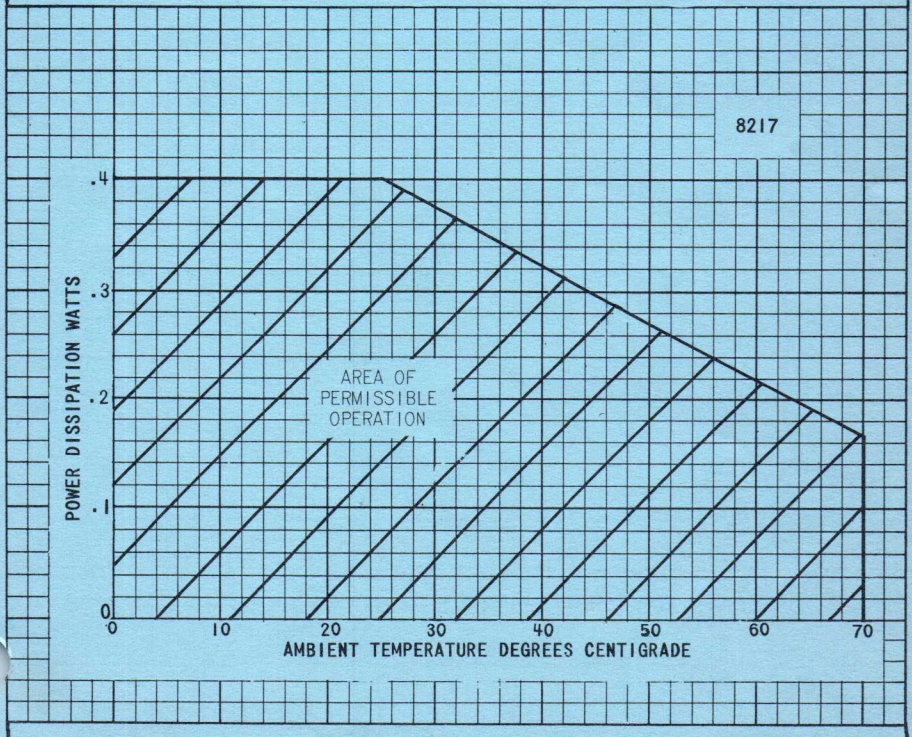

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FIGURE 4 - AVERAGE VOLTAGE-CURRENT CHARACTERISTICS
ILLUMINATION OF 2870 °K COLOR TEMPERATURE
DISSIPATION LIMIT APPLIES UP TO 20 °C

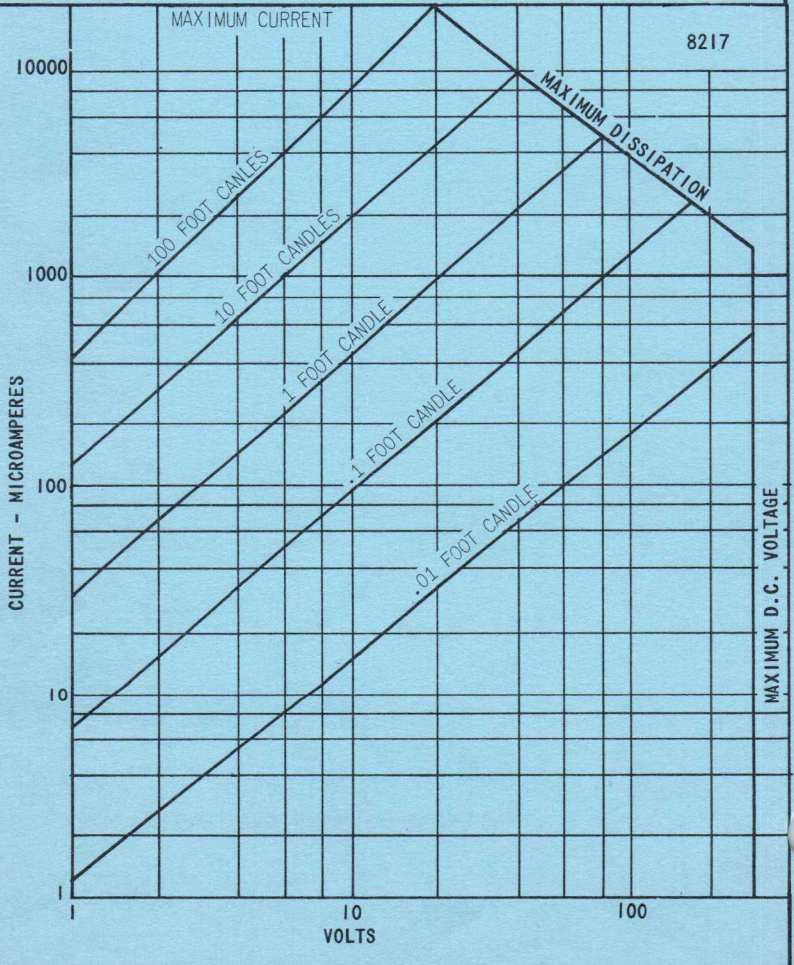
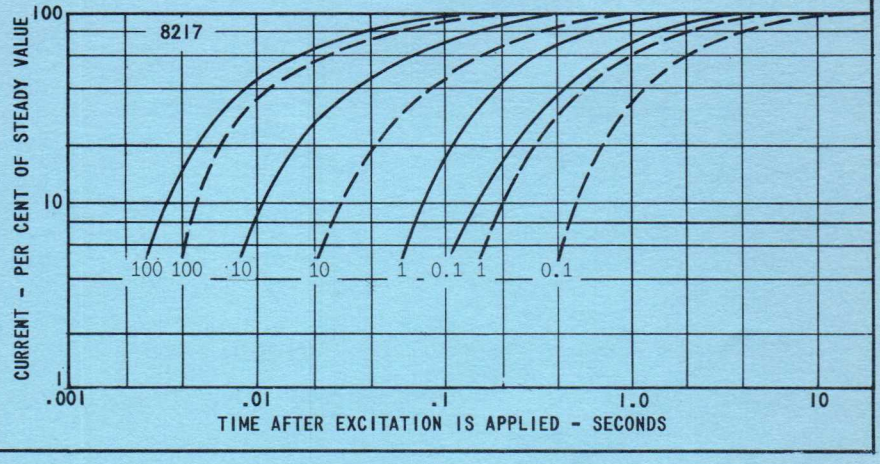


FIGURE 5 - AVERAGE RISE CHARACTERISTICS

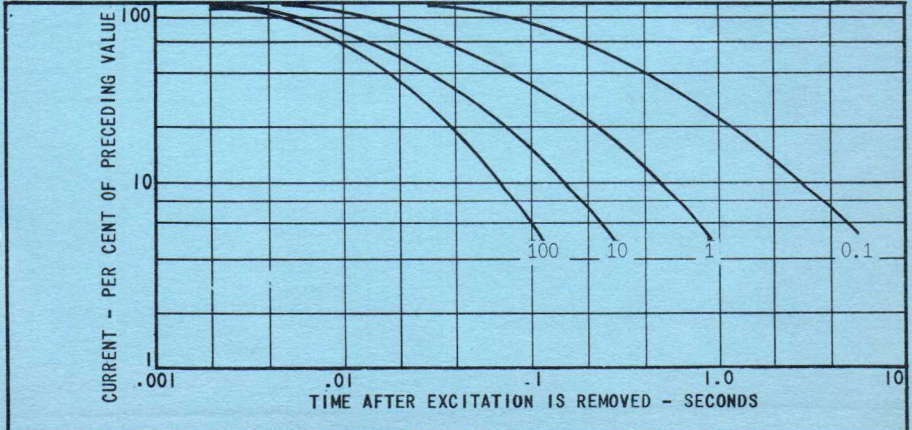


NUMBERS ON CURVES GIVE FOOT-CANDLES OF ILLUMINATION OF COLOR TEMPERATURE 2870°K.

SOLID LINES APPLY TO 5 SEC. STORAGE IN DARKNESS PRIOR TO EXCITATION.

DASHED LINES APPLY TO 5 MIN. STORAGE IN DARKNESS PRIOR TO EXCITATION.

FIGURE 6 - AVERAGE DECAY CHARACTERISTICS



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TUNG-SOL

TRIODE PENTODE

MINIATURE TYPE

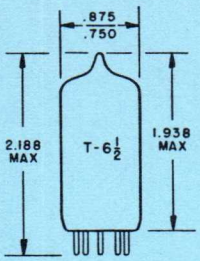
MEDIUM MU TRIODE AND
SHARP CUT-OFF PENTODE

FOR

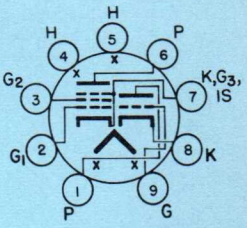
MOBILE COMMUNICATIONS EQUIPMENT

COATED UNIPOTENTIAL CATHODES

ANY MOUNTING POSITION



GLASS BULB
MINIATURE BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9AE

THE 8445 CONTAINS A MEDIUM MU TRIODE AND A SHARP CUT-OFF HIGH-FREQUENCY PENTODE WITH SEPARATE CATHODES IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS ADAPTED TO GIVE IMPROVED RELIABILITY IN MOBILE RADIO COMMUNICATION EQUIPMENT. ITS HEATER IS DESIGNED TO BE OPERATED FROM AN AUTOMOTIVE BATTERY.
ELECTRICALLY THE SAME TYPE, BUT WITH DIFFERENT BASING ARRANGEMENT, IS THE 8446.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT SHIELD

TRIODE SECTION:			
GRID TO PLATE: (TG TO TP)		1.5	pf
INPUT: TG TO (TK + H + PK + PG3 + I.S.)		2.5	pf
OUTPUT: TP TO (TK + H + PK + PG3 + I.S.)		1.8	pf
PENTODE SECTION:			
GRID 1 TO PLATE: (PG1 TO PP)	MAX.	0.025	pf
INPUT: PG1 TO (H + PK + PG2 + PG3 + I.S.)		5.5	pf
OUTPUT: PP TO (H + PK + PG2 + PG3 + I.S.)		3.8	pf
COUPLING:			
TRIODE GRID TO PENTODE PLATE	MAX.	0.02	pf
PENTODE GRID 1 TO TRIODE PLATE	MAX.	0.16	pf
PENTODE PLATE TO TRIODE PLATE	MAX.	0.07	pf

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HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.75	VOLTS	440	MA.
LIMITS OF APPLIED HEATER VOLTAGE			6.0 TO 7.5	VOLTS
HEATER CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE				
TOTAL DC AND PEAK			200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE				
DC			100	VOLTS
TOTAL DC AND PEAK			200	VOLTS

MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

	TRIODE	PENTODE	
PLATE VOLTAGE	330	330	VOLTS
GRID 2 VOLTAGE		200	VOLTS
POSITIVE GRID 1 VOLTAGE	0	0	VOLTS
PLATE DISSIPATION	2.0	1.7	WATTS
GRID 2 DISSIPATION		0.5	WATTS
GRID 1 CIRCUIT RESISTANCE			
FIXED BIAS	0.5	0.5	MEGOHM
CATHODE BIAS	1.0	1.0	MEGOHM

AVERAGE CHARACTERISTICS

PLATE VOLTAGE	100	170	VOLTS
GRID 2 VOLTAGE	-----	170	VOLTS
GRID 1 VOLTAGE	-1.0	-2.0	VOLTS
PLATE CURRENT	12.5	10.0	MA.
GRID 2 CURRENT	-----	2.5	MA.
TRANSCONDUCTANCE	7,000	6,200	μMHOS
AMPLIFICATION FACTOR	43		
PLATE RESISTANCE (APPROX.)	-----	0.4	MEGOHMS
GRID VOLTAGE (APPROX.) FOR Ib = 50 μA	-10	-----	VOLTS
GRID 1 VOLTAGE (APPROX.) FOR Ib = 100 μA.	-----	-7	VOLTS

TUNG-SOL

TRIODE PENTODE

MINIATURE TYPE

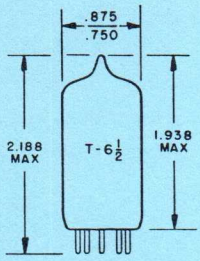
MEDIUM MU TRIODE AND
SHARP CUT-OFF PENTODE

FOR

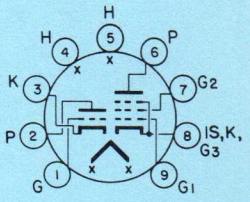
MOBILE COMMUNICATIONS EQUIPMENT

COATED UNIPOTENTIAL CATHODES

ANY MOUNTING POSITION



GLASS BULB
MINIATURE BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9FA

THE 8446 CONTAINS A MEDIUM MU TRIODE AND A SHARP CUT-OFF HIGH-FREQUENCY PENTODE WITH SEPARATE CATHODES IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS ADAPTED TO GIVE IMPROVED RELIABILITY IN MOBILE RADIO COMMUNICATION EQUIPMENT. ITS HEATER IS DESIGNED TO BE OPERATED FROM AN AUTOMOTIVE BATTERY.
ELECTRICALLY THE SAME TYPE, BUT WITH DIFFERENT BASING ARRANGEMENT, IS THE 8445.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT SHIELD

TRIODE SECTION:			
GRID TO PLATE: (TG TO TP)		1.5	pf
INPUT: TG TO (TK + H + PK + PG3 + I.S.)		2.5	pf
OUTPUT: TP TO (TK + H + PK + PG3 + I.S.)		2.2	pf
PENTODE SECTION:			
GRID 1 TO PLATE: (PG1 TO PP)	MAX.	0.046	pf
INPUT: PG1 TO (H + PK + PG2 + PG3 + I.S.)		5.0	pf
OUTPUT: PP TO (H + PK + PG2 + PG3 + I.S.)		3.5	pf
COUPLING:			
TRIODE GRID TO PENTODE PLATE	MAX.	0.02	pf
PENTODE GRID 1 TO TRIODE PLATE	MAX.	0.16	pf
PENTODE PLATE TO TRIODE PLATE	MAX.	0.07	pf

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HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.75	VOLTS	440	MA.
LIMITS OF APPLIED HEATER VOLTAGE			6.0 TO 7.5	VOLTS
HEATER CATHODE VOLTAGE:				
HEATER NEGATIVE WITH RESPECT TO CATHODE				
TOTAL DC AND PEAK			200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE				
DC			100	VOLTS
TOTAL DC AND PEAK			200	VOLTS

MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

	TRIODE	PENTODE	
PLATE VOLTAGE	330	330	VOLTS
GRID 2 VOLTAGE		200	VOLTS
POSITIVE GRID 1 VOLTAGE	0	0	VOLTS
PLATE DISSIPATION	2.0	1.7	WATTS
GRID 2 DISSIPATION		0.5	WATTS
GRID 1 CIRCUIT RESISTANCE			
FIXED BIAS	0.5	0.5	MEGOHM
CATHODE BIAS	1.0	1.0	MEGOHM

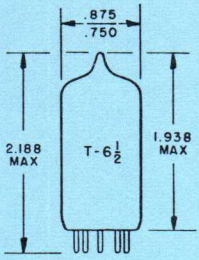
AVERAGE CHARACTERISTICS

PLATE VOLTAGE	100	170	VOLTS
GRID 2 VOLTAGE	-----	170	VOLTS
GRID 1 VOLTAGE	-1.0	-2.0	VOLTS
PLATE CURRENT	12.5	10.0	MA.
GRID 2 CURRENT	-----	2.5	MA.
TRANSCONDUCTANCE	7,000	6,200	μMHOS
AMPLIFICATION FACTOR	43		
PLATE RESISTANCE (APPROX.)	-----	0.4	MEGOHMS
GRID VOLTAGE (APPROX.) FOR Ib = 50 μA	-10	-----	VOLTS
GRID 1 VOLTAGE (APPROX.) FOR Ib = 100 μA.	-----	-7	VOLTS

TUNG-SOL

DOUBLE-DIODE-TRIODE

MINIATURE TYPE



GLASS BULB

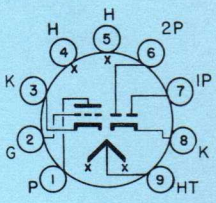
MINIATURE BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2

HIGH PERVEANCE DOUBLE DIODE
AND HIGH MU TRIODE

FOR
MOBILE COMMUNICATIONS EQUIPMENT

COATED UNIPOTENTIAL CATHODES

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 9CF

THE 8447 IS A HIGH PERVEANCE DOUBLE DIODE AND HIGH MU TRIODE WITH SEPARATE CATHODES IN THE 9 PIN MINIATURE CONSTRUCTION FOR USE IN RELIABLE MOBILE RADIO COMMUNICATION EQUIPMENT. IT IS INTENDED TO REPLACE THE 12BR7 WHERE RELIABILITY IS THE PRIMARY CONSIDERATION. ITS HEATER IS DESIGNED TO OPERATE DIRECTLY FROM A 3 OR 6-CELL AUTOMOTIVE BATTERY.

DIRECT INTERELECTRODE CAPACITANCES

WITH SHIELD #315
CONNECTED TO CATHODE OF THE SECTION UNDER TEST

DIODE		
EACH: P TO (K + H)	2.0	pf
TRIODE		
GRID TO PLATE: G TO P	1.9	pf
INPUT: G TO (H + K)	2.8	pf
OUTPUT: P TO (H + K)	1.0	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

SUPPLY CONNECTED TO PINS:	9 AND 4+5	4 AND 5	
AVERAGE VALUES - VOLTAGE	6.75	13.5	VOLTS
CURRENT	380	190	MA.
LIMITS OF APPLIED HEATER VOLTAGE	6.0 – 7.5	12.0 – 15.0	VOLTS
HEATER CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			
TOTAL DC AND PEAK	200		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			
DC	100		VOLTS
TOTAL DC AND PEAK	200		VOLTS

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MAXIMUM RATINGS

DESIGN MAXIMUM RATINGS - SEE EIA STANDARD RS-239

DIODE SECTION:

PEAK INVERSE VOLTAGE	300	VOLTS
PEAK CURRENT, EACH	60	MA.

TRIODE SECTION:

PLATE VOLTAGE	300	VOLTS
NEGATIVE GRID VOLTAGE	50	VOLTS
PLATE DISSIPATION	2.5	WATTS

AVERAGE CHARACTERISTICS

DIODE SECTION:

AVERAGE DIODE CURRENT WITH 5 VOLTS DC APPLIED (EACH SECTION)	17	MA.

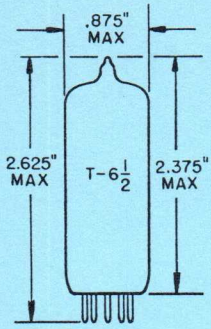
TRIODE SECTION:

PLATE VOLTAGE	250	VOLTS
CATHODE BIAS RESISTOR	200	OHMS
PLATE CURRENT	10	MA.
TRANSCONDUCTANCE	5,500	μMHOS
AMPLIFICATION FACTOR	60	
PLATE RESISTANCE (APPROX.)	10,900	OHMS
GRID VOLTAGE (APPROX.) FOR Ib = 10 μA	−12	VOLTS

TUNG-SOL

PENTODE

MINIATURE TYPE



GLASS BULB

MINIATURE BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-3

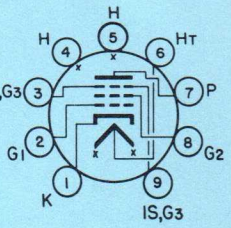
POWER PENTODE

FOR

MOBILE COMMUNICATIONS EQUIPMENT

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 9BF

THE 8448 IS A POWER PENTODE IN THE 9 PIN MINIATURE CONSTRUCTION FOR USE IN RELIABLE MOBILE RADIO COMMUNICATION EQUIPMENT. IT IS INTENDED TO REPLACE THE 12BY7A WHERE RELIABILITY IS THE PRIMARY CONSIDERATION. ITS HEATER IS DESIGNED TO OPERATE DIRECTLY FROM A 3 OR 6–CELL AUTOMOTIVE BATTERY.

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID 1 TO PLATE - G1 TO P	MAX.	0.063	pf
INPUT: G1 TO (H + K + G2 + G3 + I.S.)		10.2	pf
OUTPUT: P TO (H + K + G2 + G3 + I.S.)		3.5	pf

HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

SUPPLY CONNECTED TO PINS	6 AND 4 + 5	4 AND 5	
AVERAGE VALUES - VOLTAGE	6.75	13.5	VOLTS
CURRENT	520	260	MA.
LIMITS OF APPLIED HEATER VOLTAGE	6.0 - 7.5	12.0 - 15.0	VOLTS
HEATER CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			
TOTAL DC AND PEAK	200		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE			
DC	100		VOLTS
TOTAL DC AND PEAK	200		VOLTS

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MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

PLATE VOLTAGE	330	VOLTS
GRID 2 VOLTAGE	190	VOLTS
NEGATIVE GRID VOLTAGE	55	VOLTS
POSITIVE GRID 1 VOLTAGE	0	VOLTS
PLATE DISSIPATION	6.5	WATTS
GRID 2 DISSIPATION	1.2	WATTS
GRID 1 CIRCUIT RESISTANCE		
FIXED BIAS	0.25	MEGOHM
CATHODE BIAS	1.0	MEGOHM

AVERAGE CHARACTERISTICS

PLATE VOLTAGE	250	VOLTS
GRID 2 VOLTAGE	180	VOLTS
CATHODE BIAS RESISTOR	100	OHMS
PLATE CURRENT	26	MA.
GRID 2 CURRENT	5.7	MA.
TRANSCONDUCTANCE	11,000	μMHOS
PLATE RESISTANCE (APPROX.)	93,000	OHMS
TRIODE AMPLIFICATION FACTOR	28.5	
GRID 1 VOLTAGE (APPROX.) FOR Ib = 100 μA	−8.5	VOLTS

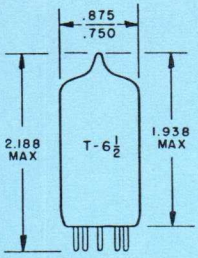
TUNG-SOL

TRIODE-PENTODE

MINIATURE TYPE

MEDIUM MU TRIODE AND

SHARP CUTOFF PENTODE

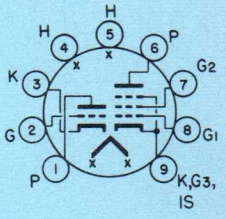


GLASS BULB

MINIATURE BUTTON
9 PIN BASE E9-1
OUTLINE DRAWING
JEDEC 6-2

COATED UNIPOTENTIAL CATHODES

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM

JEDEC 9DA

THE 8489 CONTAINS A MEDIUM MU TRIODE AND A SHARP CUTOFF PENTODE IN THE 9 PIN MINIATURE CONSTRUCTION. IT IS INTENDED FOR USE IN CIRCUITS WITH HIGH VALUES OF CONTROL GRID RESISTANCE. LEAKAGE IS MINIMIZED BY USE OF SPECIAL MATERIALS AND PROCESSING; MAINTENANCE OF THIS CHARACTERISTICS IS ASSURED BY SPECIAL LIFE TESTS.

DIRECT INTERELECTRODE CAPACITANCES

PENTODE			
GRID 1 TO PLATE: G1 TO P	(MAX.)	0.04	pf
INPUT: G1 TO (H + KP + G2 + G3 + I.S.)		7.0	pf
OUTPUT: P TO (H + KP + G2 + G3 + I.S.)		2.4	pf
TRIODE			
GRID TO PLATE: G TO P		1.5	pf
INPUT: G TO (H + KT + KP + I.S.)		2.0	pf
OUTPUT: P TO (H + KT + KP + I.S.)		1.5	pf
COUPLING			
TRIODE GRID TO PENTODE PLATE	MAX.	0.02	pf
PENTODE GRID TO TRIODE PLATE	MAX.	0.02	pf
PENTODE PLATE TO TRIODE PLATE	MAX.	0.15	pf

CONTINUED ON FOLLOWING PAGE

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HEATER CHARACTERISTICS AND RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

AVERAGE VALUES - VOLTAGE	6.3	VOLTS
- CURRENT	450	MA.
LIMITS OF APPLIED HEATER VOLTAGE	6.3±0.6	VOLTS
HEATER CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
TOTAL DC AND PEAK (MAX.)	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE		
DC (MAX.)	100	VOLTS
TOTAL DC AND PEAK (MAX.)	200	VOLTS

MAXIMUM RATINGS

DESIGN MAXIMUM VALUES - SEE EIA STANDARD RS-239

	TRIODE	PENTODE	
PLATE VOLTAGE	330	330	VOLTS
GRID 2 SUPPLY VOLTAGE	-----	330	VOLTS
GRID 2 VOL TAGE		See Rating Chart J5-C4-2	
POSITIVE GRID 1 VOLTAGE	0	0	VOLTS
PLATE DISSIPATION	2.8	2.3	WATTS
GRID 2 DISSIPATION (UP TO 165 VOLTS)		0.55	WATTS
GRID 1 CIRCUIT RESISTANCE	1.0	1.0	MEGOHMS
AT 10% OR LESS OF MAXIMUM			
PLATE AND SCREEN DISSIPATION	5	10	MEGOHMS

AVERAGE CHARACTERISTICS

	TRIODE	PENTODE	
PLATE VOLTAGE	150	125	VOLTS
GRID 2 VOLTAGE	-----	125	VOLTS
GRID 1 VOLTAGE	-3.0	-1.0	VOLTS
PLATE CURRENT	15	12	MA.
GRID 2 CURRENT	-----	3.8	MA.
TRANSCONDUCTANCE	4,500	7,000	μMHOS
AMPLIFICATION FACTOR	21	-----	
PLATE RESISTANCE (APPROX.)	4,700	170,000	OHMS
GRID VOLTAGE (APPROX.) FOR Ib = 50 μA	-15	-----	VOLTS
GRID 1 VOLTAGE (APPROX.) FOR Ib = 100 μA	-----	-7	VOLTS

TUNG-SOL

PENTODE

SUBMINIATURE

FOR

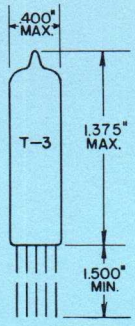
CLASS C OSCILLATOR

AND FREQUENCY MULTIPLIER

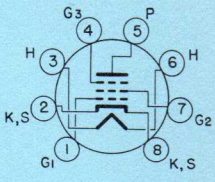
APPLICATIONS

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



GLASS BULB
SUBMINIATURE BUTTON
8 PIN BASE E8-10
OUTLINE DRAWING
JEDEC 3-1



BOTTOM VIEW
BASING DIAGRAM
JEDEC 8DC

THE 8517 IS A PENTODE IN THE 8 PIN SUBMINIATURE CONSTRUCTION. IT IS INTENDED FOR CLASS C OSCILLATOR AND FREQUENCY MULTIPLIER APPLICATIONS WHERE LONG LIFE AND RESISTANCE TO SHOCK AND VIBRATION ARE ESSENTIAL.

DIRECT INTERELECTRODE CAPACITANCES

WITH SHIELD #318 TIED TO CATHODE

GRID 1 TO PLATE	MAX.	0.02	pf
GRID 1 TO ALL OTHER ELECTRODES		4.3	pf
PLATE TO ALL OTHER ELECTRODES		3.5	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	150	MA.
LIMITS OF APPLIED VOLTAGE		6.3 ± 0.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE			
TOTAL DC AND PEAK-EITHER POLARITY		200	VOLTS

CONTINUED ON FOLLOWING PAGE

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

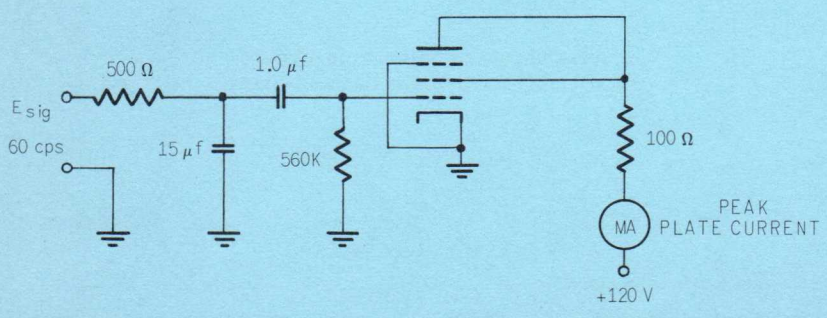
PLATE VOLTAGE	165	VOLTS
GRID 2 VOLTAGE	155	VOLTS
GRID 1 VOLTAGE	0	VOLTS
GRID 3 VOLTAGE	30	VOLTS
PLATE DISSIPATION	.80	WATTS
GRID 2 DISSIPATION	.55	WATTS
CATHODE CURRENT	16	MA.
GRID 1 CIRCUIT RESISTANCE	1.1	MEGOHMS
ENVELOPE TEMPERATURE	220	°C
ALTITUDE	60,000	FEET

AVERAGE CHARACTERISTICS

PLATE VOLTAGE	100	VOLTS
GRID 2 VOLTAGE	100	VOLTS
GRID 1 VOLTAGE	0	VOLTS
GRID 3 VOLTAGE	0	VOLTS
CATHODE RESISTOR	150	OHMS
PLATE CURRENT	6.1	MA.
GRID 2 CURRENT	4.2	MA.
GRID 1 VOLTAGE FOR I_b = 100 μA	-6.0	VOLTS
PEAK PLATE CURRENT-TRIODE CONNECTED-SEE DIAGRAM	48	MA.

CIRCUIT DIAGRAM

THIS CIRCUIT SIMULATES A CLASS C OSCILLATOR WITH HIGH-ORDER HARMONIC OUTPUT.



ADJUST E_{sig} FOR E_{g1} = 21 VOLTS RMS

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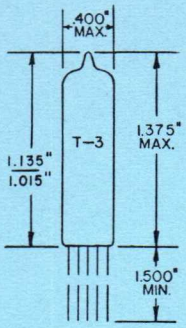
DUAL-CONTROL PENTODE

SUBMINIATURE



GLASS BULB

SUBMINIATURE BUTTON
8 PIN BASE E8-10
OUTLINE DRAWING
JEDEC 3-1

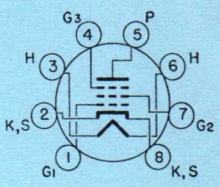
FOR

AMPLIFIER, MIXER

MODULATOR AND GATING SERVICE

COATED UNIPOTENTIAL CATHODE

ANY MOUNTING POSITION



BOTTOM VIEW

BASING DIAGRAM
JEDEC 8DC

THE 8522 IS A PREMIUM SUBMINIATURE DUAL-CONTROL PENTODE USEFUL AS AN AMPLIFIER OR MIXER UP TO UHF, AND FOR MODULATOR AND GATING SERVICE. IT REPLACES TYPE 5636 WHEN BETTER CONTROL OF INSULATION RESISTANCE AND MICROPHONICS ARE REQUIRED, OR WHEN CONTROL OF GRID #1 TRANSCONDUCTANCE AT SEVERAL GRID #3 BIAS POINTS IS DESIRABLE.

DIRECT INTERELECTRODE CAPACITANCES

	WITH SHIELD #318 CONNECTED TO CATHODE	WITHOUT SHIELD	
GRID 1 TO PLATE - MAX.	0.02	0.03	pf
GRID 3 TO PLATE - MAX.	1.1	1.1	pf
GRID 1 TO ALL OTHER ELECTRODES	4.0	4.0	pf
GRID 3 TO ALL OTHER ELECTRODES	4.0	3.8	pf
PLATE TO ALL OTHER ELECTRODES	3.4	1.9	pf
GRID 1 TO GRID 3 - MAX.	0.15	0.17	pf

HEATER CHARACTERISTICS AND RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

AVERAGE CHARACTERISTICS	6.3 VOLTS	150	MA.
LIMITS OF APPLIED VOLTAGE		6.3 ± 0.3	VOLTS
MAXIMUM HEATER-CATHODE VOLTAGE			
TOTAL DC AND PEAK-EITHER POLARITY		200	VOLTS

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MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

PLATE VOLTAGE	165	VOLTS
GRID 2 VOLTAGE	155	VOLTS
GRID 1 VOLTAGE	0,-55	VOLTS
GRID 3 VOLTAGE	+30	VOLTS
PLATE DISSIPATION	0.70	WATTS
GRID 2 DISSIPATION	0.55	WATTS
CATHODE CURRENT	16	MA.
GRID 1 CIRCUIT RESISTANCE	1.1	MEGOHMS
ENVELOPE TEMPERATURE	220	^{0}C
ALTITUDE	60,000	FEET

AVERAGE CHARACTERISTICS

ALL VOLTAGES REFERRED TO NEGATIVE END OF CATHODE RESISTOR

DUAL CONTROL AMPLIFIER

PLATE VOLTAGE	100	100	VOLTS
GRID 2 VOLTAGE	100	100	VOLTS
GRID 1 SUPPLY VOLTAGE	0	0	VOLTS
GRID 3 VOLTAGE	CATHODE POTENTIAL	SEE BELOW	
CATHODE RESISTOR	150	330	OHMS
PLATE CURRENT	5.3	-	MA.
GRID 2 CURRENT	3.6	-	MA.
GRID 1 TRANSCONDUCTANCE	3,200	-	μMHOS
PLATE RESISTANCE	.11	-	MEGOHM
GRID 3 TRANSCONDUCTANCE			
AT GRID 3 SUPPLY VOLTAGE OF - 1 VOLTS	1050	-	μMHOS
GRID 1 TRANSCONDUCTANCE			
AT GRID 3 SUPPLY VOLTAGE OF +0.5 VOLTS	-	2,250	μMHOS
AT GRID 3 SUPPLY VOLTAGE OF -1.65 VOLTS	-	1,300	μMHOS
AT GRID 3 SUPPLY VOLTAGE OF -3.0 VOLTS	-	700	μMHOS
AT GRID 3 SUPPLY VOLTAGE OF -4.0 VOLTS	-	275	μMHOS
GRID 1 VOLTAGE FOR PLATE CURRENT OF 10 μA	-7.5	-	VOLTS
GRID 3 VOLTAGE FOR PLATE CURRENT OF 10 μA	-8	-	VOLTS
LOW - FREQUENCY - VIBRATION OUTPUT			
ACROSS R_L = 10,000 OHMS AT 15 G 40 CPS	Max. 60	-	M VOLTS

MIXER

PLATE VOLTAGE	100	VOLTS
GRID 2 VOLTAGE	100	VOLTS
GRID 3 VOLTAGE - DC	0	VOLTS
AC	15	VOLTS RMS
GRID 1 VOLTAGE - DC	0	VOLTS
CATHODE RESISTOR	150	OHMS
PLATE CURRENT	3.5	MA.
GRID 2 CURRENT	5.7	MA.
CONVERSION TRANSCONDUCTANCE	1,400	μMHOS
PLATE RESISTANCE	0.32	MEGOHMS

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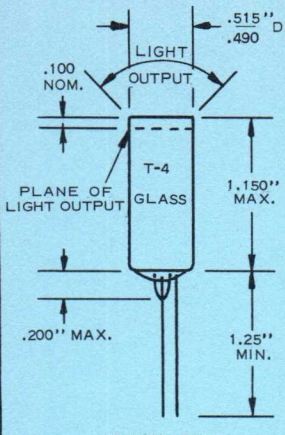
OUTLINE



4 TINNED LEADS
0.018" DIA.

INDICATOR TRIODE

SUBMINIATURE TYPE

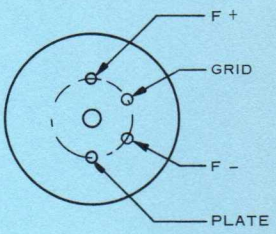
FOR

ELECTRONIC COMPUTER

APPLICATIONS

COATED FILAMENTARY CATHODE

BASE DIAGRAM



BOTTOM VIEW

THE 8569 IS A LONG-LIFE FILAMENTARY HIGH-VACUUM END-VIEW INDICATOR TRIODE IN A T-4 GLASS ENVELOPE. ITS GRID SHAPED PLATE IS COATED WITH A PHOSPHOR WHICH GIVES A BRIGHT BLUE GREEN LIGHT PROPORTIONAL TO PLATE CURRENT. IT IS DESIGNED FOR APPLICATIONS IN ELECTRONIC COMPUTERS, WHERE ITS SMALL SIZE, LOW ENERGY REQUIREMENTS, HIGH SENSITIVITY, AND FREEDOM FROM NOISE MAKE IT VERY USEFUL IN COMBINATION WITH TRANSISTORIZED CIRCUITS.

OPTICAL DATA

LIGHT OUTPUT	SEE TYPICAL OPERATION
SPECTRAL OUTPUT OF PHOSPHOR	SEE CURVE 1
PERSISTANCE CHARACTERISTICS	SEE CURVE 2
LIGHT OUTPUT VS. PLATE VOLTAGE	SEE CURVE 3

NOTE: LIGHT OUTPUT MEASURED BY COMPARISON WITH A TUNGSTEN LAMP OF 2 870°K COLOR TEMPERATURE USING AN S4 PHOTO DEVICE.

ELECTRICAL DATA

FILAMENT CHARACTERISTICS AND RATINGS

AVERAGE CHARACTERISTICS	0.70 VOLTS	35	mA
LIMITS OF APPLIED VOLTAGE - AC OR DC		0.65 – 0.75	VOLTS

MAXIMUM RATINGS

ABSOLUTE MAXIMUM SYSTEM - SEE EIA STANDARD RS-239

PLATE VOLTS	65	VOLTS
POSITIVE GRID VOLTAGE	0	VOLTS
NEGATIVE GRID VOLTAGE	50	VOLTS
PLATE CURRENT	750	μA
GRID CIRCUIT RESISTANCE	1	MEGOHM
MINIMUM GRID CIRCUIT RESISTANCE	0.1	MEGOHM

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AVERAGE CHARACTERISTICS

FILAMENT DC, NEGATIVE GROUNDED

PLATE VOLTAGE	50	VOLTS
GRID VOLTAGE	0	VOLTS
GRID RESISTOR	100	KOHMS
PLATE CURRENT	380	μA
AMPLIFICATION FACTOR	22	

TYPICAL OPERATION

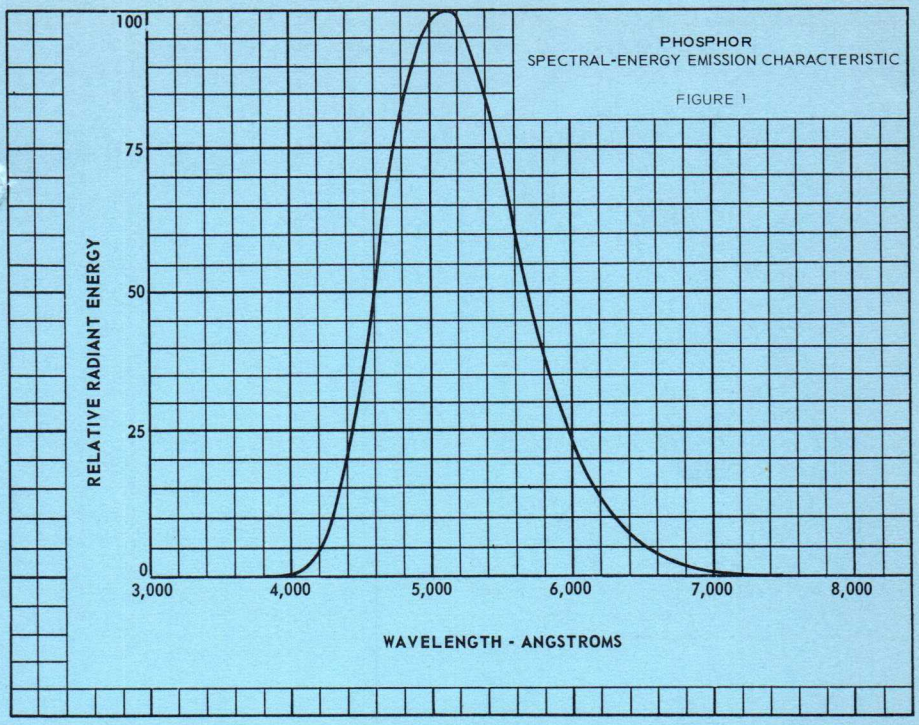
FILAMENT AC, TRANSFORMER CENTER TAP GROUNDED

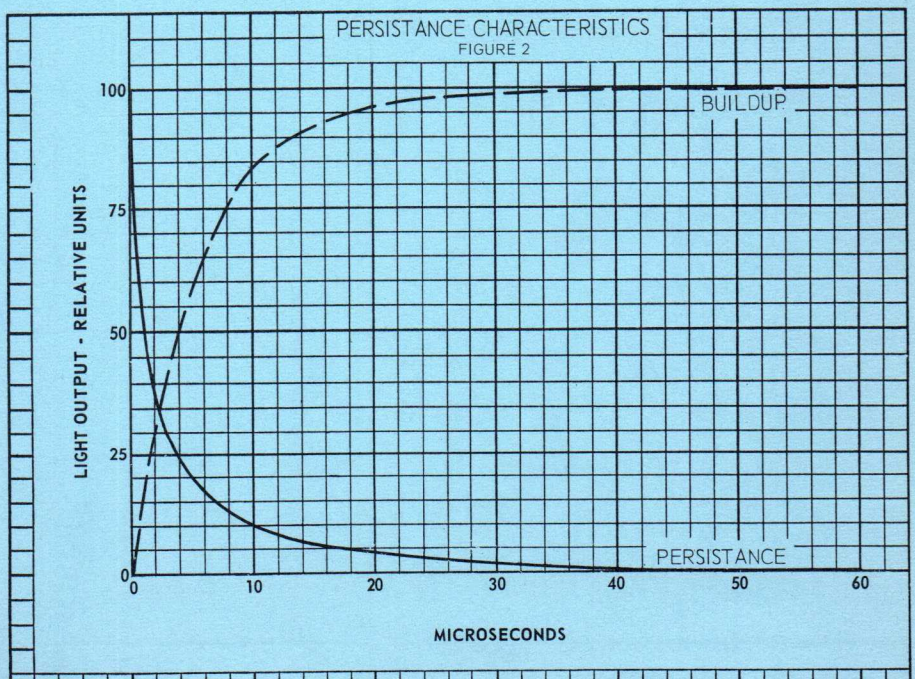
PLATE VOLTAGE	50	VOLTS
GRID RESISTOR	100	KOHMS
WITH GRID VOLTAGE = 0		
PLATE CURRENT	450	μA
LIGHT OUTPUT	5	m CANDLES
WITH GRID VOLTAGE = −3.0 VOLTS		
PLATE CURRENT	<5	μA
LIGHT OUTPUT	NOT VISIBLE	

DIRECT INTERELECTRODE CAPACITANCES

WITHOUT EXTERNAL SHIELD

GRID TO PLATE	1.9	pf
INPUT	1.6	pf
OUTPUT	1.7	pf





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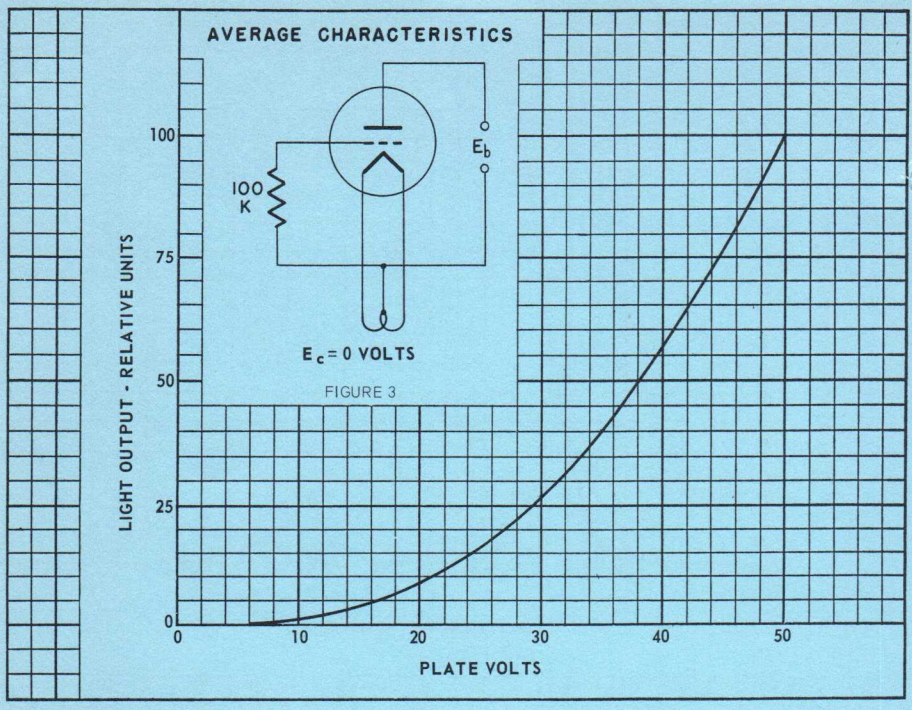
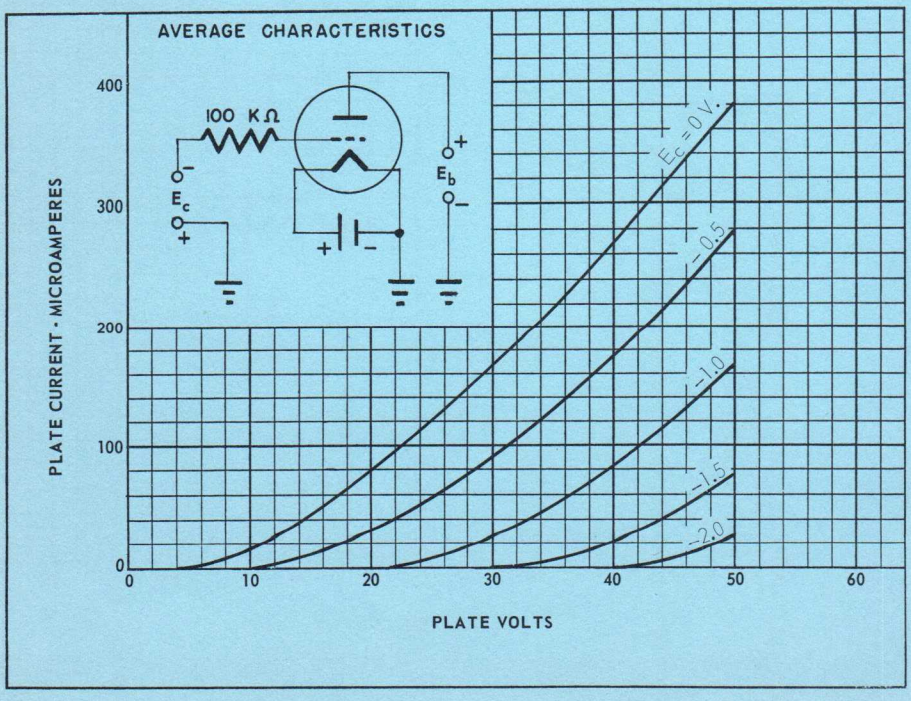
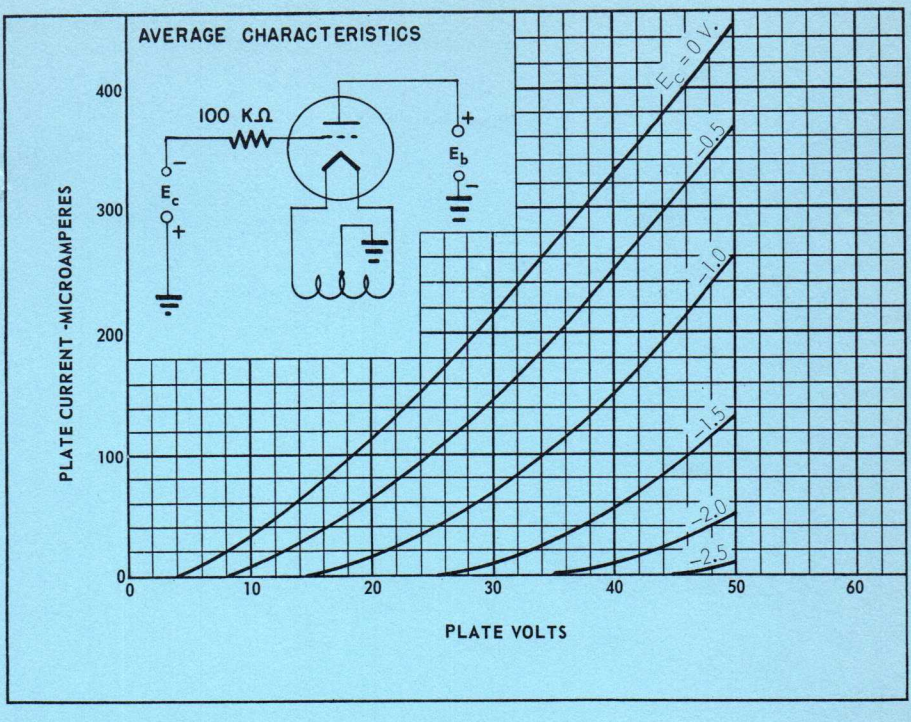

AVERAGE CHARACTERISTICS
100
K
E_b
E_c = 0 VOLTS
LIGHT OUTPUT - RELATIVE UNITS
100
75
50
25
0
0
10
20
30
40
50
PLATE VOLTS

FIGURE 3


AVERAGE CHARACTERISTICS
100 KΩ
E_c
E_b
E_c = 0 V.
-0.5
-1.0
-1.5
-2.0
PLATE CURRENT - MICROAMPERES
400
300
200
100
0
0
10
20
30
40
50
60
PLATE VOLTS



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8FP4 THRU 10DP4	6135 & 6136
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14EP4 THRU 16AEP4	6138 & 6139
16AP4 THRU 16RP4A	6139 & 6140
16SP4 THRU 17BP4A	6140 & 6141
17BP4B THRU 17CP4	6141 & 6142
17CP4A THRU 17DSP4	6142 & 6143
17DTP4 THRU 17YP4	6143 & 6144
19AP4 THRU 20HP4	6144 & 6145
20HP4A THRU 21ATP4A	6145 & 6146
21ATP4B THRU 21CEP4	6146 & 6147
21CEP4A THRU 21DLP4	6147 & 6148
21DMP4 THRU 21FP4C	6148 & 6149
21JP4 THRU 23JP4	6149 & 6150
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CATHODE RAY TUBE DATA

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TUNG-SOL ELECTRIC INC., ELECTRON TUBE DIVISION, BLOOMFIELD, NEW JERSEY, U.S.A.. APRIL 1, 1961 PLATE #6134

CATHODE RAY PICTURE TUBES

ELECTRICAL CHARACTERISTICS

All tubes in this section are for use in television receivers.

All tubes listed here use P4 Phosphor having White Fluorescence and Phosphorescence and Medium Persistence.

M denotes Magnetic deflection or focus. E denotes Electrostatic deflection or focus.

TYPE	DESCRIPTION	HEATER			RATINGS									TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS						
		VOLTS	AMPERES	ION TRAP MAGNET	EXTERNAL MAG. MEANS FOR CONV.	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE DIAGONAL	EXTERNAL CONDUCTIVE COATING	MAX. ANODE KILOVOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 OR CONVERGENCE ELECTRODE	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL MA.	ION TRAP MAGNET TURNS	ION TRAP MAGNET FIELD STRENGTH GAUSS	TYPE
7ABP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO	M	E[B]	50	NO	10	1.5	7	0 to 250	300	−55	−15 to +15μa			7ABP4
7AP4	ROUND GLASS—DIRECT VIEW	2.5	2.1	NONE	NO	NO	M	E	55	NO	3.5	2	3.5	675		−67.5				7AP4
7CP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	M	E	57	NO	8	1.5	6	1140	250	−45				7CP4
7DP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	NO	NO	M	E	50	YES	8	1.5	6	1645	250	−45		70		7DP4
7EP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	E	E	[J]	NO	3.3	1.5	2.5	650		−60				7EP4
7GP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	E	E	[K]	NO	4	1.5	3	1200		−60				7GP4
7HP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	M	M	50	YES	8.8	1.5	6		250	−55				7HP4
7JP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	E	E	[L]	NO	6	1.5	6	2400		−120				7JP4
7NP4	ROUND GLASS—PROJECTION TYPE (ALUMINIZED SCREEN)	6.6	0.62	NONE	NO	NO	M	E	35	YES	80	1.5	75		600	−155				7NP4
7QP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	52	NO	10	1.5	8		300	−55	80		35	7QP4
7RP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	YES	NO	M	M	50	YES	12	1.5	9		250	−45	120			7RP4
7TP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO	M	E	50	NO	12	1.5	10		200	−33				7TP4
7WP4	ROUND GLASS—PROJECTION TYPE (ALUMINIZED SCREEN)	6.6	0.62	NONE	NO	NO	M	E	35	YES	80	1.5	75		600	−155				7WP4
8AP4	METAL CONE—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	54	NO	9	1.5	7			−45	115			8AP4
8AP4A	METAL CONE—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	54	NO	9	1.5	7			−45	115		45	8AP4A
8BP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	E	E	[O]	NO	6.6	1.5	6	2400		−120				8BP4
8DP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	[H,S5 D,90]	YES	8	1.5	6	+15[W] to +450	150					8DP4

[A] Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[B] Horizontal. [D] Diagonal. [W] Grid # 4 to Grid # 1 Voltage.
[S] Self-focusing. [C] Grid # 4 Voltage.

[J] Deflection Factor:
D_1D_3 : 110 V. dc/in.
D_2D_4 : 95 V. dc/in.

[K] Deflection Factor:
D_1D_3 : 108 V. dc/in.
D_2D_4 : 89 V. dc/in.

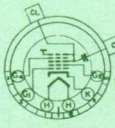
[L] Deflection Factor:
D_1D_3 : 216 V. dc/in.
D_2D_4 : 177 V. dc/in.

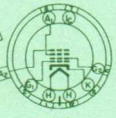
[O] Deflection Factor:
D_1D_3 : 172 V. dc/in.
D_2D_4 : 146 V. dc/in.


5AJ


8BQ


11N


12AB

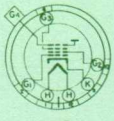

12C


12D


12H


12M


12N


12Q


14G


14N

TUNG-SOL

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TUNG-SOL

CATHODE RAY TUBE COMPARISON CHART

PRINTED IN U. S. A.

TUNG-SOL ELECTRIC INC., ELECTRON TUBE DIVISION, BLOOMFIELD, NEW JERSEY, U.S.A., JUNE 1, 1961 PLATE #6175

TUBE COMPARISON CHART

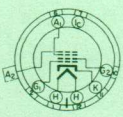
7CP4-10FP4A

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH & HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (kV)	TYPE
ROUND GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 50° TO 57° DEFLECTION ANGLE	7CP4	20	CLEAR	8BQ	13 7/16	7	7 1/16	5 1/2 x 4	NONE	BALL	NONE	8	7CP4
	7DP4	24	CLEAR	12C	14 1/16	7 5/8	8 1/16	5 1/2 x 4	400-1500	CAVITY	DOUBLE	8	7DP4
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 50° TO 52° DEFLECTION ANGLE	7HP4	24	CLEAR	12N	13	7 5/16	7 1/16	5 3/4 x 4	500	BALL	NONE	8.8	7HP4
	7QP4	24	CLEAR	12D	12 7/16	7 5/16	6 15/16	5 5/8 x 4	NONE	CAVITY	SINGLE	10	7QP4
ROUND GLASS — PROJECTION TYPE — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 35° DEFLECTION ANGLE	7NP4	15.315	CLEAR	14N	19 1/2	7	10 3/16	5 x 3 3/4	—	METAL CAP	NONE	80	7NP4
	7WP4	20.3	CLEAR	14N	19 1/2	7	10 3/16	5 x 3 3/4	—	METAL CAP	NONE	80	7WP4
ROUND METAL — MAGNETIC FOCUS & DEFLECTION 54° DEFLECTION ANGLE	8AP4	27	CLEAR	12H	14 1/4	8 1/2	7	7 x 5 1/4	NONE	METAL CONE LIP	SINGLE	9	8AP4
	8AP4A	27	GRAY	12H	14 1/4	8 1/2	7	7 x 5 1/4	NONE	METAL CONE LIP	SINGLE	9	8AP4A
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 85° DEFLECTION ANGLE	10ABP4	17 1/2	CLEAR	12L	11 7/8	9 3/4 x 7 1/2	6 1/2	8 7/8 x 6 9/16	400-850	CAVITY	SINGLE	12	10ABP4
	10ABP4A	17 1/2	CLEAR (ALUMINIZED)	12L	11 7/8	9 3/4 x 7 1/2	6 1/2	8 7/8 x 6 9/16	400-850	CAVITY	SINGLE	12	10ABP4A
	10ABP4B	17 1/2	GRAY	12L	11 7/8	9 3/4 x 7 1/2	6 1/2	8 7/8 x 6 9/16	400-850	CAVITY	SINGLE	12	10ABP4B
	10ABP4C	17 1/2	CLEAR (ALUMINIZED)	12L	11 7/8	9 3/4 x 7 1/2	6 1/2	8 7/8 x 6 9/16	400-850	CAVITY	SINGLE	12	10ABP4C
	10ADP4†	17 1/2	GRAY	12L	11 7/8	9 3/4 x 7 1/2	6 1/2	9 1/16 x 6 5/8	400-850	CAVITY	SINGLE	12	10ADP4†
	10AEP4*	17 1/2	GRAY (ALUMINIZED)	12L	11 7/8	9 3/4 x 7 1/2	6 1/2	8 7/8 x 6 9/16	400-850	CAVITY	SINGLE	12	10AEP4*
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 50° DEFLECTION ANGLE	10BP4	42	CLEAR	12N	17 5/8	10 1/2	8 3/16	8 x 6	500-2500	CAVITY	SINGLE	10	10BP4
	10BP4A	42	GRAY	12N	17 5/8	10 1/2	8 3/16	8 x 6	500-2500	CAVITY	SINGLE	10	10BP4A
	10BP4C	42	CLEAR (ALUMINIZED)	12N	17 5/8	10 1/2	8 3/16	8 x 6	500-2500	CAVITY	SINGLE	10	10BP4C
	10BP4D	42	GRAY (ALUMINIZED)	12N	17 5/8	10 1/2	8 3/16	8 x 6	500-2500	CAVITY	SINGLE	10	10BP4D
	10CP4	42	CLEAR	12N	16 5/8	10 1/2	7 3/16	8 x 6	500	BALL	NONE	12	10CP4
	10EP4	42	CLEAR	12N	17 5/8	10 1/2	8 1/16	8 x 6	—	BALL	DOUBLE	12	10EP4
	10FP4	42	CLEAR (ALUMINIZED)	12N	17 5/8	10 1/2	8 3/16	8 x 6	500-2500	CAVITY	NONE	12	10FP4
	10FP4A	42	GRAY (ALUMINIZED)	12N	17 5/8	10 1/2	8 1/16	8 x 6	500-2500	CAVITY	NONE	12	10FP4A

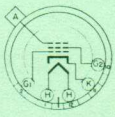
* Heater: 6.3 Volts, 450 Ma. † Heater: 8.4 Volts, 450 Ma.



8BQ



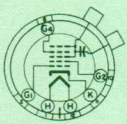
12C



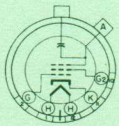
12D



12H



12L



12N

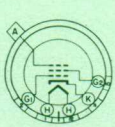


14N

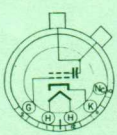
TUBE COMPARISON CHART

10MP4-14UP4

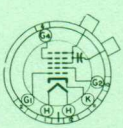
TUBE DESCRIPTION BY GROUPS	TYPE	RAD'S OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH + HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (kV)	TYPE
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 52° DEFLECTION ANGLE	10MP4	42	CLEAR	12G	17	10½	7⅝	8 x 6	500-2500	CAVITY	DOUBLE	10	10MP4
	10MP4A	42	GRAY	12G	17	10½	7⅝	8 x 6	500-2500	CAVITY	DOUBLE	10	10MP4A
	10RP4	42	CLEAR (ALUMINIZED)	12L	16½	10½	7⅛	9⅛ (DIAMETER)	750-1500	CAVITY	SINGLE	16	10RP4
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 50° TO 56° DEFLECTION ANGLE	12JP4	20	CLEAR	12D	17⅜	12	7	10 x 7⅛	NONE	BALL	NONE	12	12JP4
	12KP4	40	CLEAR (ALUMINIZED)	12N	17⅝	12⅜	7¾	10⅛ x 7¾	500-2500	CAVITY	NONE	12	12KP4
	12KP4A	40	GRAY (ALUMINIZED)	12N	17⅝	12⅜	7¾	10⅛ x 7¾	500-2500	CAVITY	NONE	12	12KP4A
	12LP4	40	CLEAR	12N	18¾	12⅜	8¾	10 x 7½	750-3000	CAVITY	DOUBLE	12	12LP4
	12LP4A	40	GRAY	12N	18¾	12⅜	8¾	10 x 7½	750-3000	CAVITY	DOUBLE	12	12LP4A
	12LP4C	40	GRAY (ALUMINIZED)	12N	18¾	12⅜	8¾	10 x 7½	750-3000	CAVITY	DOUBLE	12	12LP4C
	12QP4	40	CLEAR	12D	17⅜	12⅜	7	10 x 7⅜	NONE	BALL	SINGLE	12	12QP4
	12QP4A	40	GRAY	12D	17⅜	12⅜	7	10 x 7⅜	NONE	BALL	SINGLE	12	12QP4A
	12RP4	20	CLEAR	12D	17⅜	12⅜	7	10 x 7⅜	NONE	BALL	SINGLE	12	12RP4
	12TP4	40	CLEAR	12D	18¾	12⅜	8¼	10 x 7⅜	NONE	CAVITY	DOUBLE	12	12TP4
	12ZP4	40	CLEAR	12N	17⅝	12⅜	7¾	10¾ x 7¾	500-2500	CAVITY	SINGLE	12	12ZP4
	12ZP4A	40	GRAY (ALUMINIZED)	12N	17⅝	12⅜	7¾	10¾ x 7¾	500-2500	CAVITY	SINGLE	12	12ZP4A
ROUND METAL — MAGNETIC FOCUS & DEFLECTION 54° DEFLECTION ANGLE	12UP4	27	CLEAR	12D	18⅝	12⅜	8	10½ x 7¾	NONE	METAL CONE LIP	DOUBLE	12	12UP4
	12UP4A	27	GRAY	12D	18⅝	12⅜	8	10½ x 7¾	NONE	METAL CONE LIP	DOUBLE	12	12UP4A
	12UP4B	27	GRAY (FROSTED)	12D	18⅝	12⅜	8	10½ x 7¾	NONE	METAL CONE LIP	SINGLE	12	12UP4B
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 55° DEFLECTION ANGLE	12VP4	40	CLEAR	12G	18	12⅜	7¾	10 x 7¾	750-3000	CAVITY	DOUBLE	12	12VP4
	12VP4A	40	GRAY	12G	18	12⅜	7¾	10 x 7¾	750-3000	CAVITY	DOUBLE	12	12VP4A
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 65° DEFLECTION ANGLE	14BP4	27	GRAY	12N	16 15/16	12 3/4 x 9 11/16	7 11/16	11 1/16 x 8 11/16	500-2000	CAVITY	SINGLE	12	14BP4
	14BP4A	27	GRAY (FROSTED)	12N	16 15/16	12 3/4 x 9 11/16	7 11/16	11 1/16 x 8 11/16	500-2000	CAVITY	SINGLE	12	14BP4A
	14CP4	27	GRAY	12N	16¾	12 11/16 x 9 3/16	7 11/16	11½ x 8⅝	750-2000	CAVITY	SINGLE	14	14CP4
	14CP4A	27	GRAY (ALUMINIZED)	12N	16¾	12 11/16 x 9 3/16	7 11/16	11½ x 8⅝	750-2000	CAVITY	SINGLE	14	14CP4A
	14DP4	27	GRAY	12D	16¾	12 11/16 x 9 3/16	7 11/16	11 1/16 x 8 11/16	NONE	CAVITY	DOUBLE	14	14DP4
	14EP4	27	GRAY	12N	16½	12 11/16 x 9 3/16	6¾	11⅜ x 8½	1250	CAVITY	SINGLE	14	14EP4
	14UP4	27	GRAY (ALUMINIZED)	12D	16 15/16	12⅝ x 9¾	7½	11½ x 8⅝	NONE	CAVITY	SINGLE	14	14UP4



12D



12G



12L



12N

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TUBE COMPARISON CHART

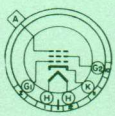
14ACP4-15DP4A

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH × HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (KV)	TYPE
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 85° DEFLECTION ANGLE	14ACP4	24	GRAY (ALUMINIZED)	12L	14 3/16	13 1/16 x 10 5/16	6 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	SINGLE	14	14ACP4
	14AEP4	24	GRAY (ALUMINIZED)	12L	13 5/8	13 1/16 x 10 5/16	5 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	NONE	14	14AEP4
	14ARP4	24	CLEAR (ALUMINIZED)	12L	13 5/8	13 x 10 5/16	5 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	NONE	14	14ARP4
	14ATP4*	24	GRAY (ALUMINIZED)	12L	13 5/8	13 1/16 x 10 5/16	5 1/2	12 1/16 x 9 1/2	500-1000	CAVITY	NONE	14	14ATP4*
	14AUP4*	24	GRAY (ALUMINIZED)	12L	13 5/8	13 1/16 x 10 5/16	5 1/2	12 1/16 x 9 1/2	1000-1500	CAVITY	NONE	16.5	14AUP4*
	14AWP4*	24	GRAY (ALUMINIZED)	12L	13 5/8	13 1/16 x 10 5/16	5 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	NONE	14	14AWP4*
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 110° DEFLECTION ANGLE	14AJP4	16 1/2	GRAY (ALUMINIZED)	8HR	11 3/8	13 3/8 x 10 3/4	5 3/4	12 3/4 x 9 3/4	500-850	CAVITY	SINGLE	11	14AJP4
	14ASP4	16 1/2	GRAY (ALUMINIZED)	8HR	11 3/8	13 3/8 x 10 3/4	5 7/8	12 3/4 x 9 3/4	500-850	CAVITY	NONE	14	14ASP4
	14AVP4	16 1/2	GRAY (ALUMINIZED)	8HR	11 3/8	13 3/8 x 10 3/4	5 7/8	12 3/4 x 9 3/4	450-700	CAVITY	NONE	14	14AVP4
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 80° DEFLECTION ANGLE	14NP4	24	GRAY	12L	14 1/4	13 1/16 x 10 5/16	6 5/8	12 1/16 x 9 5/8	800-1200	CAVITY	SINGLE	14	14NP4
	14NP4A	24	GRAY (ALUMINIZED)	12L	14 1/4	13 1/16 x 10 5/16	6 5/8	12 1/4 x 9 5/8	800-1200	CAVITY	SINGLE	14	14NP4A
	14RP4	24	GRAY	12L	14 5/8	13 1/16 x 10 5/16	6 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	SINGLE	14	14RP4
	14RP4A	24	GRAY (ALUMINIZED)	12L	14 5/8	13 1/16 x 10 5/16	6 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	SINGLE	14	14RP4A
	14WP4	24	GRAY (ALUMINIZED)	12L	13 5/8	13 1/16 x 10 5/16	5 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	NONE	14	14WP4
	14ZP4	24	GRAY (ALUMINIZED)	12L	13 5/8	13 1/16 x 10 5/16	5 1/2	12 1/16 x 9 1/2	800-1200	CAVITY	NONE	15.4	14ZP4
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 65° DEFLECTION ANGLE	14QP4	27	GRAY	12L	16 1/2	12 5/8 x 9 3/4	6 3/4	11 1/2 x 8 5/8	600-1000	CAVITY	SINGLE	11	14QP4
	14QP4A	27	GRAY (ALUMINIZED)	12L	16 1/2	12 5/8 x 9 3/4	6 3/4	11 1/2 x 8 5/8	600-1000	CAVITY	SINGLE	11	14QP4A
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 79° DEFLECTION ANGLE	14SP4	24	GRAY (ALUMINIZED)	12L	14 3/8	13 1/16 x 10 5/16	6 3/4	12 1/16 x 9 1/2	900-1200	CAVITY	SINGLE	15.4	14SP4
	14XP4*	24	GRAY	12L	14 3/8	13 1/16 x 10 5/16	6 3/4	12 1/16 x 9 1/2	1100-1500	CAVITY	SINGLE	16.5	14XP4*
	14XP4A*	24	GRAY (ALUMINIZED)	12L	14 3/8	13 1/16 x 10 5/16	6 3/4	12 1/4 x 9 1/2	1100-1500	CAVITY	SINGLE	16.5	14XP4A*
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 50° TO 57° DEFLECTION ANGLE	15AP4	45	CLEAR	12D	20 1/2	15 1/2	6 15/16	12 3/4 x 9 1/2	NONE	BALL	NONE	15	15AP4
	15CP4	45	CLEAR	12D	21 1/2	15 1/2	8	12 3/4 x 9 1/2	NONE	CAVITY	DOUBLE	15	15CP4
	15DP4	45	CLEAR	12D	20 1/2	15 1/2	6 15/16	12 3/4 x 9 1/2	NONE	BALL	SINGLE	15	15DP4
	15DP4A	45	GRAY	12D	20 1/2	15 1/2	6 15/16	12 3/4 x 9 1/2	NONE	BALL	SINGLE	15	15DP4A

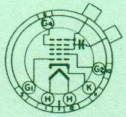
* Heater: 6.3 Volts, 450 Ma.



8HR



12D



12L

TUBE COMPARISON CHART

16CP4-16XP4

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH * HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE (EHV) VOLTAGE	TYPE
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 50° TO 57° DEFLECTION ANGLE	**16CP4**	56⅜	CLEAR	12D	21⅛	15⅞	6⅝	14⅛ x 10¼	NONE	CAVITY	DOUBLE	15	**16CP4**
	16LP4	56⅜	CLEAR	12N	22¼	15⅞	7⅜	13¼ x 10¼	750-2000	CAVITY	DOUBLE	14	**16LP4**
	16LP4A	56⅜	GRAY	12N	22¼	15⅞	7⅜	13¼ x 10¼	750-2000	CAVITY	DOUBLE	14	**16LP4A**
	16ZP4	56⅜	GRAY	12N	22¼	15⅞	7⅜	13⅛ x 10⅜	750-1500	CAVITY	DOUBLE	16	**16ZP4**
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 60° TO 62° DEFLECTION ANGLE	**16DP4**	60	CLEAR	12D	20¾	15⅞	7⅜	13¼ x 10	NONE	CAVITY	DOUBLE	15	**16DP4**
	16DP4A	56⅜	GRAY	12D	20¾	15⅞	7⅜	13¼ x 10	NONE	CAVITY	DOUBLE	15	**16DP4A**
	16FP4	27	CLEAR	12D	20¼	16⅛	7	13¼ x 10	NONE	BALL	SINGLE	16	**16FP4**
	16HP4	40	CLEAR	12N	21¼	15⅞	8⅜	13¼ x 10¼	1500-3500	CAVITY	DOUBLE	14	**16HP4**
	16HP4A	56⅜	GRAY	12N	21¼	15⅞	8⅜	13¼ x 10¼	1500-3500	CAVITY	DOUBLE	14	**16HP4A**
	16JP4	27	CLEAR	12N	20¾	16⅛	7½	13¼ x 10¼	750-2000	CAVITY	DOUBLE	14	**16JP4**
	16JP4A	27	GRAY	12N	20¾	16⅛	7½	13¼ x 10¼	750-2000	CAVITY	DOUBLE	14	**16JP4A**
	16MP4	27	CLEAR	12N	21¾	16⅛	8½	13¼ x 10¼	750-2000	CAVITY	DOUBLE	14	**16MP4**
	16MP4A	27	GRAY	12N	21¾	16⅛	8½	13¼ x 10¼	750-2000	CAVITY	DOUBLE	14	**16MP4A**
ROUND METAL — MAGNETIC FOCUS & DEFLECTION 55° TO 60° DEFLECTION ANGLE	**16AP4**	27	CLEAR	12D	22⅜	15⅞	7⅝	13¼ x 10	NONE	METAL CONE LIP	DOUBLE	14	**16AP4**
	16AP4A	27	GRAY (FROSTED)	12D	22⅜	15⅞	7⅝	13¼ x 10	NONE	METAL CONE LIP	DOUBLE	14	**16AP4A**
	16EP4	40	CLEAR	12D	19⅝	15⅞	6⅞	13¼ x 10	NONE	METAL CONE LIP	DOUBLE	14	**16EP4**
	16EP4A	40	GRAY (FROSTED)	12D	19⅝	15⅞	6⅞	13¼ x 10	NONE	METAL CONE LIP	DOUBLE	14	**16EP4A**
	16EP4B	40	GRAY	12D	19⅝	15⅞	6⅞	13¼ x 10	NONE	METAL CONE LIP	SINGLE	14	**16EP4B**
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 65° DEFLECTION ANGLE	**16KP4**	27	GRAY	12N	18¾	14¾ x 11½	7½	13½ x 10⅜	750-1500	CAVITY	SINGLE	16	**16KP4**
	16KP4A	27	GRAY (ALUMINIZED)	12N	18¾	14¾ x 11½	7½	13½ x 10⅜	750-1500	CAVITY	SINGLE	16	**16KP4A**
	16QP4	27	GRAY	12D	19⅛	14¾ x 11½	8⅛	13½ x 10⅜	NONE	CAVITY	DOUBLE	16	**16QP4**
	16RP4	27	GRAY	12N	18¾	14¾ x 11½	7½	13½ x 10⅜	750-1500	CAVITY	SINGLE	16	**16RP4**
	16RP4A	27	GRAY (ALUMINIZED)	12N	18¾	14¾ x 11½	7½	13½ x 10⅜	750-1500	CAVITY	SINGLE	16	**16RP4A**
	16TP4	27	GRAY	12N	18⅛	14¾ x 11½	6⅞	13½ x 10⅜	750-2000	CAVITY	SINGLE	14	**16TP4**
	16UP4	27	GRAY	12D	18⅛	14¾ x 11½	6⅞	13½ x 10⅜	NONE	CAVITY	SINGLE	15	**16UP4**
	16XP4	27	GRAY	12D	18¾	14¾ x 11½	7½	13½ x 10⅜	NONE	CAVITY	DOUBLE	15	**16XP4**



12D



12N

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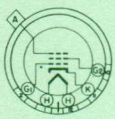
TUBE COMPARISON CHART

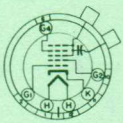
16SP4-17DKP4

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH & HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (D.C.)	TYPE
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 70° DEFLECTION ANGLE	16SP4	56⅜	CLEAR	12N	17⅝	15⅞	7	13¼ x 10	1500-3500	CAVITY	DOUBLE	14	16SP4
	16SP4A	56⅜	GRAY	12N	17⅝	15⅞	7	13¼ x 10	1500-3500	CAVITY	DOUBLE	14	16SP4A
	16VP4	56⅜	GRAY	12D	17⅝	15⅞	6⅞	13¼ x 10	NONE	CAVITY	SINGLE	15	16VP4
	16WP4	56⅜	GRAY	12D	17¾	15⅞	7⅛	14½ x 10¾	NONE	CAVITY	DOUBLE	15	16WP4
	16WP4A	56⅜	GRAY	12N	17¾	15⅞	7⅛	14½ x 10¾	750-1500	CAVITY	DOUBLE	16	16WP4A
	16YP4	56⅜	GRAY	12N	17¾	15⅞	7	14½ x 10¾	750-2000	CAVITY	SINGLE	14	16YP4
ROUND METAL — MAGNETIC FOCUS & DEFLECTION 70° DEFLECTION ANGLE	16GP4	40	GRAY	12D	17¹¹⁄₁₆	15⅞	7⅛	13¼ x 10	NONE	METAL CONE LIP	SINGLE	14	16GP4
	16GP4A	40	CLEAR	12D	17¹¹⁄₁₆	15⅞	7⅛	13¼ x 10	NONE	METAL CONE LIP	SINGLE	14	16GP4A
	16GP4B	40	GRAY (FROSTED)	12D	17¹¹⁄₁₆	15⅞	7⅛	13¼ x 10	NONE	METAL CONE LIP	SINGLE	14	16GP4B
	16GP4C	40	GRAY (CLEAR)	12D	17¹¹⁄₁₆	15⅞	7⅛	13¼ x 10	NONE	METAL CONE LIP	SINGLE	14	16GP4C
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 65° DEFLECTION ANGLE	17AP4	27	GRAY	12N	18⅜	15⅜ x 12¼	6⅜	14¼ x 10¾	750-2000	CAVITY	SINGLE	16	17AP4
	17BP4	27	GRAY	12D	19¼	15⅜ x 12¼	7⅜	14¼ x 10¾	NONE	CAVITY	SINGLE	16	17BP4
	17BP4A	27	GRAY	12N	19¼	15⅜ x 12¼	7⅜	14¹⁵⁄₁₆ x 11⅛	750-1500	CAVITY	SINGLE	16	17BP4A
	17BP4B	27	GRAY (ALUMINIZED)	12N	19¼	15⅜ x 12¼	7⅜	14¹⁵⁄₁₆ x 11⅛	750-1500	CAVITY	SINGLE	16	17BP4B
	17BP4C	27	GRAY (FROSTED)	12N	19¼	15⅜ x 12¼	7⅜	14¼ x 10¾	750-1500	CAVITY	SINGLE	16	17BP4C
	17JP4	27	GRAY	12N	19¼	15⅜ x 12¼	7⅜	14¼ x 10¾	500-750	CAVITY	SINGLE	16	17JP4
RECTANGULAR METAL — MAGNETIC FOCUS & DEFLECTION — 66° DEFLECTION ANGLE	17CP4	30	GRAY (FROSTED)	12D	18⅓	16¹³⁄₁₆ x 12¼	7⅜	14⅜ x 11	NONE	METAL CONE LIP	SINGLE	16	17CP4
	17CP4A	30	GRAY	12D	18⅓	16¹³⁄₁₆ x 12¼	7⅜	14⅜ x 11	NONE	METAL CONE LIP	SINGLE	16	17CP4A
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 90° DEFLECTION ANGLE SERIES STRING OPERATION	17BKP4*	27	GRAY	12L	15⅜	15⅜ x 12⅝	6⅓	14⅛ x 11⅓	1200-1500	CAVITY	SINGLE	17.6	17BKP4*
	17BKP4A*	27	GRAY (ALUMINIZED)	12L	15⅜	15⅜ x 12⅝	6⅓	14⅛ x 11⅓	1200-1500	CAVITY	SINGLE	17.6	17BKP4A*
	17CMP4	27	GRAY (ALUMINIZED)	12L	14⅝	15⅜ x 12¼	5⅓	14⅛ x 11⅓	1000-1500	CAVITY	NONE	17.6	17CMP4
	17CNP4	20¾	GRAY (ALUMINIZED)	12L	15	15⅜ x 12¾	5⅓	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	17.6	17CNP4
	17CRP4	27	GRAY (ALUMINIZED)	12L	14⅜	15⅜ x 12⅝	5⅓	14⅛ x 11⅓	1800-2300	CAVITY	NONE	17.6	17CRP4
	17CUP4 ø	20¾	GRAY (ALUMINIZED)	12L	15⅝	15⅜ x 12¾	5⅓	14¾ x 11¹¹⁄₁₆	1200-1500	CAVITY	NONE	17.6	17CUP4 ø
	17CYP4	20¾	GRAY (ALUMINIZED)	12L	14	15⅜ x 12¾	4⅓	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	16.0	17CYP4
	17CZP4	27	GRAY (ALUMINIZED)	12L	13⅝	15⅜ x 12¼	4⅓	14⅛ x 11⅓	1000-1500	CAVITY	NONE	16.0	17CZP4
	17DKP4 ø	27	GRAY (ALUMINIZED)	12L	15⅜	15⅜ x 12⅝	6⅓	14⅛ x 11⅓	900-1400	CAVITY	SINGLE	17.6	17DKP4 ø

* Heater: 6.3 Volts, 450 Ma. ø 6.3 Volts, 300 Ma.



12D



12L



12N

TUBE COMPARISON CHART

17ATP4-17RP4C

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVERALL LENGTH	DIAMETER OR WIDTH × HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (kV)	TYPE
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 90° DEFLECTION ANGLE	17ATP4	27	GRAY	12L	16	15 3/8 x 12 1/4	6 3/8	14 1/4 x 10 3/4	750-1500	CAVITY	SINGLE	16	17ATP4
	17ATP4A	27	GRAY (ALUMINIZED)	12L	16	15 3/8 x 12 1/4	6 3/8	14 1/4 x 10 3/4	750-1500	CAVITY	SINGLE	16	17ATP4A
	17AVP4	27	GRAY	12L	15 5/8	15 3/8 x 12 5/8	6 3/8	14 13/16 x 11 1/8	1200-1500	CAVITY	SINGLE	16	17AVP4
	17AVP4A	27	GRAY (ALUMINIZED)	12L	15 5/8	15 3/8 x 12 5/8	6 3/8	14 13/16 x 11 1/8	1200-1500	CAVITY	SINGLE	16	17AVP4A
	17BJP4	27	GRAY* (ALUMINIZED)	12L	14 7/8	15 3/8 x 12 1/4	5 3/8	14 5/8 x 11 3/8	1200-1500	CAVITY	NONE	16	17BJP4
	17BMP4	27	GRAY (ALUMINIZED)	12L	15 3/8	15 3/8 x 12 5/8	6 1/8	14 5/8 x 11 1/8	750-1500	CAVITY	SINGLE	18	17BMP4
	17BNP4	27	GRAY (ALUMINIZED)	12L	14 3/8	15 3/8 x 12 5/8	5 3/8	14 5/8 x 11 1/8	750-1500	CAVITY	NONE	18	17BNP4
	17BSP4†	27	GRAY (ALUMINIZED)	12L	14 3/8	15 3/8 x 12 5/8	5 3/8	14 5/8 x 11 1/8	1200-1500	CAVITY	NONE	16	17BSP4†
	17BUP4	27	GRAY (ALUMINIZED)	12L	15 1/4	15 3/8 x 12 1/4	6 1/8	14 5/8 x 11 1/8	1000-1500	CAVITY	SINGLE	18	17BUP4
	17CBP4	27	GRAY	12L	15 1/4	15 3/8 x 12 5/8	6 1/8	14 5/8 x 11 1/8	1000-1500	CAVITY	SINGLE	18	17CBP4
	17CEP4†	20 3/4	GRAY (ALUMINIZED)	12L	15	15 5/8 x 12 3/4	5 3/8	14 3/4 x 11 11/16	1200-1500	CAVITY	NONE	16	17CEP4†
	17CFP4	20 3/4	GRAY (ALUMINIZED)	12L	15	15 5/8 x 12 3/4	5 1/2	14 3/4 x 11 11/16	1200-1500	CAVITY	NONE	16	17CFP4
	17CLP4	27	GRAY (ALUMINIZED)	12L	15 5/8	15 3/8 x 12 5/8	6 1/2	14 5/8 x 11 1/8	1800-2300	CAVITY	SINGLE	17.6	17CLP4
	17CXP4†	27	GRAY (ALUMINIZED)	12L	14 5/8	15 3/8 x 12 1/4	5 1/2	14 5/8 x 11 1/8	1000-1500	CAVITY	NONE	16	17CXP4†
	17DCP4 ø	27	GRAY (ALUMINIZED)	12L	14 5/8	15 3/8 x 12 5/8	5 1/2	14 5/8 x 11 1/8	1000-1500	CAVITY	NONE	17.6	17DCP4 ø
	17DLP4	20 3/4	GRAY (ALUMINIZED)	8JS	11 5/8	15 5/8 x 12 3/4	4 1/8	14 3/4 x 11 11/16	1000-1500	CAVITY	NONE	18.0	17DLP4
	17DQP4†	20 3/4	GRAY (ALUMINIZED)	7FA	12 3/8	15 5/8 x 12 3/4	5	14 3/4 x 11 11/16	1200-1700	CAVITY	NONE	17.6	17DQP4†
	17DSP4	20 3/4	GRAY (ALUMINIZED)	8HR	11 3/4	15 5/8 x 12 3/4	4 1/8	14 3/4 x 11 11/16	1000-1500	CAVITY	NONE	18.0	17DSP4
	17DXP4†	20 3/4	GRAY (ALUMINIZED)	8JR	10 11/16	15 5/8 x 12 3/4	3 5/8	14 3/4 x 11 11/16	1000-1500	CAVITY	NONE	17.6	17DXP4†
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 65° DEFLECTION ANGLE	17CGP4	27	GRAY	12L	17 7/16	15 31/64 x 12 29/32	5 3/8	14 1/8 x 11 3/8	500-750	CAVITY	NONE	14	17CGP4
	17FP4	27	GRAY (TREATED)	12L	19 3/4	15 3/8 x 12 3/4	7 3/8	14 3/4 x 10 3/4	500-1500	CAVITY	SINGLE	18	17FP4
	17FP4A	27	GRAY	12L	19 3/4	15 3/8 x 12 3/4	7 3/8	14 3/4 x 10 3/4	500-1500	CAVITY	SINGLE	18	17FP4A
	17HP4	27	GRAY	12L	19 1/16	15 3/8 x 12 1/4	7 1/8	14 13/16 x 11 1/8	750-1500	CAVITY	SINGLE	16	17HP4
	17HP4A	27	GRAY (TREATED)	12L	19 1/16	15 3/8 x 12 1/4	7 1/8	14 13/16 x 11 1/8	750-1500	CAVITY	SINGLE	16	17HP4A
	17HP4B	27	GRAY (ALUMINIZED)	12L	19 1/16	15 3/8 x 12 1/4	7 1/8	14 13/16 x 11 1/8	750-1500	CAVITY	SINGLE	16	17HP4B
	17KP4*	27	GRAY	12P	19 3/4	15 3/8 x 12 3/4	7 3/8	14 3/4 x 10 3/4	750-1500	CAVITY	SINGLE	16	17KP4*
	17KP4A*	27	GRAY (ALUMINIZED)	12P	19 3/4	15 3/8 x 12 3/4	7 1/8	14 3/4 x 10 3/4	750-1500	CAVITY	SINGLE	16	17KP4A*
	17RP4	27	GRAY	12L	19 3/4	15 3/8 x 12 3/4	7 3/8	14 3/4 x 10 3/4	750-1500	CAVITY	SINGLE	16	17RP4
	17RP4C	27	GRAY (ALUMINIZED)	12L	19 1/4	15 5/8 x 12 1/4	7 3/8	14 1/4 x 10 3/4	750-1500	CAVITY	SINGLE	16	17RP4C

* Automatic focus. † Heater: 6.3 Volts, 450 Ma. ø 6.3 Volts, 300 Ma.



7FA



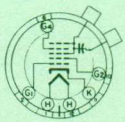
8HR



8JR



8JS



12L



12P

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TUBE COMPARISON CHART

17BRP4-19AP4D

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH × HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (kV)	TYPE
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 110° DEFLECTION ANGLE SERIES STRING OPERATION	**17BRP4**	20¾	GRAY (ALUMINIZED)	8HR	12⅝	15⅜ x 12¾	5⅞	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	SINGLE	15	**17BRP4**
	17BVP4	20¾	GRAY (ALUMINIZED)	7FA	13¼	15⅜ x 12¾	6¼	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	SINGLE	17.6	**17BVP4**
	17BWP4	20¾	GRAY (ALUMINIZED)	7FA	12½	15⅜ x 12¾	5⅜	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	17.6	**17BWP4**
	17BYP4†	20¾	GRAY (ALUMINIZED)	7FA	12⅝	15⅜ x 12¾	5⅜	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	17.6	**17BYP4†**
	17CAP4	20¾	GRAY (ALUMINIZED)	8HR	12⅝	15⅜ x 12¾	5⅞	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	17.6	**17CAP4**
	17CDP4†	20¾	GRAY (ALUMINIZED)	8HR	12⅝	15⅜ x 12¾	5⅞	14¾ x 11¹¹⁄₁₆	800-1500	CAVITY	NONE	16	**17CDP4†**
	17CKP4	20¾	GRAY (ALUMINIZED)	8HR	12⅝	15⅜ x 12¾	5⅞	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	SINGLE	15	**17CKP4**
	17CSP4	20¾	GRAY (ALUMINIZED)	7FA	12½	15⅜ x 12¾	5⅜	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	17.6	**17CSP4**
	17CTP4†	20¾	GRAY (ALUMINIZED)	8HR	12⅝	15⅜ x 12¾	5⅞	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	17.6	**17CTP4†**
	17CVP4§	20¾	GRAY (ALUMINIZED)	8HR	12⅝	15⅜ x 12¾	5⅞	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	17.6	**17CVP4§**
	17DEP4♂	20¾	GRAY (ALUMINIZED)	8JN	10⅝	15⅜ x 12¾	3⅝	14¾ x 11¹¹⁄₁₆	900-1400	CAVITY	NONE	17.6	**17DEP4♂**
	17DHP4†	20¾	GRAY (ALUMINIZED)	8HR	11¾	15⅜ x 12¾	4⅛	14¾ x 11¹¹⁄₁₆	1000-1500	CAVITY	NONE	16.0	**17DHP4†**
RECTANGULAR GLASS — CYLINDRICAL FACEPLATE — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 65° TO 66° DEFLECTION ANGLE	**17LP4**	27	GRAY	12L	19⅜	15⅜ x 12¾	7½	14¾ x 10¾	750-1500	CAVITY	SINGLE	16	**17LP4**
	17LP4A	27	GRAY (ALUMINIZED)	12L	19⅜	15⅜ x 12¼	7½	14¼ x 10¾	750-1500	CAVITY	SINGLE	16	**17LP4A**
	17SP4*	27	GRAY	12N	19⅜	15⅜ x 12¼	7½	14⅜ x 10⅞	500-750	CAVITY	SINGLE	14	**17SP4***
	17VP4	27	GRAY	12L	19⅜	15⅜ x 12¼	7½	14⅜ x 10⅞	750-1500	CAVITY	SINGLE	16	**17VP4**
	17VP4B	27	GRAY (ALUMINIZED)	12L	19⅜	15⅜ x 12¼	7½	14½ x 10⅞	750-1500	CAVITY	SINGLE	16	**17VP4B**
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — CYLINDRICAL FACEPLATE — 65° DEFLECTION ANGLE	**17QP4**	27	GRAY	12N	19⅜	15⅜ x 12¼	7½	14¼ x 10¾	750-1500	CAVITY	SINGLE	16	**17QP4**
	17QP4A	27	GRAY (ALUMINIZED)	12N	19⅜	15⅜ x 12¼	7½	14¼ x 10¾	750-1500	CAVITY	SINGLE	18	**17QP4A**
	17UP4	27	GRAY	12N	19⅜	15⅜ x 12¼	7½	14¾ x 10¾	750-1500	CAVITY	SINGLE	14	**17UP4**
	17YP4	27	GRAY	12N	19⅜	15⅜ x 12¼	7½	14¼ x 10¾	500-1500	CAVITY	SINGLE	16	**17YP4**
ROUND METAL — MAGNETIC FOCUS & DEFLECTION 66° DEFLECTION ANGLE (All types in this group are directly interchangeable)	**19AP4**	28	CLEAR	12D	21⅜	18⅝	7⅛	15¾ x 11¾	NONE	METAL CONE LIP	SINGLE	19	**19AP4**
	19AP4A	28	GRAY	12D	21⅜	18⅝	7⅛	15¾ x 11¾	NONE	METAL CONE LIP	SINGLE	19	**19AP4A**
	19AP4B	28	GRAY (FROSTED)	12D	21⅜	18⅝	7⅛	15¾ x 11¾	NONE	METAL CONE LIP	SINGLE	19	**19AP4B**
	19AP4C	28	GRAY (ALUMINIZED)	12D	21⅜	18⅝	7⅛	15¾ x 11¾	NONE	METAL CONE LIP	SINGLE	19	**19AP4C**
	19AP4D	28	CLEAR (FROSTED)	12D	21⅜	18⅝	7⅛	15¾ x 11¾	NONE	METAL CONE LIP	SINGLE	19	**19AP4D**

* Automatic Focus. † Heater: 6.3 Volts, 450 Ma. § Heater: 6.3 Volts, 300 Ma. ♂ 2.35 Volts, 600 Ma.













TUBE COMPARISON CHART

19QP4-21DWP4

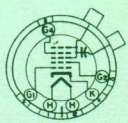
TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH & HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (KV)	TYPE
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 65° TO 66° DEFLECTION ANGLE	19QP4	27	GRAY	12L	21 3/16	17 1/16 x 13 3/16	7 1/2	16 x 12	500-750	CAVITY	SINGLE	18	19QP4
	20FP4	40	GRAY	12M	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	NONE	CAVITY	SINGLE	18	20FP4
	20GP4	40	GRAY	12L	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	500-750	CAVITY	SINGLE	18	20GP4
	20HP4	40	GRAY	12M	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	NONE	CAVITY	SINGLE	16	20HP4
	20HP4A	40	GRAY	12L	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	750-1500	CAVITY	SINGLE	16	20HP4A
	20HP4B	40	GRAY (TREATED)	12M	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	NONE	CAVITY	SINGLE	16	20HP4B
	20HP4C	40	GRAY (ALUMINIZED)	12M	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	NONE	CAVITY	SINGLE	16	20HP4C
	20HP4D	40	GRAY (ALUMINIZED)	12L	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	750-1500	CAVITY	SINGLE	16	20HP4D
	20LP4	40	GRAY	12L	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 13 1/4	750-1500	CAVITY	SINGLE	16	20LP4
	20MP4	40	GRAY	12L	21 3/4	18 11/16 x 14 15/16	7 1/2	17 3/4 x 13 1/4	500-1500	CAVITY	SINGLE	16	20MP4
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 65° TO 66° DEFLECTION ANGLE	19EP4	27	GRAY	12D	21 3/16	17 x 13 3/16	7 1/2	16 x 12	NONE	CAVITY	DOUBLE	19	19EP4
	19JP4	27	GRAY	12D	20 13/16	17 1/16 x 13 3/16	7 5/16	16 x 12	NONE	CAVITY	SINGLE	18	19JP4
ROUND GLASS — MAGNETIC FOCUS & DEFLECTION 66° DEFLECTION ANGLE	19DP4	60	CLEAR	12N	21 3/16	18 7/16	7 1/16	15 3/16 x 11 3/4	750-2500	CAVITY	DOUBLE	17	19DP4
	19DP4A	60	GRAY	12N	21 3/16	18 7/16	7 1/16	15 3/16 x 11 3/4	750-2500	CAVITY	DOUBLE	17	19DP4A
	19FP4	60	GRAY	12D	22	18 7/16	7 5/16	15 3/16 x 11 3/4	NONE	CAVITY	DOUBLE	19	19FP4
	19GP4	60	GRAY	12D	21 3/4	18 7/16	6 5/16	15 3/16 x 11 3/4	NONE	CAVITY	SINGLE	19	19GP4
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 65° TO 66° DEFLECTION ANGLE	20CP4	40	GRAY	12D	21 3/16	18 11/16 x 14 15/16	7 5/16	17 x 12 3/4	NONE	CAVITY	SINGLE	18	20CP4
	20CP4A	40	GRAY	12N	21 3/16	18 11/16 x 14 15/16	7 5/16	17 x 12 3/4	500-750	CAVITY	SINGLE	18	20CP4A
	20CP4B	40	GRAY (ALUMINIZED)	12D	21 3/16	18 11/16 x 14 15/16	7 5/16	17 x 12 3/4	NONE	CAVITY	SINGLE	18	20CP4B
	20CP4C	40	GRAY (TREATED)	12D	21 3/16	18 11/16 x 14 15/16	7 5/16	17 x 12 3/4	NONE	CAVITY	SINGLE	18	20CP4C
	20CP4D	40	GRAY (ALUMINIZED)	12N	21 3/16	18 11/16 x 14 15/16	7 5/16	17 x 12 3/4	500-750	CAVITY	SINGLE	18	20CP4D
	20DP4	40	GRAY	12D	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	NONE	CAVITY	SINGLE	18	20DP4
	20DP4A	40	GRAY	12N	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	500-750	CAVITY	SINGLE	18	20DP4A
	20DP4B	40	GRAY (ALUMINIZED)	12D	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	NONE	CAVITY	SINGLE	18	20DP4B
	20DP4C	40	GRAY (ALUMINIZED)	12N	21 3/4	18 11/16 x 14 15/16	7 1/2	17 x 12 3/4	500-750	CAVITY	SINGLE	18	20DP4C
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 110° DEFLECTION ANGLE	21DMP4	28 1/2	GRAY (ALUMINIZED)	8HR	13 3/4	20 1/4 x 16 3/16	4 3/16	20 1/4 x 15 1/16	2000-2500	CAVITY	NONE	16.0	21DMP4
	21DWP4	33	GRAY (ALUMINIZED)	8HR	14 7/16	20 3/4 x 16 3/16	5 7/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	18.00	21DWP4



8HR



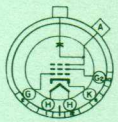
12D



12L



12M



12N

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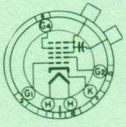
TUBE COMPARISON CHART
21ALP4-21DSP4

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH & HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (kV)	TYPE
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 85° DEFLECTION ANGLE	21ALP4	33	GRAY	12L	20 3/4	16 3/8	7 1/2	19 1/16 x 15	2000-2500	CAVITY	SINGLE	18	21ALP4
	21ALP4A	33	GRAY (ALUMINIZED)	12L	20 3/4	16 3/8	7 1/2	19 1/16 x 15	2000-2900	CAVITY	SINGLE	18	21ALP4A
	21ALP4B	33	GRAY (ALUMINIZED)	12L	20 3/4	16 3/8	7 1/2	19 1/16 x 15	2000-2900	CAVITY	SINGLE	20	21ALP4B
	21ANP4	33	GRAY	12M	20 3/4	16 3/8	7 1/2	19 1/16 x 15	NONE	CAVITY	SINGLE	18	21ANP4
	21ANP4A	33	GRAY (ALUMINIZED)	12M	20 3/4	16 3/8	7 1/2	19 1/16 x 15	NONE	CAVITY	SINGLE	18	21ANP4A
	21ATP4	33	GRAY (ALUMINIZED)	12L	20 3/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2200-2900	CAVITY	SINGLE	18	21ATP4
	21ATP4A	33	GRAY (ALUMINIZED)	12L	20 1/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2200-2900	CAVITY	SINGLE	20	21ATP4A
	21ATP4B	33	GRAY	12L	20 1/4	16 3/8	7 1/2	19 5/8 x 15	850-1500	CAVITY	SINGLE	18	21ATP4B
	21BAP4	33	GRAY (ALUMINIZED)	12L	20 1/4	16 3/8	7 1/2	19 1/16 x 15	2000-2900	CAVITY	NONE	18	21BAP4
	21BNP4	33	GRAY (ALUMINIZED)	12L	20 1/4	16 3/8	7 1/2	19 1/16 x 15	2000-2900	CAVITY	NONE	18	21BNP4
	21BTP4	33	GRAY (ALUMINIZED)	12L	20 1/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	22	21BTP4
	21CBP4	33	GRAY (ALUMINIZED)	12L	18	20 1/4	16 3/8	5 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	18	21CBP4
	21CBP4A	33	GRAY (ALUMINIZED)	12L	18	20 1/4	16 3/8	5 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	22	21CBP4A
	21CDP4	33	GRAY	12L	20	20 1/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	22	21CDP4
	21CDP4A	33	GRAY (ALUMINIZED)	12L	20	20 1/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	22	21CDP4A
	21CGP4	33	GRAY (ALUMINIZED)	12L	20	20 1/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	20	21CGP4
	21CHP4	33	GRAY (ALUMINIZED)	12L	18	20 1/4	16 3/8	5 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	20	21CHP4
	21CKP4	33	GRAY (ALUMINIZED)	12L	18	20 1/4	16 3/8	5 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	20	21CKP4
	21CMP4	33	GRAY (ALUMINIZED)	12L	19	20 1/4	16 3/8	6 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	22	21CMP4
	21CVP4	33	GRAY (ALUMINIZED)	12L	20	20 1/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	22	21CVP4
	21CWP4	33	GRAY (ALUMINIZED)	12L	20	20 1/4	16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	22	21CWP4
	21CXP4	33	GRAY (ALUMINIZED)	12L	18	20 1/4	16 3/8	5 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	22	21CXP4
	21DLP4	33	GRAY (ALUMINIZED)	12L	17	20 1/4	16 3/8	4 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	20	21DLP4
	21DRP4	28 1/2	GRAY (ALUMINIZED)	12L	18 1/4	20 1/4	16 3/8	5 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	20	21DRP4
	21DSP4	33	GRAY (ALUMINIZED)	12L	18	20 1/4	16 3/8	5 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	20	21DSP4



12L



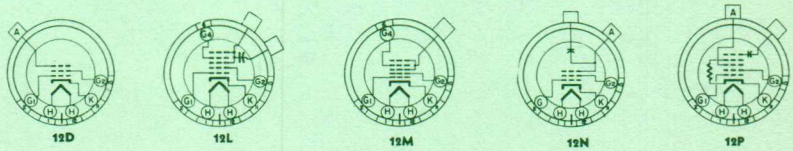
12M

TUBE COMPARISON CHART

21DNP4-21AVP4

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF F. C. PLATE CURVATURE INCHES	FACEPLATE TEP RIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVERALL LENGTH	DIAMETER OR WIDTH & HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTION	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (KV)	TYPE
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 85° DEFLECTION ANGLE SERIES STRING OPERATION	**21DNP4**	33	GRAY (ALUMINIZED)	12L	19	20¾ x 16⅜	6½	19⅛ x 15⅛	1200-1500	CAVITY	SINGLE	22	**21DNP4**
	21DQP4	33	GRAY (ALUMINIZED)	12L	17½	20¾ x 16⅜	5	19⅛ x 15⅛	2000-2500	CAVITY	NONE	20	**21DQP4**
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 90° DEFLECTION ANGLE	**21ELP4**	33	GRAY (ALUMINIZED)	12L	19	20¾ x 16⅜	6½	19⅛ x 15⅛	2000-2500	CAVITY	NONE	20.0	**21ELP4**
	21DVP4‡	33	GRAY (ALUMINIZED)	12L	20	21⅜ x 16⅜	7½	19⅛ x 15⅛	500-750	CAVITY	SINGLE	20.0	**21DVP4‡**
	21ENP4‡	33	GRAY (ALUMINIZED)	12L	19	20¾ x 16⅜	6½	19⅛ x 15⅛	2000-2500	CAVITY	SINGLE	22.0	**21ENP4‡**
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 85° DEFLECTION ANGLE	**21ACP4**	33	GRAY	12N	20	20¾ x 16⅜	7½	19⅛ x 15⅛	2000-2900	CAVITY	SINGLE	20	**21ACP4**
	21ACP4A	33	GRAY (ALUMINIZED)	12N	20	20¾ x 16⅜	7½	19⅛ x 15⅛	2000-2500	CAVITY	SINGLE	20	**21ACP4A**
	21AMP4	33	GRAY	12N	20	20¾ x 16⅜	7½	19⅛ x 15⅛	2000-2500	CAVITY	SINGLE	18	**21AMP4**
	21AMP4A	33	GRAY (ALUMINIZED)	12N	20	20¾ x 16⅜	7½	19⅛ x 15⅛	2000-2500	CAVITY	SINGLE	18	**21AMP4A**
	21AQP4	33	GRAY	12D	20	20¾ x 16⅜	7½	19¼ x 15	NONE	CAVITY	SINGLE	18	**21AQP4**
	21AQP4A	33	GRAY (ALUMINIZED)	12D	20	20¾ x 16⅜	7½	19¼ x 15	NONE	CAVITY	SINGLE	18	**21AQP4A**
	21BSP4	33	GRAY (ALUMINIZED)	12N	20	20¼ x 16⅜	7½	19⅛ x 15⅛	2000-2500	CAVITY	SINGLE	22	**21BSP4**
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — CYLINDRICAL FACEPLATE — 65° DEFLECTION ANGLE	**21EP4**	35	GRAY	12D	23	20¾ x 15⅝	7½	19¼ x 13⅞	NONE	CAVITY	SINGLE	18	**21EP4**
	21EP4A	35	GRAY	12N	23	20¾ x 15⅝	7½	19¼ x 13⅞	500-750	CAVITY	SINGLE	18	**21EP4A**
	21EP4B	35	GRAY (ALUMINIZED)	12N	23	20¾ x 15⅝	7½	19¼ x 13⅞	500-750	CAVITY	SINGLE	18	**21EP4B**
	21JP4*	35	GRAY	12N	23⅛	20¾ x 15⅝	7½	19¼ x 13⅞	1200-1500	CAVITY	INTERNAL	20	**21JP4***
	21JP4A*	35	GRAY (ALUMINIZED)	12N	23⅛	20¾ x 15⅝	7½	19¼ x 13⅞	500-750	CAVITY	INTERNAL	20	**21JP4A***
RECTANGULAR GLASS—CYLINDRICAL FACEPLATE—MAGNETIC DEFLECTION—ELECTROSTATIC FOCUS—65° TO 70° DEFLECTION ANGLE	**21FP4**	35	GRAY	12D	23	20¾ x 15⅝	7½	19¼ x 13⅞	NONE	CAVITY	SINGLE	18	**21FP4**
	21FP4A	35	GRAY	12L	23	20¾ x 15⅝	7½	19¼ x 13⅞	500-750	CAVITY	SINGLE	18	**21FP4A**
	21FP4C	35	GRAY (ALUMINIZED)	12L	23	20¾ x 15⅝	7½	19¼ x 13⅞	500-750	CAVITY	SINGLE	18	**21FP4C**
	21KP4†	35	GRAY	12D	23	20¾ x 15⅝	7½	19¼ x 13⅞	NONE	CAVITY	SINGLE	18	**21KP4†**
	21KP4A†	35	GRAY	12P	23	20¾ x 15⅝	7½	19¼ x 13⅞	500-750	CAVITY	SINGLE	18	**21KP4A†**
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 65° TO 66° DEFLECTION ANGLE	**21AFP4**	40	GRAY	12M	23	20¾ x 15⅝	7½	19¼ x 13⅞	NONE	CAVITY	SINGLE	18	**21AFP4**
	21ASP4	40	GRAY	12L	22¾	18¹³⁄₁₆ x 14¹³⁄₁₆	7½	17¾ x 13½	NONE	CAVITY	SINGLE	18	**21ASP4**
	21AUP4	33	GRAY	12L	23⅛	20¾ x 16⅜	7½	19⅛ x 15⅛	500-750	CAVITY	SINGLE	18	**21AUP4**
	21AUP4A	33	GRAY (ALUMINIZED)	12L	23⅛	20¾ x 16⅜	7½	19⅛ x 15⅛	2000-2900	CAVITY	SINGLE	18	**21AUP4A**
	21AUP4B	33	GRAY (ALUMINIZED)	12L	23⅛	20¼ x 16⅜	7½	19⅛ x 15⅛	2000-2900	CAVITY	SINGLE	20	**21AUP4B**
(Section Continued On Following Page)	**21AVP4**	33	GRAY	12L	23⅛	20¾ x 16⅜	7½	19⅛ x 15⅛	1200-1500	CAVITY	SINGLE	18	**21AVP4**

* Internal magnetic focusing unit. † Automatic focus. ‡ 6.3 Volts, 300 Ma.



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TUBE COMPARISON CHART

21AVP4A-21ZP4

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE INCHES	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVERALL LENGTH	DIAMETER OR WIDTH + HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (kV)	TYPE
(Continued From Preceding Page)	21AVP4A	33	GRAY (ALUMINIZED)	12L	23 1/32	20 1/4 x 16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	18	21AVP4A
	21AVP4B	33	GRAY (ALUMINIZED)	12L	23 1/32	20 1/4 x 16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2900	CAVITY	SINGLE	20	21AVP4B
RECTANGULAR GLASS—MAGNETIC DEFLECTION—ELECTROSTATIC FOCUS—65° TO 66° DEFLECTION ANGLE	21AYP4	40	GRAY	12L	22 3/4	18 11/16 x 14 15/16	7 1/2	17 3/8 x 13 5/8	2000-2500	CAVITY	SINGLE	18	21AYP4
	21XP4	40	GRAY	12L	22 3/4	18 11/16 x 14 15/16	7 1/2	17 3/8 x 13 5/8	2000-2500	CAVITY	SINGLE	18	21XP4
	21XP4A	40	GRAY	12L	22 3/4	18 11/16 x 14 15/16	7 1/2	17 3/8 x 13 5/8	2000-2500	CAVITY	SINGLE	18	21XP4A
	21YP4	40	GRAY	12L	23	20 1/4 x 15 5/16	7 1/2	19 1/16 x 14 5/16	500-750	CAVITY	SINGLE	18	21YP4
	21YP4A	40	GRAY (ALUMINIZED)	12L	23	20 1/4 x 15 5/16	7 1/2	19 1/16 x 14 5/16	500-750	CAVITY	SINGLE	18	21YP4A
	21CEP4	28 1/2	GRAY (ALUMINIZED)	8HR	14 5/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	19.8	21CEP4
	21CEP4A	28 1/2	GRAY (ALUMINIZED)	8HR	14 5/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	22	21CEP4A
	21CQP4	28 1/2	GRAY (ALUMINIZED)	7FA	14 5/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 16 3/8	2000-2500	CAVITY	NONE	19.8	21CQP4
	21CSP4†	28 1/2	GRAY (ALUMINIZED)	7FA	14 5/16	20 1/4 x 16 3/8	5 3/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	19.8	21CSP4†
	21CZP4	28 1/2	GRAY (ALUMINIZED)	8HR	14 11/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	18	21CZP4
	21DAP4	28 1/2	GRAY (ALUMINIZED)	8HR	14 11/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	18	21DAP4
	21DEP4	28 1/2	GRAY (ALUMINIZED)	8HR	14 11/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	18	21DEP4
RECTANGULAR GLASS—MAGNETIC DEFLECTION—ELECTROSTATIC FOCUS—110° DEFLECTION ANGLE SERIES STRING OPERATION	21DEP4A	28 1/2	GRAY (ALUMINIZED)	8HR	14 11/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	20	21DEP4A
	21DHP4†	28 1/2	GRAY (ALUMINIZED)	8HR	14 11/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	1700-2500	CAVITY	NONE	19.8	21DHP4†
	21DKP4	28 1/2	GRAY (ALUMINIZED)	8HR	14 11/16	20 1/4 x 16 3/8	5 7/16	19 1/16 x 15 1/16	1700-2500	CAVITY	NONE	19.8	21DKP4
	21EAP4	28 1/2	CLEAR	8JK	12 15/16	20 1/4 x 16 3/8	3 11/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	16.0	21EAP4
	21EMP4	33	GRAY (ALUMINIZED)	8HR	13 3/16	20 1/4 x 16 3/8	4 3/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	18.0	21EMP4
	21EQP4*	33	GRAY (ALUMINIZED)	8JR	12 5/16	20 1/4 x 16 3/8	3 5/16	19 1/16 x 15 1/16	1500-2000	CAVITY	NONE	20.0	21EQP4*
	21ERP4*	33	GRAY (ALUMINIZED)	8JR	12 13/16	20 1/4 x 16 3/8	3 5/16	19 1/16 x 15 1/16	1500-2000	CAVITY	NONE	20.0	21ERP4*
	21ESP4	28	GRAY (ALUMINIZED)	8JS	13	20 1/4 x 16 3/8	4 1/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	18.0	21ESP4
	21EXP4▲	33	GRAY (ALUMINIZED)	8JR	12 7/16	20 1/4 x 16 3/8	3 5/16	19 1/16 x 15 1/16	2000-2500	CAVITY	NONE	20.0	21EXP4▲
	21ARP4*	40	GRAY	12N	23 1/16	20 1/4 x 15 5/16	7 1/2	19 1/16 x 14 5/16	500-750	CAVITY	INTERNAL	20	21ARP4*
	21ARP4A*	40	GRAY (ALUMINIZED)	12N	23 1/16	20 1/4 x 15 5/16	7 1/2	19 1/16 x 14 5/16	500-750	CAVITY	INTERNAL	20	21ARP4A*
RECTANGULAR GLASS—MAGNETIC FOCUS & DEFLECTION—65° TO 66° DEFLECTION ANGLE	21AWP4	40	GRAY* (ALUMINIZED)	12N	23 1/16	20 1/4 x 16 3/8	7 1/2	19 1/16 x 15 1/16	2000-2500	CAVITY	SINGLE	18	21AWP4
	21WP4	40	GRAY	12N	22 7/16	18 11/16 x 14 15/16	7 1/2	17 3/8 x 13 5/8	500-750	CAVITY	SINGLE	18	21WP4
	21WP4A	40	GRAY (ALUMINIZED)	12N	22 7/16	18 11/16 x 14 15/16	7 1/2	17 3/8 x 13 5/8	500-750	CAVITY	SINGLE	18	21WP4A
(Section Continued On Following Page)	21ZP4	40	GRAY	12D	23 1/16	20 1/4 x 15 5/16	7 1/2	19 1/16 x 14 5/16	NONE	CAVITY	SINGLE	18	21ZP4

* Internal magnetic focusing unit. † Heater: 6.3 Volts, 450 Ma. ■ Tri-Potential Focus. ▲ Tri-Potential Focus, 6.3 Volts, 300 Ma.

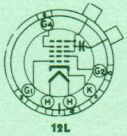














TUBE COMPARISON CHART

21ZP4A-24XP4

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH × HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (KV)	TYPE
(Continued From Preceding Page) RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 65° TO 66° DEFLECTION ANGLE	21ZP4A	40	GRAY	12N	23 1/16	20 1/4 x 15 5/16	7 1/2	19 1/16 x 14 3/16	500-750	CAVITY	SINGLE	18	21ZP4A
	21ZP4B	40	GRAY (ALUMINIZED)	12N	23 1/16	20 1/4 x 15 5/16	7 1/2	19 1/16 x 14 3/16	500-750	CAVITY	SINGLE	18	21ZP4B
RECTANGULAR GLASS — MAGNETIC DEFLECTION ELECTROSTATIC FOCUS — 70°-72° DEFLECTION ANGLE	21BCP4	40	GRAY (ALUMINIZED)	12L	23 1/16	20 1/4 x 16 9/16	7 1/2	19 1/4 x 14	500-750	CAVITY	NONE	18	21BCP4
	21BDP4	33	GRAY (ALUMINIZED)	12L	23 1/16	20 1/4 x 16 3/4	7 1/2	19 1/4 x 15	500-750	CAVITY	NONE	18	21BDP4
ROUND METAL — MAGNETIC FOCUS & DEFLECTION — 70° DEFLECTION ANGLE	22AP4	27	CLEAR	12D	22 3/16	21 11/16	7 1/4	18 x 13 1/2	NONE	METAL CONE LIP	SINGLE	19	22AP4
	22AP4A	27	GRAY	12D	22 3/16	21 11/16	7 1/4	18 x 13 1/2	NONE	METAL CONE LIP	SINGLE	19	22AP4A
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 90° DEFLECTION ANGLE	23ACP4*	50 1/4	GRAY (ALUMINIZED)	12L	19 11/16	21 5/16 x 17 5/16	5 3/4	19 5/16 x 15 1/4	2000-2500	CAVITY	NONE	18.0	23ACP4*
	23TP4	50 13/64	GRAY (ALUMINIZED)	12L	19 11/16	21 5/16 x 17 5/16	5 3/4	19 5/16 x 15 1/4	1700-2500	CAVITY	NONE	22.0	23TP4
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 110° DEFLECTION ANGLE	23BP4*	50 1/4	GRAY (ALUMINIZED)	8HR	14 3/8	21 5/16 x 17 5/16	4 3/4	19 5/16 x 15 1/4	1700-2500	CAVITY	NONE	18.0	23BP4*
	23CP4*	50 3/4	GRAY (ALUMINIZED)	8HR	15 5/16	21 5/16 x 17 5/16	5 3/4	19 5/16 x 15 1/4	2000-2500	CAVITY	NONE	22.0	23CP4*
	23DP4*	50 1/4	GRAY (ALUMINIZED)	8JR	13 5/8	21 5/16 x 17 5/16	3 5/16	19 5/16 x 15 1/4	2000-2500	CAVITY	NONE	22.0	23DP4*
	23GP4*	50 13/64	CLEAR	8HR	15 5/16	21 5/16 x 17 5/16	5 3/4	19 5/16 x 15 1/4	2000-2500	CAVITY	NONE	20.0	23GP4*
	23JP4*°	50 5/8	GRAY (ALUMINIZED)	7FA	15 7/16	21 5/16 x 17 5/16	5 3/4	19 5/16 x 15 1/4	2000-2500	CAVITY	NONE	22.0	23JP4*°
	23RP4*▪	50 1/4	GRAY (ALUMINIZED)	8JR	15 3/4	21 5/16 x 17 5/16	3 5/16	19 5/16 x 15 1/4	2000-2500	CAVITY	NONE	22.0	23RP4*▪
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 114° DEFLECTION ANGLE	23FP4	50	GRAY (ALUMINIZED)	8HR	13 3/4	20 1/2 x 16 1/2	4 1/2	19 1/4 x 15 5/16	2000-2500	CAVITY	NONE	22.0	23FP4
	23VP4	50	GRAY (ALUMINIZED)	8HR	13 3/4	20 1/2 x 16 1/2	4 1/2	19 1/4 x 15 5/16	2000-2500	CAVITY	NONE	22.0	23VP4
ROUND METAL — MAGNETIC FOCUS & DEFLECTION — 70° DEFLECTION ANGLE	24AP4	40	GRAY	12D	23 15/16	24	6 27/32	22 1/16 x 16 5/16	NONE	METAL CONE LIP	SINGLE	16	24AP4
	24AP4A	40	GRAY (ALUMINIZED)	12D	23 15/16	24	6 27/32	22 1/16 x 16 5/16	NONE	METAL CONE LIP	SINGLE	16	24AP4A
	24AP4B	40	GRAY (TREATED)	12D	23 15/16	24	6 27/32	22 1/16 x 16 5/16	NONE	METAL CONE LIP	SINGLE	16	24AP4B
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 85° TO 87° DEFLECTION ANGLE	24CP4	40	GRAY	12N	21 3/16	22 11/16 x 18 1/16	7 3/16	21 1/16 x 16 7/16	2000-2500	CAVITY	SINGLE	20	24CP4
	24CP4A	40	GRAY (ALUMINIZED)	12N	21 3/16	22 11/16 x 18 1/16	7 3/16	21 1/16 x 16 7/16	2000-2900	CAVITY	SINGLE	20	24CP4A
	24QP4	40	GRAY	12N	21 3/16	22 11/16 x 18 1/16	7 3/16	21 3/4 x 16 3/4	500-750	CAVITY	SINGLE	18	24QP4
	24TP4	40	GRAY (ALUMINIZED)	12N	21 3/16	22 11/16 x 18 1/16	7 3/16	21 3/4 x 16 3/4	250-750	CAVITY	SINGLE	18	24TP4
	24VP4	40	GRAY	12N	21 3/16	22 11/16 x 18 1/16	7 3/16	21 3/16 x 16 5/16	2000-2500	CAVITY	SINGLE	22	24VP4
	24VP4A	40	GRAY (ALUMINIZED)	12N	21 3/16	22 11/16 x 18 1/16	7 3/16	21 3/16 x 16 5/16	2000-2500	CAVITY	SINGLE	22	24VP4A
	24XP4	40	GRAY	12D	21 3/16	22 11/16 x 18 1/16	7 3/16	21 3/4 x 16 3/4	NONE	CAVITY	SINGLE	20	24XP4

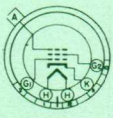
* Laminated. ° 6.3 Volts, 450 Ma. ▪ 6.3 Volts, 300 Ma. ▲ Tri-Potential, 6.3 Volts, 300 Ma.



7FA



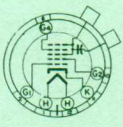
8HR



8JR



12D



12L



12N

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TUBE COMPARISON CHART

24AEP4-27VP4

TUBE DESCRIPTION BY GROUPS	TYPE	RADIUS OF FACEPLATE CURVATURE (INCHES)	FACEPLATE DESCRIPTION	EIA BASE NUMBER	TUBE DIMENSIONS IN INCHES: OVER-ALL LENGTH	DIAMETER OR WIDTH × HEIGHT OF BULB	NECK LENGTH	USEFUL SCREEN AREA	EXTERNAL CONDUCTIVE COATING	ANODE CONNECTOR	TYPE OF ION TRAP	MAXIMUM ANODE VOLTAGE (kV)	TYPE
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 85° DEFLECTION ANGLE SERIES STRING OPERATION	**24AEP4**	40	GRAY (ALUMINIZED)	12L	19 3/16	22 11/16 × 18 7/16	5 3/16	21 7/16 × 16 7/16	2000-2500	CAVITY	NONE	20	**24AEP4**
	24ANP4	40	GRAY (ALUMINIZED)	12L	20 1/16	22 49/64 × 18 5/16	6 1/2	21 7/16 × 16 7/16	1700-2500	CAVITY	SINGLE	22	**24ANP4**
	24ASP4	40	GRAY (ALUMINIZED)	12L	19 3/16	22 49/64 × 18 7/16	5 1/2	21 7/16 × 16 7/16	1700-2500	CAVITY	NONE	22	**24ASP4**
	24ATP4	40	GRAY (ALUMINIZED)	12L	19 3/16	22 11/16 × 18 7/16	5 1/2	21 1/2 × 16 31/32	2000-2500	CAVITY	NONE	20	**24ATP4**
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 85° DEFLECTION ANGLE	**24ADP4**	40	GRAY (ALUMINIZED)	12N	21 3/16	22 11/16 × 18 7/16	7 1/2	21 7/16 × 16 7/16	2000-2500	CAVITY	SINGLE	24.2	**24ADP4**
	24DP4	40	GRAY	12L	21 3/16	22 11/16 × 18 7/16	7 1/2	21 7/16 × 16 7/16	2000-2500	CAVITY	SINGLE	20	**24DP4**
	24DP4A	40	GRAY (ALUMINIZED)	12L	21 3/16	22 11/16 × 18 7/16	7 1/2	21 7/16 × 16 7/16	2000-2900	CAVITY	SINGLE	20	**24DP4A**
	24YP4	40	GRAY (ALUMINIZED)	12L	21 3/16	22 11/16 × 18 7/16	7 1/2	21 7/16 × 16 7/16	2000-2500	CAVITY	SINGLE	20	**24YP4**
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 110° DEFLECTION ANGLE SERIES STRING OPERATION	**24ALP4**	32	GRAY (ALUMINIZED)	8HR	15 3/16	22 11/16 × 18 1/2	5 7/16	21 7/16 × 16 7/16	2000-2500	CAVITY	NONE	20	**24ALP4**
	24AMP4	32	GRAY (ALUMINIZED)	7FA	15 3/16	22 11/16 × 18 1/2	5 3/16	21 7/16 × 16 7/16	2000-2500	CAVITY	NONE	22	**24AMP4**
	24AQP4*	32	GRAY (ALUMINIZED)	8HR	15 7/16	22 11/16 × 18 1/2	5 7/16	21 7/16 × 16 7/16	1700-2500	CAVITY	NONE	22	**24AQP4***
	24AVP4§	32	GRAY (ALUMINIZED)	8JK	14 13/16	22 11/16 × 18 1/2	4 3/16	21 7/16 × 16 7/16	1700-2500	CAVITY	NONE	20	**24AVP4§**
	24AXP4†	32	GRAY (ALUMINIZED)	8HR	15 3/16	22 11/16 × 18 1/2	5 7/16	21 7/16 × 16 7/16	1700-2500	CAVITY	NONE	22	**24AXP4†**
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 110° DEFLECTION ANGLE	**24AHP4**	32	GRAY (ALUMINIZED)	8HR	15 3/16	22 11/16 × 18 1/2	5 7/16	21 7/16 × 16 7/16	2000-2500	CAVITY	NONE	20	**24AHP4**
	24AWP4	32	GRAY (ALUMINIZED)	8HR	14 3/16	22 11/16 × 18 1/2	4 7/16	21 7/16 × 16 7/16	2000-2500	CAVITY	NONE	20	**24AWP4**
	24BAP4	32	GRAY (ALUMINIZED)	8HR	15 3/16	22 11/16 × 18 1/2	5 7/16	21 7/16 × 16 7/16	2000-2500	CAVITY	NONE	20.0	**24BAP4**
RECTANGULAR GLASS — MAGNETIC FOCUS & DEFLECTION — 85° TO 90° DEFLECTION ANGLE	**27EP4**	40	GRAY (ALUMINIZED)	12D	23 1/16	25 15/16 × 20 7/16	7 1/2	24 1/4 × 18 3/16	NONE	CAVITY	SINGLE	20	**27EP4**
	27GP4	40	GRAY	12D	23 1/16	25 15/16 × 20 7/16	7 1/2	24 1/4 × 18 3/16	NONE	CAVITY	SINGLE	22.5	**27GP4**
	27LP4	40	GRAY (ALUMINIZED)	12N	24 29/64	25 15/16 × 20 7/16	9 45/64	23 1/4 × 18 3/16	250-400	CAVITY	SINGLE	22	**27LP4**
	27NP4	40	GRAY	12N	23	25 15/16 × 20 7/16	7 1/2	24 1/4 × 18 3/16	500-750	CAVITY	SINGLE	18	**27NP4**
	27RP4	40	GRAY (ALUMINIZED)	12N	23 1/16	25 15/16 × 20 7/16	7 1/2	24 1/4 × 18 3/16	500-750	CAVITY	SINGLE	20	**27RP4**
RECTANGULAR GLASS — MAGNETIC DEFLECTION — ELECTROSTATIC FOCUS — 85° DEFLECTION ANGLE	**27SP4**	40	GRAY (ALUMINIZED)	12L	23 1/16	25 15/16 × 20 7/16	7 1/2	24 1/4 × 18 3/16	500-750	CAVITY	SINGLE	20	**27SP4**
	27UP4	40	GRAY	12L	23 1/16	25 15/16 × 20 7/16	7 1/2	24 × 18 1/2	500-750	CAVITY	SINGLE	20	**27UP4**
	27VP4	40	GRAY (ALUMINIZED)	12L	21 1/16	25 15/16 × 20 7/16	5 1/2	24 1/4 × 18 3/16	2000-2500	CAVITY	NONE	18	**27VP4**

* Heater: 6.3 Volts, 450 Ma. † Heater: 6.3 Volts, 300 Ma. § Heater: 2.35 Volts, 600 Ma.











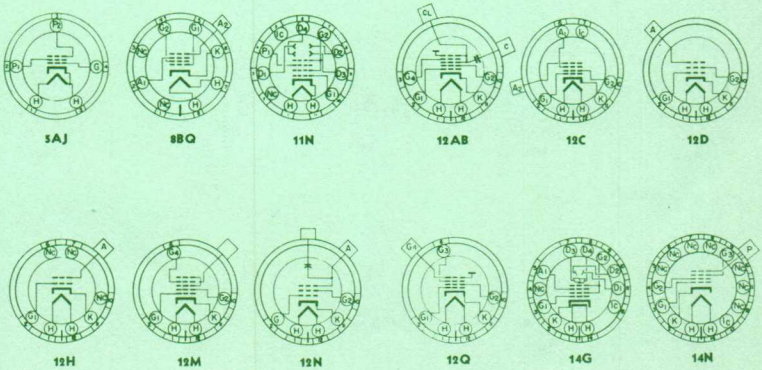


CATHODE RAY PICTURE TUBES

PHYSICAL DIMENSIONS

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH MAX INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: PISTON TO CP MIN FROM EIA NECK END INCHES	OVERALL DIMENSIONS: USEFUL SCREEN DIAMETER INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		MIN LENGTH ANODE CONTACT SPRING INCHES	TYPE
7ABP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	13 3/4	7 5/8	1 7/8	7 1/8	5 15/16	6					7ABP4
7AP4	NONE	MEDIUM 5-PIN	5AJ	13 1/2	7 3/8	1 7/8	7 1/8	6 3/8	6 3/8	6	4 1/2			7AP4
7CP4	RECESSED SMALL BALL CAP	LONG MEDIUM SHELL OCTAL 8-PIN	8BQ	13 5/8	7 1/8	1 3/8	7	6	6 1/2	5 1/2	4			7CP4
7DP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12C	14 1/8	8 1/8	1 1/8	7 1/8	5 15/16	6	5 1/2	4		4 1/4	7DP4
7EP4	NONE	MEDIUM MAGNAL 11-PIN	11N	15 1/2	6 1/2	1 3/8	7	9						7EP4
7GP4	NONE	MEDIUM SPELL DIHEPTAL 12-PIN	14G	14 1/2	5 3/8	2	7	9 1/2	6	5 1/2	4			7GP4
7HP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 7-PIN	12N	13	7 1/2	1 1/8	7 1/8	5 15/16		5 3/4	4			7HP4
7JP4	NONE	MEDIUM SHELL DIHEPTAL 12-PIN	14G	14 1/2	5 3/8	2	7	9 1/2	6	5 1/2	4			7JP4
7NP4	MEDIUM METAL CAP	PLASTIC FILLED SMALL SHELL DIHEPTAL 14-PIN	14N	19 1/2	10 5/16	2	7	9 5/16		5	3 3/4		2 13/16	7NP4
7QP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	12 7/8	6 13/16	1 7/8	7 1/8	5 15/16	6	5 3/8	4		3 11/16	7QP4
7RP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	14 1/8	8 1/8	1 1/8	7 1/8	5 15/16	6	5 1/2	4			7RP4
7TP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12Q	13 1/2	7 1/16	1 1/8	7 1/8	5 15/16	6	5 3/8	4			7TP4
7WP4	MEDIUM METAL CAP	PLASTIC FILLED SMALL SHELL DIHEPTAL 14-PIN	14N	19 5/16	10 5/16	2	7	9 1/4		5	3 3/4		2 13/16	7WP4
8AP4	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12H	14 1/4	7	1 1/8	8 3/8	7 3/4	7 3/4	7	5 3/4			8AP4
8AP4A	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12H	14 3/4	7	1 1/8	8 1/2	7 3/4	7 3/4	7	5 3/4			8AP4A
8BP4	NONE	MEDIUM SHELL DIHEPTAL 12-PIN	14G	16 1/2	5 3/4	2	8 3/4	10 3/4	8	6 1/2	4 3/4			8BP4
8DP4	RECESSED SMALL CAVITY CAP	DWARF-SHELL DUODECAL 6-PIN	12AB	10 7/8	6 1/2	1 1/8	8 1/16[D]	3 11/16	7 11/16[D]	7 5/8	5 3/8			8DP4

[D] Diagonal.



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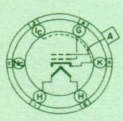
8FP4-10DP4

TYPE	DESCRIPTION	HEATER											RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS						TYPE
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. SHIELD OR COIL	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 OR ANODE #3 VOLTS	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET PAIRS MAX.	ION-TRAP MAGNET FIELD STRENGTH GAUSS	
8FP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3[A]	0.6	SINGLE	YES	YES	M	M	85-[H] 90-[D]	NO	19.8	1.5	16		300	−53	125	30	33	8FP4
8HP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6 ±10%	NONE	NO	YES	M	E	85[H] 90[D]	YES	14	1.5	11	0[C] to 300	300	−50				8HP4
8JP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6 ±5%	NONE	NO	YES	M	E	105[H] 110[D]	NO	20	1.5	16		300	−53.5				8JP4
8XP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	YES	M	E[B]	H-.85 D-.90	NO	22	1.5	16	0[C] to 400	300	−50				8XP4
8YP4	RECTANGULAR GLASS—DIRECT VIEW	6.3[A]	0.6	NONE	NO	YES	M	E[B]	105-[H] 110-[D]	NO	22	1.5	16		300	−53				8YP4
9AP4	ROUND GLASS—DIRECT VIEW	2.5	2.1	NONE	NO	NO	M	E	40	NO	7	1.5	7	1425	250	−87.5				9AP4
9CP4	ROUND GLASS—DIRECT VIEW	2.5	2.1	NONE	NO	NO	M	M		NO	7	1.5	7			−100				9CP4
9QP4	RECTANGULAR GLASS—DIRECT VIEW	4.7	0.3*	SINGLE	NO	NO	M	E	H-.61 D-.70	NO	6.8	1.5	5.5		200	−40			22	9QP4
9QP4A	RECTANGULAR GLASS—DIRECT VIEW	4.7 ±10%	0.3*	SINGLE	NO	NO	M	E	61[H] 70[D]	NO	6.8	1.5	5.5		200	−40			22	9QP4A
10ABP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	NO	M	E	H-.85 D-.90	YES	12	1.5	7.5	0[C] to 500	300	−50			32	10ABP4
10ABP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	NO	M	E	H-.85 D-.90	YES	12	1.5	7.5	0[C] to 500	300	−50			32	10ABP4A
10ABP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H-.85 D-.90	YES	12	1.5	7.5	0[C] to 500	300	−50			32	10ABP4B
10ABP4C	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	NO	M	E	H-.85 D-.90	YES	12	1.5	7.5	0[C] to 500	300	−50			32	10ABP4C
10ADP4	RECTANGULAR GLASS—DIRECT VIEW	8.4	0.45	SINGLE	NO	YES	M	E	H-.85 D-.90	YES	12	1.5	7.5	0[C] to 500	300	−50			32	10ADP4
10AEP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45	SINGLE	NO	YES	M	E	H-.85 D-.90	YES	12	1.5	7.5	0[C] to 500	300	−50			32	10AEP4
10BP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	50	YES	10	1.5	9		250	−45	100	109		10BP4
10BP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	50	YES	10	1.5	9		250	−45	110	120		10BP4A
10BP4C	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	NO	M	M	50	YES	10	1.5	9		250	−45	110	85		10BP4C
10BP4D	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	50	YES	10	1.5	9		250	−45	110	85		10BP4D
10CP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	M	M	50	YES	12	1.5	9		250	−48				10CP4
10DP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO	M	E	50	NO	10	1.5	9	3250	250	−60				10DP4

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[A] Receiver Check Tube. [H] Horizontal. [D] Diagonal. [C] Grid # 4 Voltage.

[F] Deflection Factor:
D_1D_4 : 145 V. dc/in.
D_2D_4 : 118 V. dc/in.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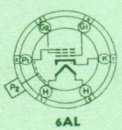
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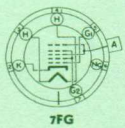
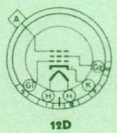

7FG


8JL


12AD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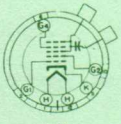
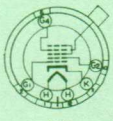
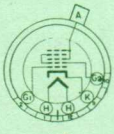

12L


12M

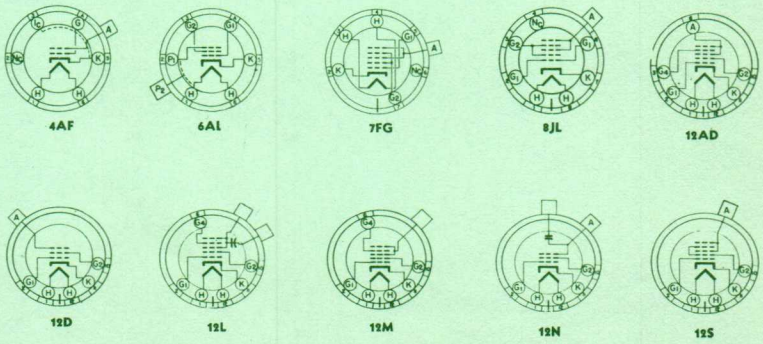

12N


12S

8FP4-10DP4

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	NECK LENGTH INCHES	NECK DIAMETER INCHES	BULB DIAMETER INCHES	FROM MAX. SEALED-IN TUBULATION TO MAX. BULB SURFACE INCHES	RASTER SIZE: USEFUL SCREEN DIAMETER INCHES	USEFUL SCREEN WIDTH INCHES	USEFUL SCREEN HEIGHT INCHES		MFR.'S PHOTO-FLUOROGRAPH SCREEN NUMBER	TYPE
8FP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	11 7/16	7 1/2	1 7/16	8 7/16 D	3 1/16	7 3/4 D	7 3/16	5 3/4			8FP4
8HP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	9 1/16	6	1 7/16	7 15/16 D	3 11/16	7 13/16	7 3/16	5 3/4			8HP4
8JP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	8JL	8 11/16	5 7/16	1 1/8	8 1/16 D	3 1/2	7 3/4 D	7 1/2	5 3/8			8JP4
8XP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12S	11 7/16	7 1/2	1 7/16	8 1/16 D	3 11/16	7 3/4 D	7 3/16	5 3/8			8XP4
8YP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FG	8 11/16	5 3/16	1 1/8	8 1/16 D	3 1/2		7 1/2	5 3/8			8YP4
9AP4	MEDIUM METAL CAP	MEDIUM 6-PIN	6AL	21	9 7/8	1 3/8	9		7 3/8	7 3/4	5 3/8		3 5/16	9AP4
9CP4	MEDIUM METAL CAP	MEDIUM 6-PIN	4AF	15 7/8	8 3/8	1 7/16	9 1/16	7 1/2					3 5/8	9CP4
9QP4	NONE	SMALL SHELL DUODECAL 7-PIN	12AD	12 3/4	6 1/2	1 7/16	8 3/4 D	6 1/4	8 3/4 D	7 11/16	6 1/4		4 1/2	9QP4
9QP4A	NONE	SMALL SHELL DUODECAL 7-PIN	12AD	12 3/4	6 1/2	1 7/16	8 3/4 D	6 1/4	8 3/4 D	7 11/16	6 1/4		4 1/2	9QP4A
10ABP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	11 3/8	6 1/2	1 3/8	10 3/4 D	5 3/8	9 5/8 D	8 3/8	6 5/8		4	10ABP4
10ABP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	11 3/8	6 1/2	1 3/8	10 3/4 D	5 3/8	9 5/8 D	8 3/8	6 5/8		4	10ABP4A
10ABP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	11 3/8	6 1/2	1 3/8	10 3/4 D	5 3/8	9 5/8 D	8 3/8	6 5/8		4	10ABP4B
10ABP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	11 3/8	6 1/2	1 3/8	10 3/4 D	5 3/8	9 5/8 D	8 3/8	6 5/8		4	10ABP4C
10ADP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	11 3/8	6 1/2	1 3/8	10 3/4 D	5 3/8	9 5/8 D	9 1/8	6 5/8			10ADP4
10AEP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	11 3/8	6 1/2	1 3/8	10 3/4 D	5 3/8	9 5/8 D	8 3/8	6 5/8		4	10AEP4
10BP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12N	17 3/8	8 1/8	1 1/8	10 1/2	9 1/16	9 1/8	8	6		4 3/8	10BP4
10BP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12N	17 3/8	8 1/8	1 1/8	10 1/2	9 1/16	9	8	6		4 5/8	10BP4A
10BP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 3/8	8 1/8	1 1/8	10 1/2	9 1/16	9	8	6		4 3/8	10BP4C
10BP4D	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 3/8	8 1/8	1 1/8	10 1/2	9 1/16	9	8	6		4 5/8	10BP4D
10CP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 7-PIN	12N	16 3/8	7 1/8	1 1/8	10 1/2	9 1/16	9	8	6			10CP4
10DP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12M	17 3/8	8 1/8	1 1/8	10 1/2	9 1/16	9	8	6			10DP4

D Diagonal.



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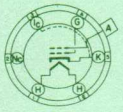
10EP4-12UP4

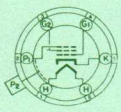
TYPE	DESCRIPTION	HEATER											RATINGS			TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS						
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. SHIELD FOR CRT	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE VOLTS (KV)	MAX. GRID #1 RESISTANCE (MEGOHMS)	MAX. RESISTANCE IN GRID #2 OR ANODE #2 SUPPLY (MEGOHMS)	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT	ION-TRAP MAGNET CURRENT (MA.)	ION-TRAP MAGNET FIELD STRENGTH (GAUSS)	TYPE
10EP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	50	YES	12			8000	250	−45	132			10EP4
10FP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	YES	NO	M	M	50	YES	12	1.5	9		250	−45	110			10FP4
10FP4A	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	YES	YES	M	M	50	YES	12	1.5	11		250	−45	110			10FP4A
10GP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	E	E	P	NO	5	1.5	5	1850		−100				10GP4
10HP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	NO	E	E	Q	NO	5	1.5	5	1800		−100				10HP4
10MP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	52	YES	10	1.5	9			−45				10MP4
10MP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	52	YES	10	1.5	9			−45				10MP4A
10RP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	NO	M	E	50	YES	16	1.5	14	−55° to +300	300	−50				10RP4
10SP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES[X]	M	E	50	NO	14	1.5	14	2225	200	−33				10SP4
12AP4	ROUND GLASS—DIRECT VIEW	2.5	2.1	NONE	NO	NO	M	E	35	NO	7	5	7	1460	250	−75				12AP4
12CP4	ROUND GLASS—DIRECT VIEW	2.5	2.1	NONE	NO	NO	M	M		NO	7		7			−110				12CP4
12JP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	YES	NO	M	M	56	NO	12	1.5	10		250	−45	146			12JP4
12KP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	YES	NO	M	M	52	YES	12	1.5	10		250	−45	135			12KP4
12KP4A	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	YES	YES	M	M	54	YES	12	1.5	11		250	−45	135			12KP4A
12LP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	54	YES	12	1.5	11		250	−45	110	120		12LP4
12LP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	54	YES	12	1.5	11		250	−45	110	120		12LP4A
12LP4C	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	DOUBLE	YES	YES	M	M	54	YES	12	1.5	11		250	−45	110		35	12LP4C
12QP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	55	NO	12	1.5	10		250	−45	135	80	52	12QP4
12QP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	55	NO	12	1.5	10		250	−45	135	80	52	12QP4A
12RP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	56	NO	12	1.5	10		250	−45	135	80	52	12PR4
12TP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	54	NO	12	1.5	11		250	−45	110	120		12TP4
12UP4	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	54	NO	12	1.5	11		250	−45	110			12UP4

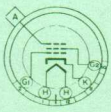
* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

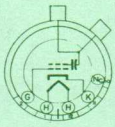
[D] Diagonal. [H] Horizontal. [A] Grid # 4 Voltage. [X] Spherical Faceplate.

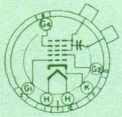
[Q] Deflection Factor:
D_1D_4 : 130 V. dc/in.
D_2D_4 : 100 V. dc/in.









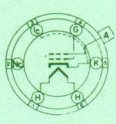


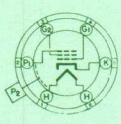


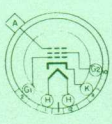


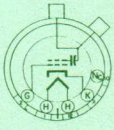


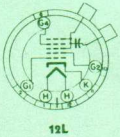
TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: DISTANCE FROM BASE SEAT TO CENTER OF MESH ANODE INCHES	RASTER SIZE: USEFUL SCREEN DIAMETER INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES	MAX HEIGHT ABOVE MOUNTING SURFACE INCHES	TYPE
10EP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 3/8	8 1/16	1 3/16	10 1/2	9 5/16	9 1/16				10EP4
10FP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12N	17 3/8	8 1/16	1 3/16	10 1/2	9 5/16	9	8	6		10FP4
10FP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 3/8	8 1/16	1 3/16	10 1/2	9 1/16	9 1/16	8	6		10FP4A
10GP4	NONE	MEDIUM SHELL DIHEPTAL 12-PIN	14G	18 1/2	5 3/4	2	10	12 3/4	9	8	6		10GP4
10HP4	NONE	MEDIUM SHELL DIHEPTAL 12-PIN	14G	19 3/4	6 1/4	2	10	13	8 3/4	8	6		10HP4
10MP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12G	17	7 5/16	1 3/16	10 1/2	9 5/16	9 1/16	8	6		10MP4
10MP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12G	17	7 5/16	1 3/16	10 1/2	9 5/16	9 1/16	8	6		10MP4A
10RP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	16 1/2	7 1/16	1 1/16	10 1/2	9 1/16	9 1/16				10RP4
10SP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	16 5/8	7 5/16	1 3/16	10 1/2	9 1/16	9 1/16	8	6		10SP4
12AP4	MEDIUM METAL CAP	MEDIUM 6-PIN	6AL	25	9 5/16	1 3/16	12 5/16	15 7/16	10 3/4	9 3/4	7 3/16	3 5/16	12AP4
12CP4	MEDIUM METAL CAP	MEDIUM 6-PIN	4AF	18 3/16	8	1 3/16	12 1/16	10 5/16		10 3/4	7 3/4	3 5/16	12CP4
12JP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 7-PIN	12D	17 1/2	7	1 1/16	12	10 1/2	11	10	7 1/2		12JP4
12KP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12N	17 5/8	7 1/2	1 1/16	12 1/16	10 1/2	11 3/4	10 1/2	7 3/4		12KP4
12KP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12N	17 5/8	7 1/2	1 1/16	12 1/16	10 1/2	11 3/4	10 1/2	7 3/4		12KP4A
12LP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18 3/4	8 1/4	1 1/16	12 5/16	10 1/2	11	10	7 1/2	4 1/4	12LP4
12LP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18 3/4	8 1/4	1 1/16	12 5/16	10 1/2	11	10	7 1/2	4 1/4	12LP4A
12LP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18 3/4	8 1/4	1 1/16	12 1/16	10 1/2	11	10	7 1/2		12LP4C
12QP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 7-PIN	12D	17 1/2	7	1 1/16	12 5/16	10 1/2	11	10	7 1/2	4 1/4	12QP4
12QP4A	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 7-PIN	12D	17 1/2	7	1 1/16	12 5/16	10 1/2	11	10	7 1/2	4 1/4	12QP4A
12RP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 5-PIN	12D	17 1/2	7	1 1/16	12	10 1/2	11	10	7 1/2	4 1/4	12RP4
12TP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12D	18 3/4	8 1/4	1 1/16	12 5/16	10 1/2	11	10	7 1/2	4 1/4	12TP4
12UP4	METAL CONE LIP	SMALL SHELL DUODECAL 7-PIN	12D	18 5/8	8	1 1/16	12 1/16	10 5/8	11 3/4	10 1/2	7 3/4	4 1/4	12UP4

















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12UP4A-14DP4

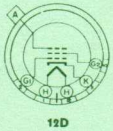
TYPE	DESCRIPTION	HEATER										RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS					
		VOLTS	AMPERES	ION TRAP MAGNET	EXTERNAL MAG. METAL SHIELD CONN.	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE DEGREES	EXTERNAL CONDUCTIVE COATING	MAX. ANODE VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	GRID #1 VOLTS OR ANODE VOLTS FOR CUTOFF	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #2 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION TRAP MAGNET CURR. MA.	ION TRAP & RESIDUAL FIELD GAUSS	TYPE
12UP4A	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	54	NO	12	1.5	11		250	−45	110			12UP4A
12UP4B	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES[a]	M	M	54	NO	12	1.5	11		250	−45	130		35	12UP4B
12VP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	55	YES	12	1.5	11			−55				12VP4
12VP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	55	YES	12	1.5	11			−55				12VP4A
12WP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	55	YES	12	1.5	10			−45			95	12WP4
12YP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	NO	M	E	54	YES	12	1.5	11			−55		120	40	12YP4
12ZP4	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	NO	M	M	54	YES	12	1.5	11		250	−45	135	85		12ZP4
12ZP4A	ROUND GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	54	YES	12	1.5	11		250	−45	135	85		12ZP4A
14ACP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	E	H. 85 D. 90	YES	14	1.5	10	−50[A] to +350	125	−60			36	14ACP4
14AEP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 85 D. 90	YES	14	1.5	12	−50[A] to +350	110	−41				14AEP4
14AJP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	H. 105 D. 110	YES	11	1.5	9	−100[A] to +400	250	−44	−15 to +25[aa]		29	14AJP4
14ARP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO	M	E	H. 85 D. 90	YES	14	1.5	10	−50[A] to +350	50	0				14ARP4
14ASP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 105 D. 110	YES	14	1.5	12	−50[A] to +350	300	−50				14ASP4
14ATP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	H. 85 D. 90	YES	14	1.5	10	0[A] to 400	300	−47				14ATP4
14AUP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	H. 85 D. 90	YES	16.5	1.5	12	0[A] to 350	50	−40				14AUP4
14AVP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 105 D. 110	YES	14	1.5	12	−50[A] to +350	300	−50				14AVP4
14AWP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45	NONE	NO	YES	M	E	H. 85 D. 90	YES	14	1.5	12	−50[A] to +350	50	−39.5				14AWP4
14BP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H. 65 D. 70	YES	12	1.5	11		250	−45	110	120		14BP4
14CP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H. 65 D. 70	YES	14	1.5	12		300	−55	115		23	14CP4
14CP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H. 65 D. 70	YES	14	1.5	12		300	−55				14CP4A
14DP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	H. 65 D. 70	NO	14	1.5	11		250	−45	100	120		14DP4

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

D Diagonal. H Horizontal. A Grid # 4 Voltage.



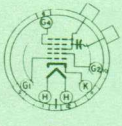
8HR



12D



12G



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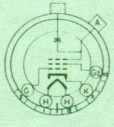


12N



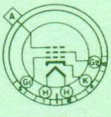
12WP4

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	NECK LENGTH INCHES	NECK DIAMETER INCHES	BULB DIAMETER INCHES	DISTANCE FROM BOTTOM OF BULB TO CENTER OF NECK INCHES	USEFUL SCREEN DIAMETER INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	USEFUL SCREEN HEIGHT INCHES	MFR'S HIGH VOLTAGE RECTIFIER TUBE INCHES	TYPE
12UP4A	METAL CONE LIP	SMALL SHELL DUODECAL 7-PIN	12D	18 5/8	8	1 7/8	12 1/16	10 5/8	11 3/8	10 1/2	7 3/4	4 1/4	12UP4A
12UP4B	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	18 5/8	8	1 7/8	12 1/16	10 5/8	11 3/8	10 1/2	7 3/4	4 1/4	12UP4B
12VP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12G	18 3/8	7 3/4	1 7/8	12 1/16	10 1/2	11	10	7 1/2		12VP4
12VP4A	RECESSED SMALL CAVITY	SMALL SHELL DUODECAL 5-PIN	12G	18	7 1/2	1 7/8	12 1/16	10 1/2	11	10	7 1/2		12VP4A
12WP4	SPECIAL	MINIATURE 9-PIN	12WP4	17 3/4	5 55/64	3/8	12 1/16	12 1/64	11 3/4	8	6	4	12WP4
12YP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18 3/4	8 3/4	1 7/8	12 1/16	10 1/2	11 3/4			4 1/2	12YP4
12ZP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 5/8	7 3/4	1 7/8	12 1/16	10 1/2	11 3/4	7 3/4	10 1/2	3 1/2	12ZP4
12ZP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 5/8	7 3/4	1 7/8	12 1/16	10 1/2	11 3/4	7 3/4	10 1/2	3 1/2	12ZP4A
14ACP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/16	6 1/2	1 7/8	14[D]	7 11/16	13[D]	12 1/16	9 1/2		14ACP4
14AEP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 5/16	5 1/2	1 5/8	14[D]	7 11/16	13[D]	12 1/16	9 1/2		14AEP4
14AJP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	11 7/16	5 1/2	1 1/2	13 3/4[D]	5 13/16	13 1/4[D]	12 3/8	9 3/8	4 1/4	14AJP4
14ARP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 5/16	5 1/2	1 5/8	14[D]	7 11/16	13[D]	12 1/16	9 1/2		14ARP4
14ASP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	11 3/8	5 7/16	1 1/2	13 3/4[D]	5 13/16	13 1/4[D]	12 5/16	9 3/8		14ASP4
14ATP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 5/16	5 1/2	1 5/8	14[D]	7 11/16	13[D]	12 1/16	9 1/2		14ATP4
14AUP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 5/16	5 1/2	1 5/8	14[D]	7 11/16	13[D]	12 1/16	9 1/2		14AUP4
14AVP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	11 3/8	5 7/16	1 1/2	13 3/4[D]	5 13/16	13 1/4[D]	12 5/16	9 3/8		14AVP4
14AWP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 5/16	5 1/2	1 5/8	14[D]	7 11/16	13[D]	12 1/16	9 1/2		14AWP4
14BP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	16 13/16	7 11/16	1 7/8	13 11/16[D]	9 5/16	12 3/4[D]	11 5/8	8 11/16	3 5/8	14BP4
14CP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	16 3/4	7 15/16	1 7/8	13 11/16[D]	9 5/16	12 3/4[D]	11 3/8	8 5/8	4 1/16	14CP4
14CP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	16 3/4	7 11/16	1 7/8	13 11/16[D]	9 5/16	12 3/4[D]	11 3/8	8 5/8	4 1/16	14CP4A
14DP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12Q	16 3/4	7 11/16	1 5/8	13 11/16[D]	9 5/16	12 3/4[D]	11 5/8	8 11/16	5 3/4	14DP4

[D] Diagonal.



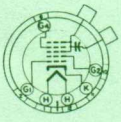
8HR



12D



12G



12L



12N



12WP4

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14EP4-16AEP4

TYPE	DESCRIPTION	HEATER										RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS						
		VOLTS	AMPERES	ION-TRAP MAGNET	MATERIAL HAS IMPREGNATED COAT	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE DIAGONAL	EXTERNAL CONDUCTIVE COATING	MAX. ANODE VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	MAX. RESISTANCE IN ANODE OR ANODE BLOCKING	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET CURRENT MA.	ION-TRAP MAGNET FIELD STRENGTH	TYPE
14EP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H. 65 D. 70	YES	14	1.5	12		300	−55	110	110		14EP4
14GP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 65 D. 70	YES	14	1.5	12	2940[A]	300	−55		70	35	14GP4
14HP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 65 D. 70	YES	14	1.5	12	50 to 200	300	−55		70		14HP4
14NP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 80 D. 90	YES	14	1.5	12	−50[A] to +350	300	−50			30	14NP4
14NP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 80 D. 90	YES	14	1.5	12	−50[A] to +350	300	−50			30	14NP4A
14QP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 65 D. 70	YES	11	1.5	9	−50[A] to +250	250	−44		24	27	14QP4
14QP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 65 D. 70	YES	11	1.5	9	−50[W] to +250	250	−44			27	14QP4A
14RP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	14	1.5	10	−50[W] to +350	300	−48			36	14RP4
14RP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	14	1.5	10	−50[W] to +350	300	−48			36	14RP4A
14SP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	15.4	1.5	12	−48[W] to +264	300	−50		26	28	14SP4
14UP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H. 65 D. 70	NO	14	1.5	12		300	−50	105			14UP4
14WP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 85 D. 90	YES	14	1.5	12	−50[W] to +350	300	−50				14WP4
14XP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.45*	SINGLE	NO	YES	M	E	H. 79 D. 85	YES	16.5	1.5	12	−50[W] to +350	300	−50		28	30	14XP4
14XP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	SINGLE	NO	YES	M	E	H. 79 D. 85	YES	16.5	1.5	12	−50[W] to +350	300	−50		28	30	14XP4A
14ZP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 85 D. 90	YES	15.4	1.5	12	0[W] to +450	300	−50				14ZP4
15AP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	NONE	YES	NO	M	M	57	NO	15	1.5	12		250	−45	159			15AP4
15CP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	50	NO	15	1.5	15		250	−45	115	109		15CP4
15DP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	57	NO	15	1.5	12		250	−45	140	90	58	15DP4
15DP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	57	NO	15	1.5	12		250	−45	140	90	58	15DP4A
16ABP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	D. 70	YES	16	1.5	14		300	−55		75		16ABP4
16ACP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	NO	M	E	60	YES	14	1.5	13		250	−55		120		16ACP4
16AEP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	D. 70	YES	16	1.5	14		300	−55		75		16AEP4

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[W] Grid # 4 Voltage. [D] Diagonal. [H] Horizontal. [#] Frosted.



12D



12L



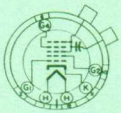
12N

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	NECK LENGTH INCHES	NECK DIAMETER INCHES	BULB DIAMETER INCHES	DISTANCE FROM BASE SEATING PLANE TO HIGHEST POINT ON BULB INCHES	RASTER SIZE: USEFUL SCREEN DIAMETER INCHES	USEFUL SCREEN WIDTH INCHES	USEFUL SCREEN HEIGHT INCHES		MAX. LENGTH REDUCTION FOR VERTICAL DEFLECTION INCHES	TYPE
14EP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	16 1/32	6 3/8	1 7/16	13 11/16 D	9 1/16	12 1/2 D	11 3/8	8 1/2		2 3/4	14EP4
14GP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	16 13/16	7 1/2	1 7/16	13 11/16 D	9 1/16	12 3/4 D	11 3/8	8 1/2			14GP4
14HP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	16 13/16	7 1/2	1 7/16	13 11/16 D	9 1/16	12 3/4 D	11 3/8	8 1/2			14HP4
14NP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 1/4	6 1/16	1 7/16	14 D	7 11/16	13 1/16 D	13 1/16	12 3/4			14NP4
14NP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/4	6 1/16	1 7/16	14 D	7 11/16	13 1/16 D	13 1/16	12 3/4			14NP4A
14QP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	16 1/16	6 7/8	1 7/16	13 11/16 D	9 1/16	12 3/4 D	11 1/2	8 3/4		4 1/8	14QP4
14QP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	16 1/16	6 7/8	1 7/16	13 11/16 D	9 1/16	12 3/4 D	11 1/2	8 3/4		4 7/8	14QP4A
14RP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/16	6 1/2	1 7/16	14 D	7 11/16	13 D	12 1/16	9 1/2			14RP4
14RP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/16	6 1/2	1 7/16	14 D	7 11/16	13 D	12 1/16	9 1/2			14RP4A
14SP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/16	6 1/2	1 7/16	14 D	7 11/16	12 15/16 D	12 1/16	9 1/2			14SP4
14UP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	16 31/32	7 1/2	1 7/16	13 11/16 D	9 1/32	12 3/4 D	11 3/8	8 1/8			14UP4
14WP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 3/16	5 1/2	1 7/16	14 D	7 11/16	13 D	12 1/16	9 1/2			14WP4
14XP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 1/16	6 1/2	1 7/16	14 D	7 11/16	12 15/16 D	12 1/16	9 1/2			14XP4
14XP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/16	6 1/2	1 7/16	14 D	7 11/16	12 15/16 D	12 1/16	9 1/2			14XP4A
14ZP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 3/16	5 1/2	1 7/16	14 D	7 11/16	13 D	12 1/16	9 1/2			14ZP4
15AP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 7-PIN	12D	20 1/2	6 15/16	1 7/16	15 1/2	13 7/16	14	12 3/4	9 1/2			15AP4
15CP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12D	21 1/2	8	1 7/16	15 1/2	13 1/2	14	12 3/4	9 1/2			15CP4
15DP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 5-PIN	12D	20 1/2	6 15/16	1 7/16	15 1/2	13 7/16	14	12 3/4	9 1/2		4 1/4	15DP4
15DP4A	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 5-PIN	12D	20 1/2	6 15/16	1 7/16	15 1/2	13 7/16	14	12 3/4	9 1/2			15DP4A
16ABP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18 3/4	7 1/2	1 7/16	16 1/4 D	11 1/4	14 3/4 D	13 1/2	10 1/2		3 5/8	16ABP4
16ACP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20 7/8	8	1 7/16	16 1/2	11 3/4	14 3/4	13 1/2	10 1/2		4 1/4	16ACP4
16AEP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18 3/4	7 1/2	1 7/16	16 1/4 D	11 1/4	14 3/4 D	13 1/2	10 1/2		3 5/8	16AEP4

D Diagonal.



12D



12L



12N

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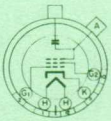
16AP4-16RP4A

TYPE	DESCRIPTION	HEATER										RATINGS			TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS					
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. RESTRICTION COIL	TILTED FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE VOLTS (DC or PULSE)	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 OR ANODE #3 (DC or PULSE)	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 FOR CUTOFF VOLTAGE	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET TURNS	TYPE
16AP4	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	53	NO	14	1.5	12		300	−55				16AP4
16AP4A	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	53	NO	14	1.5	12		300	−55	80			16AP4A
16CP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	52	NO	15	1.5	12		250	−45	110	120		16CP4
16DP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	60	NO	15	1.5	12		250	−45	115	109		16DP4
16DP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	60	NO	15	1.5	12		250	−45	115	110		16DP4A
16EP4	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	60	NO	14	1.5	12		300	−55	105			16EP4
16EP4A	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	60	NO	14	1.5	12		300	−55	105			16EP4A
16EP4B	ROUND METAL—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES[a]	M	M	60	NO	14	1.5	12		300	−55	105			16EP4B
16FP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	62	NO	16	1.5	13		250	−45	146	105	58	16FP4
16GP4	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	70	NO	14	1.5	12		300	−55	100		23	16GP4
16GP4A	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	70	NO	14	1.5	12		300	−55	100		35	16GP4A
16GP4B	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[a]	M	M	70	NO	14	1.5	12		300	−55	100		35	16GP4B
16GP4C	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO[a]	M	M	70	NO	14	1.5	12		300	−55	100		45	16GP4C
16HP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	60	YES	14	1.5	12		300	−55	110	120		16HP4
16HP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	60	YES	14	1.5	12		300	−55	110	120		16HP4A
16JP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	60	YES	14	1.5	11		250	−45	115	120		16JP4
16JP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	60	YES	14	1.5	11		250	−45	115	120		16JP4A
16KP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H-65 D-70	YES	16	1.5	14		300	−55	90		30	16KP4
16KP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-65 D-70	YES	16	1.5	14		300	−55	90		30	16KP4A
16LP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	52	YES	14	1.5	12		300	−55	110	120		16LP4
16LP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	52	YES	14	1.5	12		300	−55	110	120		16LP4A
16MP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	60	YES	14	1.5	12		300	−55	110	120		16MP4
16MP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	60	YES	14	1.5	12		300	−55	110	120		16MP4A
16QP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	H-54.5 D-70	NO	16	1.5	14		250	−45	150	120		16QP4
16RP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H-65 D-70	YES	14	1.5	12		300	−55	100	120		16RP4
16RP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-65 D-70	YES	14	1.5	12		300	−55	100	120		16RP4A

[D] Diagonal. [H] Horizontal. [a] Frosted.



12D



12N

16AP4-16RP4A

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: PROJECTION OF CONTACT BUTTON BEYOND BULB INCHES	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		MCA-JAN-EIA ASSIGNED OUTLINE NUMBER	TYPE
16AP4	METAL CONE LIP	SMALL SHELL DUODECAL 7-PIN	12D	22¾	7⅝	1⅜	15⅞	14¹¹⁄₁₆	14⅜	13¼	10		4	16AP4
16AP4A	METAL CONE LIP	SMALL SHELL DUODECAL 7-PIN	12D	22¾	7⅝	1⅜	15⅞	14¹¹⁄₁₆	14⅜	13¼	10		4	16AP4A
16CP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12D	21½	6⅝	1⅜	15⅞	14⅞	15	14½	10¼		4¼	16CP4
16DP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12D	20¾	7⅛	1⅜	15⅞	12⅞	14½	13¼	10		3⅝	16DP4
16DP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12D	20¾	7⅛	1⅜	15⅞	12⅞	14½	13¼	10		3⅝	16DP4A
16EP4	METAL CONE LIP	SMALL SHELL DUODECAL 7-PIN	12D	19⅝	6⅛	1⅜	15⅞	12⅝	14⅜	13¼	10		3¾	16EP4
16EP4A	METAL CONE LIP	SMALL SHELL DUODECAL 7-PIN	12D	19⅝	6⅛	1⅜	15⅞	12⅝	14⅜	13¼	10		3¾	16EP4A
16EP4B	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	19⅝	6⅜	1⅜	15⅞	12⅝	14⅜	13¼	10		3¾	16EP4B
16FP4	RECESSED SMALL BALL CAP	SMALL SHELL DUODECAL 5-PIN	12D	20¾	7	1⅜	16⅛	13¾	15	13¼	10¼		4¼	16FP4
16GP4	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	17¹¹⁄₁₆	7⅛	1⅜	15⅞	10⅝	14⅜	13¼	10		4	16GP4
16GP4A	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	17¹¹⁄₁₆	7⅛	1⅜	15⅞	10⅝	14⅜	13¼	10		4	16GP4A
16GP4B	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	17¹¹⁄₁₆	7⅛	1⅜	15⅞	10⅝	14⅜	13¼	10		4	16GP4B
16GP4C	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	17¹¹⁄₁₆	7⅛	1⅜	15⅞	10⅝	14⅜	13¼	10		4	16GP4C
16HP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21¾	8⅛	1⅜	15⅞	12⅞	14½	13¼	10¼		4⅝	16HP4
16HP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21¾	8⅛	1⅜	15⅞	12⅞	14½	13½	10¼		4⅝	16HP4A
16JP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20¾	7½	1⅜	16⅛	13¾	15	13¼	10¼			16JP4
16JP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20¾	7½	1⅜	16⅛	13¾	15	13¼	10¼			16JP4A
16KP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18¾	7½	1⅜	16⅛[D]	11¾	14⅜[D]	13½	10⅛		3¾	16KP4
16KP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18¾	7½	1⅜	16⅛[D]	11¾	14⅜[D]	13½	10⅛		3¾	16KP4A
16LP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	22¾	7⅝	1⅜	15⅞	14⅞	14½	13¼	10¼		3⅝	16LP4
16LP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	22¾	7⅝	1⅜	15⅞	14⅞	14½	13¼	10¼		3⅝	16LP4A
16MP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21¾	8½	1⅜	16⅛	13¼	14¾	13¼	10¼		4⅝	16MP4
16MP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21¾	8½	1⅜	16⅛	13¼	14¾	13¼	10¼		4⅝	16MP4A
16QP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 7-PIN	12D	19½	8⅛	1⅜	16⅛[D]	11	15[D]	13½	10⅛		5⅛	16QP4
16RP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18¾	7½	1⅜	16⅛[D]	11¾	14⅞[D]	13½	10⅛		4¼	16RP4
16RP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18¾	7½	1⅜	16⅛[D]	11¾	14⅞[D]	13½	10⅛		4¼	16RP4A

[D] Diagonal.



12D



12N

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16SP4-17BP4A

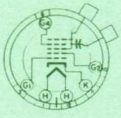
TYPE	DESCRIPTION	HEATER VOLTS	HEATER AMPERES	ION TRAP MAGNET	EXTERNAL MAG. SHIELD-POLE PIECE	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (degrees)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE #1 VOLTS	RATINGS: MAX. GRID #1 RESISTANCE	RATINGS: ANODE OR ANODE #2 VOLTS	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS: ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTS FOR CUTOFF	FOCUSING COIL CURRENT (ma.)	ION TRAP MAGNET CURRENT (ma.)	ION TRAP MAGNET FIELD STRENGTH (GAUSS)	TYPE
16SP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	NO	M	M	70	YES	14	1.5	12		300	−55	110	120		16SP4
16SP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	70	YES	14	1.5	12		300	−55	110	120		16SP4A
16TP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H .65 D .70	YES	14	1.5	12		300	−55	115		45	16TP4
16UP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H .65 D .70	NO	15	1.5	12		300	−45	100		23	16UP4
16VP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	70	NO	15	1.5	12		250	−45	110	120	23	16VP4
16WP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	70	NO	15	1.5	12		250	−45	110	120		16WP4
16WP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	70	YES	16	1.5	12		250	−45	110	120		16WP4A
16XP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	H .65 D .70	NO	15	1.5	12		250	−45	100	120		16XP4
16YP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	70	YES	14	1.5	12		300	−55	100		23	16YP4
16ZP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	52	YES	16	1.5	12		300	−55	110	120		16ZP4
17AP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H .65 D .70	YES	16	1.5	12		300	−55	100	75		17AP4
17ATP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H .80 D .90	YES	16	1.5	14	−55 W to +300	300	−55			37	17ATP4
17ATP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H .80 D .90	YES	16	1.5	14	−55 W to +300	300	−55			37	17ATP4A
17AVP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H .85 D .90	YES	16	1.5	12	−48 W to +264	300	−55	−25 to +25 μa	30		17AVP4
17AVP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H .85 D .90	YES	16	1.5	12	−48 W to +264	300	−55	−25 to +25 μa	30		17AVP4A
17BJP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H .85 D .90	YES	16	1.5	14	−55 W to +300	300	−50				17BJP4
17BKP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.45*	SINGLE	YES	YES	M	E	H .85 D .90	YES	17.6	1.5	14	−56 W to +310	300	−50		28	31	17BKP4
17BKP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	SINGLE	YES	YES	M	E	H .85 D .90	YES	17.6	1.5	14	−56 W to +310	300	−50		28	31	17BKP4A
17BMP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	E	H .85 D .90	YES	18	1.5	14	−55 W to +300	110	−41			37	17BMP4
17BNP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H .85 D .90	YES	18	1.5	14	−50 W to +350	110	−41				17BNP4
17BP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H .65 D .70	NO	16	1.5	12		300	−55	100		35	17BP4
17BP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H .65 D .70	YES	16	1.5	12		300	−55	100		35	17BP4A

H Horizontal. D Diagonal. W Grid & 4 Voltage. * Frosted.

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.



12D



12L



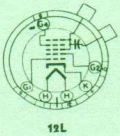
12N

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	NECK LENGTH INCHES	NECK DIAMETER INCHES	BULB DIAMETER INCHES	DISTANCE FROM BASE SEATING PLANE TO MOST REMOTE BULB CONTACT INCHES	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	USEFUL SCREEN WIDTH INCHES	USEFUL SCREEN HEIGHT INCHES		METAL LENSTIC ANTI-IMPLOSION SYSTEM	TYPE
16SP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 5/16	7	1 5/16	15 5/8	10 5/16	14 1/2	13 1/4	10		3 5/8	16SP4
16SP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 5/16	7	1 5/16	15 5/8	10 5/16	14 1/2	13 1/4	10		3 5/8	16SP4A
16TP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18 3/4	6 3/8	1 5/16	16 1/4 D	11 3/4	14 3/4 D	13 1/2	10 1/8		4 1/2	16TP4
16UP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	18 1/2	6 3/8	1 5/16	16 1/4 D	11 3/4	15D	13 1/2	10 1/8		4 1/4	16UP4
16VP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	17 5/16	6 3/8	1 5/16	15 7/8	10 5/16	14 1/2	13 1/2	10		4 3/8	16VP4
16WP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	17 3/4			15 7/8		14 1/2	13 1/2	10			16WP4
16WP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 3/4	7 7/16	1 5/16	15 3/8	10 5/16	14 1/2	13 1/2	10 1/2		4 1/16	16WP4A
16XP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	18 3/4	7 3/8	1 5/16	16 1/4 D	11 3/4	15D	13 1/2	10 1/8		5 1/4	16XP4
16YP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	17 5/16	7	1 5/16	15 7/8	10 5/16	14 1/2	13 1/2	10		3 7/8	16YP4
16ZP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	22 3/4	7 3/8	1 7/16	15 7/8	14 7/8	14 1/2	13 1/2	10 1/2		3 5/8	16ZP4
17AP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	18 3/8	6 3/8	1 7/16	16 3/8 D	11 3/4	16D	14 3/4	10 3/4		4 11/16	17AP4
17ATP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	16	6 15/16	1 7/16	16 3/8 D	9 1/16	15 3/8 D	14 3/8	11 1/16			17ATP4
17ATP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	16	6 15/16	1 5/16	16 3/8 D	9 1/16	15 3/8 D	14 3/8	11 1/16			17ATP4A
17AVP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15 5/8	6 1/2	1 7/16	16 3/8 D	9 1/8	15 9/16 D	14 15/16	11 1/8			17AVP4
17AVP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15 5/8	6 1/2	1 5/16	16 3/8 D	9 1/8	15 9/16 D	14 15/16	11 1/8			17AVP4A
17BJP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 5/8	5 1/2	1 7/16	16 3/8 D	9 1/8	15 9/16 D	14 5/16	11 1/8			17BJP4
17BKP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15 5/8	6 1/2	1 7/16	16 3/8 D	9 1/8		14 5/16	11 1/8			17BKP4
17BKP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15 5/8	6 1/2	1 7/16	16 3/8 D	9 1/8		14 5/16	11 1/8			17BKP4A
17BMP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15 5/8	6 1/2	1 7/16	16 3/8 D	9 1/8	15 9/16 D	14 5/16	11 1/8			17BMP4
17BNP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 5/8	5 1/2	1 7/16	16 3/8 D	9 1/8	15 9/16 D	14 5/16	11 1/8			17BNP4
17BP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	19 1/4	7 3/8	1 7/16	16 3/8 D	11 3/4	15 9/16 D	14 3/4	10 3/4		4 1/2	17BP4
17BP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19 3/8	7 3/8	1 7/16	16 3/8 D	11 3/4	15 9/16 D	14 15/16	11 1/8			17BP4A

D Diagonal.



12D



12L



12N

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17BP4B-17CP4

TYPE	DESCRIPTION	HEATER										RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS						TYPE
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL CONDUCTIVE COATING	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE #1 VOLTAGE	MAX. GRID #1 RESISTANCE (MEGOHMS)	CATHODE #1 OR CATHODE #2	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET CURRENT MA.	ION-TRAP MAGNET PEAK FIELD STRENGTH (GAUSS)	
17BP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-65 D-70	YES	16	1.5	12		300	−55	100		35		17BP4B
17BP4C	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[g]	M	M	H-65 D-70	YES	16	1.5	12		300	−55	100		35		17BP4C
17BRP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	H-105 D-110	YES	15	1.5	14	0[w] to +500	300	−50	−15 to +25 μa		37		17BRP4
17BSP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45	NONE	NO	YES	M	E	H-85 D-90	YES	16	1.5	14	−50[w] to +350	300	−50					17BSP4
17BUP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	E	H-85 D-90	YES	18	1.5	12	−48[w] to +264	300	−55		30			17BUP4
17BVP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	H-105 D-110	YES	17.6	1.5	14	−50[w] to +350	300	−53.5			33		17BVP4
17BWP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H-105 D-110	YES	17.6	1.5	14	−50[w] to +350	300	−53.5					17BWP4
17BYP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	H-105 D-110	YES	17.6	1.5	14	0[w] to +400	300	−53.5					17BYP4
17BZP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-105 D-110	YES	16	1.5	14	0[w] to +400	300	−50					17BZP4
17CAP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H-105 D-110	YES	17.6	1.5	14	−50[w] to +350	300	−53.5					17CAP4
17CBP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	E	H-85 D-90	YES	18	1.5	12	−50[w] to +350	300	−50			32		17CBP4
17CDP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	8.4	0.45*	NONE	NO	YES	M	E	H-105 D-110	YES	16	1.5	12	0[w] to +400	200		−25 to +25 μamp		0 to 8		17CDP4
17CEP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45	NONE	NO	YES	M	E	H-85 D-90	YES	16	1.5	14	−50[w] to +350	300	−50					17CEP4
17CFP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-85 D-90	YES	16	1.5	14	−50[w] to +350	300	−50					17CFP4
17CGP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	YES	M	E	H-65 D-70	YES	14	1.5	11	−36[w] to +310	300	−50					17CGP4
17CKP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	H-105 D-110	YES	15	1.5	14	0[w] to +300	300	−50	−15 to +25 μamp				17CKP4
17CLP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	E	H-85 D-90	YES	17.6	1.5	14	−48[w] to +264	300	−53.5			35		17CLP4
17CMP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H-85 D-90	YES	17.6	1.5	14	0[w] to +400	50	−40					17CMP4
17CNP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H-85 D-90	YES	17.6	1.5	14	0[w] to +400	50	−42.5					17CNP4
17CP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[g]	M	M	H-66 D-70	NO	16	1.5	14		300	−55	104		50		17CP4

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[g] Frosted. [D] Diagonal. [H] Horizontal. [w] Grid # 4 Voltage.











TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: DISTANCE FROM TANGENT PLANE TO FACE INCHES	RASTER SIZE: USEFUL SCREEN DIAMETER INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		MAX. ANGLE BETWEEN ANY TWO PINS DEGREES	TYPE
17BP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19¼	7½	1⅝	16⅝D	11¾	15⅜D	14¹⁵⁄₁₆	11½		33¼	17BP4B
17BP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19¼	7½	1⅞	16⅝D	11¾	15½D	14¼	10¾			17BP4C
17BRP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	12⅝	5⅞	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆			17BRP4
17BSP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14⅝	5½	1⅞	16⅝D	9½		14⅝	11¼			17BSP4
17BUP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15¾	6½	1⅞	16⅝D	9½	15⅝D	14⅝	11⅜			17BUP4
17BVP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	13¾	6½	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆			17BVP4
17BWP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	12⅝	5⅝	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆			17BWP4
17BYP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	12⅝	5⅝	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆			17BYP4
17BZP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	12⅝	5⅞	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆			17BZP4
17CAP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	12⅝	5⅞	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆			17CAP4
17CBP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15¾	6½	1⅞	16⅝D	9½	15⅝D	14⅝	11⅜			17CBP4
17CDP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	12⅝	5⅞	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆			17CDP4
17CEP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15	5½	1⅞	16⅝D	9½		14¾	11¹¹⁄₁₆			17CEP4
17CFP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15	5½	1⅞	16⅝D	9½		14¾	11¹¹⁄₁₆			17CFP4
17CGP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	17⅝	5½	1⅞	16⅝D	11¹¹⁄₁₆	15⅝D	14⅝	11⅜			17CGP4
17CKP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	12⅝	5⅞	1½	16⅝D	7½	15¾D	14¾	11¹¹⁄₁₆		2	17CKP4
17CLP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15⅝	6½	1⅞	16⅝D	9½	15⅝D	14⅝	11⅜			17CLP4
17CMP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14⅝	5½	1⅞	16⅝D	9½		14⅝	11⅜			17CMP4
17CNP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15	5½	1⅞	16⅝D	9½		14¾	11¹¹⁄₁₆			17CNP4
17CP4	METAL SHELL LIF	SMALL SHELL DUODECAL 5-PIN	12D	18½	7⅝	1⅞	16¹³⁄₁₆D	11⅝	15½D	14½	11		43¼	17CP4

D Diagonal.



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17CP4A-17DSP4

TYPE	DESCRIPTION	HEATER									RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS							TYPE
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. FOCUS COIL	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE DEGREES	EXTERNAL CONDUCTIVE COATING	MAX. ANODE KV. VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 OR GRID #2 VOLTS	ANODE #1 VOLTS	GRID #1 VOLTS	GRID #1 FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET CURRENT MA.	ION-TRAP MAGNET FIELD STRENGTH GAUSS	
17CP4A	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H.-66 D.-70	NO	16	1.5	14		300	−55	104		50	17CP4A
17CRP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H.-85 D.-90	YES	17.6	1.5	14	0[W] to +350	50	−40				17CRP4
17CSP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H.-105 D.-110	YES	17.6	1.5	14	0[W] to +350	300	−53.5				17CSP4
17CTP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	H.-105 D.-110	YES	17.6	1.5	14	0[W] to +400	300	−53.5				17CTP4
17CUP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3* ±5%	NONE	NO	YES	M	E	85[H] 90[D]	YES	17.6	1.5	14	−50[W] to +350	300	−43.5				17CUP4
17CVP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3*	NO	NO	YES	M	E	H.-105 D.-110	YES	17.6	1.5	14	0[W] to +400	300	−53.5				17CVP4
17CWP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	NONE	NO	YES	M	E	105[H] 110[D]	YES	16	1.5	14	−50[W] to +350	400	−64				17CWP4
17CXP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45	NONE	NO	YES	M	E	H.-85 D.-90	YES	16	1.5	14	−50[W] to +350	50	−39.5				17CXP4
17CYP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZE SCREEN)	6.3	0.6	NONE	NO	YES	M	E	85[H] 90[D]	YES	16	1.5	14	−50[W] to +350	450	−72				17CYP4
17CZP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	85[H] 90[D]	YES	16	1.5	14	−50[W] to +350	450	−72				17CZP4
17DAP4	RECTANGULAR GLASS—DIRECT VIEW	2.68 ±10%	0.45*	NONE	NO	YES	M	E	105[H] 110[D]	YES	17.6	1.5	14	100[W] to 500	300	−53.5				17DAP4
17DBP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3* ±5%	SINGLE	NO	YES	M	E	65[H] 70[D]	YES	17.6	1.5	14	−50[W] to +300	300	−53.5			30	17DBP4
17DCP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3* ±5%	NONE	NO	YES	M	E	85[H] 90[D]	YES	17.6	1.5	14	−50[W] to +300	300	−53.5				17DCP4
17DEP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	2.35	0.6*	NONE	NO	YES[X]	M	E	105[H] 110[D]	YES	17.6	1.5	14	0[V] to +400	500	−57.5				17DEP4
17DHP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	NO[X]	M	E	105[H] 110[D]	YES	16	1.5	14	0[W] to +400	500	−57.5				17DHP4
17DJP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3*	SINGLE	NO	YES[X]	M	E	85[H] 90[D]	YES	17.6	1.5	14	−50[W] to +300	300	−53.5			31	17DJP4
17DKP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±5%	NONE	NO	YES[X]	M	E	105[H] 110[D]	YES	17.6	1.5	14	0[V] to +400	500	−60.5				17DKP4
17DLP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±10%	NONE	NO	NO[X]	M	E	105[H] 110[D]	YES	18	1.5	17	0 to +500	450	−50				17DLP4
17DQP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45* ±5%	NONE	NO	YES[X]	M	E	105[H] 110[D]	YES	17.6	1.5	14.5	−200[W] to +550	50	−42.5				17DQP4
17DSP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	NO	M	E	105[H] 110[D]	YES	18	1.5	14	0[W] to 400	450	−62.5				17DSP4

[D] Diagonal. [H] Horizontal. [F] Frosted. [X] Cylindrical Face Plate. [W] Grid # 4 Voltage. [Y] Special "Filter" Glass Face Plate
[X] Spherical Face Plate.

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[W] Grid #3.



7FA



8HR



8JK



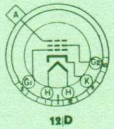
8JN



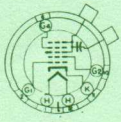
8JR



8JS



12D



12L

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: DISTANCE FROM FACE OF BULB TO NECK SEAL INCHES	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		MFR'S ADDED NOTES AND/OR SPECIAL FEATURES	TYPE
17CP4A	METAL SHELL LIP	SMALL SHELL DUODECAL 5-PIN	12D	18 3/8	7 7/16	1 7/16	16 13/16 D	11 5/16	15 3/4 D	14 3/8	11		4 3/4	17CP4A
17CRP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/8	5 1/2	1 7/8	16 5/8 D	9 1/2	15 9/16 D	14 5/16	11 1/8			17CRP4
17CSP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	12 5/16	5 5/16	1 3/4	16 5/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17CSP4
17CTP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	12 5/16	5 7/16	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17CTP4
17CUP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15	5 1/2	1 7/8	16 5/8 D	9 1/2	15 9/16 D	14 3/4	11 11/16			17CUP4
17CVP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	12 5/16	5 5/16	1 1/8	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17CVP4
17CWP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	11 5/8	4 1/2	1 3/4	16 3/16 D	7 3/8	15 9/16 D	14 3/4	11 11/16			17CWP4
17CXP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 5/8	5 1/2	1 7/8	16 5/8 D	9 1/16	15 9/16 D	14 5/8	11 3/8			17CXP4
17CYP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14	4 1/2	1 7/8	16 5/8 D	9 1/2	15 9/16 D	14 3/4	11 11/16			17CYP4
17CZP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	13 5/8	4 1/2	1 7/8	16 5/8 D	9 3/8	15 9/16 D	14 5/8	11 3/8			17CZP4
17DAP4	RECESSED SMALL CAVITY CAP	SHORT GLASS BUTTON 7-PIN	8JK	10 11/16	3 9/16	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17DAP4
17DBP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 5/8	7 1/2	1 7/8	16 5/8 D	11 11/16	15 9/16 D	14 5/8	11 3/4		5 1/2	17DBP4
17DCP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	14 3/8	5 1/2	1 7/8	16 5/8 D	9 3/8	15 9/16 D	14 5/8	11 3/8			17DCP4
17DEP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JN	10 5/16	3 5/8	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17DEP4
17DHP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	11 3/4	4 3/8	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17DHP4
17DJP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	15 3/8	6 1/2	1 7/8	16 5/8 D	9 3/8	15 9/16 D	14 5/8	11 3/8			17DJP4
17DKP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JR	10 11/16	3 9/16	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17DKP4
17DLP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 6-PIN	8TS	11 5/16	3 15/16	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17DLP4
17DQP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	12 3/8	5	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17DQP4
17DSP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	11 3/4	4 3/8	1 3/4	16 3/16 D	7 3/8	15 3/4 D	14 3/4	11 11/16			17DSP4

D Diagonal.





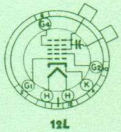












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17DTP4-17YP4

TYPE	DESCRIPTION	HEATER										RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS					
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL-MU METAL SHIELD	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE DIAGONAL DEGREES	EXTERNAL CONDUCTIVE COATING	MAX. ANODE VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 OR ANODE #3 VOLTS	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 CUTOFF VOLTAGE	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET CURRENT	ION-TRAP MAGNET FIELD STRENGTH GAUSS	TYPE
17DTP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6 ±5%	NONE	NO	NO	M	E	105° 110°	YES	17.6	1.5	14	0[W] to 400	300	−50				17DTP4
17DXP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	105° 110°	YES	17.6	1.5	14	0[V] to 400	500	−60.5				17DXP4
17FP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H.65 D.70	YES	18	1.5	12	2300 to 3100[W]	300	−55			35	17FP4
17FP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[V]	M	E	H.65 D.70	YES	18	1.5	12	2170 to 2940[W]	300	−55		70	35	17FP4A
17GP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[B]	M	E	H.66 D.70	NO	16	1.5	14	2400[W] to 3200	300	−55			40	17GP4
17HP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H.65 D.70	YES	16	1.5	14	−56[W] to +310	300	−55		85		17HP4
17HP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[V]	M	E	H.65 D.70	YES	16	1.5	14	55[W] to 300	300	−55		85		17HP4A
17HP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H.65 D.70	YES	16	1.5	14	−56[W] to +310	300	−50			30	17HP4B
17JP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H.65 D.70	YES	18	1.5	16		300	−55	100		45	17JP4
17KP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H.65 D.70	YES	16	1.5	12		300	−55		50		17KP4
17KP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H.65 D.70	YES	16	1.5	12		300	−55		50		17KP4A
17LP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[X]	M	E	H.65 D.70	YES	16	1.5	12	0-400[W]	300	−55		70	35	17LP4
17LP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES[X]	M	E	H.65 D.70	YES	16	1.5	14	−56[W] +310	300	−55	−15 to +25 μa	85		17LP4A
17QP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[X]	M	M	H.65 D.70	YES	16	1.5	12		300	−55	100		35	17QP4
17QP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES[X]	M	M	H.65 D.70	YES	18	1.5	14		300	−50	95		30	17QP4A
17RP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H.66 D.70	YES	16	1.5	12	0[W]	300	−55		75	35	17RP4
17RP4C	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H.66 D.70	YES	16	1.5	12	0[W]	300	−55		75	35	17RP4C
17SP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[X]	M	E	H.70	YES	14	1.5	13		250	−50		120	40	17SP4
17TP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[B]	M	E	H.66 D.70	NO	16	1.5	14	55 to 300	300	−55			35	17TP4
17UP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[X]	M	M	H.70	YES	14	1.5	13		250	−50	110	120	40	17UP4
17VP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[X]	M	E	H.66 D.70	YES	16	1.5	14	0	300	−55			35	17VP4
17VP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES[X]	M	E	H.66 D.70	YES	16	1.5	14	0	300	−55			35	17VP4B
17YP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[X]	M	M	H.65 D.70	YES	18	1.5	16		300	−55	100		45	17YP4

[W] Grid #4 Voltage. [V] Grid #3. * Thermal Characteristics, etc. [H] Horizontal [D] Diagonal.



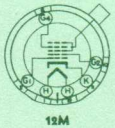
8HR



8JR



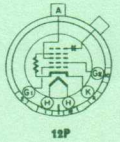
12L



12M



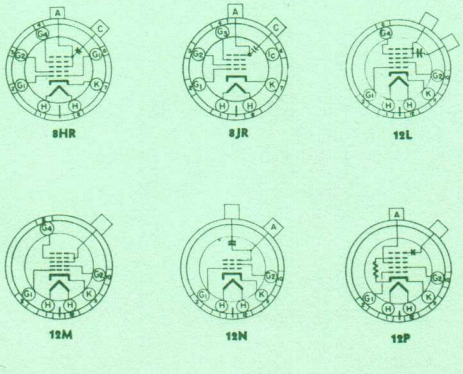
12N



12P

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: DISTANCE FROM PROJECTED MECHANICAL AXIS TO BULB INCHES	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES			TYPE
17DTP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	10 3/4	3 5/8	1 1/8	16 5/16 D	7 1/8	15 3/4 D	14 1/4	11 11/16			17DTP4
17DXP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JR	10 11/16	3 5/8	1 1/8	16 5/16 D	7 1/8	15 3/4 D	14 1/4	11 11/16			17DXP4
17FP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 3/4	7 1/2	1 5/8	16 5/8 D	11 3/4	15 3/4 D	14 3/4	10 3/4			17FP4
17FP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 3/4	7 1/2	1 5/8	16 5/8 D	11 3/4	15 3/4 D	14 3/4	10 3/4			17FP4A
17GP4	METAL CONE LIP	SMALL SHELL DUODECAL 6-PIN	12M	19 5/8	7 1/2	1 5/8	16 13/16 D	11 13/16	15 3/4 D	14 1/2	10 13/16			17GP4
17HP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 5/8	7 1/2	1 5/8	16 5/8 D	11 11/16	15 3/4 D	14 11/16	11 1/2		4 1/4	17HP4
17HP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 5/8	7 1/2	1 5/8	16 5/8 D	11 11/16	15 3/4 D	14 1/4	10 3/4		4 1/4	17HP4A
17HP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 5/8	7 1/2	1 5/8	16 5/8 D	11 11/16	15 3/4 D	14 11/16	11 1/2			17HP4B
17JP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19 3/4	7 1/2	1 5/8	16 5/8 D	11 3/4		14 3/4	11 1/2			17JP4
17KP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12P	19 3/4	7 1/2	1 5/8	16 5/8 D	11 3/4	15 3/4 D	14 1/4	10 3/4			17KP4
17KP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12P	19 3/4	7 1/2	1 5/8	16 5/8 D	11 3/4	15 3/4 D	14 1/4	10 3/4			17KP4A
17LP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 3/4	7 1/2	1 5/8	16 5/8 D	11 3/4	15 3/4 D	14 1/4	10 3/4			17LP4
17LP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 3/4	7 1/2	1 3/4	16 5/8 D	11 3/4	15 1/2 D	14 1/4	10 3/4			17LP4A
17QP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19 3/4	7 1/2	1 5/8	16 5/8 D	11 3/4	16 D	14 1/4	10 3/4			17QP4
17QP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19 3/4	7 1/2	1 7/8	16 5/8 D	11 3/4	16 D	14 1/4	10 3/4			17QP4A
17RP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 3/4	7 1/2	1 7/8	16 3/8 D	11 3/4	15 1/2 D	14 1/4	10 3/4		5 1/2	17RP4
17RP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 3/4	7 1/2	1 7/8	16 3/8 D	11 3/4	15 1/2 D	14 1/4	10 3/4		5 1/2	17RP4C
17SP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19 5/8	7 3/8	1 1/8	16 3/8 D	11 11/16	15 13/16 D	14 1/2	10 7/8		3 3/8	17SP4
17TP4	METAL CONE LIP	SMALL SHELL DUODECAL 6-PIN	12M	19 5/8	7 3/8	1 1/8	16 13/16 D	11 13/16	15 3/8 D	14 1/2	10 13/16			17TP4
17UP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19 5/8	7 3/8	1 1/8	16 3/8 D	11 11/16	15 11/16 D	14 1/2	10 7/8		3 3/8	17UP4
17VP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 5/8	7 3/8	1 1/8	16 3/8 D	11 11/16	15 3/4 D	14 1/2	10 7/8			17VP4
17VP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 5/8	7 3/8	1 1/8	16 3/4 D	11 11/16	15 3/4 D	14 1/2	10 7/8			17VP4B
17YP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	19 5/8	7 1/2	1 1/8	16 3/4 D	11 11/16	15 3/4 D	14 1/4	10 3/4			17YP4

D Diagonal.



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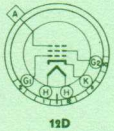
19AP4-20HP4

TYPE	DESCRIPTION	HEATER										RATINGS			TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS					
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL GAS DIRECTRON®	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE DEGREES	EXTERNAL CONDUCTIVE COATING	MAX. ANODE #1 VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 OR ANODE RESISTOR	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT M.A.	ION-TRAP MAGNET CURRENT M.A.	ION-TRAP MAGNET FIELD GAUSS	TYPE
19AP4	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	66	NO	19	1.5	12		300	−55	75	105		19AP4
19AP4A	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	66	NO	19	1.5	12		300	−55	140	75		19AP4A
19AP4B	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[g]	M	M	66	NO	19	1.5	12		300	−55	140	75		19AP4B
19AP4C	ROUND METAL—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	66	NO	19	1.5	12		300	−55	140		32	19AP4C
19AP4D	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO[g]	M	M	66	NO	19	1.5	12		300	−55	140	75		19AP4D
19DP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	66	YES	19	1.5	13		250	−45	146	105		19DP4
19DP4A	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	66	YES	19	1.5	13		250	−45	146	105		19DP4A
19EP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	H-65 D-70	NO	19	1.5	13		250	−45	146	105		19EP4
19FP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	DOUBLE	YES	YES	M	M	66	NO	19	1.5	13		250	−45	120	110		19FP4
19GP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	66	NO	19	1.5	13		250	−45	120	105	23	19GP4
19JP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H-66 D-70	NO	18	1.5	12		300	−55	95	75		19JP4
19QP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-66 D-70	YES	18	1.5	12	−50[w] to 350	300	−55		75		19QP4
20BP4	ROUND GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	54	NO	20	1.5	15		250	−45	135			20BP4
20CP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H-66 D-70	NO	18	1.5	12		300	−55	95	75		20CP4
20CP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H-66 D-70	YES	18	1.5	12		300	−55	95	75		20CP4A
20CP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-66 D-70	NO	18	1.5	12		300	−55	95	75		20CP4B
20CP4C	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[y]	M	M	H-66 D-70	NO	18	1.5	12		300	−55	95	75		20CP4C
20CP4D	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-66 D-70	YES	18	1.5	12		300	−55	95	75		20CP4D
20DP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H-65 D-70	YES	18	1.5	12		300	−55	95	75		20DP4A
20DP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-66 D-70	NO	18	1.5	16		300	−50	95		35	20DP4B
20DP4C	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-66 D-70	YES	18	1.5	16		300	−50	95		35	20DP4C
20FP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-66 D-70	NO	18	1.5	12		300	−55		75		20FP4
20GP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-66 D-70	YES	18	1.5	14		300	−55		75	40	20GP4
20HP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-66 D-70	NO	16	1.5	14		300	−55				20HP4

[y] Special "Filter" Glass Face Plate. [D] Diagonal. [H] Horizontal. [g] Frosted. [w] Grid #4 Voltage.



12D



12L



12M



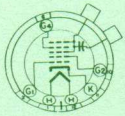
12N

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	NECK LENGTH INCHES	NECK DIAMETER INCHES	BULB DIAMETER INCHES	FROM VAVE PROJECTION TO FACE OF NECK SEAL INCHES	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	USEFUL SCREEN WIDTH INCHES	USEFUL SCREEN HEIGHT INCHES		MCA AND RCA ELECTRON GUN AND SHIELD SYSTEM	TYPE
19AP4	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/8	7 1/8	1 5/8	18 5/8	14 3/8	17 3/8	15 3/4	11 3/4		4 1/4	19AP4
19AP4A	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/8	7 1/8	1 5/8	18 5/8	14 3/8	17 3/8	15 3/4	11 3/4		4 1/4	19AP4A
19AP4B	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/8	7 1/8	1 5/8	18 5/8	14 3/8	17 3/8	15 3/4	11 3/4		4 1/4	19AP4B
19AP4C	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/8	7 1/8	1 5/8	18 5/8	14 3/8	17 3/8	15 3/4	11 3/4		3 3/8	19AP4C
19AP4D	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/8	7 1/8	1 5/8	18 5/8	14 3/8	17 3/8	15 3/4	11 3/4		4 1/4	19AP4D
19DP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/8	7 1/8	1 5/8	18 7/8	14 3/8	17 3/8	15 3/4	11 3/4		3 5/8	19DP4
19DP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/8	7 1/8	1 5/8	18 7/8	14 3/8	17 3/8	15 3/4	11 3/4		3 5/8	19DP4A
19EP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/8	7 1/8	1 5/8	18 5/8 D	13 5/8	17 11/16 D	16	12		3 5/8	19EP4
19FP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	22	7 5/8	1 5/8	18 7/8	14 3/8	17 3/8	15 3/4	11 3/4		5	19FP4
19GP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/4	6 7/8	1 5/8	18 7/8	14 3/8	17 3/8	15 3/4	11 3/4		4 3/8	19GP4
19JP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	20 13/16	7 3/8	1 5/8	18 5/8 D	13 5/8	17 11/16 D	16	12		4 1/4	19JP4
19QP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/8	7 1/8	1 5/8	18 5/8 D	13 5/8	17 11/16 D	16	12		4 1/4	19QP4
20BP4	MEDIUM METAL CAP	SMALL SHELL DUODECAL 5-PIN	12D	28	8	1 5/8	20	20	18 3/4	17	12 3/4			20BP4
20CP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 7/8	7 3/8	1 5/8	20 1/16 D	14 1/4	18 3/4 D	17	12 3/4		4 1/4	20CP4
20CP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 7/8	7 3/8	1 5/8	20 1/16 D	14 1/4	18 3/4 D	17	12 3/4		4 1/4	20CP4A
20CP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 7/8	7 3/8	1 5/8	20 1/16 D	14 1/4	18 3/4 D	17	12 3/4		4 1/4	20CP4B
20CP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 7/8	7 3/8	1 5/8	20 1/16 D	14 1/4	18 3/4 D	17	12 3/4		4 1/4	20CP4C
20CP4D	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 7/8	7 3/8	1 5/8	20 1/16 D	14 1/4	18 3/4 D	17	12 3/4		4 1/4	20CP4D
20DP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/4	7 3/8	1 5/8	20 1/16 D	14 1/4	18 3/4 D	17	12 3/4		4 1/16	20DP4A
20DP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/4	7 1/2	1 5/8	20 1/16 D	14 1/4		17	12 3/4			20DP4B
20DP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/4	7 1/2	1 5/8	20 1/16 D	14 1/4		17	12 3/4			20DP4C
20FP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	21 3/4	7 1/2	1 5/8	20 1/16 D	14 1/4	18 3/4 D	17	12 3/4		4 1/4	20FP4
20GP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/4	7 1/2	1 5/8	20 1/16 D	14 1/4	18 1/2 D	17	12 3/4			20GP4
20HP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	21 3/4	7 1/2	1 5/8	20 1/16 D	14 1/4	18 11/16 D	17	12 3/4		4 1/4	20HP4

D Diagonal.



12D



12L



12M



12N

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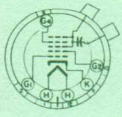
20HP4A-21ATP4A

TYPE	DESCRIPTION	HEATER										RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS					
		VOLTS	AMPERES	ION TRAP MAGNET	EXTERNAL MAG. METAL FOIL COND.	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE, DEGREES	EXTERNAL CONDUCTIVE COATING	MAX. ANODE #1 VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #3 OR ANODE #2 VOLTS	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT, MA.	ION TRAP MAGNET CURRENT	ION TRAP MAGNET FIELD INTENSITY, GAUSS	TYPE
20HP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 66 D. 70	YES	16	1.5	14		300	−55				20HP4A
20HP4B	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[T]	M	E	H. 66 D. 70	NO	16	1.5	14		300	−55				20HP4B
20HP4C	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 66 D. 70	NO	16	1.5	14		300	−50			30	20HP4C
20HP4D	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 66 D. 70	YES	16	1.5	14		300	−50			30	20HP4D
20JP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	D. 70	YES	18	1.5	12		500	−55		50	0 to 8	20JP4
20LP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 65 D. 70	YES	16	1.5	14	0	300	−55			35	20LP4
20MP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 66 D. 70	YES	16	1.5	16		300	−55			50	20MP4
21AP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[S]	M	M	H. 66 D. 70	NO	18	1.5	16		300	−55	110		50	21AP4
21ACP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H. 85 D. 90	YES	20	1.5	16		300	−50	117		40	21ACP4
21ACP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H. 85 D. 90	YES	20	1.5	16		300	−50	117		40	21ACP4A
21AFP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 65 D. 70	NO	18	1.5	16	−64[W] to +350	300	−55		80	45	21AFP4
21ALP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	18	1.5	14	−55[W] to +300	300	−50			40	21ALP4
21ALP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	18	1.5	14	−55[W] to +300	300	−50			40	21ALP4A
21ALP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	20	1.5	14	−55[W] to +300	300	−50			40	21ALP4B
21AMP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H. 85 D. 90	YES	18	1.5	16		300	−50	102	95	45	21AMP4
21AMP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H. 85 D. 90	YES	18	1.5	16		300	−50	102	95	45	21AMP4A
21ANP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	NO	18	1.5	14	−55[W] to +300	300	−50			40	21ANP4
21ANP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	NO	18	1.5	14	−55[W] to +300	300	−50			40	21ANP4A
21AQP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H. 85 D. 90	NO	18	1.5	16		300	−50	102	95	45	21AQP4
21AQP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H. 85 D. 90	NO	18	1.5	16		300	−50	102	95	45	21AQP4A
21ARP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	INTERNAL	NO	YES	M	M	H. 65 D. 70	YES	20	1.5	16		300	−50				21ARP4
21ARP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	INTERNAL	NO	YES	M	M	H. 65 D. 70	YES	20	1.5	16		300	−50				21ARP4A
21ASP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H. 66 D. 70	NO	18	1.5	16	−64[W] to +352	300	−50		75		21ASP4
21ATP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	18	1.5	16	−64[W] to +350	300	−50			35	21ATP4
21ATP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H. 85 D. 90	YES	20	1.5	16	−64[W] to +350	300	−50			35	21ATP4A

[A] Capacitance Range: 500 to 750 μμf. [D] Diagonal. [H] Horizontal. [W] Grid # 4 Voltage. [S] Frosted.



12D



12L



12M



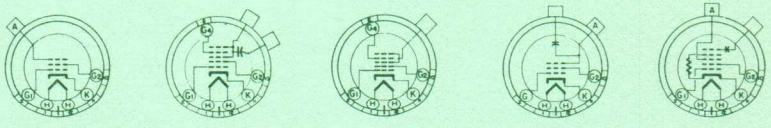
12N



12P

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: CONTACTS PROJECTED BEYOND NECK SEAL INCHES	OVERALL DIMENSIONS: MAX. USEFUL SCREEN DIAMETER INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		MEA. LENGTH BLUE REFERENCE PATTERN INCHES	TYPE
20HP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/4	7 1/2	1 5/8	20 5/8 D	1 4 3/4	18 11/16 D	17	12 3/4		4 1/4	20HP4A
20HP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	21 3/4	7 1/2	1 5/8	20 5/8 D	1 4 3/4	18 11/16 D	17	12 3/4		4 1/4	20HP4B
20HP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	21 3/4	7 1/2	1 5/8	20 5/8 D	1 4 3/4		17	12 3/4			20HP4C
20HP4D	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/4	7 1/2	1 5/8	20 5/8 D	1 4 3/4		17	12 3/4			20HP4D
20JP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12P	21 3/4	7 1/2	1 5/8	20 5/8	1 4 3/4	18 11/16	17	12 3/4			20JP4
20LP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/4	7 1/2	1 5/8	20 5/8 D	1 4 3/4	18 3/8	17	13 1/4		5 1/2	20LP4
20MP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/4	7 1/2	1 5/8	20 5/8 D	1 4 3/4	18 3/8 D	17 1/2	13 1/4			20MP4
21AP4	METAL SHELL LIP	SMALL SHELL DUODECAL 5-PIN	12D	21 7/8	7 3/8	1 5/8	20 3/4 D	1 4 11/16	19 3/8 D	18 3/8	13 15/16		4 3/4	21AP4
21ACP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16		3 3/4	21ACP4
21ACP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16		3 3/4	21ACP4A
21AFP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	23	7 1/2	1 5/8	21 5/8 D	1 5 1/2		19 1/2	13 3/8		3 7/8	21AFP4
21ALP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20 7/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16			21ALP4
21ALP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20 7/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16			21ALP4A
21ALP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20 7/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16			21ALP4B
21AMP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20 7/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16			21AMP4
21AMP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20 7/16	7 1/2	1 5/8 *	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16			21AMP4A
21ANP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	20 5/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/4	15			21ANP4
21ANP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	20 5/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/4	15			21ANP4A
21AQP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	20 7/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/4	15			21AQP4
21AQP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	20 7/16	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/4	15			21AQP4A
21ARP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23 1/32	7 1/2	1 5/8	21 7/32 D	1 5 11/32	20 1/4 D	19 1/4	14 5/16			21ARP4
21ARP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23 1/32	7 1/2	1 5/8	21 7/32 D	1 5 11/32	20 1/4 D	19 1/4	14 5/16			21ARP4A
21ASP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	22 5/16	7 1/2	1 5/8	20 5/8 D	1 4 13/16	19 1/2 D	17 3/4	13 5/8		3	21ASP4
21ATP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4 D	19 1/16	15 1/16			21ATP4
21ATP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 1/2	1 5/8	21 3/4 D	1 2 1/2	20 1/4	19 1/16	15 1/16			21ATP4A

D Diagonal.



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21ATP4B-21CEP4

TYPE	DESCRIPTION	HEATER VOLTS	HEATER AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. FIELD SHIELDING	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	RATINGS MAX. ANODE #1 VOLTS	RATINGS MAX. GRID #1 RESISTANCE (MEGOHMS)	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS ON ANODE #2 VOLTS	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS ANODE #1 VOLTS	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS GRID #2 VOLTS	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS GRID #1 VOLTAGE FOR CUTOFF	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS FOCUSING COIL CURRENT M.A.	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS ION-TRAP MAGNET FIELD STRENGTH	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS ION-TRAP MAGNET FIELD ADJUSTMENT	TYPE
21ATP4B	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-85 D-90	YES	18	1.5	16	−64[H] to +350	300	−50			35	21ATP4B
21AUP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-67 D-72	YES[A]	18	1.5	14	−55[W] to +300	300	−50			40	21AUP4
21AUP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H-67 D-72	YES[A]	18	1.5	14	−55[W] to +300	300	−50			40	21AUP4A
21AUP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H-67 D-72	YES[A]	20	1.5	14	−55[W] to +300	300	−50			40	21AUP4B
21AVP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-67 D-72	YES[B]	18	1.5	14	−55[W] to +300	300	−50			40	21AVP4
21AVP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H-67 D-72	YES[B]	18	1.5	14	−55[W] to +300	300	−50			40	21AVP4A
21AVP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H-67 D-72	YES[B]	20	1.5	14	−55[W] to +300	300	−50			40	21AVP4B
21AWP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-67 D-72	YES	18	1.5	16		300	−50	108		35	21AWP4
21AYP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H-66 D-70	YES	18	1.5	16	−64[W] to +352	300	−50		75		21AYP4
21BAP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-85 D-90	YES	20	1.5	16	0[W] to 500	300	−50			*	21BAP4
21BCP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-65 D-70	YES	20	1.5	16	+50[W] to +550	300	−50				21BCP4
21BDP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-67 D-72	YES	20	1.5	16	50[W] to +550	300	−55				21BDP4
21BNP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-85 D-90	YES	20	1.5	16	+0[W] to +300	300	−50				21BNP4
21BSP4	RECTANGULAR GLASS—DIRECT VIEW [D] (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H-85 D-90	YES	22	1.5	16		300	−50	116	30	33	21BSP4
21BTP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H-85 D-90	YES	22	1.5	16	−64[W] to +352	300	−50		30	33	21BTP4
21CBP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-85 D-90	YES	18	1.5	14	−55[W] to +300	300	−50				21CBP4
21CBP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H-85 D-90	YES	22	1.5	16	0[W] to +450	300	−50				21CBP4A
21CDP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.45*	SINGLE	YES	YES	M	E	H-85 D-90	YES	22	1.5	16	−64[W] to +352	300	−50		30	33	21CDP4
21CDP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	SINGLE	YES	YES	M	E	H-85 D-90	YES	22	1.5	16	−64[W] to +352	300	−50		30	33	21CDP4A
21CEP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H-105 D-110	YES	19.8	1.5	16	0[W] to +400	300	−53.2				21CEP4

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[B] Frosted. [D] Diagonal. [H] Horizontal. [X] Cylindrical Face Plate. [W] Grid # 4 Voltage. [B] Capacitance Range: 750 to 1500 μμf. [A] Capacitance range 500 to 750 μμf.



8HR



12L



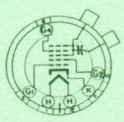
12N

21ATP4B-21CEP4

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: PROJECTION FROM BULB TO BASE INCHES	RASTER SIZE: USEFUL SCREEN DIAMETER INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		PICK-UPON PROJECTION INCHES	TYPE
21ATP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 3/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 9/16	1 5/16			21ATP4B
21AUP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 31/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 9/16	1 5/16			21AUP4
21AUP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 31/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 9/16	1 5/16			21AUP4A
21AUP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 31/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 9/16	1 5/16			21AUP4B
21AVP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 31/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 9/16	1 5/16			21AVP4
21AVP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 31/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 9/16	1 5/16			21AVP4A
21AVP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 31/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 9/16	1 5/16		4 1/4	21AVP4B
21AWP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	2 31/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 9/16	1 5/16			21AWP4
21AYP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 27/32	7 3/32	1 7/16	2 05/32 D	1 41/64	1 91/32 D	1 73/32	1 33/32		3	21AYP4
21BAP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 3/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 93/64	15			21BAP4
21BCP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 11/32	7 3/32	1 7/16	2 11/32 D	1 51/64	2 3/4 D	1 93/64	1 43/64			21BCP4
21BDP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	2 11/32	7 3/32	1 7/16	2 13/32 D	1 51/64	2 3/4 D	1 93/64	15			21BDP4
21BNP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 3/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 93/64	15			21BNP4
21BSP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20	7 3/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 91/64	1 51/64			21BSP4
21BTP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 3/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 91/64	1 51/64			21BTP4
21CBP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18	5 31/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 93/64	15			21CBP4
21CBP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18	5 31/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 91/64	1 51/64			21CBP4A
21CDP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 3/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 91/64	1 51/64			21CDP4
21CDP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 3/32	1 7/16	2 13/32 D	1 23/32	2 3/4 D	1 91/64	1 51/64			21CDP4A
21CEP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	1 47/64	5 7/64	1 1/4	2 13/32 D	9	2 3/4 D	1 91/64	1 51/64			21CEP4

D Diagonal.







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21CEP4A-21DLP4

TYPE	DESCRIPTION	HEATER VOLTS	HEATER AMPERES	ION TRAP MAGNET	EXTERNAL MAG. SHIELD FOR CGE	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DIAGONAL)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE KILOVOLTS	RATINGS MAX. GRID #1 RESISTANCE (MEGOHMS)	TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS: GRID #1 VOLTAGE FOR CUTOFF	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR VG=100FC	FOCUSING COIL CURRENT MA.	ION TRAP MAGNET CURRENT MA.	IONTRAP MAGNET FIELD INTENSITY GAUSS	TYPE
21CEP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H. 105 D. 110	YES	20	1.5	13.5	0[W] to +40	300	−53.2				21CEP4A
21CGP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	E	H. 85 D. 90	YES	20	1.5	18	−72[W] to +396	110	−41			46	21CGP4
21CHP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 85 D. 90	YES	20	1.5	18	−50[W] to +350	110	−41				21CHP4
21CKP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45	NONE	NO	YES	M	E	H. 85 D. 90	YES	20	1.5	16	−50[W] to +350	300	−50				21CKP4
21CMP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	E	H. 85 D. 90	YES	22	1.5	16	−64[W] to +352	300	−50		30	33	21CMP4
21CQP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H. 105 D. 110	YES	19.8	1.5	16	−50[W] to +350	300	−53.5				21CQP4
21CSP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	H. 105 D. 110	YES	19.8	1.5	16	0[W] to +400	300	−53.5				21CSP4
21CUP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H. 85 D. 90	YES	22	1.5	16		300	−50	117		40	21CUP4
21CVP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 85 D. 90	YES	22	1.5	16	−64[W] to +352	300	−50				21CVP4
21CWP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	E	H. 85 D. 90	YES	22	1.5	16	−64[W] to +352	300	−50			40	21CWP4
21CXP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 85 D. 90	YES	22	1.5	18	0[W] to +350	50	−42.5				21CXP4
21CZP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	H. 105 D. 110	YES	18	1.5	17	0[W] to +500	300	−50	−15 to +25 μamp		37	21CZP4
21DP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[F]	M	E	H. 66 D. 70	NO	18	1.5	16		300	−55			40	21DP4
21DAP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	H. 105 D. 110	YES	18	1.5	16	0[W] to +400	400	−65				21DAP4
21DEP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	H. 105 D. 110	YES	18	1.5	17	0[W] to +500	300	−50	−15 to +25 μamp			21DEP4
21DEP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	H. 105 D. 110	YES	20	1.5	17	0[W] to +500	300	−50	−15 to +25 μamp			21DEP4A
21DFP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 105 D. 110	YES	18	1.5	16	0[W] to +400	400	−65				21DFP4
21DHP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	H. 105 D. 110	YES	19.8	1.5	16	0[W] to +400	300	−53.5				21DHP4
21DKP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3*	NONE	NO	YES	M	E	H. 105 D. 110	YES	19.8	1.5	16	0[W] to +400	300	−53.5				21DKP4
21DLP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H. 85 D. 90	YES	20	1.5	16	0[W] to +400	300	−50				21DLP4

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[F] Frosted. [D] Diagonal. [H] Horizontal. [W] Grid # 4 Voltage.



7FA



8HR



12L



12M



12N

21CEP4A-21DLP4

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: DISTANCE FROM TOP OF NECK TO CENTER OF BULB INCHES	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES			TYPE
21CEP4A	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 5/16	5 7/16	1 1/2	2 13/64 D	9	20 3/4 D	19 1/16	15 1/16			21CEP4A
21CGP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 1/2	1 3/8	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21CGP4
21CHP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18	5 1/2	1 3/8	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21CHP4
21CKP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18	5 1/2	1 5/16	2 13/64 D	12 1/2		19 1/16	15 1/16			21CKP4
21CMP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19	6 1/2	1 3/8	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21CMP4
21CQP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	14 5/16	5 1/16	1 1/2	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21CQP4
21CSP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	14 5/16	5 1/16	1 1/2	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21CSP4
21CUP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	20	7 1/2	1 7/16	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21CUP4
21CVP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 1/2	1 5/16	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21CVP4
21CWP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 1/2	1 7/16	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21CWP4
21CXP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18	5 1/2	1 7/16	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21CXP4
21CZP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 11/16	5 5/16	1 1/2	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16		4 1/4	21CZP4
21DP4	METAL CONE LIP	SMALL SHELL DUODECAL 6-PIN	12M	22 5/8	7 3/8	1 5/8	2 03/4 D	14 5/8	19 3/4 D	18 3/4	13 15/16			21DP4
21DAP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 11/16	5 5/16	1 3/8	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21DAP4
21DEP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 11/16	5 7/16	1 1/2	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21DEP4
21DEP4A	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 11/16	5 5/16	1 1/2	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21DEP4A
21DFP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 5/16	5 7/16	1 1/2	2 13/64 D	9	20 1/4	19 1/16	15 1/16			21DFP4
21DHP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 11/16	5 5/16	1 1/2	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21DHP4
21DKP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 11/16	5 7/16	1 1/2	2 13/64 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21DKP4
21DLP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	17	4 1/2	1 7/16	2 13/64 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21DLP4

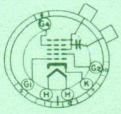
D Diagonal.



7FA



8HR



12L



12M



12N

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21DMP4-21FP4C

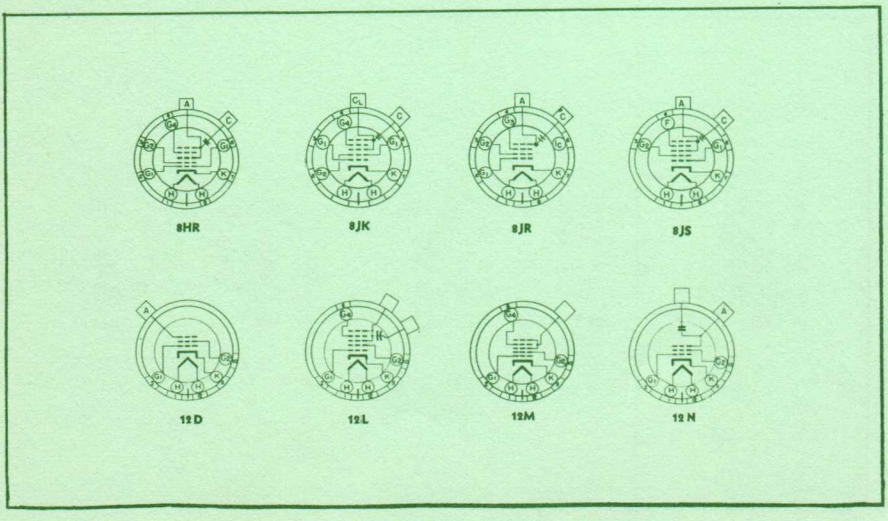
TYPE	DESCRIPTION	HEATER			RATINGS									TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS						TYPE
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. SHIELD/DAG COAT	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 & GRID #4 VOLTS	ANODE #1 VOLTS	GRID #2 & #4 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET ORIENT. MAX.	ION-TRAP MAGNET FIELD STRENGTH MAX.	
21DMP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6 ±5%	NONE	NO	YES[Y]	M	E	105[H] 110[D]	YES	20	1.5	16	−50[W] to +350	400	−64				21DMP4
21DNP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	85[H] 90[D]	YES	22	1.5	16	−64[W] to +352	300	53.5		30	33	21DNP4
21DQP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	85[H] 90[D]	YES	20	1.5	16	−50[W] to +350	300	−53.5				21DQP4
21DRP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	85[H] 90[D]	YES	20	1.5	16	0[W] to +450	300	−50				21DRP4
21DSP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	85[H] 90[D]	YES	20	1.5	16	0[W] to +400	50	−39.5				21DSP4
21DVP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3*	SINGLE	NO	NO[Y]	M	E	85[H] 90[D]	YES	20	1.5	14	−50[W] to +300	300	−50			40	21DVP4
21DWP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO	M	E	105[H] 110[D]	YES	18	1.5	14	−50[W] to +350	450	−50				21DWP4
21EAP4	RECTANGULAR GLASS—DIRECT VIEW	2.34	0.6*	NONE	NO	NO	M	E	105[H] 110[D]	YES	20	1.5	16	100[W] to 500	300	−52.5				21EAP4
21ELP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3	NONE	NO	YES[Y]	M	E	85[H] 90[D]	YES	20	1.5	14	−50[W] to +350	450	−75				21ELP4
21EMP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO	M	E	105[H] 110[D]	YES	18	1.5	16	0[W] to +400	450	−75				21EMP4
21ENP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3* ±5%	SINGLE	NO	YES[Y]	M	E	85[H] 90[D]	YES	22	1.5	16	−64[W] to +352	300	−53.5		30	33	21ENP4
21EP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[X]	M	M	85[H] 70[D]	NO	18	1.5	12		300	−55	95	70		21EP4
21EP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[X]	M	M	85[H] 70[D]	YES	18	1.5	12		300	−55	95	70		21EP4A
21EP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	NO[X]	M	M	85[H] 70[D]	YES	18	1.5	16		300	−55	116		35	21EP4B
21EQP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±5%	NONE	NO	YES[Y]	M	E	105[H] 110[D]	YES	20	1.5	16	0[V] to +400	500	−57.5				21EQP4
21ERP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±5%	NONE	NO	YES[Y&B]	M	E	105[H] 110[D]	YES	20	1.5	16	0[V] to +400	500	−57.5				21ERP4
21ESP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±10%	NONE	NO	NO[Y]	M	E	105[H] 110[D]	YES	18	1.5	17	0[W] to +500	450	−50				21ESP4
21EXP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3* ±5%	NONE	NO	YES[Y]	M	E	105[H] 110[D]	YES	20	1.5	16	0[V] to +400	500	−60.5				21EXP4
21FP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[X]	M	E	85[H] 70[D]	NO	18	1.5	14	−56[W] to +310	300	−55			35	21FP4
21FP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[X]	M	E	85[H] 70[D]	YES	18	1.5	14		300	−55		75	40	21FP4A
21FP4C	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES[X]	M	E	85[H] 70[D]	YES	18	1.5	14	−56[W] to +310	300	−50		75		21FP4C

[Y] Spherical Face Plate.

* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[V] Grid # 3 Voltage.

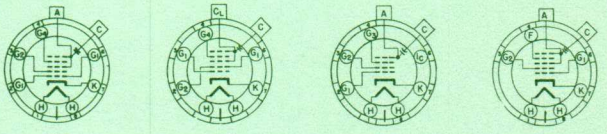
[H] Horizontal. [D] Diagonal. [X] Cylindrical Face Plate. [B] Frosted. [W] Grid # 4 Voltage.



21DMP4-21FP4C

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: RESTRAINT RECTANGLE TO TOP OF BULB AREA INCHES	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		MFG. FINISH DRAWING SERIES NUMBER	TYPE
21DMP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	13 3/4	4 1/2	1 1/4	2 13/16 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21DMP4
21DNP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19	6 1/2	1 7/16	2 13/16 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21DNP4
21DQP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	17 1/2	5	1 7/16	2 13/16 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21DQP4
21DRP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18 1/4	5 1/2	1 7/16	2 13/16 D	12 3/4	20 3/4 D	19 1/16	15 1/16			21DRP4
21DSP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	18	5 1/2	1 7/16	2 13/16 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21DSP4
21DVP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	20	7 1/2	1 7/16	2 13/16 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21DVP4
21DWP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 7/16	5 1/16	1 1/4	2 13/16 D	9	20 3/4 D	19 1/16	15 1/16			21DWP4
21EAP4	RECESSED SMALL CAVITY CAP	SHORT GLASS BUTTON 7-PIN	8JK	12 15/16	3 11/16	1 1/4	2 13/16 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21EAP4
21ELP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19	6 1/2	1 7/16	2 13/16 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21ELP4
21EMP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	13 5/16	4 3/16	1 1/4	2 13/16 D	9	20 3/4 D	19 1/16	15 1/16			21EMP4
21ENP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19	6 1/2	1 7/16	2 13/16 D	12 1/2	20 3/4 D	19 1/16	15 1/16			21ENP4
21EP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	23	7 1/2	1 7/16	2 13/16 D	15 1/2		19 1/2	13 7/8			21EP4
21EP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23	7 1/2	1 7/16	2 13/16 D	15 1/2		19 1/2	13 7/8			21EP4A
21EP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23	7 31/32	1 7/16	2 13/16 D	15 17/32		19 1/2	13 7/8		5 1/2	21EP4B
21EQP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JR	12 5/8	3 5/8	1 1/4	2 13/16 D	9	20 3/4 D	19 1/16	15 1/16			21EQP4
21ERP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JR	12 13/16	3 5/8	1 1/4	2 13/16 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21ERP4
21ESP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 6-PIN	8JS	13 3/16	3 11/16	1 1/4	2 13/16 D	9 1/4	20 3/4 D	19 1/16	15 1/16			21ESP4
21EXP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JR	12 5/8	3 5/8	1 1/4	2 13/16 D	9	20 5/8 D	19 1/16	15 1/16			21EXP4
21FP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12M	23	7 1/2	1 7/16	2 13/16 D	15 1/2	20 5/8 D	19 1/2	13 7/8			21FP4
21FP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	23	7 1/2	1 7/16	2 13/16 D	15 1/2	20 3/4 D	19 1/2	13 7/8		3 5/8	21FP4A
21FP4C	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	23	7 1/2	1 7/16	2 13/16 D	15 1/2		19 1/2	13 7/8		3 1/4	21FP4C

D Diagonal.



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21JP4-23JP4

TYPE	DESCRIPTION	HEATER										RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS					
		VOLTS	AMPERES	ION TRAP MAGNET	EXTERNAL-CONDUCTIVE COATING	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE, DEGREES	EXTERNAL CONDUCTIVE COATING	MAX. ANODE #1 VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #1 OR ANODE #2 MEGOHMS	ANODE #1 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION TRAP MAGNET CURRENT MA.	ION TRAP MAGNET FIELD STRENGTH GAUSS	TYPE
21JP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	INTERNAL	NO	YES[P]	M	M	67 D-70	YES	20	1.5	16		300	−55				21JP4
21JP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	INTERNAL	NO	YES[P]	M	M	65 D-70	YES	20	1.5	16		300	−50				21JP4A
21KP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[P]	M	E	70	NO	18	1.5	13		300	−57		120	40	21KP4
21KP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[P]	M	E	65 D-70	YES	18	1.5	12		300	−55		50		21KP4A
21MP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES[S]	M	E	65 D-70	NO	16	1.5								21MP4
21WP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	66 D-70	YES	18	1.5	16		300	−50	100	75	45	21WP4
21WP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	66 D-70	YES	18	1.5	16		300	−50	100	30	35	21WP4A
21XP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	66 D-70	YES	18	1.5	16	−64[W] to +352	300	−50		75		21XP4
21XP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	66 D-70	YES	18	1.5	16	−64[W] to +352	300	−50		30	35	21XP4A
21YP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.3	SINGLE	NO	YES	M	E	65 D-70	YES	18	1.5	14		300	−55	95	40		21YP4
21YP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	65 D-70	YES	18	1.5	16	−64[W] to +350	300	−50	−15 to +25 μa	58	0 to 8	21YP4A
21ZP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	65 D-70	NO	18	1.5	12		300	−55	95	75		21ZP4
21ZP4A	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	D-70	YES	18	1.5	16		300	−55	100	95	45	21ZP4A
21ZP4B	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	67 D-70	YES	18	1.5	16		300	−55	118		40	21ZP4B
22AP4	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	NO	M	M	70	NO	19	1.5	14		300	−55	117		35	22AP4
22AP4A	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	70	NO	19	1.5	14		300	−55	117		35	22AP4A
23ACP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±5%	NONE	NO	YES[Y]	M	E	76[H] 87[D]	YES	18	1.5	16	0[W] to 400	300	−52.5				23ACP4
23BP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	99[H] 110[D]	YES	20	1.5	14	0[W] to 400	450	−75				23BP4
23CP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±5%	NONE	NO	YES[Y]	M	E	99[H] 110[D]	YES	20	1.5	16	0[W] to +400	300	−53.5				23CP4
23DP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6* ±5%	NONE	NO	YES[Y]	M	E	99[H] 110[D]	YES	22	1.5	16	0[Y] to +400	500	−60.5				23DP4
23FP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6 ±10%	NONE	NO	YES[X]	M	E	102[H] 114[D]	YES	22	1.5	14	200[W]	450	−75				23FP4
23GP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6 ±5%	NONE	NO	NO	M	E	99[H] 110[D]	YES	20	1.5	16	0[W] to +400	300	−50				23GP4
23JP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45* ±5%	NONE	NO	YES[Y]	M	E	99[H] 110[D]	YES	22	1.5	16	+250	50	−42.5				23JP4

[Y] Spherical Face Plate—Bonded Shield.
* Thermal Characteristics, etc.
[H] Horizontal.
[D] Diagonal.
[P] Cylindrical Face Plate.
[S] Frosted Face Plate.
[X] Spherical Face Plate.
[W] Grid # 4 Voltage.
[Y] Grid # 3 Voltage.



7FA



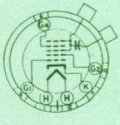
8HR



8JR



12D



12L



12M



12N



12P

TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	NECK LENGTH INCHES	NECK DIAMETER INCHES	BULB DIAMETER INCHES	REGISTRATION OF LONG AXIS OF ANODE BUTTON WITH BASE KEY	RASTER SIZE: USEFUL SCREEN DIAGONAL INCHES	USEFUL SCREEN WIDTH INCHES	USEFUL SCREEN HEIGHT INCHES	MCM-1 SIMILAR ELECTRICAL PERFORMANCE	TYPE
21JP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23 1/32	7 1/2	1 5/8	21 7/16 D	15 11/32	20 1/4 D	19 1/8	13 7/8			21JP4
21JP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23 1/32	7 1/2	1 5/8	21 7/16 D	15 11/32	20 1/4 D	19 1/8	13 7/8			21JP4A
21KP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	22 7/8	7 1/2	1 5/8	21 5/8 D		20 1/4 D	19 1/8	13 7/8	3 5/8		21KP4
21KP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12P	23	7 1/2	1 5/8	21 7/16 D	15 1/2	20 1/4 D	19 1/8	13 7/8			21KP4A
21MP4	METAL CONE LIP	SMALL SHELL DUODECAL 6-PIN	12M	22 5/8	7 1/2	1 5/8	20 3/4 D	14 11/16	19 1/4 D	18 1/4	13 11/16			21MP4
21WP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	22 1/16	7 1/2	1 5/8	20 3/4 D	14 3/4	19 1/4 D	17 3/4	13 3/8	4 3/4		21WP4
21WP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	22 1/16	7 1/2	1 5/8	20 3/4 D	14 11/16	19 1/4 D	17 3/4	13 3/8			21WP4A
21XP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	22 1/16	7 1/2	1 5/8	20 3/4 D	14 11/16	19 1/4 D	17 3/4	13 3/8	3		21XP4
21XP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	22 1/16	7 1/2	1 5/8	20 3/4 D	14 11/16	19 1/4 D	17 3/4	13 3/8			21XP4A
21YP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	23	7 1/2	1 5/8	21 3/4 D	15 1/2	20 D	19 1/8	14 3/8			21YP4
21YP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	23	7 1/2	1 5/8	21 7/16 D	15 1/2	20 D	19 1/8	14 3/8			21YP4A
21ZP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	22 25/32	7 1/2	1 5/8	21 7/16 D	15 11/32		19 1/8	14 3/8	4 1/4		21ZP4
21ZP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23	7 1/2	1 5/8	21 7/16 D	15 1/2	20 D	19 1/8	14 3/8			21ZP4A
21ZP4B	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23 1/32	7 1/2	1 5/8	21 7/16 D	15 11/32	20 D	19 1/8	14 3/8	3 3/4		21ZP4B
22AP4	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	22 7/8	7 1/4	1 5/8	21 11/16	16 25/32	20 3/4	18	13 1/2	3 3/4		22AP4
22AP4A	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	22 7/8	7 1/4	1 5/8	21 11/16	16 25/32	20 3/4	18	13 1/2	3 3/4		22AP4A
23ACP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 11/32	5 1/2	1 5/8	24 45/64 D	13 27/32	22 5/8 D	19 1/8	15 1/4			23ACP4
23BP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 3/8	4 3/4	1 3/8	24 45/64 D	10	22 5/8 D	19 1/8	15 1/4			23BP4
23CP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	15 1/16	5 1/2	1 3/8	24 45/64 D	10 1/16	22 5/8 D	19 1/8	15 1/4			23CP4
23DP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JR	13 3/8	3 5/8	1 1/4	24 45/64 D	10 1/16	22 5/8 D	19 1/8	15 1/4			23DP4
23FP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	13 3/4	4 1/2	1 3/8	23 31/64 D	9 1/4	22 5/8 D	19 1/4	15 1/16			23FP4
23GP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	15 1/16	5 1/4	1 1/4	24 45/64 D	9 3/4	22 5/8 D	19 1/8	15 1/4			23GP4
23JP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	15 7/16	5 5/8	1 1/2	24 45/64 D	10 1/16	22 5/8 D	19 1/8	15 1/4			23JP4

D Diagonal.



7FA



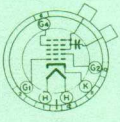
8HR



8JR



12D



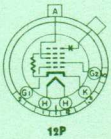
12L



12M



12N



12P

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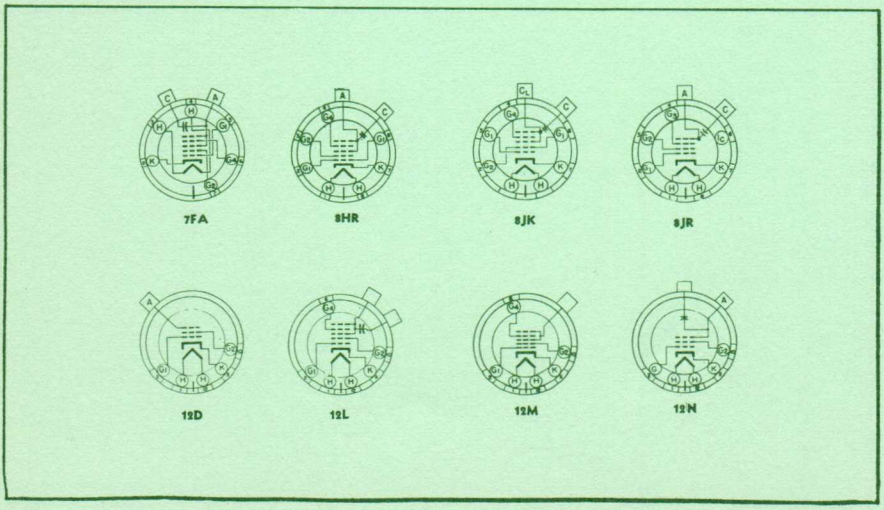
23RP4-24DP4

TYPE	DESCRIPTION	HEATER										RATINGS		TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS					
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. SHIELD OR COIL	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE #2 VOLTS	MAX. GRID #1 RESISTANCE MEGOHMS	ANODE #2 OR ANODE VOLTAGE	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET CURRENT MA.	VOLTAGE MAGNET FOR 3 GAUSS	TYPE
23RP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3* ±5%	NONE	NO	YES[Y]	M	E	99[H] 110[D]	YES	22	1.5	16	0[V] to +400	500	−60.5				23RP4
23VP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3*	NONE	NO	YES[P]	M	E	102[H] 114[D]	YES	22	1.5	14	200[W]	450	−75				23VP4
24ADP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	M	85[H] 90[D]	YES	24.2	1.5	18		300	−50	125	32	36	24ADP4
24AEP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	85[H] 90[D]	YES	20	1.5	18	−50[W] to +350	300	−50				24AEP4
24AHP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	105[H] 110[D]	YES	20	1.5	16	−50[W] to +350	300	−50				24AHP4
24AJP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	85[H] 90[D]	YES	22	1.5	18	0[W] to +350	50	−42.5				24AJP4
24ALP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	105[H] 110[D]	YES	20	1.5	17	0[W] to +500	300	−50	−15 to +25 μamp			24ALP4
24AMP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	105[H] 110[D]	YES	22	1.5	16	0[W] to +400	300	−53.5				24AMP4
24ANP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	SINGLE	YES	YES	M	E	85[H] 90[D]	YES	22	1.5	18	−72[W] to +396	300	−53.5		33	37	24ANP4
24AQP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.45*	NONE	NO	YES	M	E	105[H] 110[D]	YES	22	1.5	16	0[W] to +400	300	−53.5				24AQP4
24ASP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3	NONE	NO	YES	M	E	85[H] 90[D]	YES	22	1.5	18	0[W] to +400	300	−53.5				24ASP4
24ATP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6*	NONE	NO	YES	M	E	85[H] 90[D]	YES	20	1.5	18	0[W] to +400	50	−41.5				24ATP4
24AP4	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	70	NO	16	1.5	15		300	−55	114	75	36	24AP4
24AP4A	ROUND METAL—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	70	NO	16	1.5	15		300	−55	114		36	24AP4A
24AP4B	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES[X]	M	M	70	NO	16	1.5	15		300	−55	114			24AP4B
24AVP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	2.35	0.6* ±5%	NONE	NO	YES[P]	M	E	105[H] 110[D]	YES	20	1.5	16	−100[W] to +300	300	−53.5				24AVP4
24AWP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO	M	E	105[H] 110[D]	YES	20	1.5	16	0[W] to +400	300	−50				24AWP4
24AXP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.3* ±5%	NONE	NO	YES[P]	M	E	105[H] 110[D]	YES	22	1.5	16	0[W] to +400	300	−53.5				24AXP4
24BAP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	NO[F]	M	E	105[H] 110[D]	YES	20	1.5	16	0[W] to +400	50	−39.5				24BAP4
24BP4	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	70	NO	16	1.5	14		300	−55		85		24BP4
24CP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	85-[H] 90-[D]	YES	20	1.5	18		300	−55	115	100	40	24CP4
24CP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	85-[H] 90-[D]	YES	20	1.5	16		300	−55	105	85		24CP4A
24DP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	85-[H] 90-[D]	YES	20	1.5	18		300	−55		100	40	24DP4

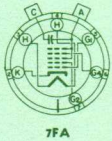
* Thermal characteristics of the heater are controlled such that heater voltage surges during the warm-up cycle are minimized provided it is used with other types which are similarly controlled. Heater warm-up time: 11.0 seconds.

[D] Diagonal. [H] Horizontal. [F] Frosted. [X] Cylindrical Face Plate.
[W] Grid # 4 Voltage. [P] Spherical Face Plate. [Y] Spherical Face Plate—Bonded Shield.



TYPE	BULB CONTACT	BASE	EIA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	NECK LENGTH INCHES	NECK DIAMETER INCHES	BULB DIAMETER INCHES	DISTANCE FROM SEAL TO NECK SHOULDER INCHES	RASTER SIZE: USEFUL SCREEN DIAMETER INCHES	USEFUL SCREEN WIDTH INCHES	USEFUL SCREEN HEIGHT INCHES		MTG. HEIGHT TO TOP OF BULB INCHES	TYPE
23RP4	RECESSED SMALL CAVITY CAP	SMALL SHELL 8-PIN	8JR	13 5/8	3 9/16	1 1/8	24 45/64 D	10 1/16	22 5/16	19 5/16	15 1/4			23RP4
23VP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	13 3/4	4 1/2	1 1/8	23 35/64 D	9 3/4	22 5/16 D	19 3/4	15 3/16			23VP4
24ADP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/8	7 3/8	1 7/8	24 D	13 3/8	22 13/16 D	21 5/16	16 7/8			24ADP4
24AEP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 1/8	5 1/2	1 7/8	24 D	13 3/8	22 13/16 D	21 7/8	16 7/8			24AEP4
24AHP4	RECESSED SMALL CAVITY CAP	SMALL SHELL EIGHTAR 7-PIN	8HR	15 1/2	5 7/16	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24AHP4
24AJP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	19 3/8	5 1/2	1 7/8	24 D	13 3/8	22 13/16 D	21 5/16	16 7/8			24AJP4
24ALP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	15 7/8	5 7/16	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24ALP4
24AMP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	7FA	15 5/8	5 5/16	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24AMP4
24ANP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6 PIN	12L	20 1/8	6 1/2	1 7/8	24 D	13 3/8		21 7/8	16 7/8			24ANP4
24AQP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7 PIN	8HR	15 7/8	5 7/16	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24AQP4
24ASP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6 PIN	12L	19 1/8	5 1/2	1 7/8	24 D	13 3/8		21 5/16	16 7/8			24ASP4
24ATP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6 PIN	12L	19 1/8	5 1/2	1 7/8	24 D	13 3/8	22 13/16 D	21 3/8	16 31/32			24ATP4
24AP4	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	23 15/16	6 31/32	1 7/8	24	16 35/64	22 3/8	22 1/8	16 3/16		3 1/8	24AP4
24AP4A	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	23 15/16	6 31/32	1 7/8	24	16 35/64	22 3/8	22 1/8	16 3/16		3 1/8	24AP4A
24AP4B	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	23 15/16	6 31/32	1 7/8	24	16 35/64	23 1/16	22 1/8	16 3/16			24AP4B
24AVP4	RECESSED SMALL CAVITY CAP	SMALL GLASS BUTTON 7-PIN	8JK	14 13/16	4 3/4	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24AVP4
24AWP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	14 7/8	4 7/16	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24AWP4
24AXP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	15 7/8	5 7/16	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24AXP4
24BAP4	RECESSED SMALL CAVITY CAP	SMALL BUTTON EIGHTAR 7-PIN	8HR	15 7/8	5 7/16	1 1/8	24 D	10 7/16	22 13/16 D	21 5/16	16 7/8			24BAP4
24BP4	METAL CONE LIP	SMALL SHELL DUODECAL 6-PIN	12M	24 3/4	7 1/2	1 7/8	24	16 3/4	22 1/4				4 1/2	24BP4
24CP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 1/8	7 1/2	1 7/8	24 D	13 3/8	22 13/16 D	21 5/16	16 7/8		3 3/8	24CP4
24CP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 1/8	7 1/2	1 7/8	24 D	13 3/8	22 13/16 D	21 5/16	16 7/8			24CP4A
24DP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 1/8	7 1/2	1 7/8	24 D	13 3/8	22 13/16 D	21 5/16	16 7/8		3 3/8	24DP4

D Diagonal



7FA



8HR



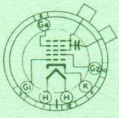
8JK



8JR



12D



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12M



12N

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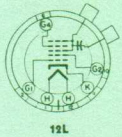
24DP4A-30BP4

TYPE	DESCRIPTION	HEATER									RATINGS			TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS						TYPE
		VOLTS	AMPERES	ION-TRAP MAGNET	EXTERNAL MAG. SHIELD OR COIL	FILTER FACE PLATE	DEFLECTION	FOCUS	DEFLECTION ANGLE (DEGREES)	EXTERNAL CONDUCTIVE COATING	MAX. ANODE #1 VOLTS	MAX. GRID #1 RESISTANCE (MEGOHMS)	ANODE #2 OR ANODE #1 VOLTS	ANODE #1 VOLTS	GRID #2 VOLTS	GRID #1 VOLTAGE FOR CUTOFF	FOCUSING COIL CURRENT MA.	ION-TRAP MAGNET FIELD STRENGTH	ION-TRAP MAGNET FIELD ANISOTROPY GAUSS	
24DP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	85.H 90.D	YES	20	1.5	16		300	−50		58		24DP4A
24QP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	85.H 90.D	YES	18	1.5	16		300	−50	100	100		24QP4
24TP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	D.90	YES	20	1.5	14		300	−55	110	85		24TP4
24VP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	87.H 90.D	YES	22	1.5	20		300	−55	125	135		24VP4
24VP4A	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	87.H 90.D	YES	22	1.5	20		300	−55	125	135		24VP4A
24XP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H.85 D.90	NO	20	1.5	18		300	−50	125	35	40	24XP4
24YP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H.85 D.90	YES	20	1.5	16		300	−50		58		24YP4
24ZP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H.85 D.90	YES	20	1.5	16	0 W to +500	300	−50				24ZP4
27AP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES S	M	E	H.85 D.90	NO	18	1.5	12		300	−55		85		27AP4
27EP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H.85	NO	20	1.5	16		300	−55	118			27EP4
27GP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	85.H 90.D	NO	22.5	1.5	16		300	−55	95	100	45	27GP4
27LP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	H.85 D.90	YES	22	1.5	20		300	−55	148		45	27LP4
27MP4	RECTANGULAR METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES S	M	M	85.H 90.D	NO	18	1.5	16		300	−55	110		50	27MP4
27NP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	H.85 D.90	YES	18	1.5	16		300	−50	95	100		27NP4
27RP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	YES	YES	M	M	85.H 90.D	YES	20	1.5	16		300	−55	105	85		27RP4
27SP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	SINGLE	NO	YES	M	E	H.85 D.90	YES	20	1.5	18	−72 W to +396	300	−50			40	27SP4
27UP4	RECTANGULAR GLASS—DIRECT VIEW	6.3	0.6	SINGLE	NO	YES	M	E	H.85 D.90	YES	20	1.5	16	0 W to +396	300	−50			40	27UP4
27VP4	RECTANGULAR GLASS—DIRECT VIEW (ALUMINIZED SCREEN)	6.3	0.6	NONE	NO	YES	M	E	H.85 D.90	YES	18	1.5	16	−72 W to +396	300	−50				27VP4
30BP4	ROUND METAL—DIRECT VIEW	6.3	0.6	SINGLE	YES	YES	M	M	90	NO	30	1.5	12		300	−55	95	75		30BP4

H Horizontal. D Diagonal. S Frosted. W Grid #4 Voltage.



12D



12L



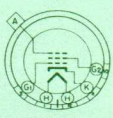
12M



12N

TYPE	BULB CONTACT	BASE	BA BASE NO.	OVERALL DIMENSIONS: OVERALL LENGTH INCHES	OVERALL DIMENSIONS: NECK LENGTH INCHES	OVERALL DIMENSIONS: NECK DIAMETER INCHES	OVERALL DIMENSIONS: BULB DIAMETER INCHES	OVERALL DIMENSIONS: DISTANCE FROM SEAL TO CENTER OF MESH FOR 4 OR 5 PIN BASES INCHES	RASTER SIZE: USEFUL SCREEN DIAMETER INCHES	RASTER SIZE: USEFUL SCREEN WIDTH INCHES	RASTER SIZE: USEFUL SCREEN HEIGHT INCHES		METAL LIMITED PROJECTION SYSTEM	TYPE
24DP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/8	7 1/2	1 7/16	24[D]	13 5/8	22 13/16[D]	21 7/16	16 3/8			24DP4A
24QP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/8	7 1/2	1 7/16	24[D]	13 5/8	22 13/16[D]	21 3/8	16 3/8		4 3/4	24QP4
24TP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/8	7 1/2	1 5/16	24[D]	13 5/8	22 13/16[D]	21 3/8	17 1/2			24TP4
24VP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/8	7 1/2	1 7/16	24[D]	13 5/8	22 13/16[D]	21 7/16	16 7/8			24VP4
24VP4A	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	21 3/8	7 1/2	1 7/16	24[D]	13 5/8	22 13/16[D]	21 7/16	16 7/8			24VP4A
24XP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	21 3/8	7 1/2	1 5/16	24[D]	13 5/8	22 13/16[D]	21 3/4	16 3/4			24XP4
24YP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/8	7 1/2	1 7/16	24[D]	13 5/8	22 13/16[D]	21 7/16	16 7/8			24YP4
24ZP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	21 3/8	7 1/2	1 7/16	24[D]	13 5/8	22 13/16[D]	21 3/4	16 3/4			24ZP4
27AP4	METAL CONE LIP	SMALL SHELL DUODECAL 6-PIN	12M	21 5/8	7 1/2	1 7/16	26 3/4[D]			23 1/16	18 1/8		4 1/2	27AP4
27EP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	23 1/16	7 3/8	1 7/16	26 13/16[D]	15 11/16	25 3/4[D]	24 1/4	18 5/8		5 1/4	27EP4
27GP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12D	23 1/16	7 1/2	1 5/16	26 13/16[D]	13 5/8	25 3/4[D]	24 1/4	18 5/8			27GP4
27LP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	24 13/16	9 1/16	1 5/16	26 13/16[D]	14 11/16	25 3/4[D]	24 1/4	18 5/8			27LP4
27MP4	METAL SHELL LIP	SMALL SHELL DUODECAL 5-PIN	12D	22 5/16	7 1/2	1 5/16	26 7/8[D]	14 1/16	25 11/16[D]	23 7/16	18 1/4			27MP4
27NP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	23	7 1/2	1 7/16	26 13/16[D]	15 1/2	25 3/4[D]	24 1/4	18 5/8		4 3/4	27NP4
27RP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 5-PIN	12N	22 1/16	7 3/8	1 7/16	26 13/16[D]	15 7/16	25 3/4[D]	24 1/4	18 5/8			27RP4
27SP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	23 1/16	7 1/2	1 5/16	26 13/16[D]	15 7/16	25 3/4[D]	24 1/4	18 5/8			27SP4
27UP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6-PIN	12L	23 1/16	7 1/2	1 7/16	26 13/16[D]	15 7/16		24	18 1/2		4 3/4	27UP4
27VP4	RECESSED SMALL CAVITY CAP	SMALL SHELL DUODECAL 6 PIN	12L	21 1/16	5 1/2	1 7/16	26 13/16[D]	15 7/16	25 3/4[D]	24 1/4	18 5/8		4 3/4	27VP4
30BP4	METAL CONE LIP	SMALL SHELL DUODECAL 5-PIN	12D	23 5/16	7 3/8	1 7/16	30 1/8	16 3/8	28 1/4	25 5/16	19 1/4			30BP4

[D] Diagonal.



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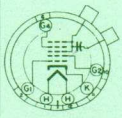

12L



12M



12N

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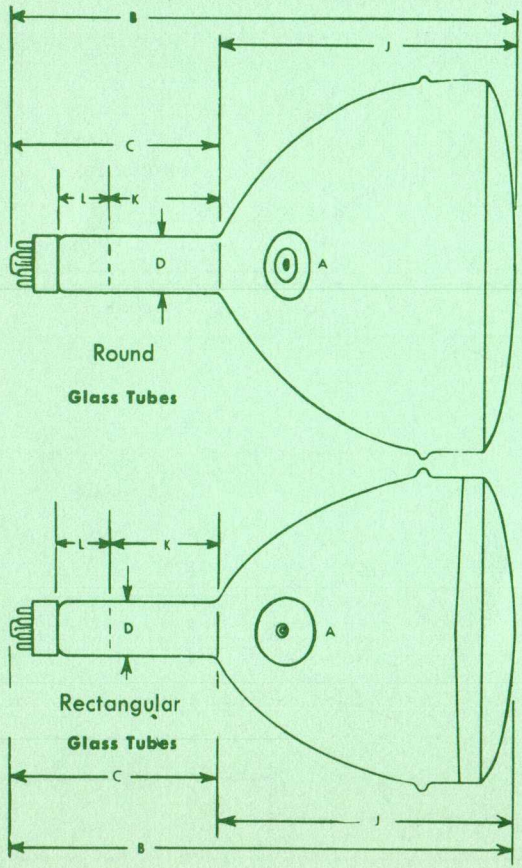
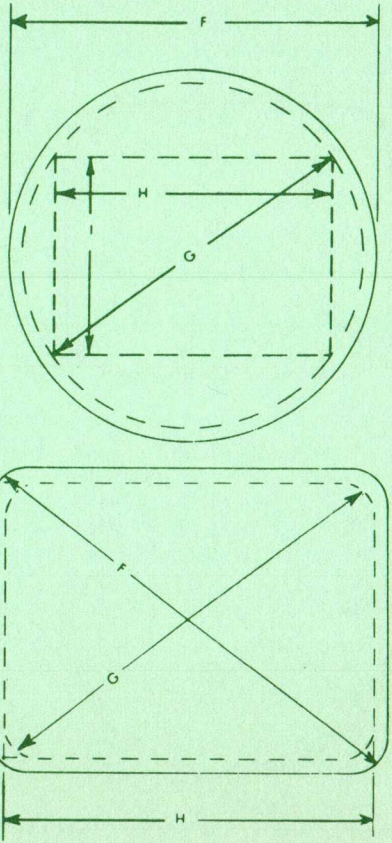




KEY

A — Bulb Contact

B — Overall Length

C — Neck Length

D — Neck Diameter

F — Outside Bulb Diameter (or Diagonal for rectangular bulb)

G — Useful Screen Diameter (or Diagonal for rectangular bulb)

H — Useful Screen Width For rectangular raster

I — Useful Screen Height For rectangular raster

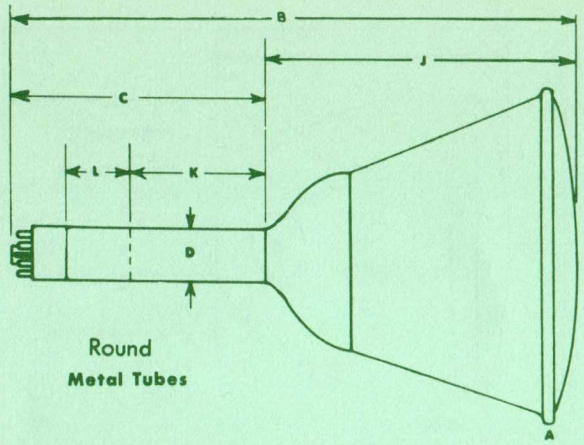
J — Distance from face to junction of neck and bulb

K — Neck Length allotted to deflection system

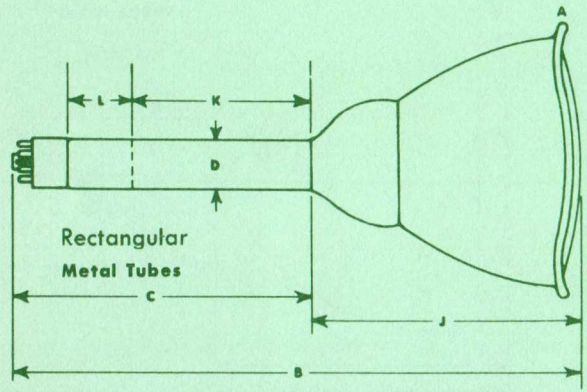
L — Space allotted to ion trap magnet

KEY DRAWINGS

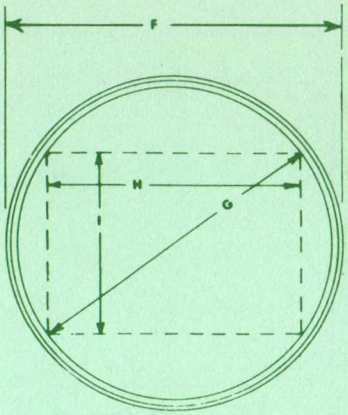
TUNG-SOL ELECTRIC INC. ELECTRON TUBE DIVISION BLOOMFIELD, NEW JERSEY U.S.A. APRIL 1, 1961 PLATE #6153

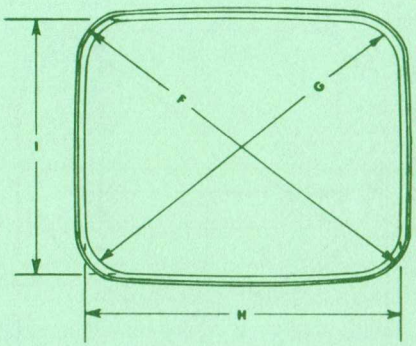


Round
Metal Tubes



Rectangular
Metal Tubes





KEY

A — Metal-Shell Lip

B — Overall Length

C — Neck Length

D — Neck Diameter

F — Outside Bulb Diameter (or Diagonal for rectangular bulb)

G — Useful Screen Diameter (or Diagonal for rectangular bulb)

H — Useful Screen Width For rectangular raster

I — Useful Screen Height For rectangular raster

J — Distance from face to junction of neck and bulb

K — Neck Length allotted to deflection system

L — Space allotted to ion trap magnet

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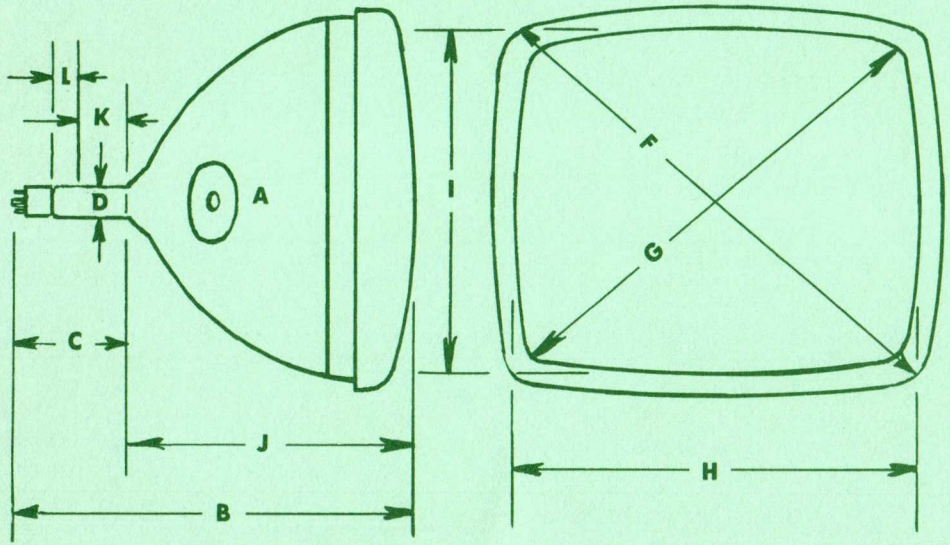

Bonded
Rectangular
Glass Tube

KEY

- **A** — Bulb Contact
- **B** — Overall Length
- **C** — Neck Length
- **D** — Neck Diameter
- **F** — Outside Bulb Diameter (or Diagonal for rectangular bulb)
- **G** — Useful Screen Diameter (or Diagonal for rectangular bulb)
- **H** — Useful Screen Width For rectangular raster
- **I** — Useful Screen Height For rectangular raster
- **J** — Distance from face to junction of neck and bulb
- **K** — Neck Length allotted to deflection system
- **L** — Space allotted to ion trap magnet

KEY DRAWINGS

TUNG-SOL ELECTRIC INC. ELECTRON TUBE DIVISION BLOOMFIELD, NEW JERSEY U.S.A. APRIL 1, 1961 PLATE #6154

TUNG-SOL

CATHODE RAY - SUPPLEMENTAL CONTENTS

Page	Plate
SUPPLEMENTAL CONTENTS	5042*
14HP4	5043→
17VP4-17VP4B	5044→
21CVP4	5045*

* INDICATES AN ADDITION.

→ INDICATES A CHANGE.

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DESCRIPTIONS OF PHOSPHORS BY COLOR AND PERSISTENCE

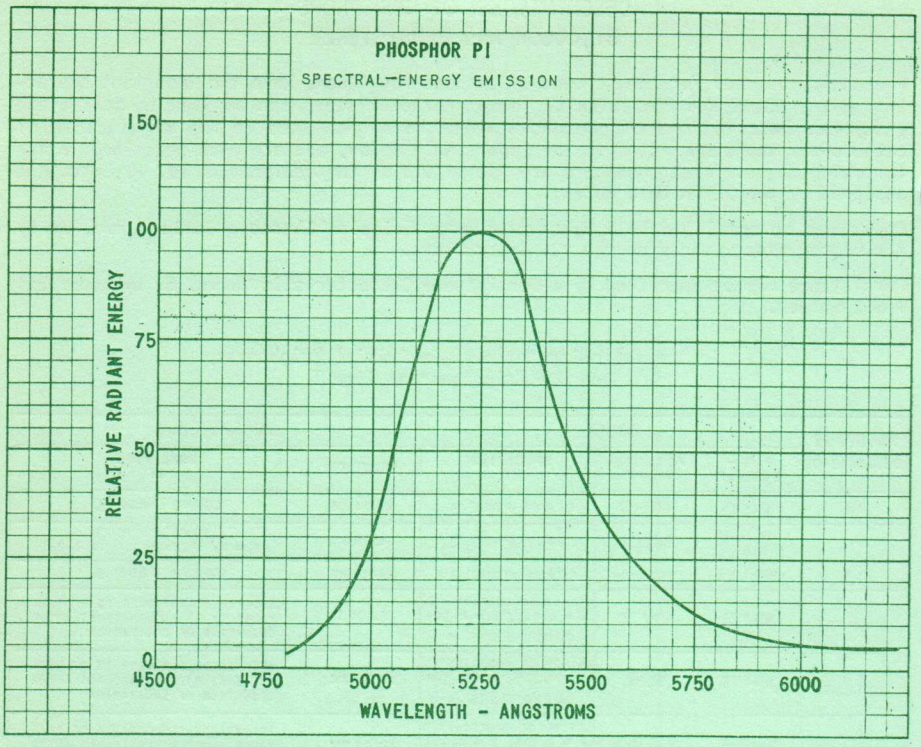
Phosphors, as used for the screens of cathode-ray tubes, have two important characteristics: COLOR and PERSISTENCE. These characteristics can be used to define the phosphor. Descriptions of phosphors which have been used in the manufacture of cathode-ray tubes are listed in the index table below, and are each described in the following pages. These phosphors are identified by the designation P1, P2, etc., as assigned by the RETMA Data Bureau.

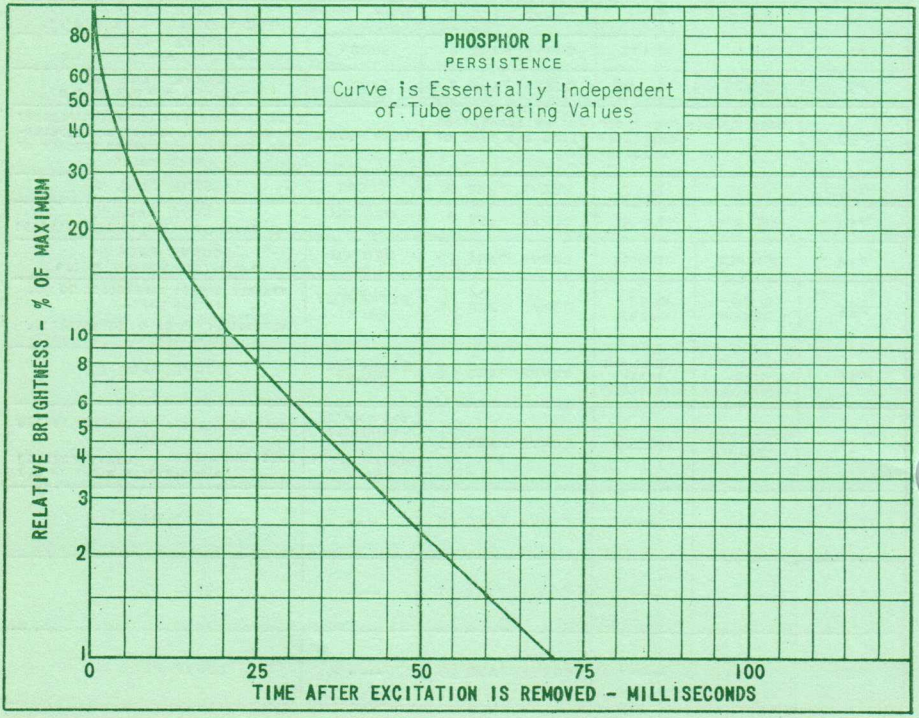
Color may be specified by a Spectral-Energy Emission Characteristic Curve, or by the coordinates x and y on the ICI Color Chart.

Persistence may be specified by a Persistence Characteristic Curve, or by numerical limit values.

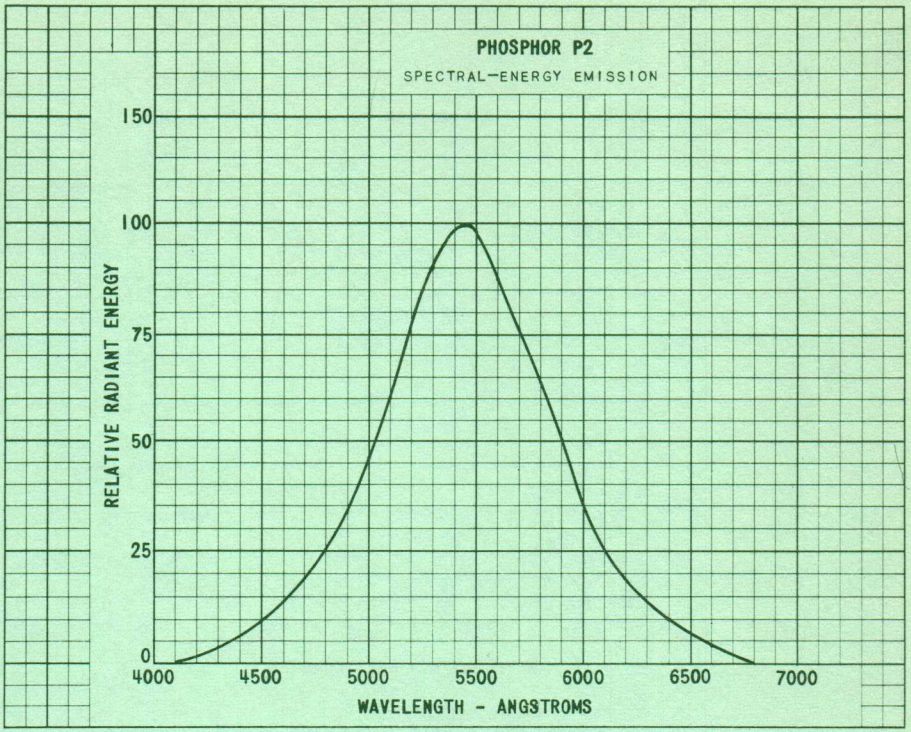
In the following table, B_o = Initial Brightness, and B = Brightness at Time T

PHOSPHOR DESIGNATION	COLOR			PERSISTENCE	
	FLUORESCENT	PHOSPHORESCENT	SPECIFIED BY	DURATION	SPECIFIED BY
P1	GREEN	GREEN	CURVE PAGE 1	MEDIUM	CURVE PAGE 1
P2	BLUE-GREEN	GREEN	CURVE PAGE 2	LONG	CURVE PAGE 2 $B = B_o/T^n$, $n = 1.0$ TO 1.2
P3	YELLOW	YELLOW	CURVE PAGE 3	MEDIUM	CURVE PAGE 3
P4 SULFIDE	WHITE	WHITE	ICI COLOR COORDINATES $x = 0.313$, $y = 0.324$ CURVE PAGE 4	SHORT	BRIGHTNESS NOT OVER 7% OF PEAK VALUE IN 33 MILLISECONDS AFTER CESSATION OF EXCITATION
P4 SILICATE	WHITE	BLUE	ICI COLOR COORDINATES $x = 0.313$, $y = 0.324$ CURVE PAGE 5	MEDIUM	BRIGHTNESS NOT OVER 7% OF PEAK VALUE IN 33 MILLISECONDS AFTER CESSATION OF EXCITATION
P4 SILICATE-SULFIDE	WHITE	YELLOW	ICI COLOR COORDINATES $x = 0.313$, $y = 0.324$ CURVE PAGE 4	MEDIUM	BRIGHTNESS NOT OVER 7% OF PEAK VALUE IN 33 MILLISECONDS AFTER CESSATION OF EXCITATION
P5	BLUE	BLUE	CURVE PAGE 5	VERY SHORT	CURVE PAGE 6 TIME CONSTANT = 6 TO 10 μSEC.
P6	WHITE	WHITE	CURVE PAGE 6	SHORT	CURVE PAGE 7 $B = B_o/T^n$, $n = 1.6$ TO 2.0
P7	BLUE-WHITE	YELLOW	CURVE PAGE 7	LONG	CURVE PAGE 8 $B = B_o/T^n$, $n = 0.7$ TO 1.2
P10	DARK TRACE: COLOR DEPENDS ON ABSORPTION CHARACTERISTICS AND TYPE OF ILLUMINATION			VERY LONG	LONG VARIABLE PERSISTENCE DEPENDENT ON TEMPERATURE, AMOUNT OF ILLUMINATION, AND ELECTRON-ENERGY DENSITY OF BOMBARDMENT
P11	BLUE	BLUE	CURVE PAGE 8	SHORT	CURVE PAGE 9
P12	ORANGE	ORANGE	CURVE PAGE 9	MEDIUM LONG	CURVE PAGE 10 TIME CONSTANT = 100 TO 130 MILLISEC
P14	PURPLE	ORANGE	CURVE PAGE 10	MEDIUM LONG	CURVE PAGE 11 $B = B_o/T^n$, $n = 0.9$ TO 1.4
P15	BLUE-GREEN	BLUE-GREEN	CURVE PAGE 11	EXTREMELY SHORT	VISIBLE DECAY: HYPERBOLIC TO 30% IN 1.5 μSEC. ULTRAVIOLET DECAY: EXPONENTIAL, TIME CONSTANT = 0.1 μSEC.
P16	VIOLET AND NEAR-ULTRAVIOLET	VIOLET AND NEAR-ULTRAVIOLET	CURVE PAGE 12	EXTREMELY SHORT	CURVE PAGE 12
P17	GREENISH-YELLOW	YELLOW	CURVE PAGE 13	ONE COMP'T: EXTREMELY SHORT OTHER COMP'T: LONG	SHORT COMPONENT: HYPERBOLIC TO 30% IN 1.5 μSEC. LONG COMPONENT: CURVE PAGE 13 $B = B_o/T^n$, $n = 0.7$ TO 1.2
P18	---	---	CURVE PAGE 14	---	CURVE PAGE 14
P19	---	---	CURVE PAGE 15	---	CURVE PAGE 15
P20	---	---	CURVE PAGE 16	---	CURVE PAGE 16

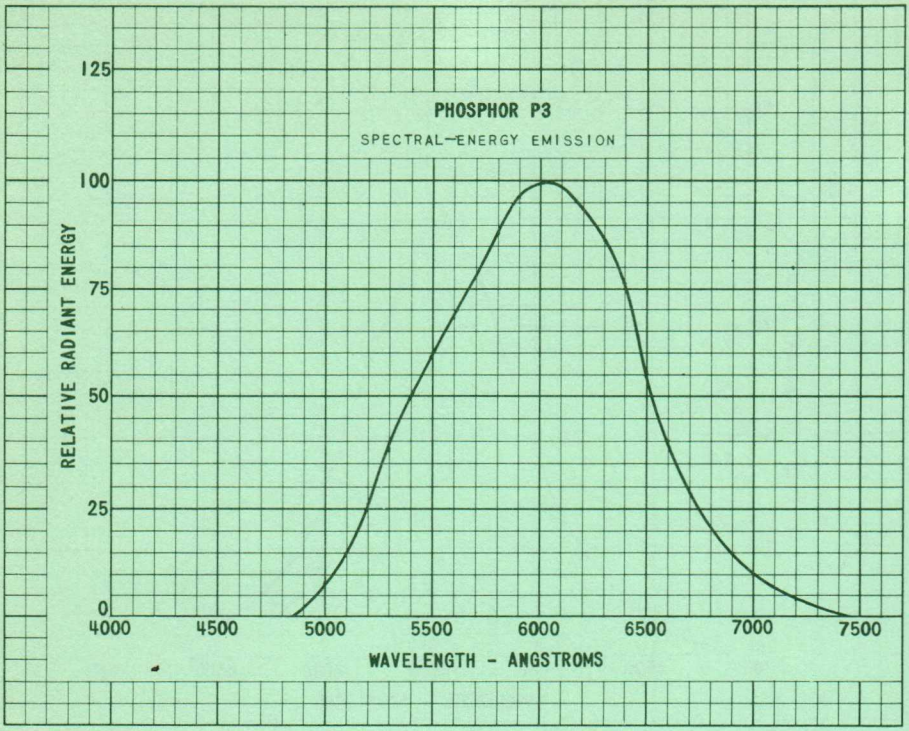

PHOSPHOR P1
SPECTRAL-ENERGY EMISSION
RELATIVE RADIANT ENERGY
150
100
75
50
25
0
4500
4750
5000
5250
5500
5750
6000
WAVELENGTH - ANGSTROMS

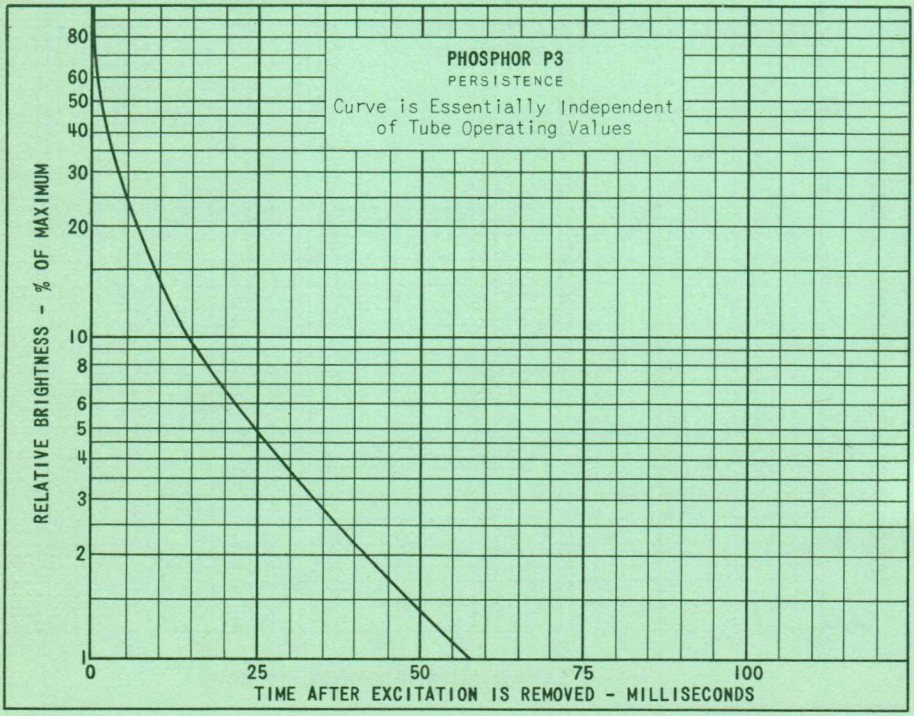

PHOSPHOR P1
PERSISTENCE
Curve is Essentially Independent of Tube operating Values
RELATIVE BRIGHTNESS - % OF MAXIMUM
80
60
50
40
30
20
10
8
6
5
4
3
2
1
0
25
50
75
100
TIME AFTER EXCITATION IS REMOVED - MILLISECONDS

PHOSPHOR CURVES

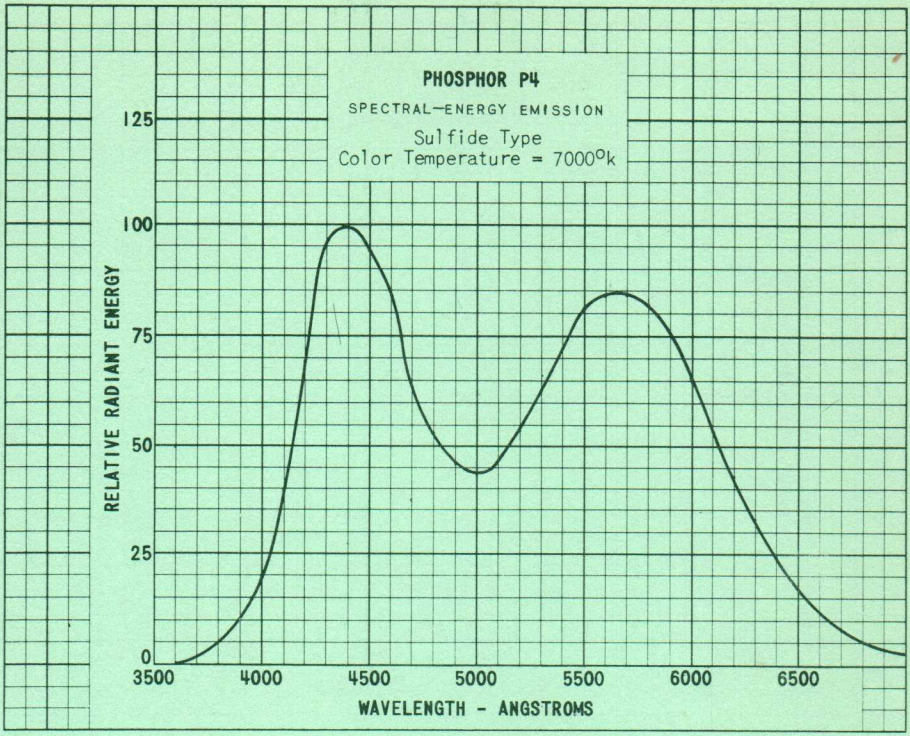


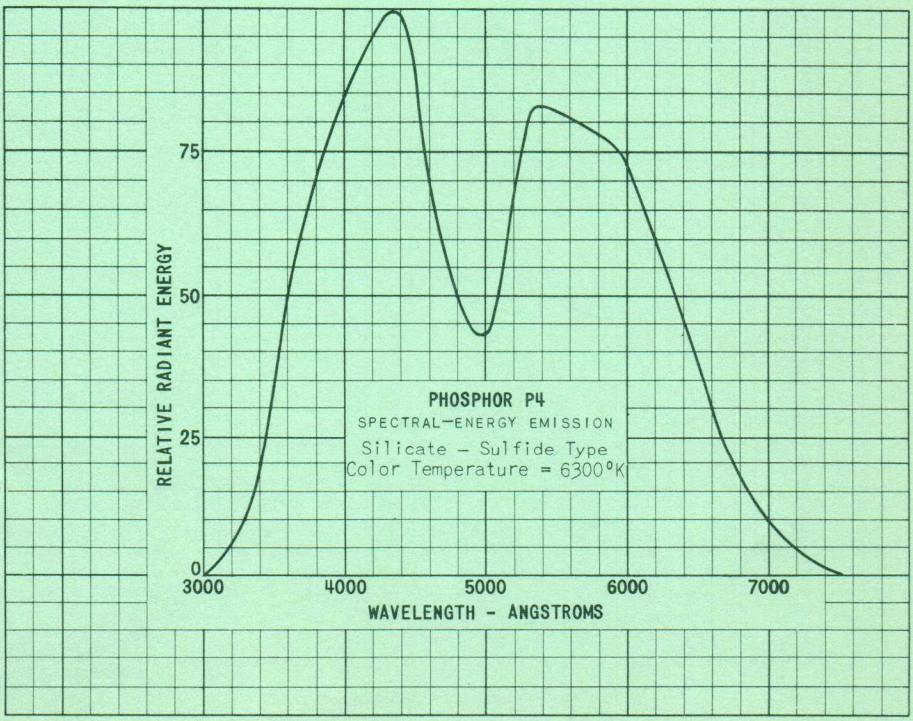


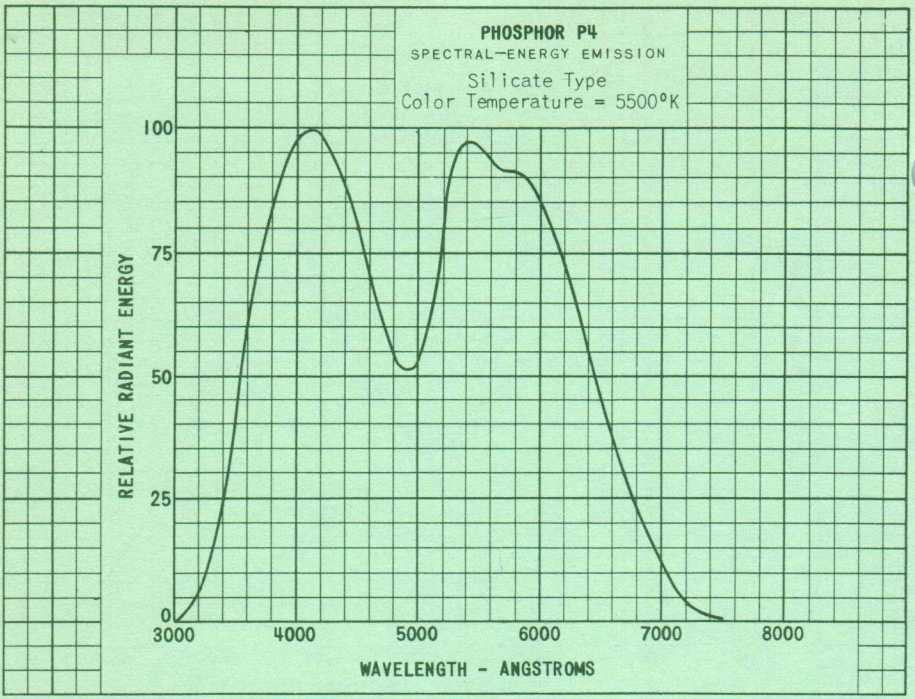

PHOSPHOR P3
SPECTRAL-ENERGY EMISSION
RELATIVE RADIANT ENERGY
125
100
75
50
25
0
4000
4500
5000
5500
6000
6500
7000
7500
WAVELENGTH - ANGSTROMS

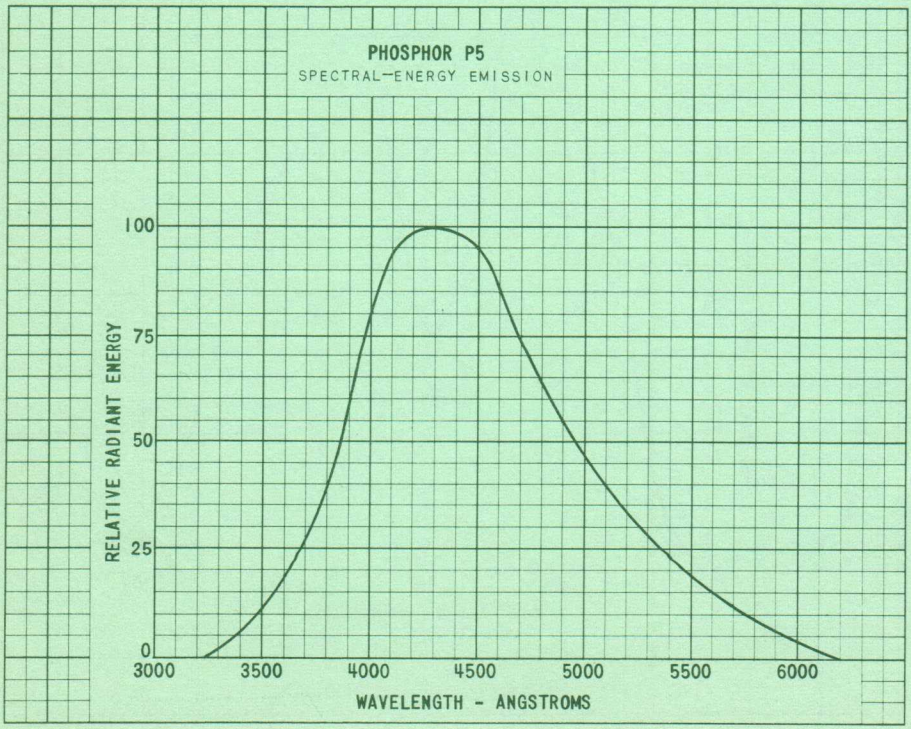

PHOSPHOR P3
PERSISTENCE
Curve is Essentially Independent
of Tube Operating Values
RELATIVE BRIGHTNESS - % OF MAXIMUM
80
60
50
40
30
20
10
8
6
5
4
3
2
1
0
25
50
75
100
TIME AFTER EXCITATION IS REMOVED - MILLISECONDS

PHOSPHOR CURVES

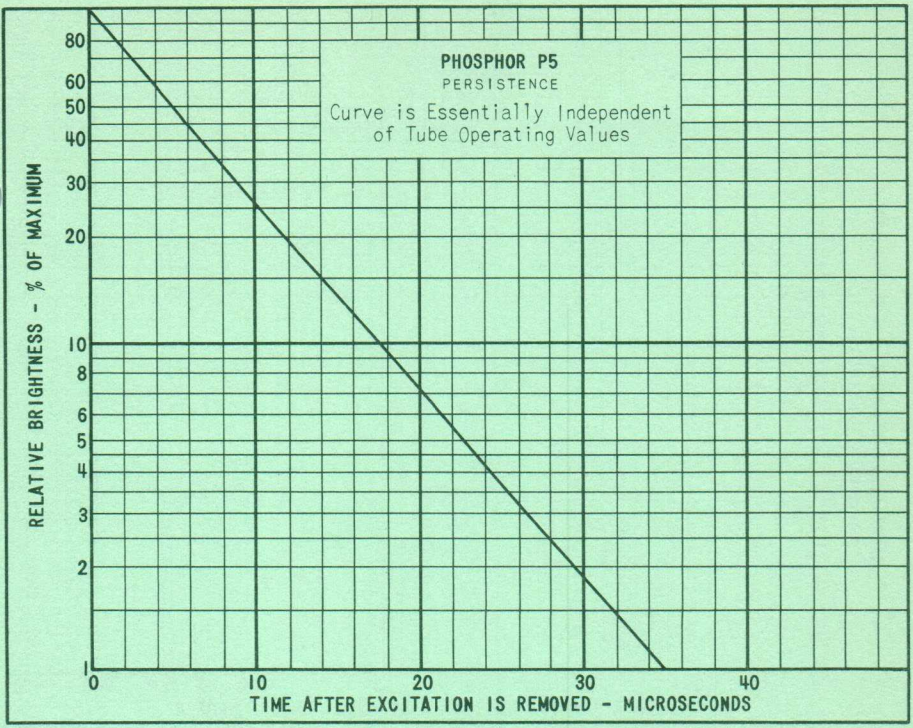


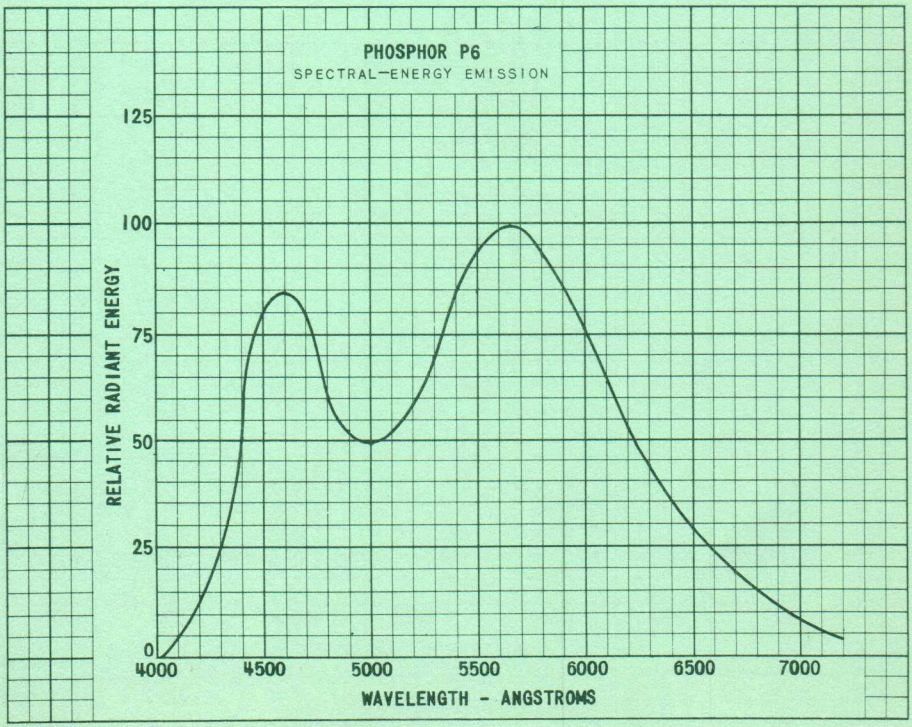



PHOSPHOR P4
SPECTRAL-ENERGY EMISSION
Silicate Type
Color Temperature = 5500°K
RELATIVE RADIANT ENERGY
100
75
50
25
0
3000
4000
5000
6000
7000
8000
WAVELENGTH - ANGSTROMS


PHOSPHOR P5
SPECTRAL-ENERGY EMISSION
RELATIVE RADIANT ENERGY
100
75
50
25
0
3000
3500
4000
4500
5000
5500
6000
WAVELENGTH - ANGSTROMS

PHOSPHOR CURVES





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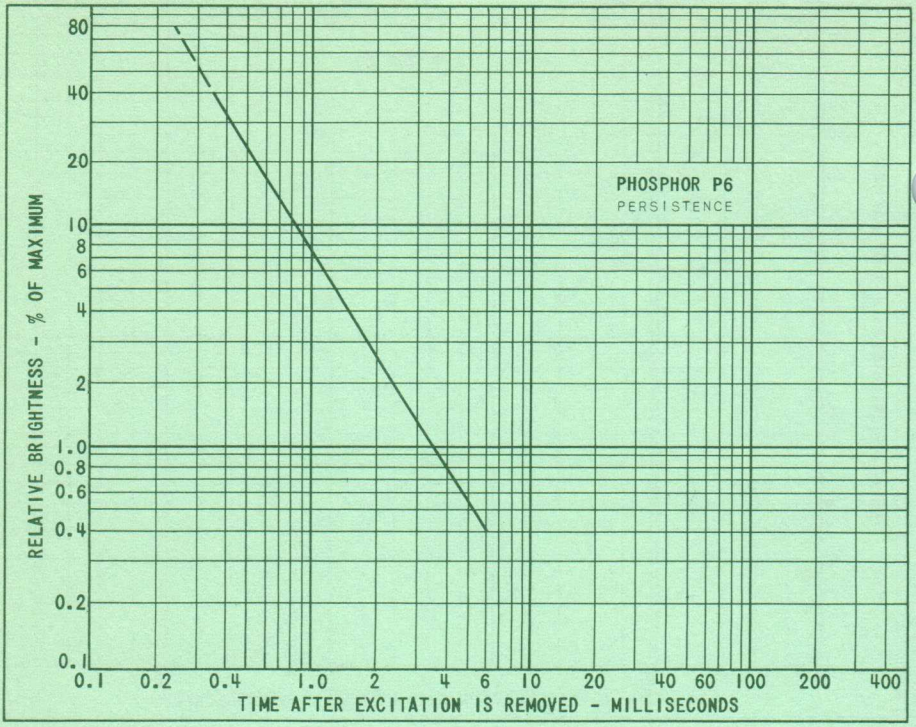
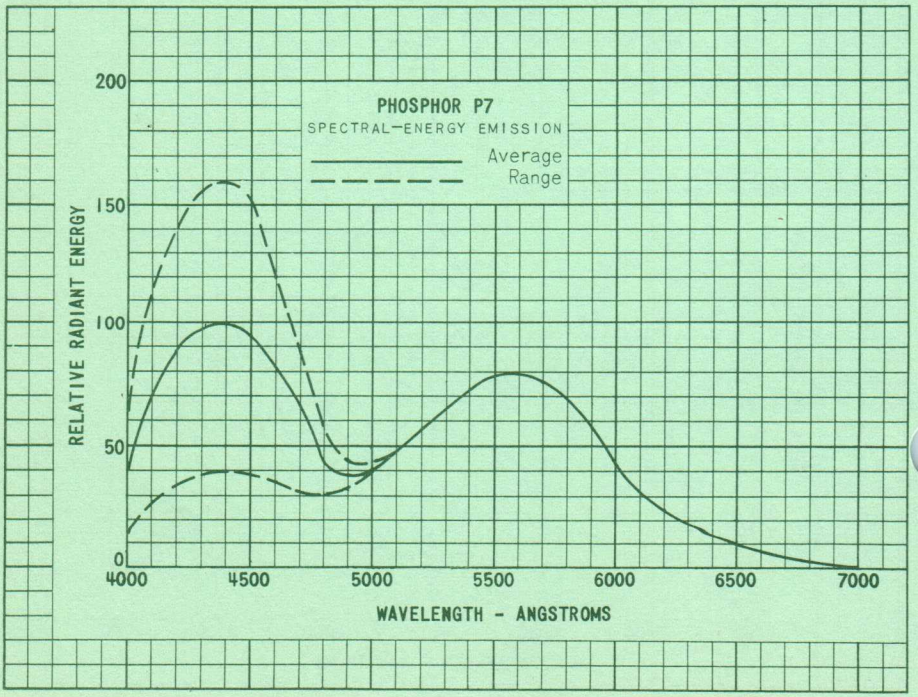
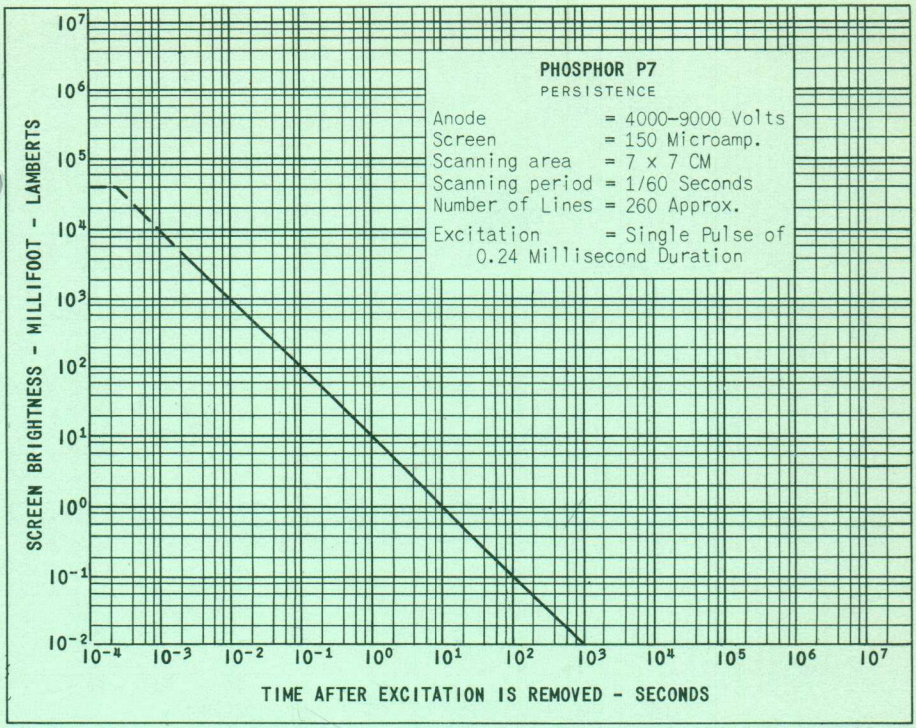
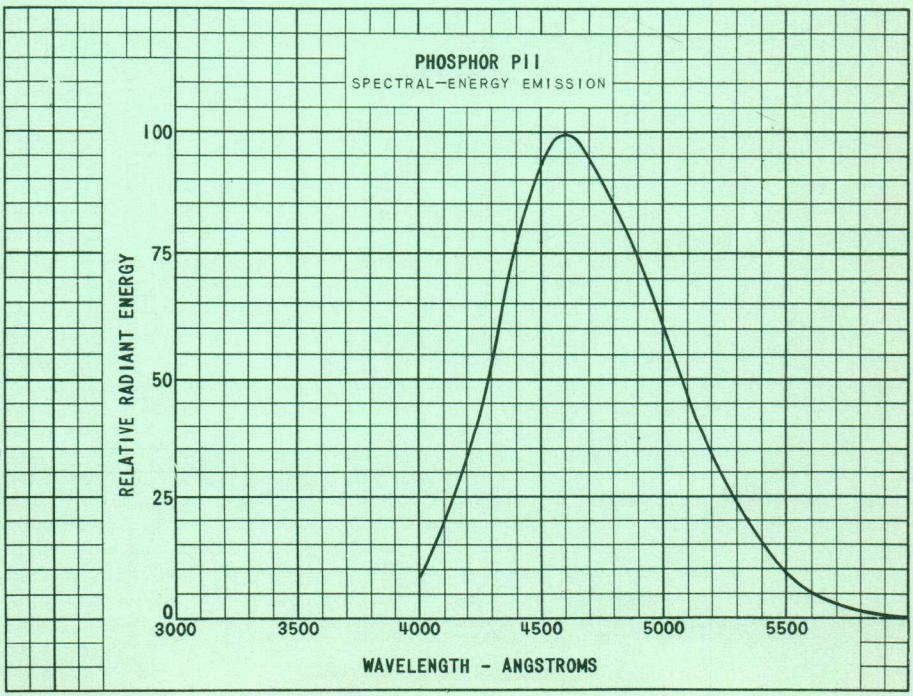

PHOSPHOR P6
PERSISTENCE
RELATIVE BRIGHTNESS - % OF MAXIMUM
80
40
20
10
8
6
4
2
1.0
0.8
0.6
0.4
0.2
0.1
0.1 0.2 0.4 1.0 2 4 6 10 20 40 60 100 200 400
TIME AFTER EXCITATION IS REMOVED - MILLISECONDS

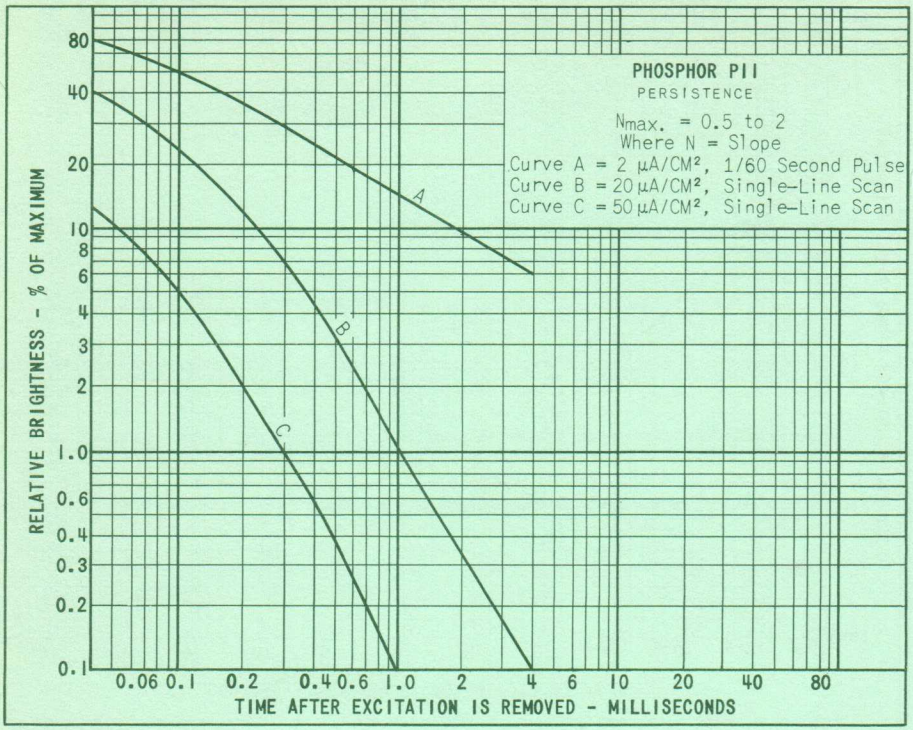

PHOSPHOR P7
SPECTRAL-ENERGY EMISSION
Average
Range
RELATIVE RADIANT ENERGY
200
150
100
50
0
4000 4500 5000 5500 6000 6500 7000
WAVELENGTH - ANGSTROMS

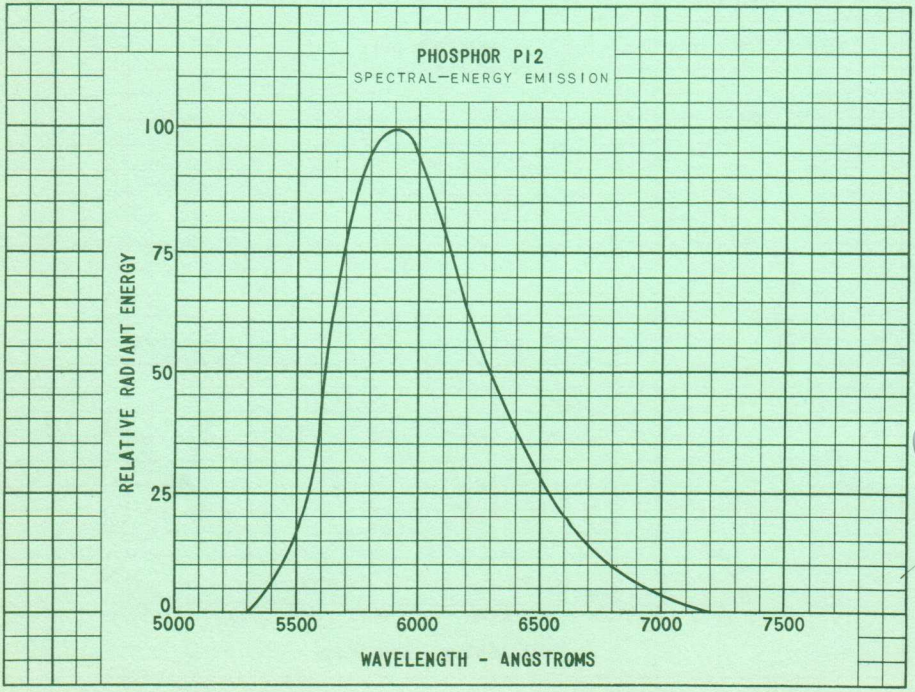
PHOSPHOR CURVES



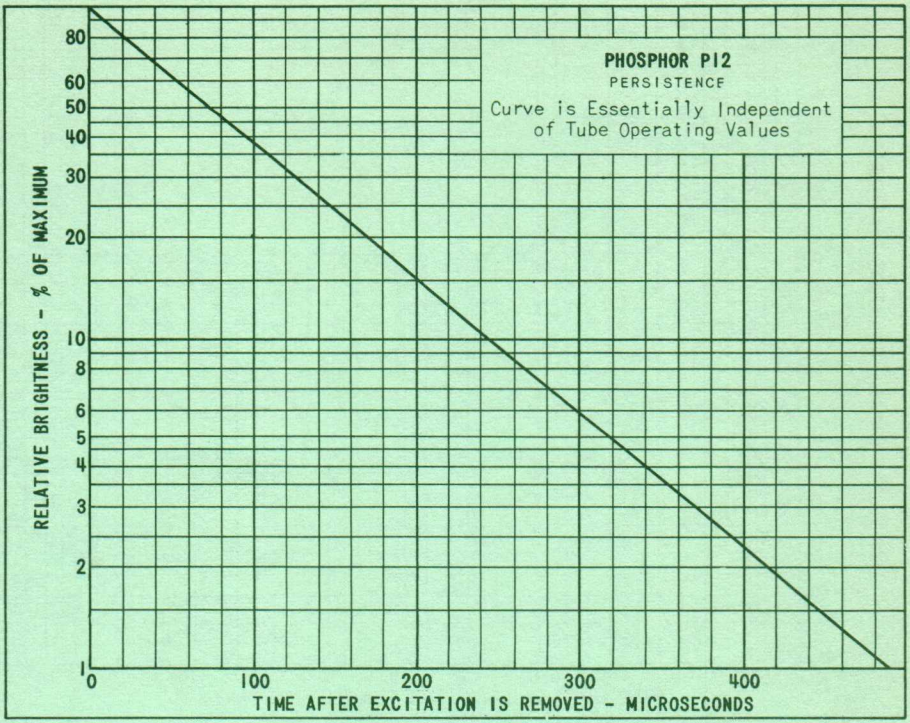


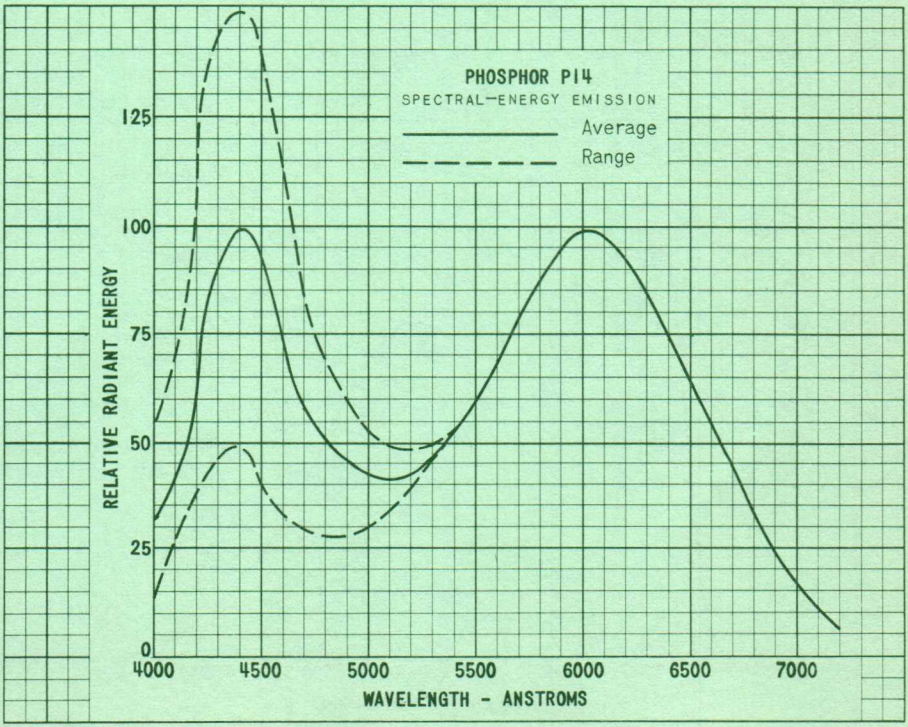
PRINTED IN U. S. A.


PHOSPHOR P11
PERSISTENCE
Nmax. = 0.5 to 2
Where N = Slope
Curve A = 2 μA/CM², 1/60 Second Pulse
Curve B = 20 μA/CM², Single-Line Scan
Curve C = 50 μA/CM², Single-Line Scan
RELATIVE BRIGHTNESS - % OF MAXIMUM
80
40
20
10
8
6
4
3
2
1.0
0.6
0.4
0.3
0.2
0.1
A
B
C
0.06 0.1 0.2 0.4 0.6 1.0 2 4 6 10 20 40 80
TIME AFTER EXCITATION IS REMOVED - MILLISECONDS

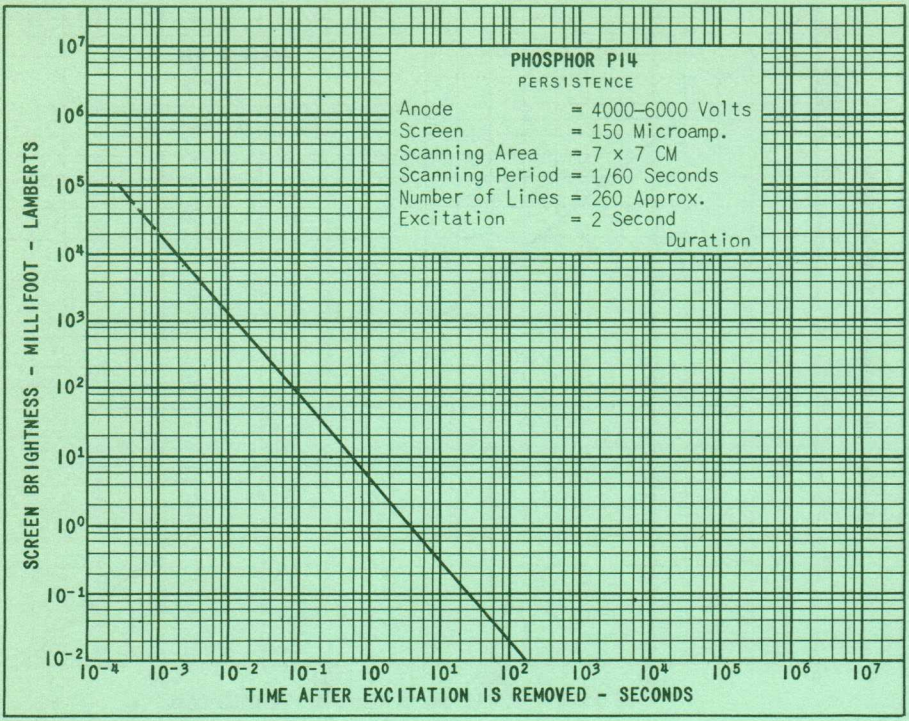

PHOSPHOR P12
SPECTRAL-ENERGY EMISSION
RELATIVE RADIANT ENERGY
100
75
50
25
0
5000 5500 6000 6500 7000 7500
WAVELENGTH - ANGSTROMS

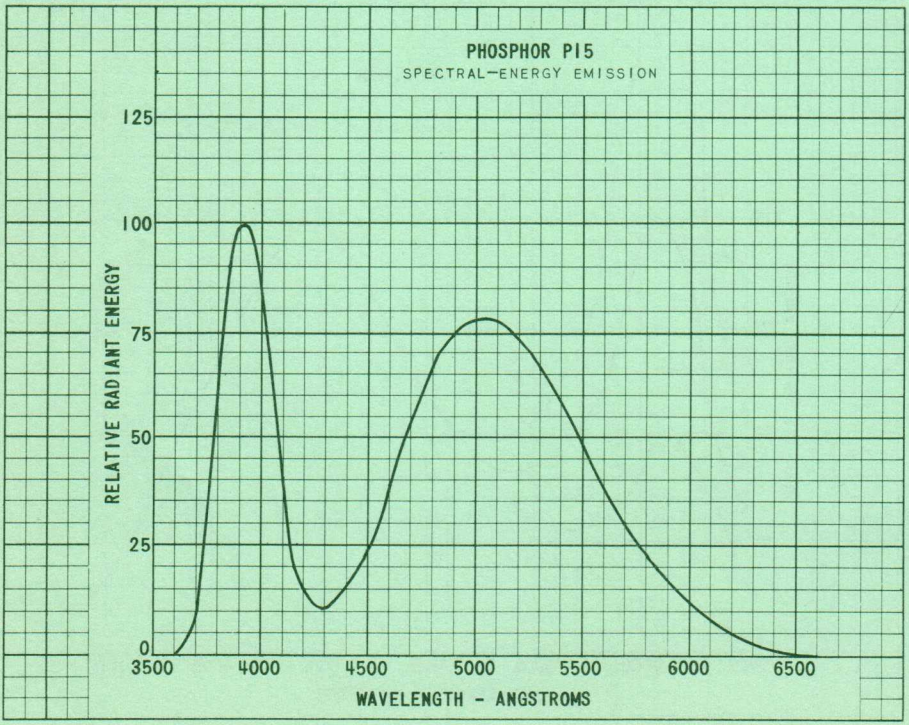
PHOSPHOR CURVES





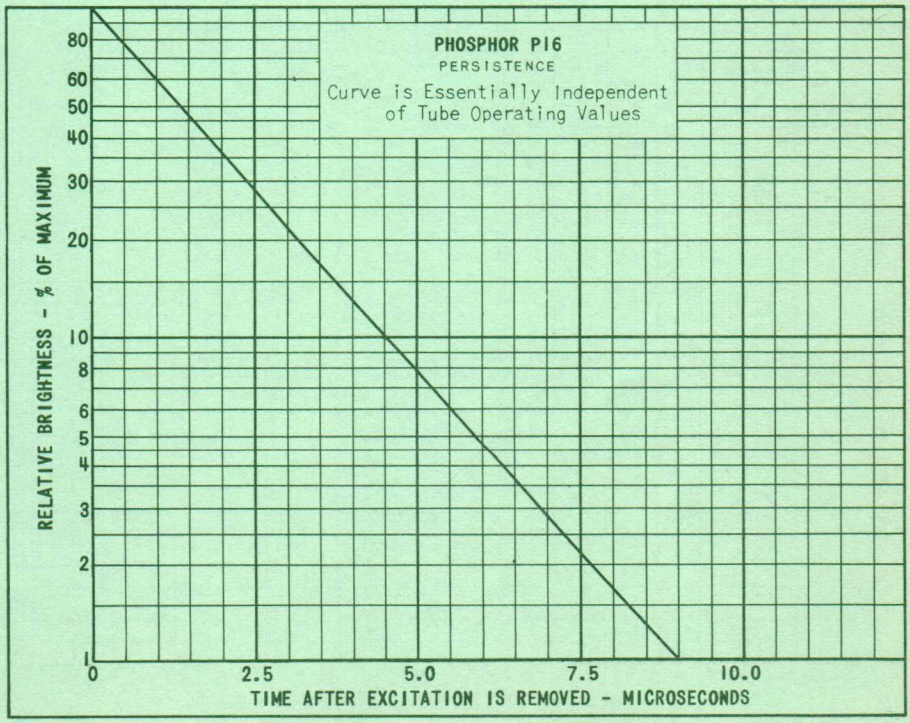
PRINTED IN U. S. A.


PHOSPHOR P14
PERSISTENCE
Anode = 4000–6000 Volts
Screen = 150 Microamp.
Scanning Area = 7 x 7 CM
Scanning Period = 1/60 Seconds
Number of Lines = 260 Approx.
Excitation = 2 Second Duration
SCREEN BRIGHTNESS - MILLIFOOT - LAMBERTS
10^7 10^6 10^5 10^4 10^3 10^2 10^1 10^0 10^{-1} 10^{-2}
10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^0 10^1 10^2 10^3 10^4 10^5 10^6 10^7
TIME AFTER EXCITATION IS REMOVED - SECONDS


PHOSPHOR P15
SPECTRAL–ENERGY EMISSION
RELATIVE RADIANT ENERGY
125 100 75 50 25 0
3500 4000 4500 5000 5500 6000 6500
WAVELENGTH - ANGSTROMS

PHOSPHOR CURVES





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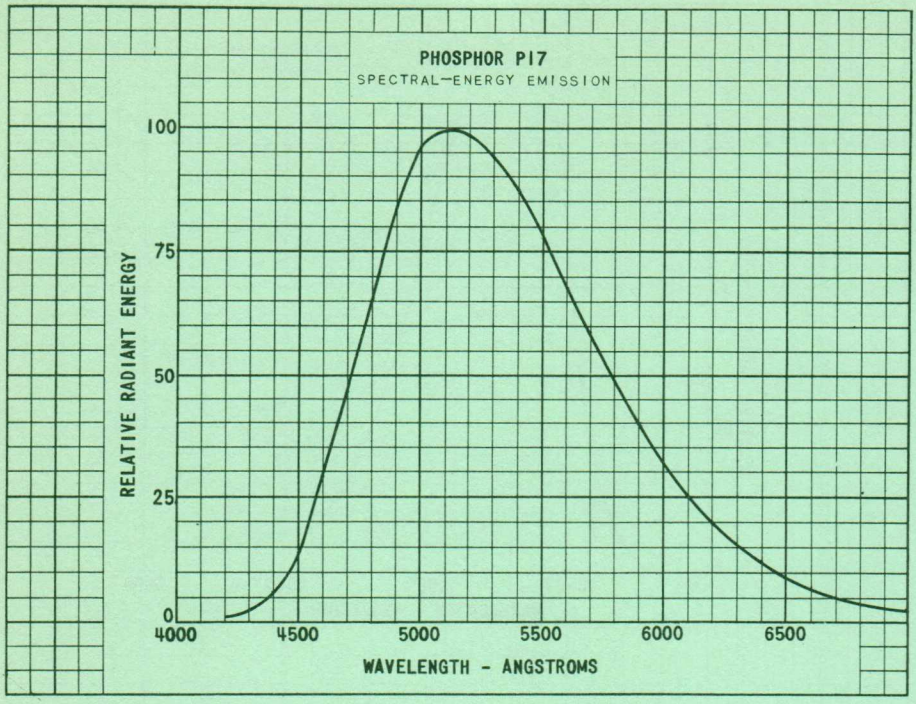
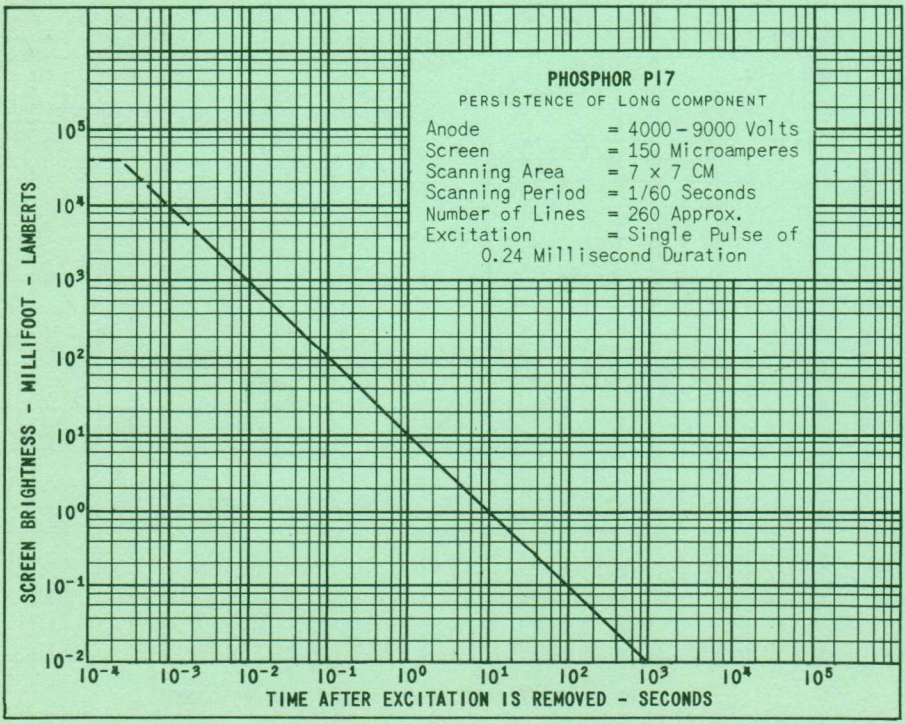
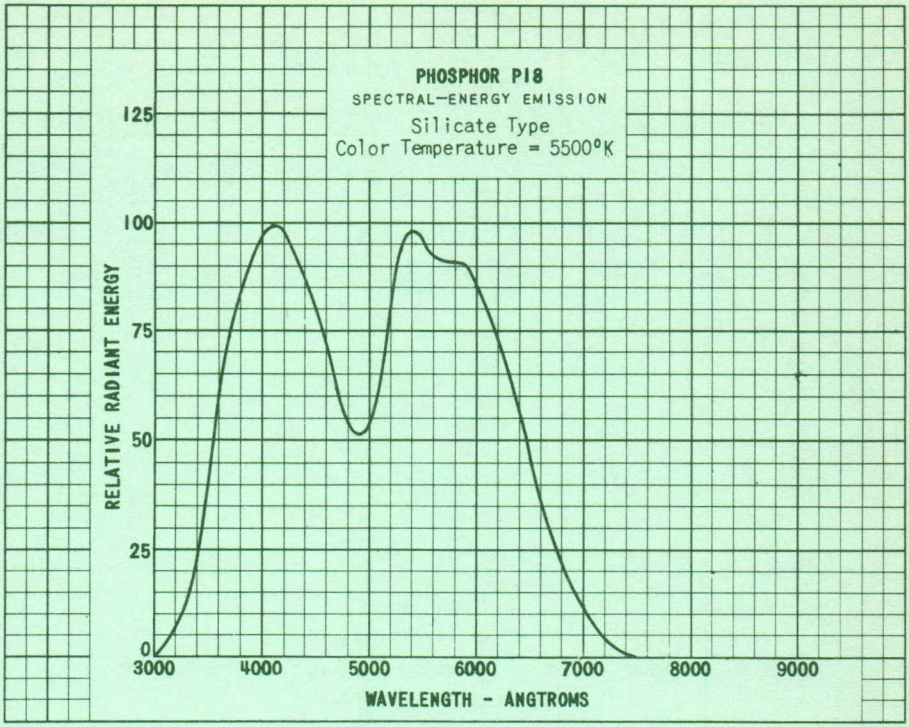

PHOSPHOR P17
SPECTRAL-ENERGY EMISSION
RELATIVE RADIANT ENERGY
100
75
50
25
0
4000
4500
5000
5500
6000
6500
WAVELENGTH - ANGSTROMS

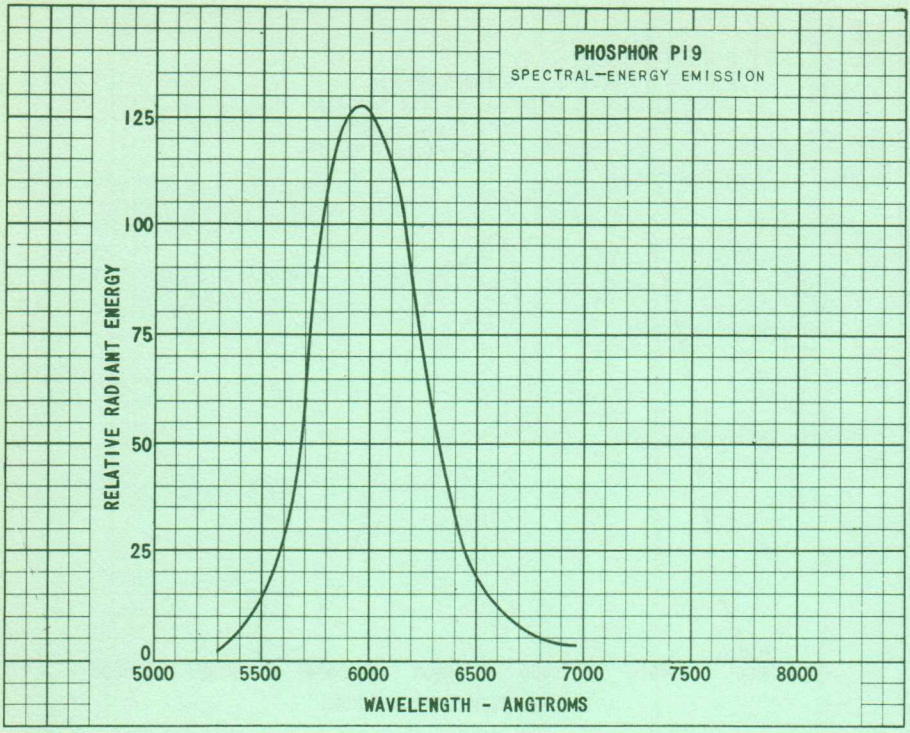

PHOSPHOR P17
PERSISTENCE OF LONG COMPONENT
Anode = 4000 - 9000 Volts
Screen = 150 Microamperes
Scanning Area = 7 x 7 CM
Scanning Period = 1/60 Seconds
Number of Lines = 260 Approx.
Excitation = Single Pulse of 0.24 Millisecond Duration
SCREEN BRIGHTNESS - MILLIFOOT - LAMBERTS
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^0
10^1
10^2
10^3
10^4
10^5
TIME AFTER EXCITATION IS REMOVED - SECONDS

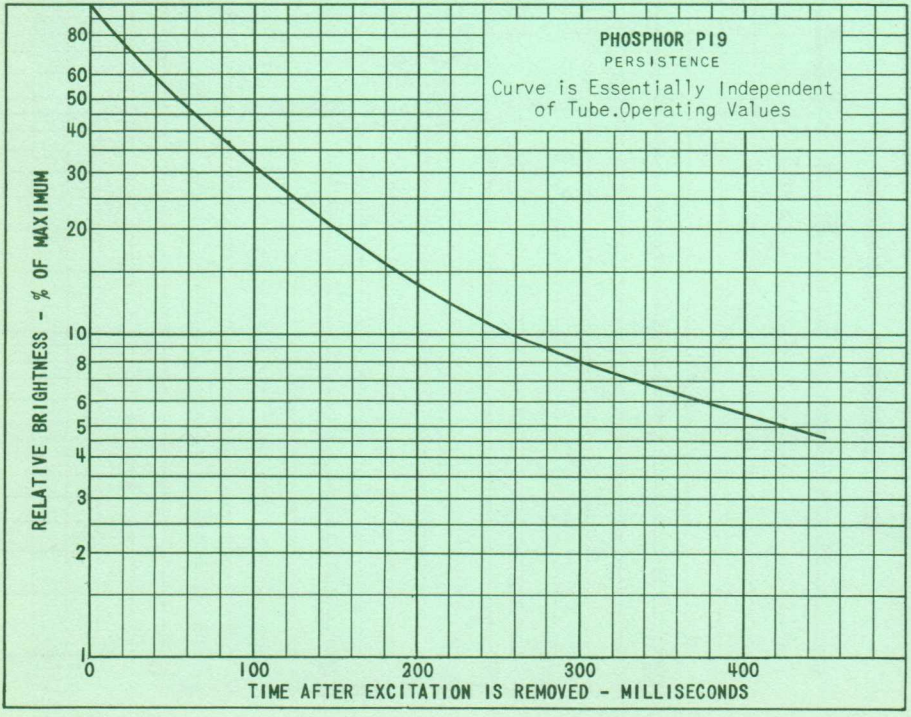
PHOSPHOR CURVES



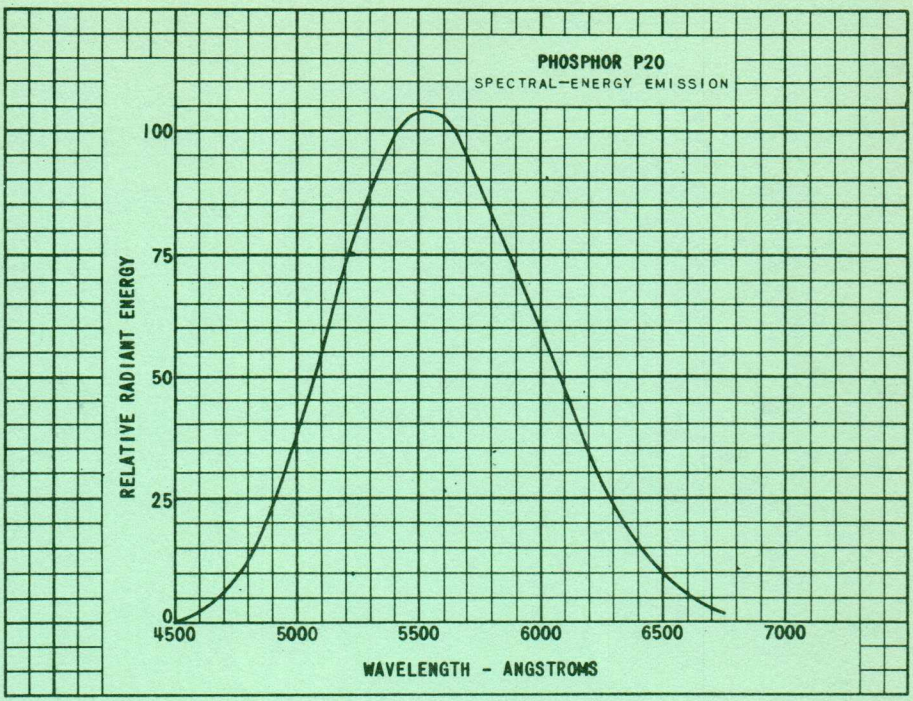


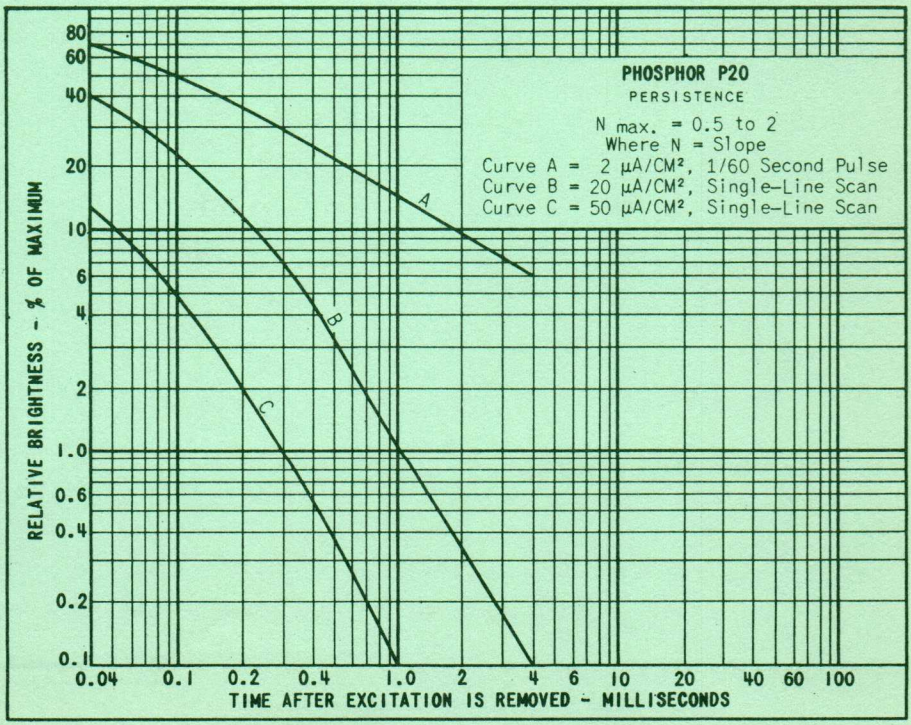
PRINTED IN U. S. A.


PHOSPHOR P19
SPECTRAL-ENERGY EMISSION
RELATIVE RADIANT ENERGY
125
100
75
50
25
0
5000
5500
6000
6500
7000
7500
8000
WAVELENGTH - ANGTROMS


PHOSPHOR P19
PERSISTENCE
Curve is Essentially Independent of Tube.Operating Values
RELATIVE BRIGHTNESS - % OF MAXIMUM
80
60
50
40
30
20
10
8
6
5
4
3
2
1
0
100
200
300
400
TIME AFTER EXCITATION IS REMOVED - MILLISECONDS

PHOSPHOR CURVES





TUNG-SOL

CATHODE RAY

THE 7DP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **ELECTROSTATIC FOCUS**
ROUND GLASS CONSTRUCTION — **MAGNETIC DEFLECTION**
EXTERNAL CONDUCTIVE COATING — **EXTERNAL DOUBLE FIELD ION TRAP**
4" X 5 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):	50	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	400	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE #2, GRID #3 VOLTAGE[A]	8 000	VOLTS
MAXIMUM DC ANODE #1 VOLTAGE	2 400	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE #2, GRID #3 VOLTAGE[B]	6 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
ANODE #1 VOLTAGE FOR FOCUS[D]	1215 TO 1645	VOLTS
DC GRID #1 VOLTAGE[C]	-27 TO -63	VOLTS
MAXIMUM ANODE #1 CURRENT RANGE	-15 TO +10	μAMP

[A] THE PRODUCT OF ANODE #2 VOLTAGE AND AVERAGE ANODE #2 CURRENT SHOULD NEVER EXCEED 6 WATTS.

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE #2 VOLTAGE. IN GENERAL, ANODE #2 VOLTAGE SHOULD NOT BE LESS THAN 5,000 VOLTS.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[D] WITH COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 12 FOOT LAMBERTS ON A 4" BY 5 1/2" PICTURE SIZE.

CONTINUED ON FOLLOWING PAGE

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TUNG-SOL

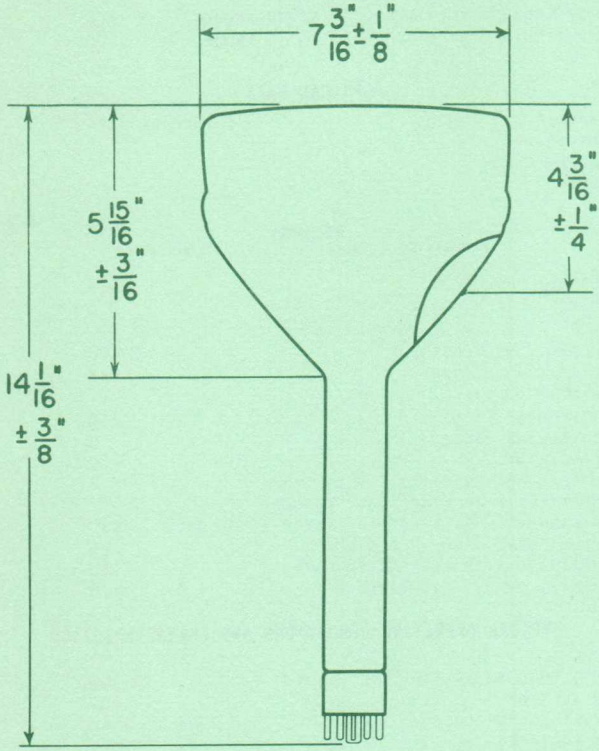
CONTINUED FROM PRECEDING PAGE

MECHANICAL DATA

OVERALL LENGTH	14 1/16 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	7 3/16 ± 1/8	INCHES
MIN. USEFUL SCREEN DIAMETER	6	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 7 PIN	
BASING		12C

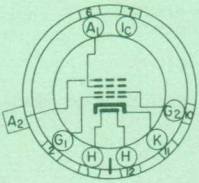
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #2 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – ANODE #1
PIN 7 – Ic DO NOT USE
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO.3

TUNG-SOL

CATHODE RAY

THE 14HP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION RECEIVERS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE	MAGNETIC DEFLECTION
EXTERNAL CONDUCTIVE COATING	GREY FILTER FACEPLATE
RECTANGULAR GLASS CONSTRUCTION	11 3/8" X 8 1/2" RASTER SIZE
LOW VOLTAGE ELECTROSTATIC FOCUS	EXTERNAL SINGLE FIELD ION TRAP MAGNET

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO + 500	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	450	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #4 VOLTAGE [A]	-48 TO + 264	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE [B]	-28 TO -72	VOLTS
DC ION TRAP MAGNET STANDARD COIL #111 (APPROX.)	70	MA.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

[A] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE #2 CURRENT OF 100 MICROAMPERES ON A 11 1/4" BY 8 3/8" PICTURE SIZE.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

CONTINUED ON FOLLOWING PAGE

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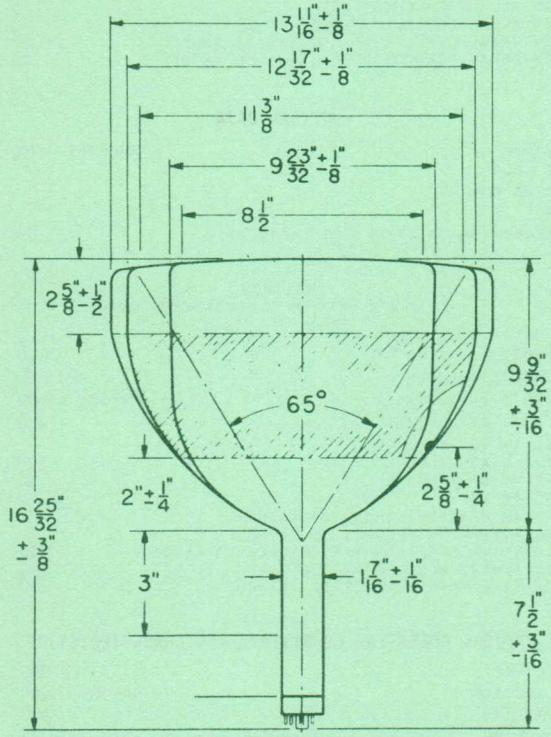
TUNG-SOL

CONTINUED FROM PRECEDING PAGE

MECHANICAL DATA

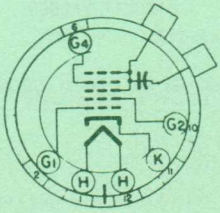
OVERALL LENGTH	16 25/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	13 11/16	INCHES
WIDTH	12 17/32 ± 1/8	INCHES
HEIGHT	9 23/32 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	11 3/8	INCHES
HEIGHT	8 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP

TUNG-SOL

CATHODE RAY

THE 15DP4 AND 15DP4A ARE DIRECT BIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THE TUBES ARE IDENTICAL *EXCEPT* FOR THE GRAY FILTER FACEPLATE USED ON THE 15DP4. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE 12 3/4" X 9 1/2" RASTER SIZE
EXTERNAL SINGLE FIELD ION TRAP MAGNETIC FOCUS AND DEFLECTION

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	57	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	7	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	15 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	140	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	140	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

DC ANODE VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[B]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	146	MA.
DC ION TRAP MAGNET STANDARD COIL #108 (APPROX.)	105	MA.

[A] CATHODE SHOULD BE TURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #106, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 38 FOOT LAMBERTS ON A 9 1/2" BY 12 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

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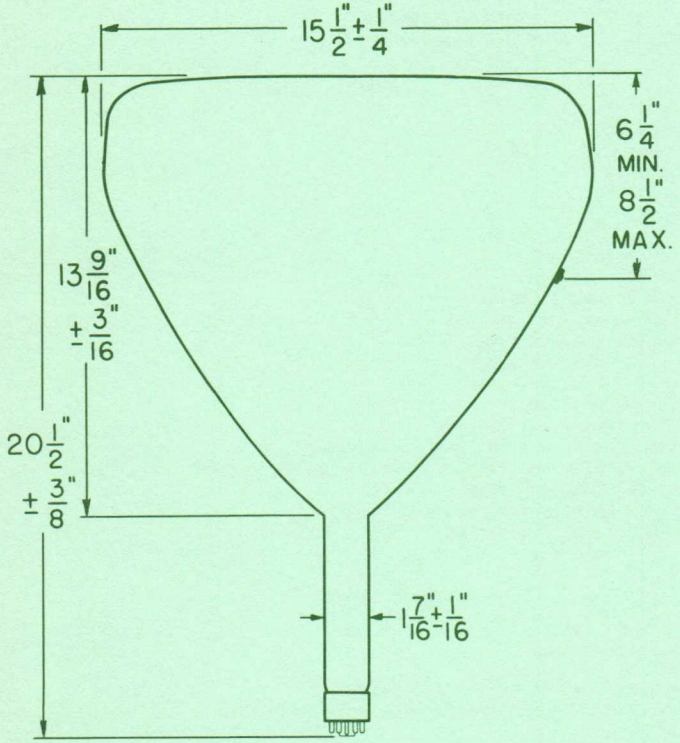
MECHANICAL DATA

OVERALL LENGTH	20 1/2 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 1/2 ± 1/4	INCHES
MIN. USEFUL SCREEN DIAMETER	14	INCHES
BULB CONTACT	RECESSED SMALL BALL CAP	J1-22
BASE	SMALL SHELL DUODECAL 5 PIN	B7-51
BASING		12D

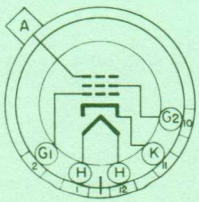
BULB CONTACT ALIGNMENT

J1-22 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 10 – GRID #2
PIN 11 – CATHODE



PIN 12 – HEATER
ANODE CAP:
GRID NO.3

BOTTOM VIEW

TUNG-SOL

CATHODE RAY

THE 16AP4 AND 16AP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE FROSTED GREY ← FILTER FACEPLATE USED ON THE 16AP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE **ROUND METAL CONSTRUCTION**
MAGNETIC FOCUS & DEFLECTION **EXTERNAL DOUBLE FIELD ION TRAP**
10" X 13 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	53	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5.0	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.0	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.) **16AP4A**	66	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE[A]	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE[B]	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[D] (APPROX.)	85 ± 20%	MA.

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 9000 VOLTS.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 10" BY 13 1/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

→ INDICATES A CHANGE.

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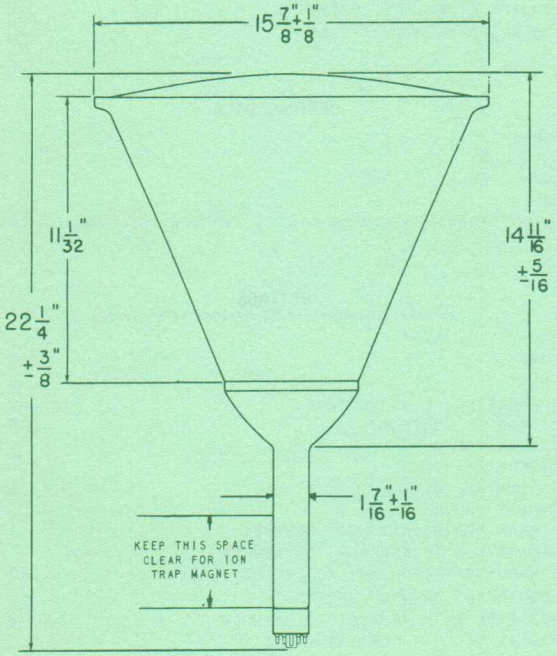
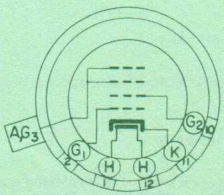
MECHANICAL DATA

OVERALL LENGTH	22 1/4 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 3/8	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
ANODE
GRID NO. 3

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CATHODE RAY

THE 16ABP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
EXTERNAL CONDUCTIVE COATING	**13 1/2" X 10 1/2" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.) DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5.0	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

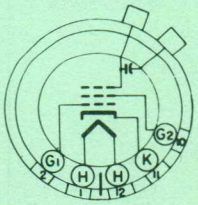
MECHANICAL DATA

OVERALL LENGTH	18 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8 ± 1/8	INCHES
WIDTH	14 3/4 ± 1/8	INCHES
HEIGHT	11 1/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	14 7/8	INCHES
WIDTH	13 1/2	INCHES
HEIGHT	10 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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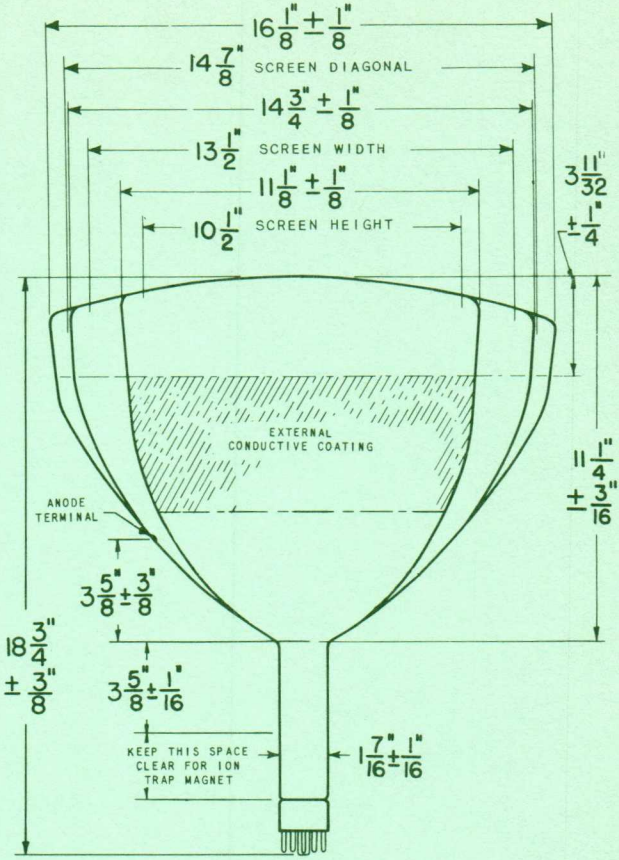

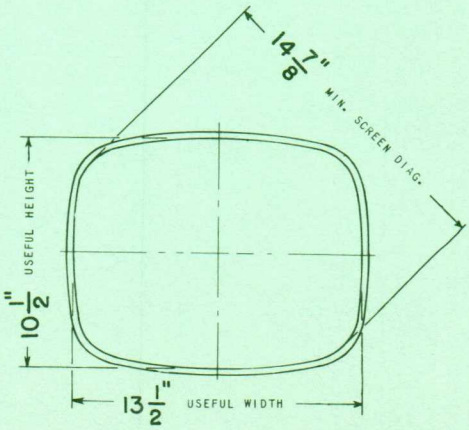

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CATHODE RAY

THE 16ACP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS **MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE **ROUND GLASS CONSTRUCTION**
EXTERNAL CONDUCTIVE COATING

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	60	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

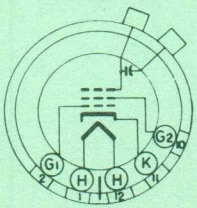
MECHANICAL DATA

OVERALL LENGTH	20 7/8 ± 1/4	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	15 1/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

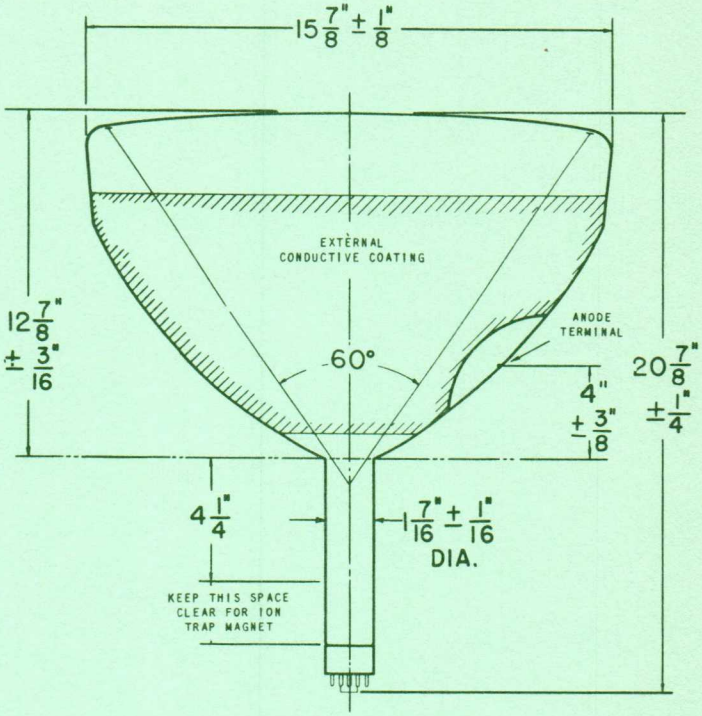
ANODE VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -68	VOLTS
DC ION TRAP CURRENT (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 16AEP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
EXTERNAL CONDUCTIVE COATING	**EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR GLASS CONSTRUCTION	**10 1/8" X 13 1/2" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5.0	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

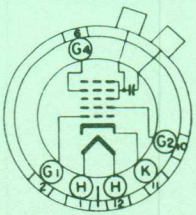
OVERALL LENGTH	18 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8 ± 1/8	INCHES
WIDTH	14 3/4 ± 1/8	INCHES
HEIGHT	11 1/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	13 1/2	INCHES
HEIGHT	10 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.
DC GRID #4 VOLTAGE	-64 TO +350	VOLTS

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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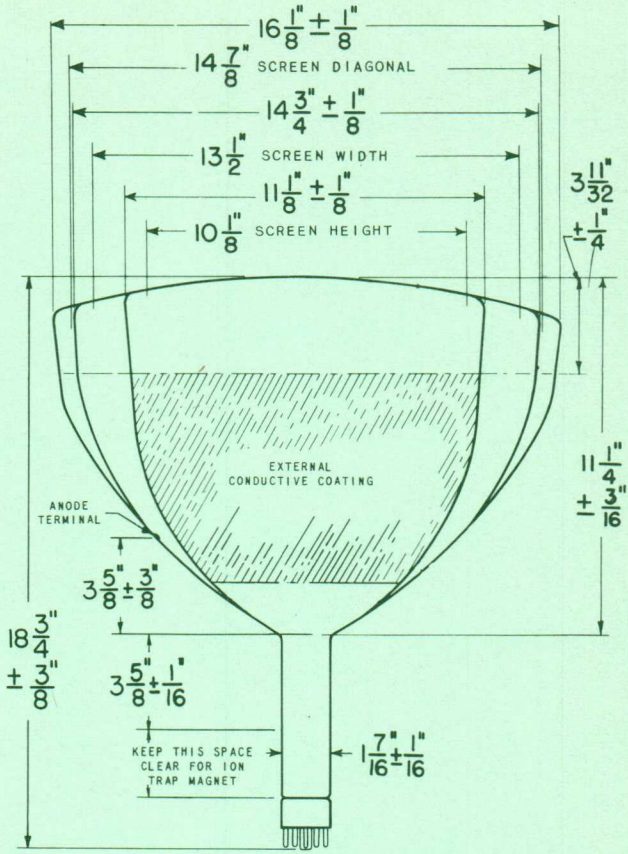

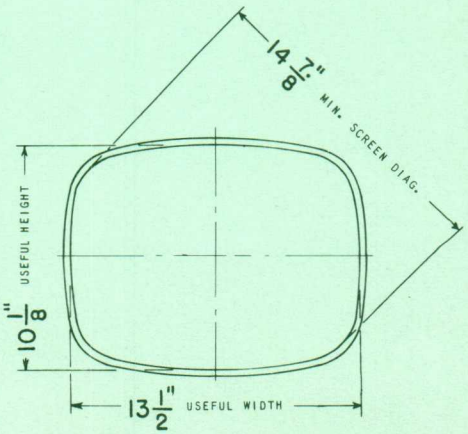

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CATHODE RAY

THE 16CP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **ROUND GLASS CONSTRUCTION**
MAGNETIC FOCUS & DEFLECTION — **DOUBLE FIELD ION TRAP MAGNET**
10 1/4" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	52	DEGREES

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

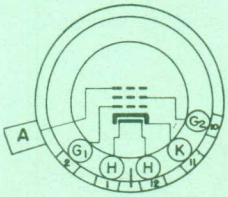
MECHANICAL DATA

OVERALL LENGTH	21 1/2 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ±1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	15 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	110	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

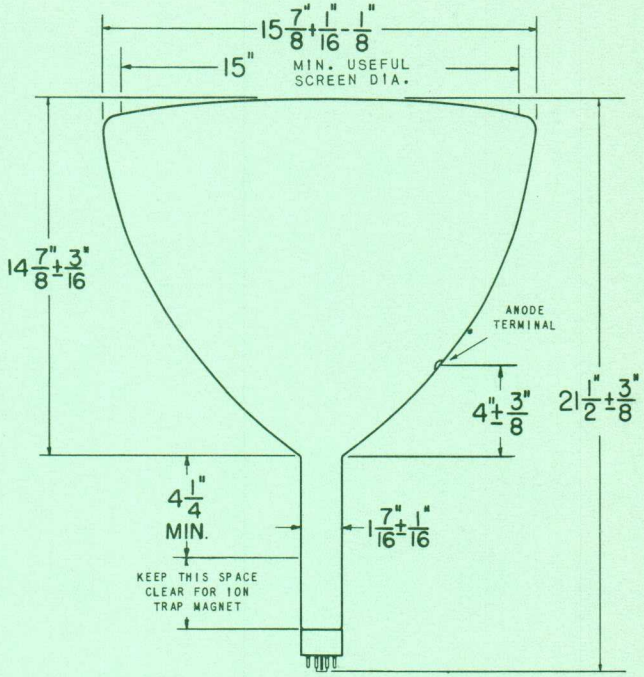
[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 16DP4 AND 16DP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING *EXCEPTION:*

16DP4 - CLEAR GLASS FACEPLATE *16DP4A - GREY FILTER FACEPLATE*

THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE **ROUND GLASS CONSTRUCTION**
MAGNETIC FOCUS & DEFLECTION **EXTERNAL DOUBLE FIELD ION TRAP**
10 1/4" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	60	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5.0	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.) **16DP4A**	70	PERCENT

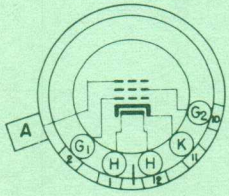
MECHANICAL DATA

OVERALL LENGTH	20 3/4 ± 1/4	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 10 - GRID NO. 2



BOTTOM VIEW

PIN 11 - CATHODE
PIN 12 - HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	15 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[A]	12 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[B]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	115 ± 15%	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	109	MA.

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 9,000 VOLTS.

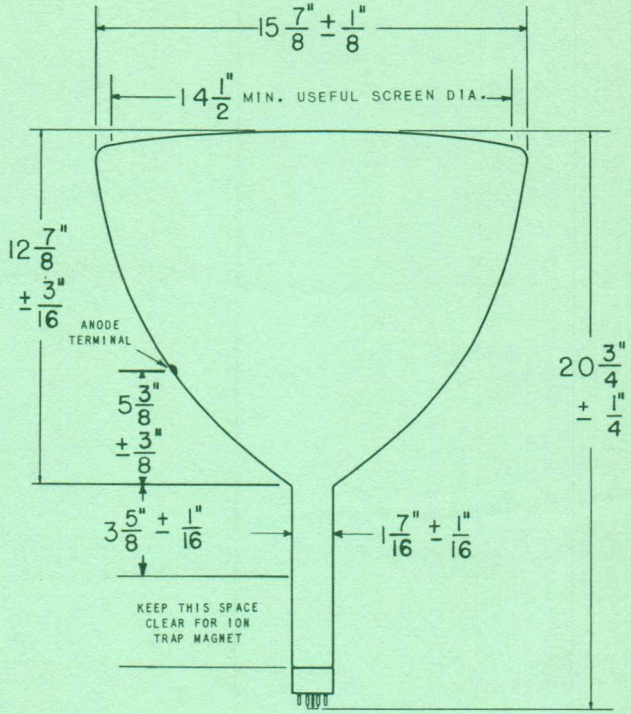
[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 16EP4, 16EP4A AND 16EP4B ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 16EP4A AND 16EP4B HAVE GREY FILTER FACEPLATES. THE FACEPLATE OF THE 16EP4B HAS ALSO BEEN TREATED TO REDUCE SPECULAR REFLECTION. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **ROUND METAL CONSTRUCTION**
MAGNETIC FOCUS & DEFLECTION — **EXTERNAL SINGLE FIELD ION TRAP**
10" X 13 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	60	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

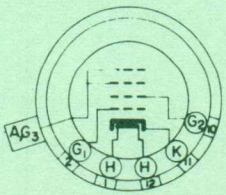
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.) **16EP4A-B**	66	PERCENT
SPECULAR REFLECTION OF AMBIENT LIGHT **16EP4B**	2.5	PERCENT

MECHANICAL DATA

OVERALL LENGTH	19 5/16 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 3/8	INCHES
BULB CONTACT	METAL CONE LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
ANODE
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	140	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	140	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	105 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	80 ± 50%	MA.

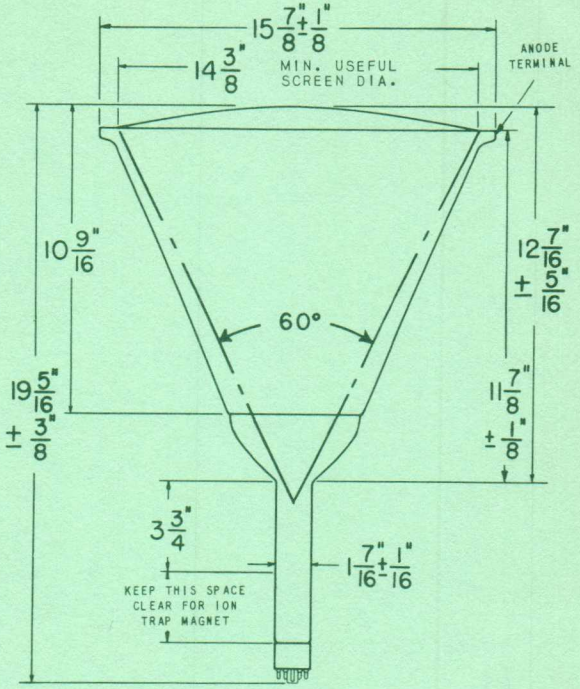
[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 10" BY 13 1/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 2.75 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 16FP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE **ROUND GLASS CONSTRUCTION**
MAGNETIC FOCUS & DEFLECTION **EXTERNAL SINGLE FIELD ION TRAP**
10 1/4" X 13 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	62	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	7	μμf

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

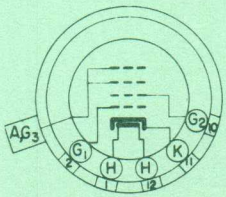
MECHANICAL DATA

OVERALL LENGTH	20 1/4 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	16 1/8 ± 1/4	INCHES
MINIMUM USEFUL SCREEN DIAMETER	15	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
WIDTH	13 1/2	INCHES
HEIGHT	10 1/4	INCHES
BULB CONTACT	RECESSED SMALL BALL CAP	J1-22
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-22 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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TUNG-SOL

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	140	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	140	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	146	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	105	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #106, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 35 FOOT LAMBERTS ON A 10 1/4" BY 13 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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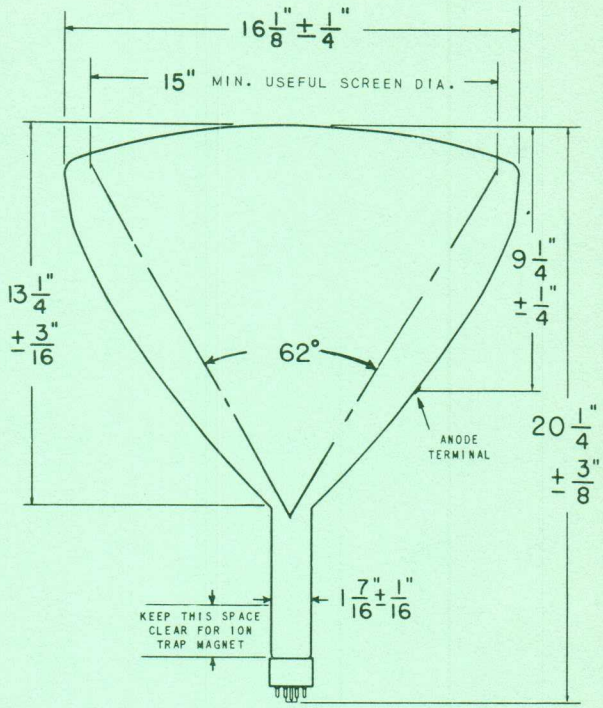

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CATHODE RAY

THE 16GP4, 16GP4A, 16GP4B, AND 16GP4C ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THEIR FACEPLATES WHICH ARE AS FOLLOWS:

16GP4 - GREY FILTER FACEPLATE
16GP4A - CLEAR GLASS FACEPLATE
16GP4B - GREY FILTER - FROSTED
16GP4C - CLEAR GLASS - FROSTED

THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **ROUND METAL CONSTRUCTION**
MAGNETIC FOCUS & DEFLECTION — **EXTERNAL SINGLE FIELD ION TRAP**
10" X 13 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHODE		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

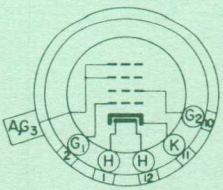
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	65	PERCENT
SPECULAR REFLECTION OF AMBIENT LIGHT **16GP4B**	2.5	PERCENT

MECHANICAL DATA

OVERALL LENGTH	17 11/16	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 3/8	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
ANODE
GRID NO. 3

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID 3 VOLTAGE[A]	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

[A] THE PRODUCT OF ANODE VOLTAGE AND AVERAGE ANODE CURRENT SHOULD BE LIMITED TO 6 WATTS.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE[B]		12 000	VOLTS
DC GRID #2 VOLTAGE		300	VOLTS
DC GRID #1 VOLTAGE[C]		-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[D]		100	MA.
ION TRAP MAGNET (RATED STRENGTH)		23	GAUSSES
	16GP4A AND 16GP4B ONLY	35	GAUSSES

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 10" BY 13 1/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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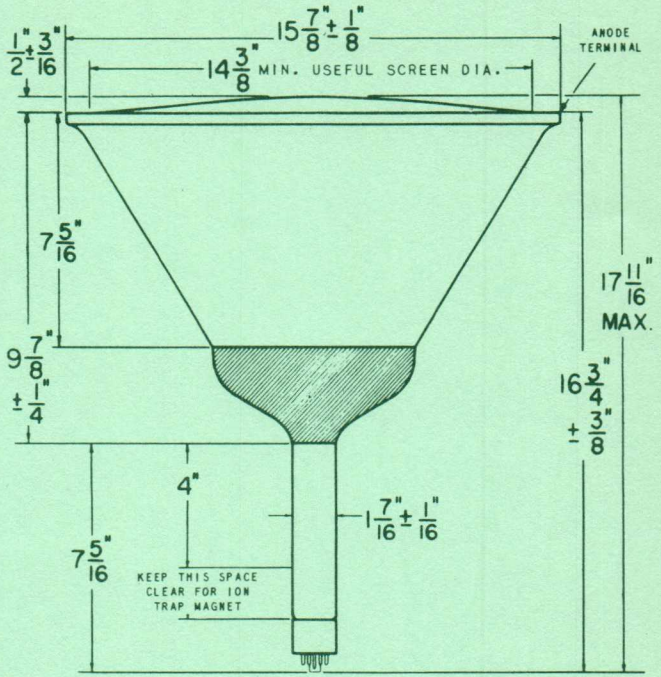

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CATHODE RAY

THE 16HP4 AND 16HP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE GREY FILTER FACEPLATE USED ON THE 16HP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL DOUBLE FIELD ION TRAP
ROUND GLASS CONSTRUCTION
EXTERNAL CONDUCTIVE COATING
10 1/4" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	60	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	3 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

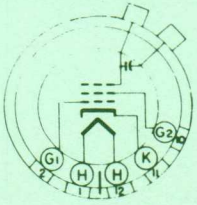
MECHANICAL DATA

OVERALL LENGTH	21 1/4 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	110	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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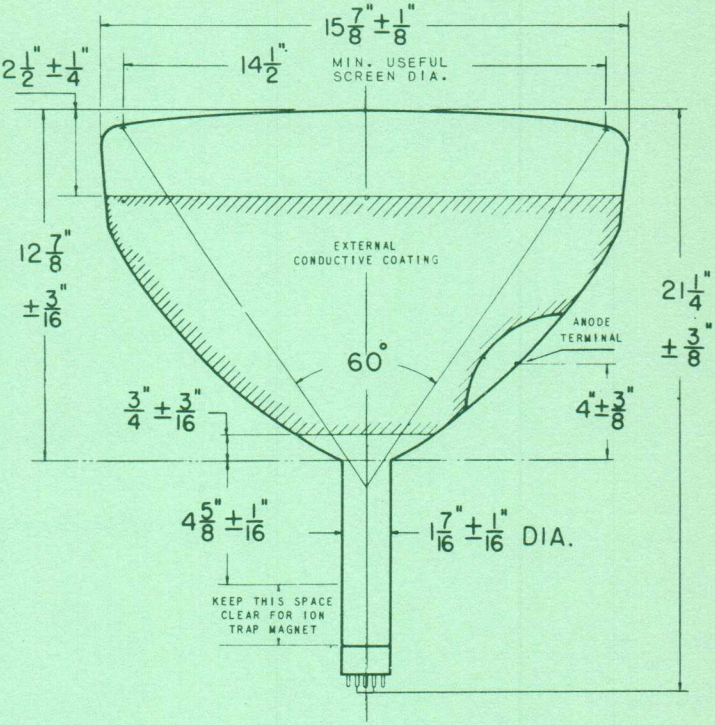

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TUNG-SOL

CATHODE RAY

THE 16JP4 AND 16JP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL EXCEPT FOR THE GREY FILTER FACEPLATE USED ON THE 16JP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **ROUND GLASS CONSTRUCTION**
MAGNETIC FOCUS & DEFLECTION — **EXTERNAL CONDUCTIVE COATING**
EXTERNAL DOUBLE FIELD ION TRAP

MECHANICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	60	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

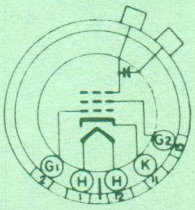
MECHANICAL DATA

OVERALL LENGTH	20 3/4 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	16 1/8 ± 1/4	INCHES
MINIMUM USEFUL SCREEN DIAMETER	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT -
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

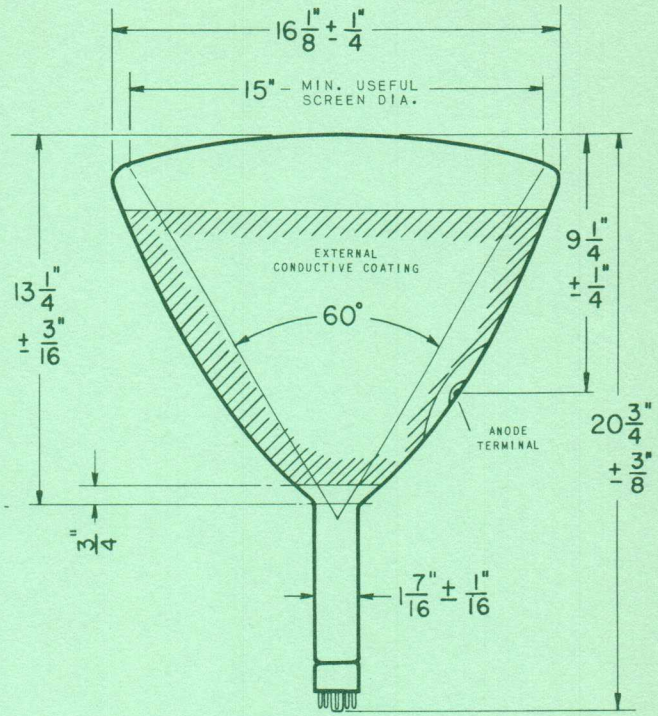
DC ANODE VOLTAGE	11 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)	115	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 16KP4 AND 16KP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 16KP4A.

UNIPOTENTIAL CATHODE — **GREY FILTER FACEPLATE**
MAGNETIC FOCUS & DEFLECTION — **EXTERNAL CONDUCTIVE COATING**
EXTERNAL SINGLE FIELD ION TRAP — **RECTANGULAR GLASS CONSTRUCTION**
13 1/2" X 10 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	72	PERCENT

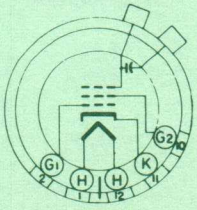
MECHANICAL DATA

OVERALL LENGTH	18 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8 ± 1/8	INCHES
WIDTH	14 3/4 ± 1/8	INCHES
HEIGHT	11 1/2 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	14 7/8	INCHES
WIDTH	13 1/2	INCHES
HEIGHT	10 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER.
ANODE CAP:
GRID NO. 3

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE[A]	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[B]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

[A] IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER OF INJURY FROM PROLONGED EXPOSURE AT CLOSE RANGE.

[B] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[D] (APPROX.)	90 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 35 FOOT LAMBERTS ON A 10 1/8" BY 13 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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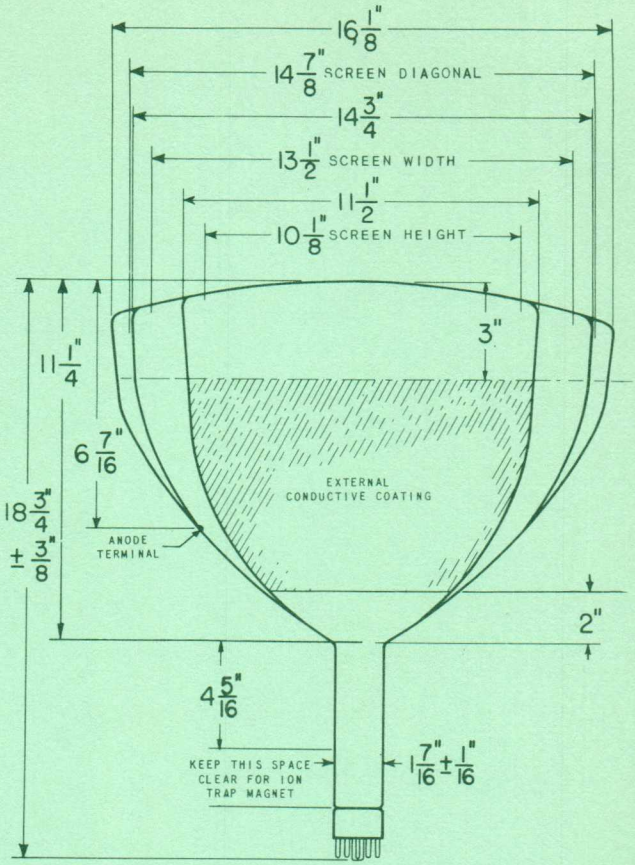

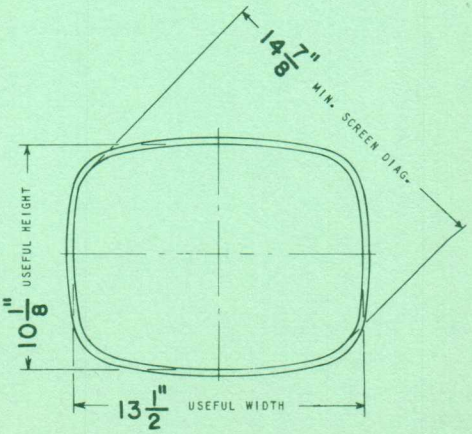

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CATHODE RAY

THE 16LP4 AND 16LP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE GREY FILTER FACEPLATE USED ON THE 16LP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL DOUBLE FIELD ION TRAP
ROUND GLASS CONSTRUCTION
EXTERNAL CONDUCTIVE COATING
10 1/4" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	52	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

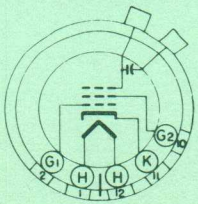
MECHANICAL DATA

OVERALL LENGTH	22 1/4 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	110	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #106, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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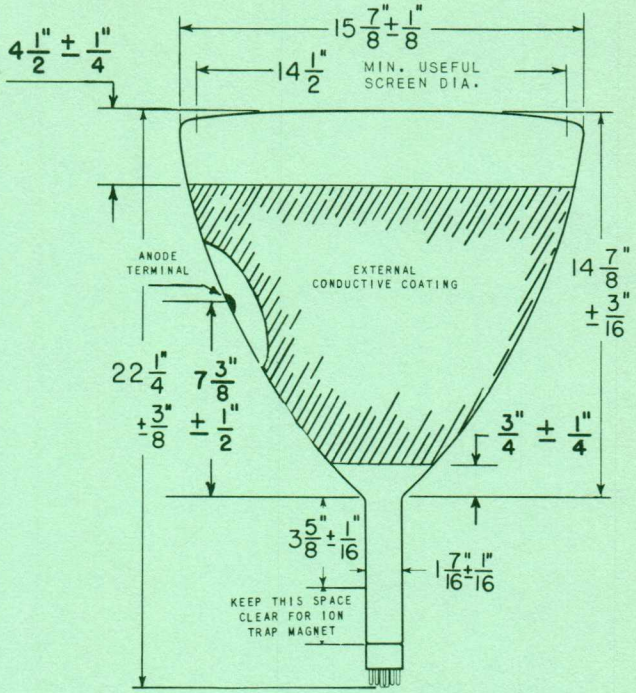

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CATHODE RAY

THE 16MP4 AND 16MP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE GREY FILTER FACEPLATE USED ON THE 16MP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL DOUBLE FIELD ION TRAP
ROUND GLASS CONSTRUCTION
EXTERNAL CONDUCTIVE COATING
10 1/2" X 14 3/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	60	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	3 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

MECHANICAL DATA

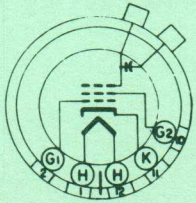
OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	16 1/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	110	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/2" BY 14 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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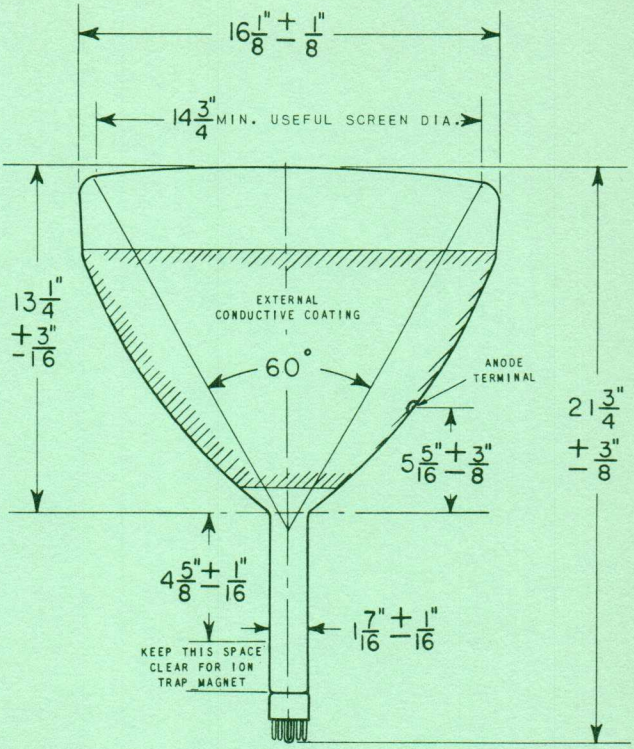

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CATHODE RAY

THE 16QP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
RECTANGULAR GLASS CONSTRUCTION
GREY FILTER FACEPLATE
10 1/8" X 13 1/2" RASTER SIZE
EXTERNAL DOUBLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	54.5	DEGREES
VERTICAL	50.8	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	7	μμf

OPTICAL DATA

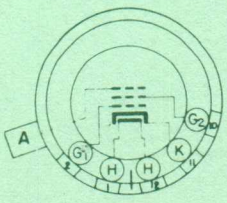
PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

MECHANICAL DATA

OVERALL LENGTH	19 1/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8	INCHES
WIDTH	14 3/4	INCHES
HEIGHT	11 1/2	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15	INCHES
WIDTH	13 19/32	INCHES
HEIGHT	10 3/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

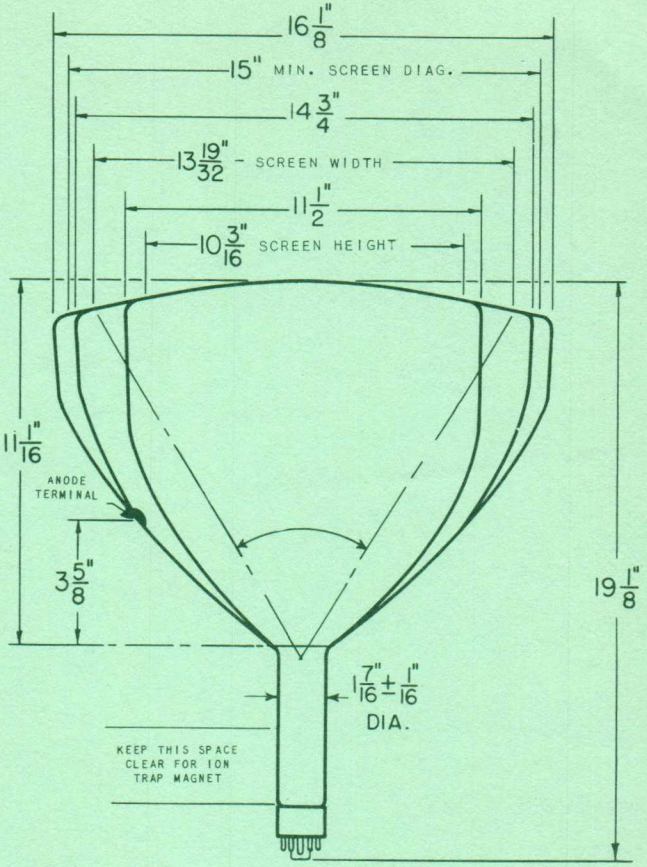
DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)	150	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

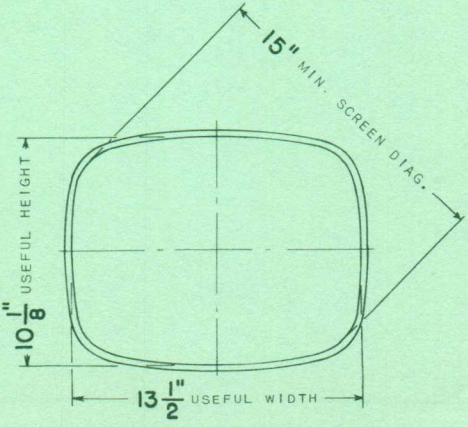
[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL





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CATHODE RAY

THE 16RP4 AND 16RP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING *EXCEPTION:*

16RP4A - ALUMINIZED SCREEN

THEIR COMMON FEATURES INCLUDE:

GREY FILTER FACEPLATE

UNIPOTENTIAL CATHODE	**EXTERNAL CONDUCTIVE COATING**
MAGNETIC FOCUS & DEFLECTION	**10 1/8" X 13 1/2" RASTER SIZE**
EXTERNAL SINGLE FIELD ION TRAP	**RECTANGULAR GLASS CONSTRUCTION**

ELECTRICAL DATA

FOCUSING METHODE		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	100 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 10 1/8" BY 13 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.50 INCHES.

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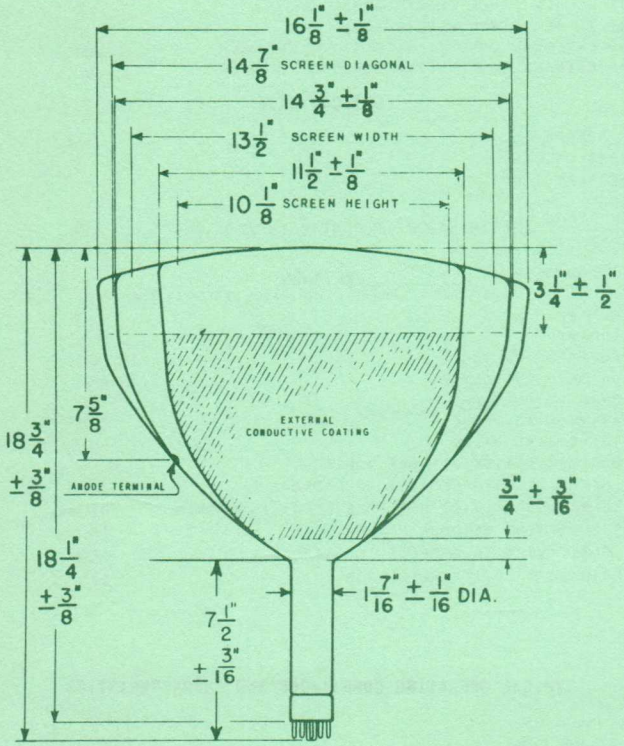
MECHANICAL DATA

OVERALL LENGTH	18 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8 ± 1/8	INCHES
WIDTH	14 3/4 ± 1/8	INCHES
HEIGHT	11 1/2 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	14 7/8	INCHES
WIDTH	13 1/2	INCHES
HEIGHT	10 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

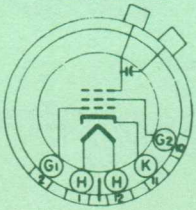
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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CATHODE RAY

THE 16SP4 AND 16SP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE GREY FILTER FACEPLATE USED ON THE 16SP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE	**EXTERNAL CONDUCTIVE COATING**
ROUND GLASS CONSTRUCTION	**MAGNETIC FOCUS & DEFLECTION**
EXTERNAL SINGLE FIELD ION TRAP	**10 1/4" X 14 1/2" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	3 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

MECHANICAL DATA

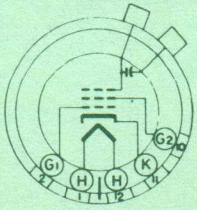
OVERALL LENGTH	17 5/16 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	110	MA.
DC ION TRAP CURRENT (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" x 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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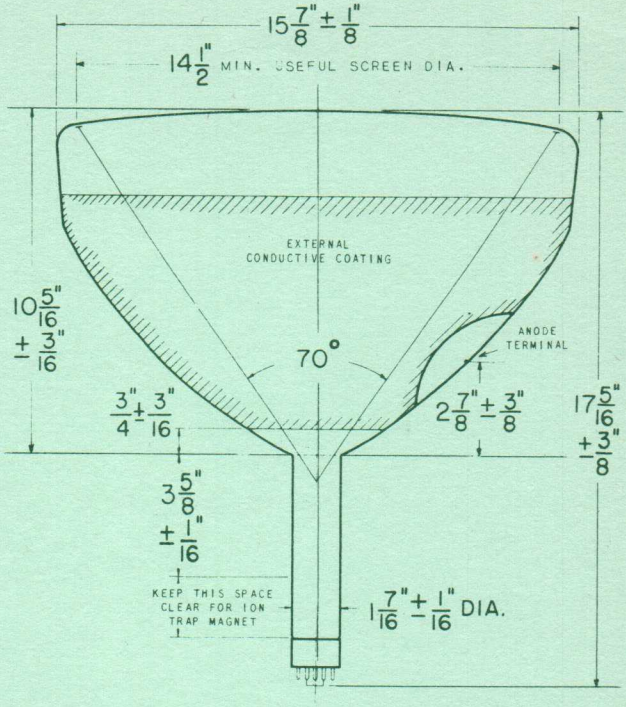

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CATHODE RAY

THE 16TP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **GREY FILTER FACEPLATE**
MAGNETIC FOCUS & DEFLECTION — **EXTERNAL CONDUCTIVE COATING**
EXTERNAL SINGLE FIELD ION TRAP — **RECTANGULAR GLASS CONSTRUCTION**
13 1/2" X 10 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	72	PERCENT

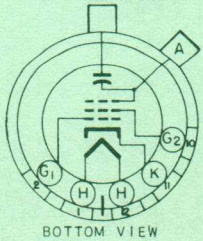
MECHANICAL DATA

OVERALL LENGTH	18 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8 ± 1/8	INCHES
WIDTH	14 3/4 ± 1/8	INCHES
HEIGHT	11 1/2 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	14 7/8	INCHES
WIDTH	13 1/2	INCHES
HEIGHT	10 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	99 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 35 FOOT LAMBERTS ON A 10 1/8" BY 13 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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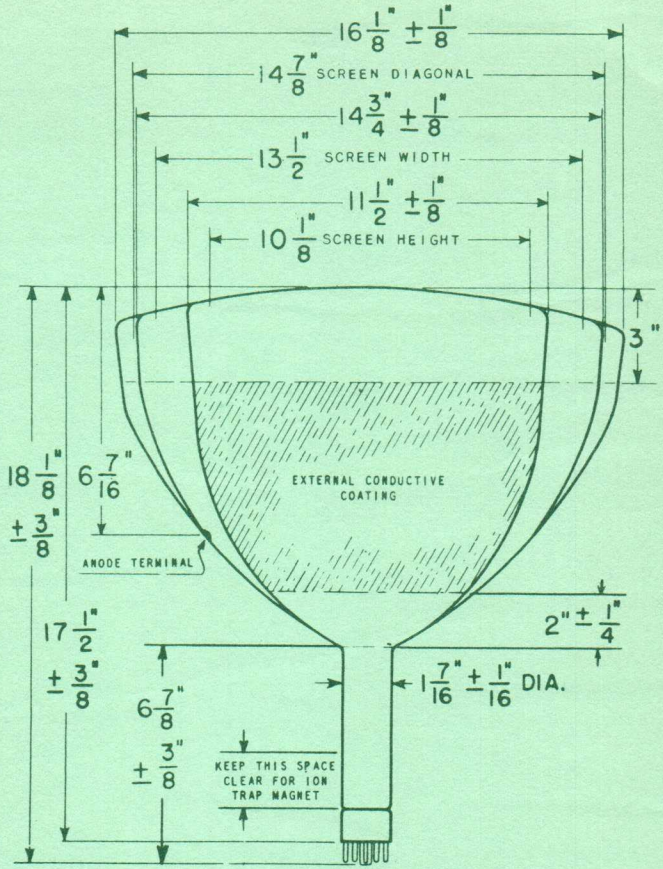

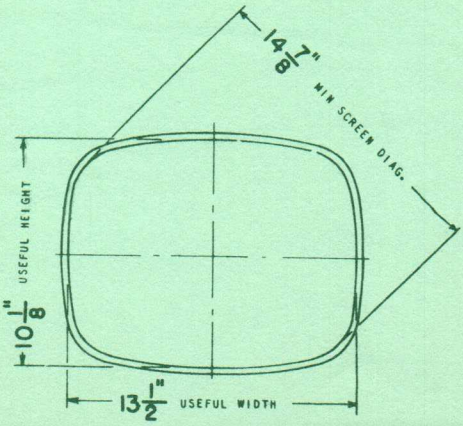

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CATHODE RAY

THE 16UP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL SINGLE FIELD ION TRAP
GREY FILTER FACEPLATE
10 1/8" X 13 1/2" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

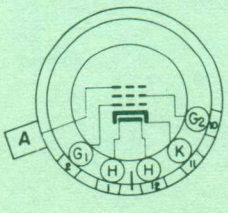
MECHANICAL DATA

OVERALL LENGTH	18 1/8 ± 1/2	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8	INCHES
WIDTH	14 3/4	INCHES
HEIGHT	11 1/2	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15	INCHES
WIDTH	13 19/32	INCHES
HEIGHT	10 3/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	15 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	100	MA.
ION TRAP MAGNET (RATED STRENGTH)	23	GAUSSES

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/8" BY 13 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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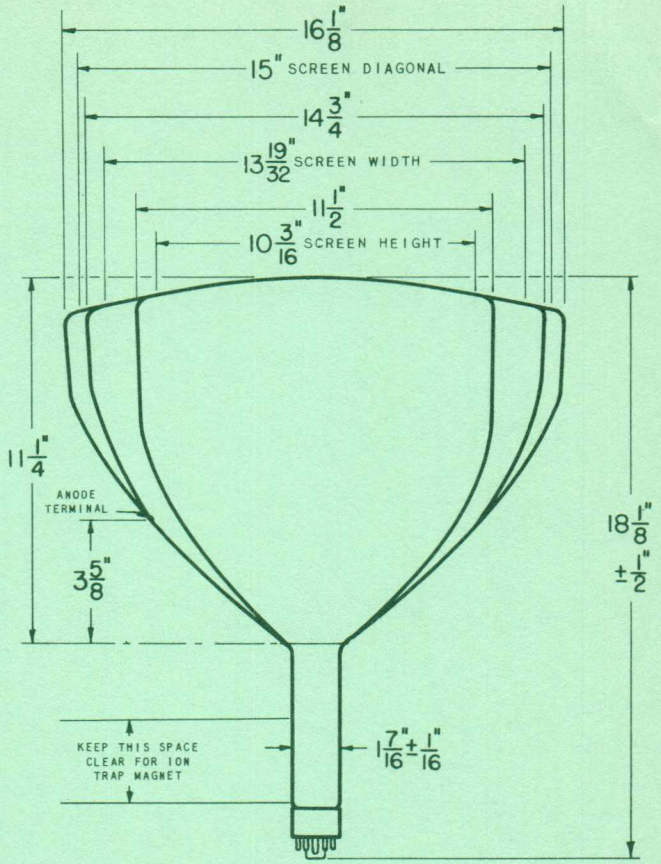

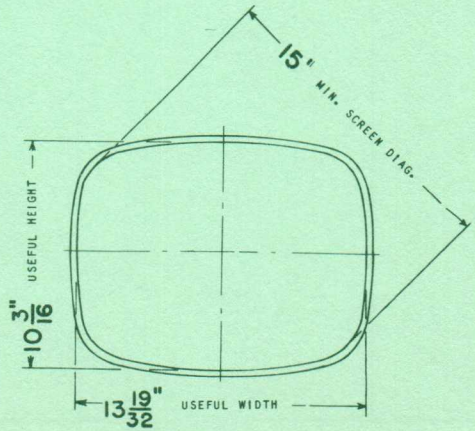

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CATHODE RAY

THE 16VP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL SINGLE FIELD ION TRAP
GREY FILTER FACEPLATE
ROUND GLASS CONSTRUCTION
10 1/8" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

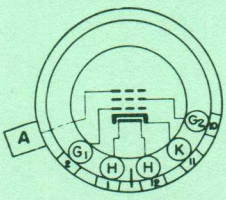
MECHANICAL DATA

OVERALL LENGTH	17 3/16 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	15 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	110	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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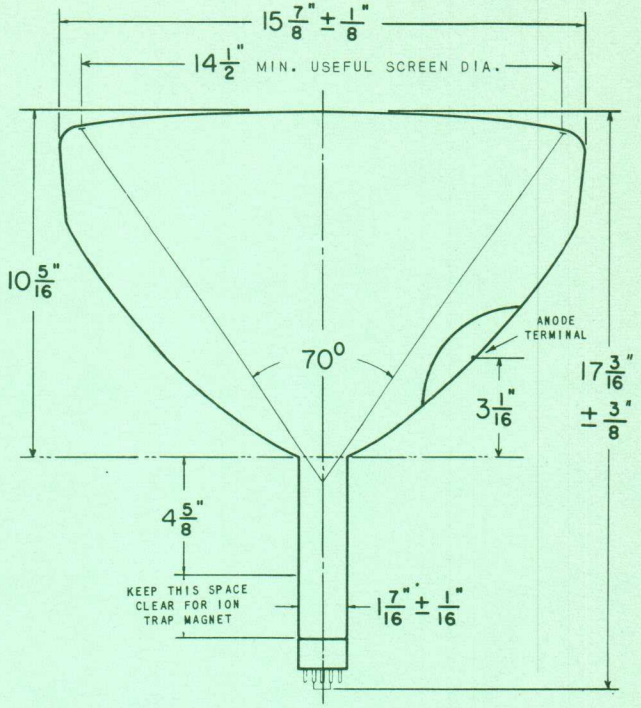

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CATHODE RAY

THE 16WP4 AND 16WP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE EXTERNAL CONDUCTIVE COATING USED ON THE 16WP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
MAGNETIC FOCUS & DEFLECTION	**ROUND GLASS CONSTRUCTION**
EXTERNAL DOUBLE FIELD ION TRAP	**10 1/4" X 14 1/2" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **16WP4A**	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **16WP4A**	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

MECHANICAL DATA

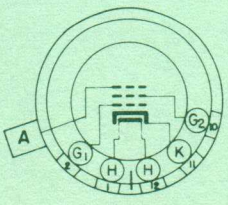
OVERALL LENGTH	17 3/4 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING	**16WP4** – 12D **16WP4A**	12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

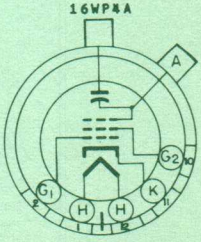
16WP4



PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

BOTTOM VIEW

16WP4A



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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	110	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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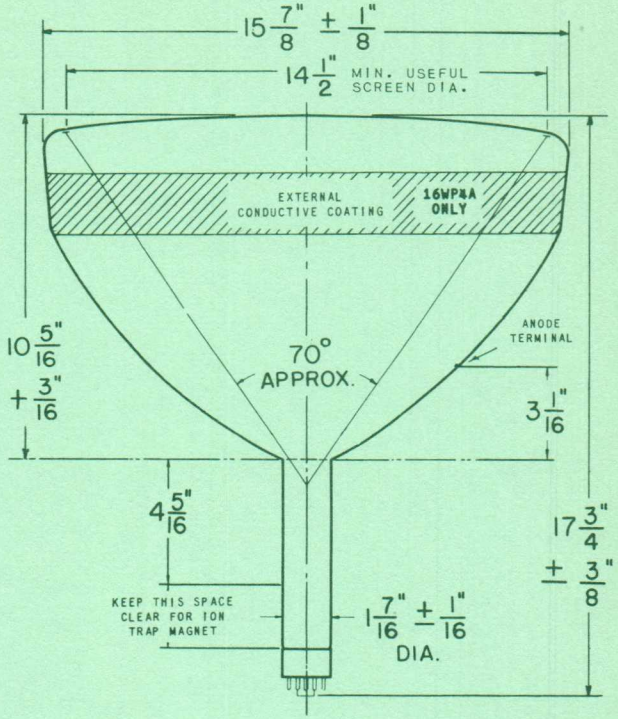

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CATHODE RAY

THE 16XP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL DOUBLE FIELD ION TRAP
GREY FILTER FACEPLATE
10 1/8" X 13 1/2" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

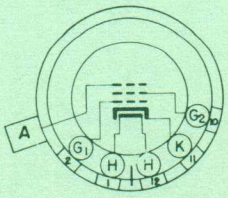
MECHANICAL DATA

OVERALL LENGTH	18 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 1/8	INCHES
WIDTH	14 3/4	INCHES
HEIGHT	11 1/2	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15	INCHES
WIDTH	13 19/32	INCHES
HEIGHT	10 3/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS BETWEEN PIN POSITIONS #6 & 7 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	15 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	100	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/8" BY 13 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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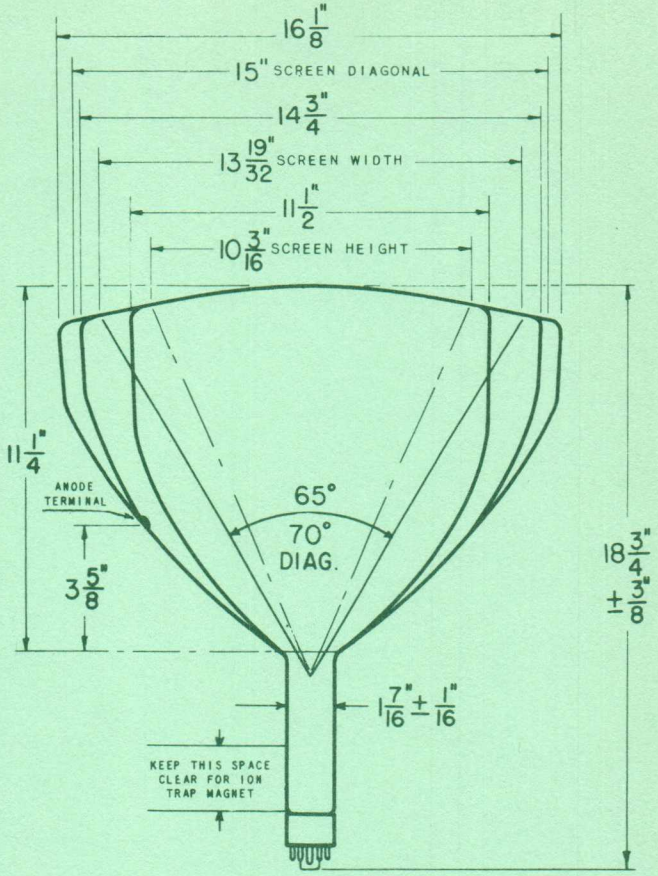

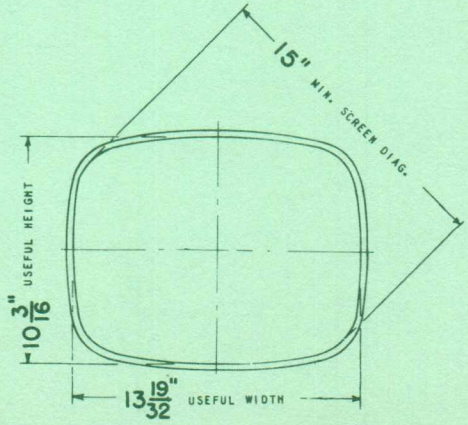

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CATHODE RAY

THE 16YP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **GREY FILTER FACEPLATE**
MAGNETIC FOCUS & DEFLECTION — **ROUND GLASS CONSTRUCTION**
EXTERNAL SINGLE FIELD ION TRAP — **EXTERNAL CONDUCTIVE COATING**
10 1/4" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5.0	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.0	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

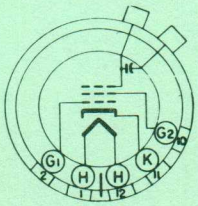
MECHANICAL DATA

OVERALL LENGTH	17 5/16 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	100	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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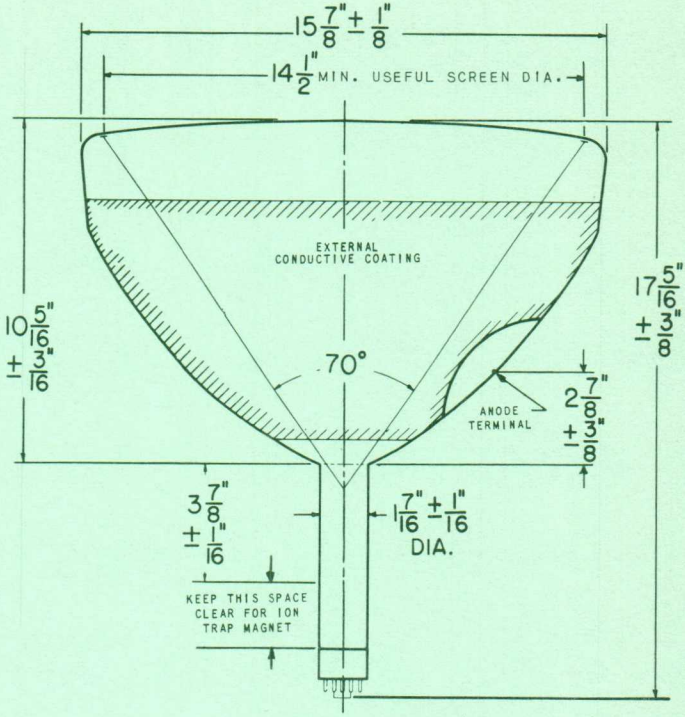

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CATHODE RAY

THE 16ZP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **GREY FILTER FACEPLATE**
MAGNETIC FOCUS & DEFLECTION — **ROUND GLASS CONSTRUCTION**
EXTERNAL DOUBLE FIELD ION TRAP — **EXTERNAL CONDUCTIVE COATING**
10 1/4" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	52	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	65	PERCENT

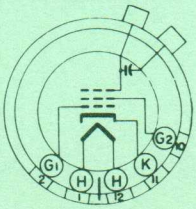
MECHANICAL DATA

OVERALL LENGTH	22 1/4 ± 3/8	INCHES
GREATEST DIAMETER	15 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	14 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	110	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	120	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 10 1/4" BY 14 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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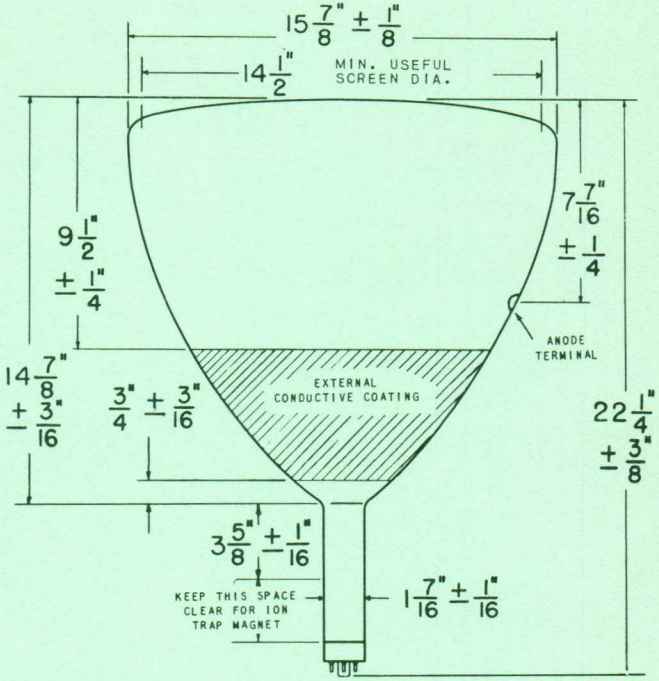

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CATHODE RAY

THE 17AP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE
EXTERNAL CONDUCTIVE COATING
RECTANGULAR GLASS CONSTRUCTION
UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL SINGLE FIELD ION TRAP
10 3/4" X 14 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	7	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2 000	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

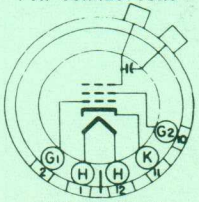
MECHANICAL DATA

OVERALL LENGTH	18 5/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH VACANT PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	100 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111	75 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 25 FOOT LAMBERTS ON A 14 1/4" BY 10 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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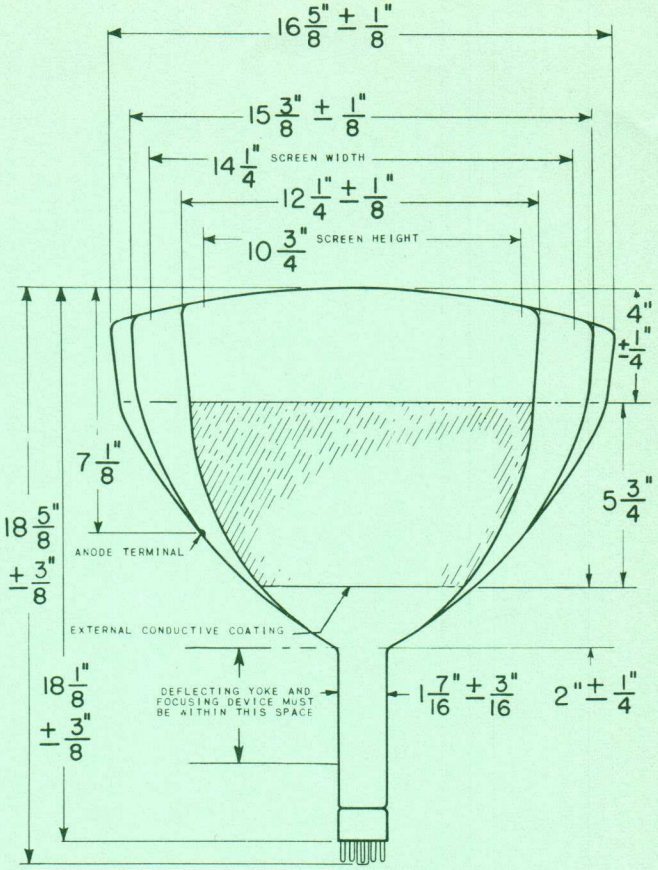

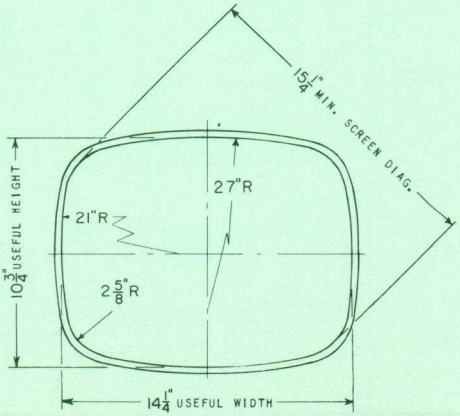

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CATHODE RAY

THE 17AVP4 AND 17AVP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 17AVP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
EXTERNAL CONDUCTIVE COATING — **MAGNETIC DEFLECTION**
RECTANGULAR GLASS CONSTRUCTION — **FILTERGLASS FACEPLATE**
LOW VOLTAGE ELECTROSTATIC FOCUS — **EXTERNAL SINGLE FIELD ION TRAP**
10 3/4" X 14 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	P-4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	SHORT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC COLLECTOR, GRID #3, GRID #5 VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE[A]	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC COLLECTOR, GRID #3, GRID #5 VOLTAGE	12 000	VOLTS
DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)[B]	-48 TO +264	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC GRID #2 CURRENT	-15 TO +15	μAMP.
DC FOCUSING COIL CURRENT (APPROX.)	-25 TO +25	μAMP.
ION TRAP CURRENT STANDARD COIL #117 (APPROX.)	30	MA.

[A] THE FOCUS ELECTRODE MAY BE MODULATED TO IMPROVE OVERALL FOCUS.

[B] WITH THE COMBINED GRID #1 VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE A COLLECTOR CURRENT OF 100 MICROAMPERES ON A 10 3/4" X 14 1/4" PICTURE AREA.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

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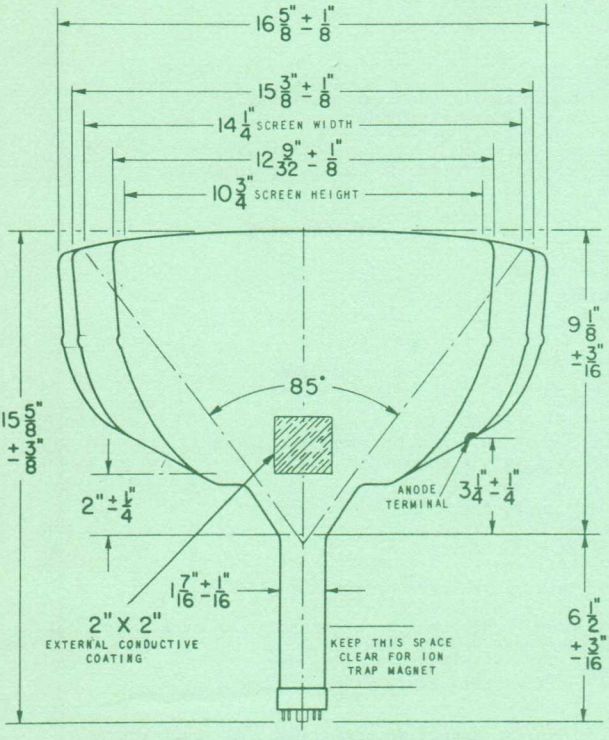
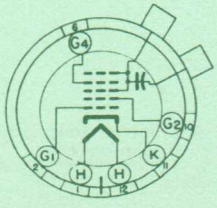
MECHANICAL DATA

OVERALL LENGTH	15 5/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID #3
GRID #5
COLLECTOR

SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED: IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY.

TUNG-SOL

CATHODE RAY

THE 17ATP4 AND 17ATP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE METAL-BACKED SCREEN ON THE 17ATP4A. THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION	**SPHERICAL FACEPLATE**
UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL CONDUCTIVE COATING**
LOW VOLTAGE ELECTROSTATIC FOCUS	**EXTERNAL SINGLE FIELD ION TRAP**

10 3/4" X 14 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	80	DEGREES
VERTICAL	65	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE[B]	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE:		
POSITIVE	1 000	VOLTS
NEGATIVE[C]	500[C]	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE (WITH ANODE CURRENT OF 100 μAMP.)	-55 TO +300	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[D]	-33 TO -77	VOLTS
DC ION TRAP MAGNET	37	GAUSSES

[A] EXTERNAL CONDUCTIVE COATING MUST BE GROUNDED.

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

[C] THIS VALUE APPLIES WHERE AN AC VOLTAGE IS PROVIDED FOR DYNAMIC FOCUSING.

[D] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

INASMUCH AS THE TUBE RATING PERMITS OPERATION AT VOLTAGES AS HIGH AS 17.6 KILOVOLTS (ABSOLUTE VALUE), SHIELDING OF THE TUBE FOR X-RAY RADIATION MAY BE NEEDED WHEREVER THE OPERATING CONDITIONS INVOLVE VOLTAGES IN EXCESS OF 16 KILOVOLTS.

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TUNG-SOL

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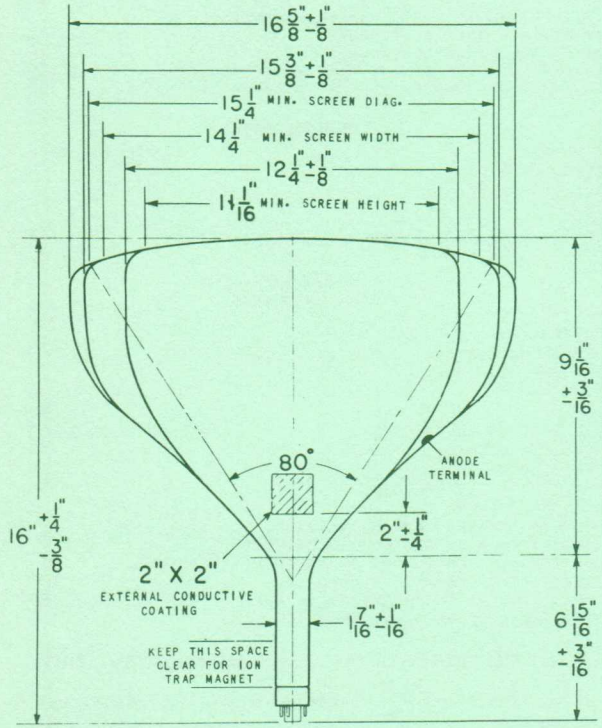
MECHANICAL DATA

OVERALL LENGTH	16 +1/4 -3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 1/4	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	11 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

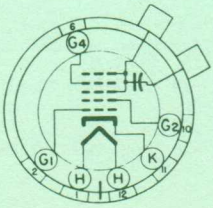
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID #3
GRID #5
COLLECTOR

SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY.

TUNG-SOL

CATHODE RAY

THE 17BJP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	ELECTROSTATIC FOCUS
MAGNETIC DEFLECTION	UNIPOTENTIAL CATHODE
GRAY FILTER FACEPLATE	EXTERNAL CONDUCTIVE COATING
REQUIRES NO ION TRAP MAGNET	RECTANGULAR GLASS CONSTRUCTION

14 1/4" X 10 3/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1200	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE[A]	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	140	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-55 TO 300	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

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TUNG-SOL

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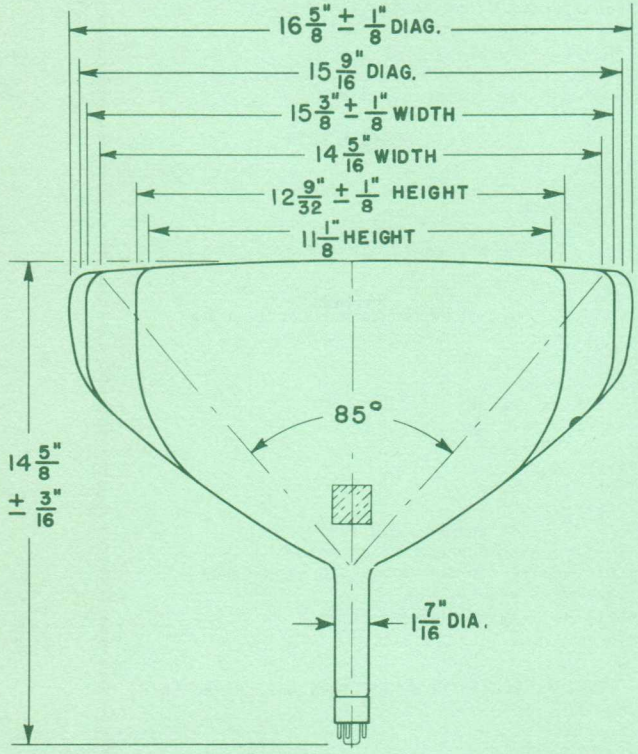
MECHANICAL DATA

OVERALL LENGTH	14 5/8 ± 3/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 9/16	INCHES
WIDTH	14 5/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

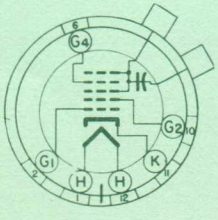
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ±30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 17BKP4 AND 17BKP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THE TUBES ARE IDENTICAL EXCEPT FOR THE ALUMINIZED SCREEN ON THE 17BKP4A.

THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION	**ELECTROSTATIC FOCUS**
UNIPOTENTIAL CATHODE	**GRAY FILTER FACEPLATE**
EXTERNAL CONDUCTIVE COATING	**EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR GLASS CONSTRUCTION	**14 5/16" X 11 1/8" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1200	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.450 ±5%	AMP.
MAXIMUM DC ANODE VOLTAGE	17 600	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-550 TO +1100	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	155	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS
HEATER WARM-UP TIME (APPROX.) *	11.0	SECONDS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-56 TO+310	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC ION TRAP MAGNET STANDARD COIL #117 (APPROX.)	28	MA.
DC ION TRAP MAGNET RATED STRENGTH	31	GAUSES

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

* HEATER WARM-UP TIME IS THE TIME REQUIRED FOR THE VOLTAGE ACROSS THE HEATER TERMINALS TO INCREASE TO 5.0 VOLTS IN THE JETEC TEST CIRCUIT, WITH E=25 VOLTS AND SERIES R=42 OHMS.

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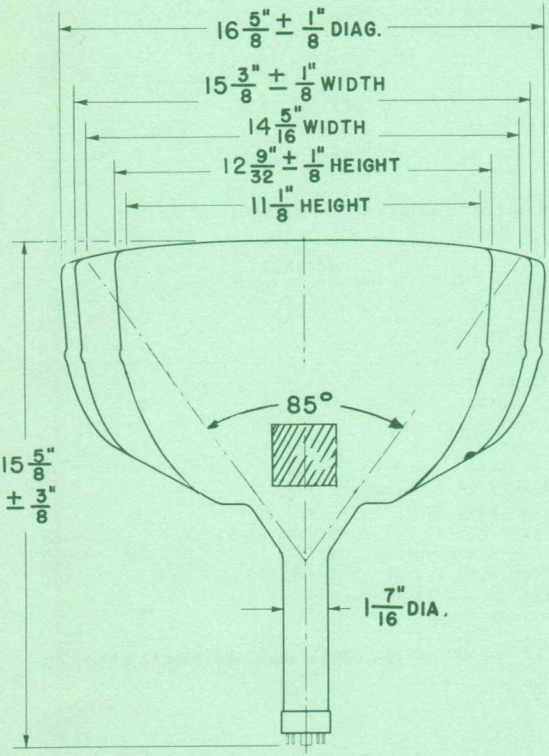
MECHANICAL DATA

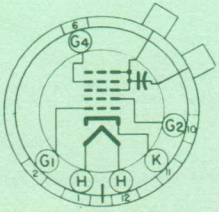
OVERALL LENGTH	15 5/8 ± 3/8	INCHES
GREATEST DIMENTSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
WIDTH	14 5/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS



BOTTOM VIEW

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE

PIN 12 – HEATER
ANODE CAP:
GRID NO.3
GRID NO.5

TUNG-SOL

CATHODE RAY

THE 17BMP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	ALUMINIZED SCREEN
MAGNETIC DEFLECTION	GRAY FILTER FACEPLATE
UNIPOTENTIAL CATHODE	19 1/8" X 15" RASTER SIZE
EXTERNAL CONDUCTIVE COATING	EXTERNAL SINGLE FIELD ION TRAP
	14 5/16" X 11 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	80	DEGREES
VERTICAL	65	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	71	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE*	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	200	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS[A]

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-55 TO +300	VOLTS
DC GRID #2 VOLTAGE	110	VOLTS
DC GRID #1 VOLTAGE	-32 TO -50	VOLTS
DC ION TRAP MAGNET RATED STRENGTH	37	GAUSSES

*BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

[A]THIS TUBE MAY BE OPERATED IN GRID DRIVE IF DESIRED, WITH SOME LOSS IN EFFICIENCY. AVERAGE RASTER CUTOFF, USING GRID DRIVE, MAY BE CALCULATED: $E_{g1c_0} = .502\ E_{g2} + 5.8$

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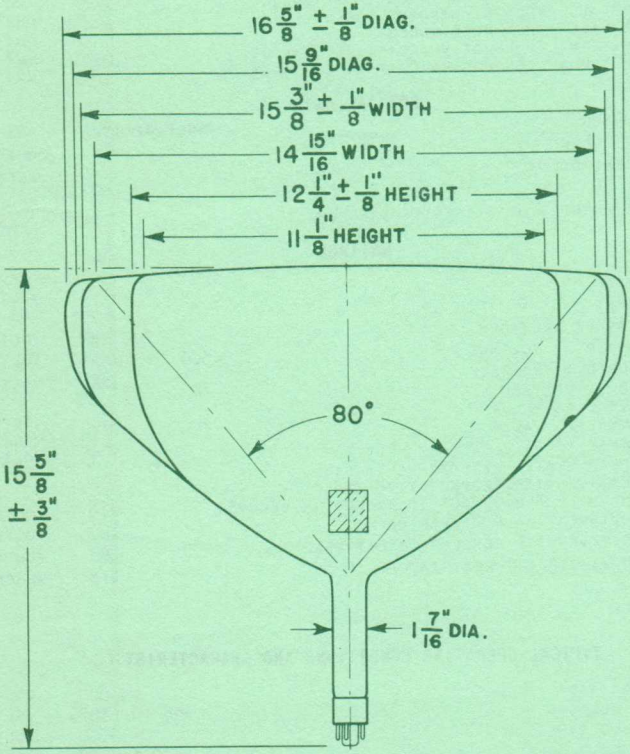
MECHANICAL DATA

OVERALL LENGTH	15 5/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 9/16	INCHES
WIDTH	14 15/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

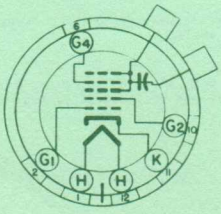
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE

PIN CONNECTIONS



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 17BNP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	ALUMINIZED SCREEN
UNIPOTENTIAL CATHODE	MAGNETIC DEFLECTION
GRAY FILTER FACEPLATE	EXTERNAL CONDUCTIVE COATING
RECTANGULAR GLASS CONSTRUCTION	14 5/16" X 11 1/8" RASTER SIZE

DOES NOT REQUIRE ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	$\mu\mu f$

OPTICAL DATA

PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

CATHODE DRIVE SERVICE

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE*	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	200	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CATHODE DRIVE[A]

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-50 TO +350	VOLTS
DC GRID #2 VOLTAGE	110	VOLTS
DC GRID #1 VOLTAGE[B]	-37 TO -50	VOLTS

[A] THIS TUBE MAY BE OPERATED IN GRID DRIVE IF DESIRED, WITH SOME LOSS IN EFFICIENCY. AVERAGE RASTER CUTOFF, USING DRIVE, MAY BE CALCULATED: $Eg1co = .502\ Eg2 + 5.8$

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

*BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

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TUNG-SOL

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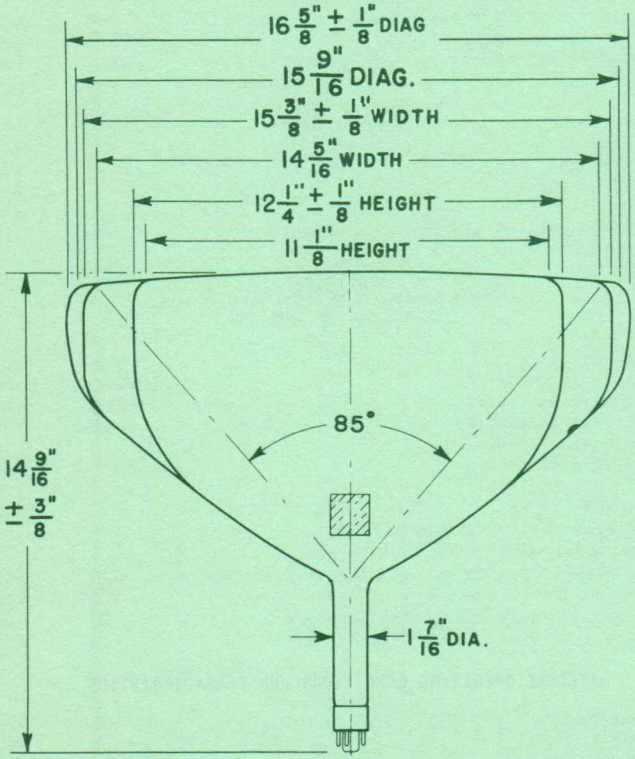
MECHANICAL DATA

OVERALL LENGTH	14 9/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 9/16	INCHES
WIDTH	14 5/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

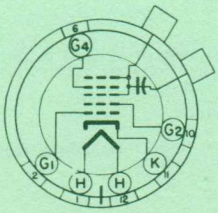
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ±30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 17BP4, 17BP4A, 17BP4B, AND 17BP4C ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING *EXCEPTIONS:*

17BP4 – NO EXTERNAL CONDUCTIVE COATING *17BP4B – ALUMINIZED SCREEN*
17BP4C – FROSTED FACEPLATE

THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE **GREY FILTER FACEPLATE**
MAGNETIC FOCUS AND DEFLECTION **14 1/4" X 10 3/4" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION **EXTERNAL SINGLE FIELD ION TRAP**
EXTERNAL CONDUCTIVE COATING

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
17BP4A, 17BP4B AND 17BP4C		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

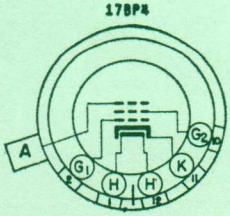
MECHANICAL DATA

OVERALL LENGTH	19 1/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 3/8	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING	17BP4 – 12D ALL OTHERS	12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

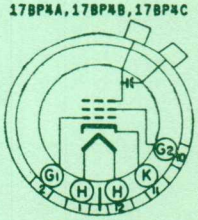
17BP4



BOTTOM VIEW

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

17BP4A, 17BP4B, 17BP4C



BOTTOM VIEW

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE[A]	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	92 ± 10%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	70	MA.

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

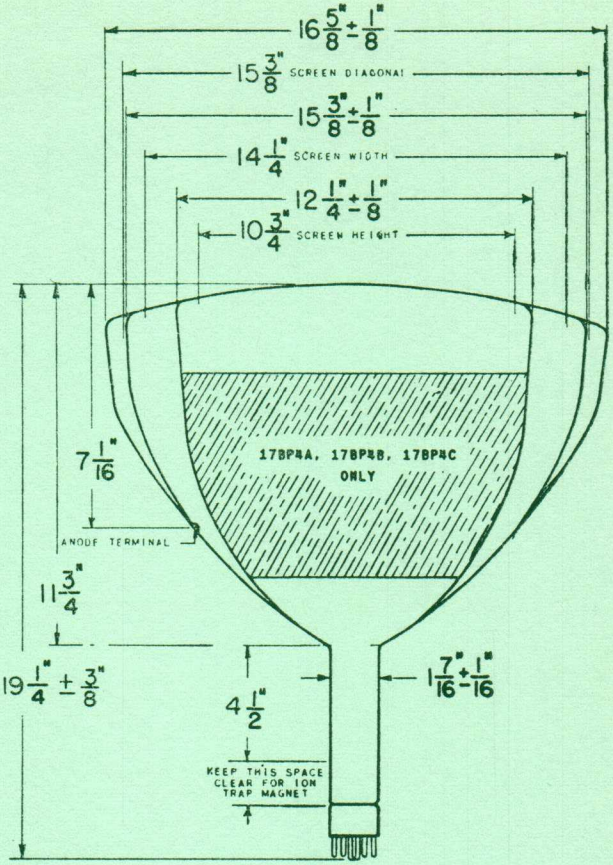
[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

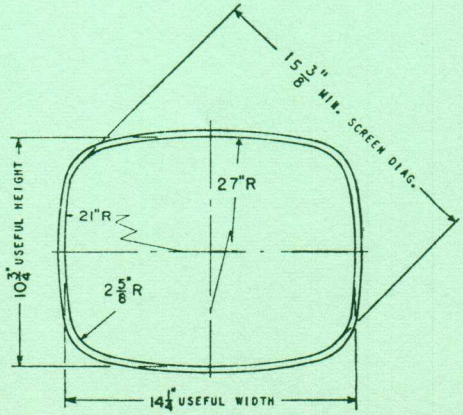
[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 14 1/4" X 10 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL





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TUNG-SOL

CATHODE RAY

THE 17BSP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

- ALUMINIZED SCREEN
- MAGNETIC DEFLECTION
- GRAY FILTER FACEPLATE
- DOES NOT REQUIRE ION TRAP
- ELECTROSTATIC FOCUS
- UNIPOTENTIAL CATHODE
- 14 5/16" X 11 1/8" RASTER SIZE
- RECTANGULAR GLASS CONSTRUCTION

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1200	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.45 ±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	140	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-50 TO +350	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MIDTAP OF THE HEATER TRANSFORMER WINDING.

[C] VISUAL EXTINCTION OF FOCUSED RASTER.

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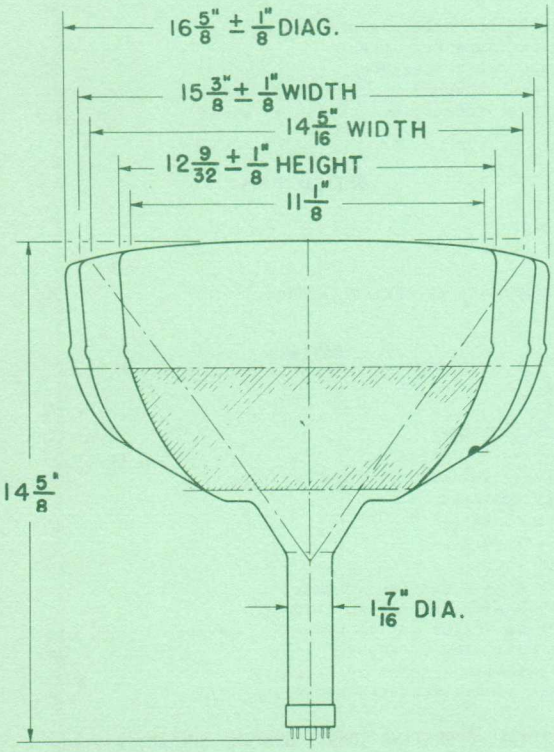
MECHANICAL DATA

OVERALL LENGTH	14 5/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
WIDTH	14 5/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

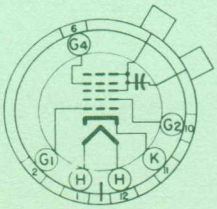
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 17BUP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. *EXCEPT* FOR HAVING AN ALUMINIZED SCREEN, THE 17BUP4 IS IDENTICAL TO THE 17CBP4. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE	**GRAY FILTER FACEPLATE**
EXTERNAL CONDUCTIVE COATING	**EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR GLASS CONSTRUCTION	**14 5/16" X 11 1/8" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1200	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	−500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[A]	12 000	VOLTS
DC GRID #4 VOLTAGE	−50 TO +350	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	−28 TO −72	VOLTS
DC ION TRAP MAGNET RATED STRENGTH	32	GAUSSES

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

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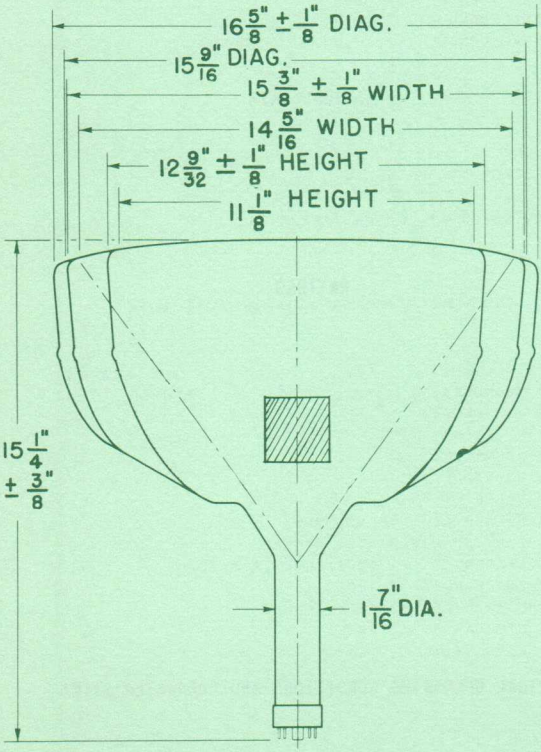
MECHANICAL DATA

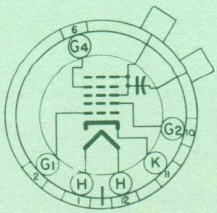
OVERALL LENGTH	15 1/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 9/16	INCHES
WIDTH	14 5/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6± 30 DEGREES



PIN CONNECTIONS



BOTTOM VIEW

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 17BVP4 IS A VERY SHORT, DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	ELECTROSTATIC FOCUS
MAGNETIC DEFLECTION	UNIPOTENTIAL CATHODE
GRAY FILTER FACEPLATE	EXTERNAL CONDUCTIVE COATING
14 3/4 X 11 3/4 RASTER SIZE	EXTERNAL SINGLE FIELD ION TRAP
RECTANGULAR GLASS CONSTRUCTION	CONTROLLED HEATER WARM-UP TIME

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	105	DEGREES
VERTICAL	87	DEGREES
DIAGONAL	110	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1000	$\mu\mu f$

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE	SHORT TO MEDIUM	
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	79	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±5%	AMP.
MAXIMUM DC ANODE VOLTAGE	17 600	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-550 TO +1100	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	154	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS
HEATER WARM-UP TIME (APPROX.)*	11.0	SECONDS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-50 TO +350	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-35 TO -72	VOLTS
DC ION TRAP MAGNET RATED STRENGTH	33	GAUSSES

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

*HEATER WARM-UP TIME IS THE TIME REQUIRED FOR THE VOLTAGE ACROSS THE HEATER TERMINALS TO INCREASE TO 5.0 VOLTS IN THE JETEC TEST CIRCUIT, WITH E =25 VOLTS AND SERIES R =31.5 OHMS.

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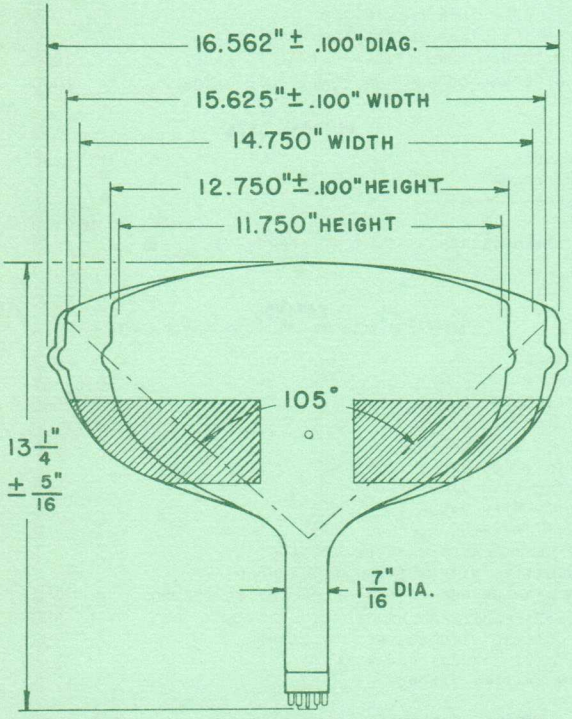
MECHANICAL DATA

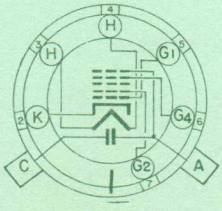
OVERALL LENGTH	13 1/4 ± 5/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16.562 ± .100	INCHES
WIDTH	15.625 ± .100	INCHES
HEIGHT	12.750 ± .100	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15.750	INCHES
WIDTH	14.750	INCHES
HEIGHT	11.750	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE		B6-185
BASING		7FA

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #7 ± 30 DEGREES



PIN CONNECTIONS

PIN 2 – CATHODE
PIN 3 – HEATER
PIN 4 – HEATER
PIN 5 – GRID #1
PIN 6 – GRID #4
PIN 7 – GRID #2



BOTTOM VIEW

ANODE CAP:
GRID NO. 3

TUNG-SOL

CATHODE RAY

THE 17BZP4 IS A VERY SHORT DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	ELECTROSTATIC FOCUS
MAGNETIC DEFLECTION	UNIPOTENTIAL CATHODE
GRAY FILTER FACEPLATE	DOES NOT REQUIRE ION TRAP
EXTERNAL CONDUCTIVE COATING	RECTANGULAR GLASS CONSTRUCTION

14 3/4" X 11 11/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	105	DEGREES
VERTICAL	87	DEGREES
DIAGONAL	110	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	800	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	78	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

GRID DRIVE SERVICE[A]

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	140	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

[A] GRID DRIVE IS THE OPERATING CONDITION IN WHICH THE VIDEO SIGNAL VARIES THE GRID #1 POTENTIAL WITH RESPECT TO CATHODE.

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RATINGS - CONT'D.

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

CATHODE DRIVE SERVICE[B]

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	140	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #2 TO GRID #1 VOLTAGE	640	VOLTS
MAXIMUM GRID #2 TO CATHODE VOLTAGE	500	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

GRID DRIVE SERVICE

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	0 TO 400	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS

CATHODE DRIVE SERVICE

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	0 TO 400	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	28 TO 60	VOLTS

[B] CATHODE DRIVE IS THE OPERATING CONDITION IN WHICH THE VIDEO SIGNAL VARIES THE CATHODE POTENTIAL WITH RESPECT TO GRID #1 AND THE OTHER ELECTRODES.

[C] VISUAL EXTINCTION ON FOCUSED RASTER.

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TUNG-SOL

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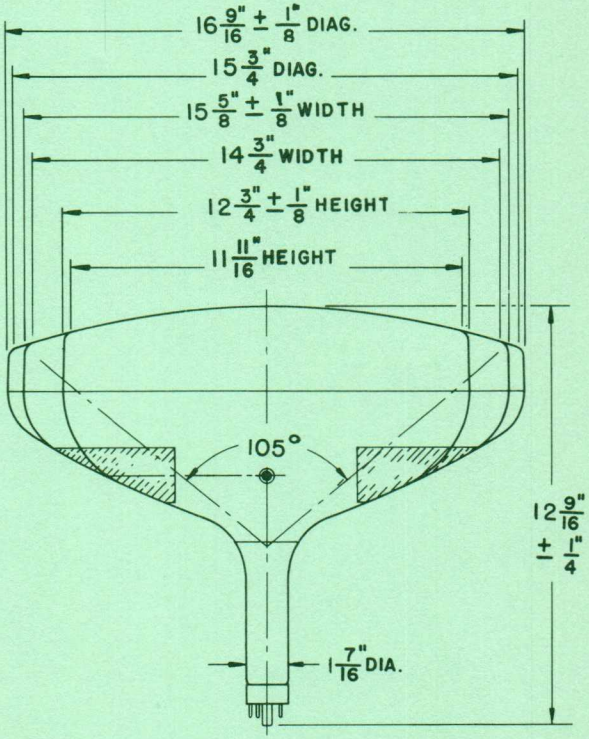
MECHANICAL DATA

OVERALL LENGTH	12 9/16 ± 1/4	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 9/16 ± 1/8	INCHES
WIDTH	15 5/8 ± 1/8	INCHES
HEIGHT	12 3/4 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 3/4	INCHES
WIDTH	14 3/4	INCHES
HEIGHT	11 11/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL BUTTON EIGHTAR 7 PIN-STYLE B	B7-183
BASING		8HR

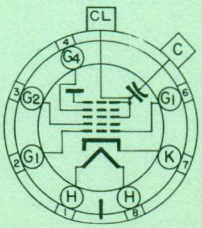
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #4 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 3 – GRID #2
PIN 4 – GRID #4
PIN 6 – GRID #1
PIN 7 – CATHODE



PIN 8 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

BOTTOM VIEW

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TUNG-SOL

CATHODE RAY

THE 17CBP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. *EXCEPT* FOR THE NON ALUMINIZED SCREEN, THE 17CBP4 IS IDENTICAL TO THE 17BUP4. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE	**GRAY FILTER FACEPLATE**
EXTERNAL CONDUCTIVE COATING	**EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR GLASS CONSTRUCTION	**14 5/16" X 11 1/8" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1200	$\mu\mu f$

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[A]	12 000	VOLTS
DC GRID #4 VOLTAGE	-50 TO +350	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC ION TRAP MAGNET RATED STRENGTH	32	GAUSSES

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

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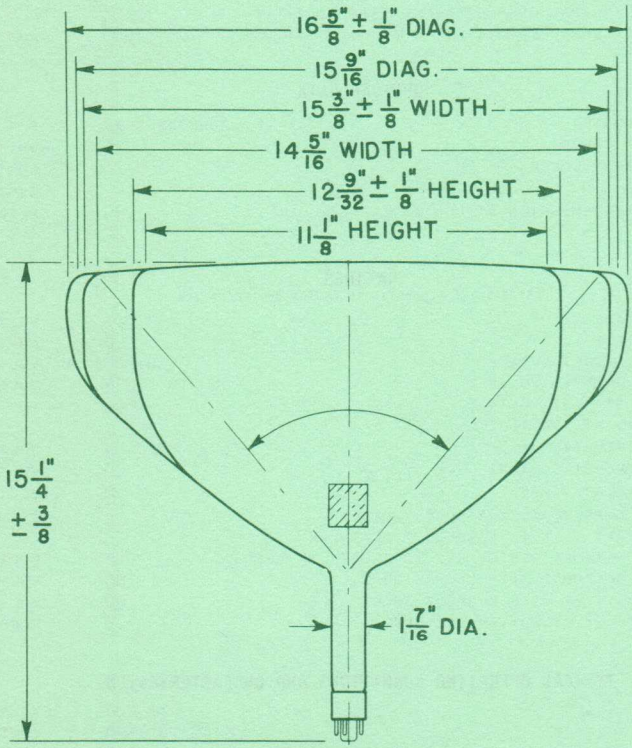
MECHANICAL DATA

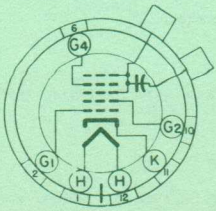
OVERALL LENGTH	15 1/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 9/16	INCHES
WIDTH	14 5/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6± 30 DEGREES



PIN CONNECTIONS



BOTTOM VIEW

PIN 1 — HEATER
PIN 2 — GRID #1
PIN 6 — GRID #4
PIN 10 — GRID #2
PIN 11 — CATHODE

PIN 12 — HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 17CDP4 IS A VERY SHORT DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	ELECTROSTATIC FOCUS
MAGNETIC DEFLECTION	UNIPOTENTIAL CATHODE
GRAY FILTER FACEPLATE	DOES NOT REQUIRE ION TRAP
EXTERNAL CONDUCTIVE COATING	RECTANGULAR GLASS CONSTRUCTION
CONTROLLED HEATER WARM-UP TIME	14 3/4" X 11 11/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	105	DEGREES
VERTICAL	87	DEGREES
DIAGONAL	110	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	800	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	78	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

GRID DRIVE SERVICE[A]

HEATER VOLTAGE	8.4	VOLTS
HEATER CURRENT	0.45	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	140	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
HEATER WARM-UP TIME (APPROX.)	11.0	SECONDS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

[A] GRID DRIVE IS THE OPERATING CONDITION IN WHICH THE VIDEO SIGNAL VARIES THE GRID #1 POTENTIAL WITH RESPECT TO CATHODE.

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RATINGS - CONT'D.

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

CATHODE DRIVE SERVICE[B]

HEATER VOLTAGE	8.4	VOLTS
HEATER CURRENT	0.45	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	140	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #2 TO GRID #1 VOLTAGE	640	VOLTS
MAXIMUM GRID #2 TO CATHODE VOLTAGE	500	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

GRID DRIVE SERVICE

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	0 TO 400	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS

CATHODE DRIVE SERVICE

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	0 TO 400	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	28 TO 60	VOLTS

[B] CATHODE DRIVE IS THE OPERATING CONDITION IN WHICH THE VIDEO SIGNAL VARIES THE CATHODE POTENTIAL WITH RESPECT TO GRID #1 AND THE OTHER ELECTRODES.

[C] VISUAL EXTINCTION ON FOCUSED RASTER.

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TUNG-SOL

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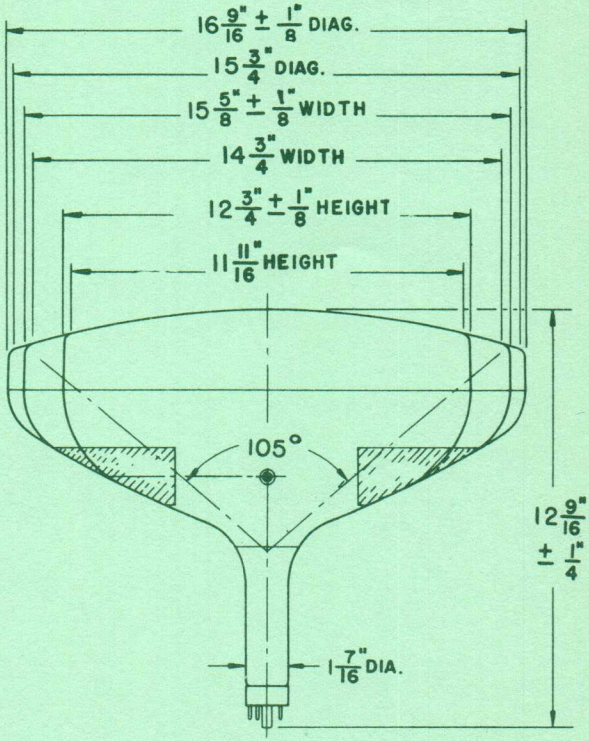
MECHANICAL DATA

OVERALL LENGTH	12 9/16 ± 1/4	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 9/16 ± 1/8	INCHES
WIDTH	15 5/8 ± 1/8	INCHES
HEIGHT	12 3/4 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 3/4	INCHES
WIDTH	14 3/4	INCHES
HEIGHT	11 11/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL BUTTON EIGHTAR 7 PIN-STYLE B	B7-183
BASING		8HR

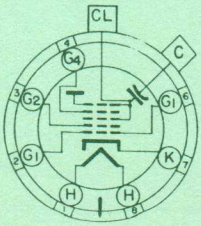
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #4 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 3 – GRID #2
PIN 4 – GRID #4
PIN 6 – GRID #1
PIN 7 – CATHODE



BOTTOM VIEW

PIN 8 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

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CATHODE RAY

THE 17CGP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN — **MAGNETIC DEFLECTION**
ELECTROSTATIC FOCUS — **UNIPOTENTIAL CATHODE**
GRAY FILTER FACEPLATE — **EXTERNAL CONDUCTIVE COATING**
RECTANGULAR GLASS CONSTRUCTION — **14 5/16" X 18 1/8" RASTER SIZE**
DOES NOT REQUIRE ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	11 000	VOLTS
DC GRID #4 VOLTAGE	-56 TO +310	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

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TUNG-SOL

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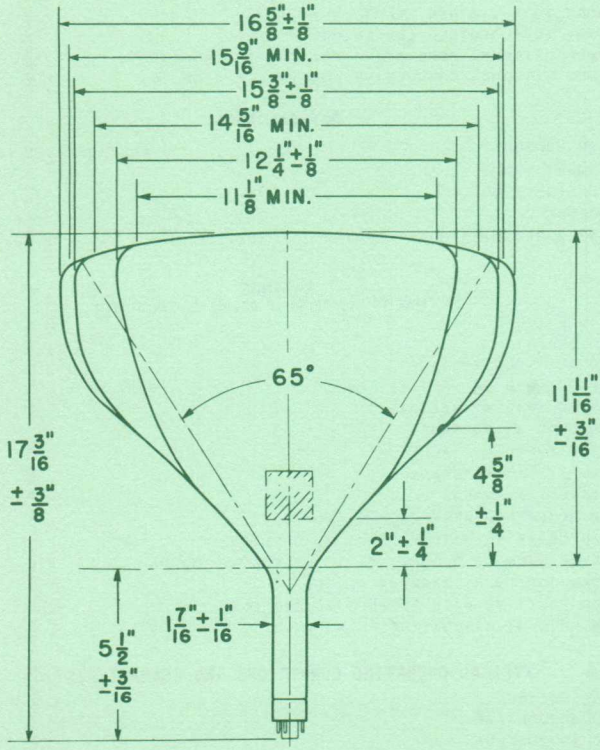
MECHANICAL DATA

OVERALL LENGTH	17 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	15 9/16	INCHES
WIDTH	14 5/16	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

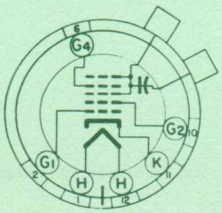
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 — HEATER
PIN 2 — GRID #1
PIN 6 — GRID #4
PIN 10 — GRID #2
PIN 11 — CATHODE



BOTTOM VIEW

PIN 12 — HEATER
ANODE CAP:
GRID NO.3
GRID NO.5

TUNG-SOL

CATHODE RAY

THE 17CP4 AND 17CP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING *EXCEPTION:*

17CP4 — FROSTED FACEPLATE *17CP4A - UNFROSTED FACEPLATE*

THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
14 5/8" X 11" RASTER SIZE
RECTANGULAR METAL CONSTRUCTION
FILTER GLASS FACEPLATE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	65	PERCENT

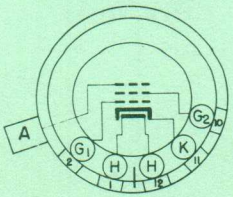
MECHANICAL DATA

OVERALL LENGTH	19	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 13/16 ± 3/16	INCHES
WIDTH	15 15/16 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
WIDTH	14 5/8	INCHES
HEIGHT	11	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BASE ALIGNMENT
PIN #6 ALIGNS WITH HORIZONTAL PICTURE AXIS ± 10 DEGREES

PIN CONNECTIONS

PIN 1 — HEATER
PIN 2 — GRID NO. 1
PIN 10 — GRID NO. 2
PIN 11 — CATHODE



BOTTOM VIEW

PIN 12 — HEATER
METAL SHELL LIP: ANODE

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE[A]	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] THE PRODUCT OF ANODE VOLTAGE AND AVERAGE ANODE CURRENT SHOULD BE LIMITED TO 6 WATTS.

TYPICAL OPERATING CONDITIONS ANDECHARACTERISTICS

DC ANODE VOLTAGE[B]	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[D] (APPROX.)	96 ± 6%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	70	MA.
FIELD STRENGTH OF ION TRAP MAGNET	45	GAUSSES

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 12,000 VOLTS.

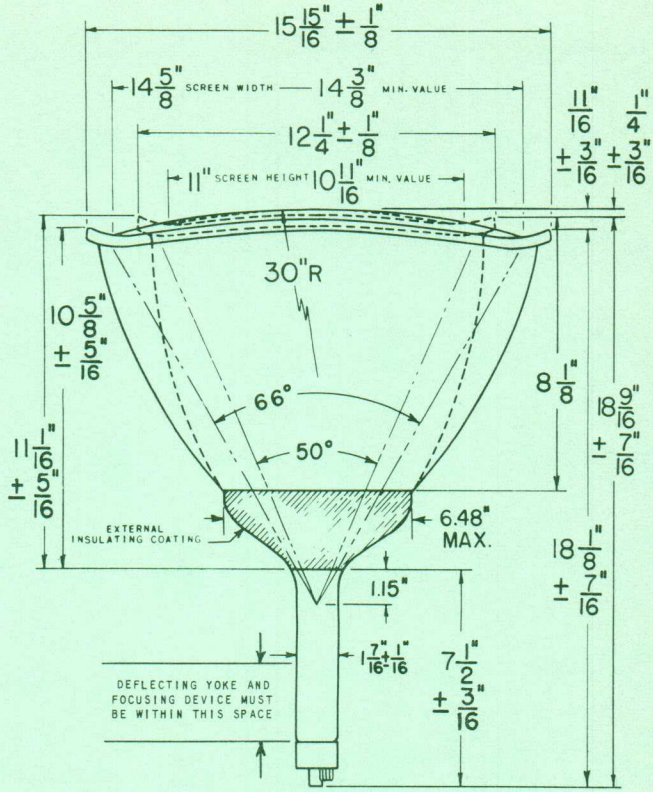
[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

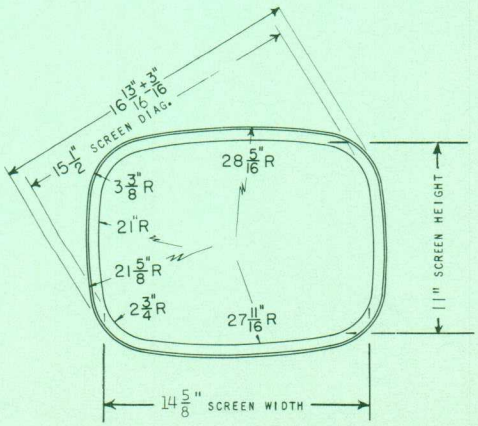
[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 10 11/16" BY 14 3/8" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL


15 15/16" ± 1/8"
14 5/8" SCREEN WIDTH
14 3/8" MIN. VALUE
12 1/4" ± 1/8"
11" SCREEN HEIGHT
10 11/16" MIN. VALUE
11/16" ± 3/16"
1/4" ± 3/16"
30"R
10 5/8" ± 5/16"
66°
50°
8 1/8"
18 9/16" ± 7/16"
11 1/16" ± 5/16"
EXTERNAL INSULATING COATING
6.48" MAX.
18 1/8" ± 7/16"
1.15"
1 7/16" ± 1/16"
7 1/2" ± 3/16"
DEFLECTING YOKE AND FOCUSING DEVICE MUST BE WITHIN THIS SPACE


16 13/16" ± 3/16" SCREEN DIAG.
15 1/2" SCREEN DIAG.
28 5/16"R
3 3/8"R
21"R
21 5/8"R
2 3/4"R
27 11/16"R
11" SCREEN HEIGHT
14 5/8" SCREEN WIDTH

TUNG-SOL

CATHODE RAY

THE 17FP4 AND 17FP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING *EXCEPTION:*

17FP4 - PARTIAL EXTERNAL COATING *17FP4A - COMPLETE EXTERNAL COATING*

THEIR COMMON FEATURES INCLUDE:

ELECTROSTATIC FOCUS **MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE **GREY FILTER FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION **EXTERNAL SINGLE FIELD ION TRAP**
14 1/4" X 11 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD			ELECTROSTATIC
DEFLECTING METHOD			MAGNETIC
DEFLECTION ANGLE (APPROX.)			
HORIZONTAL		65	DEGREES
DIAGONAL		70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)			
CATHODE TO ALL OTHER ELECTRODES		5	µµf
GRID #1 TO ALL OTHER ELECTRODES		6	µµf
	17FP4A	**17FP4**	
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	750	µµf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	500	µµf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

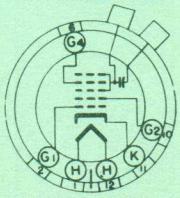
MECHANICAL DATA

OVERALL LENGTH	19 1/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 1/2	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	11 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID #3,
GRID #5,
COLLECTOR

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TUNG-SOL

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC ANODE #1 VOLTAGE	5 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[B]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

[A] IF THIS TUBE IS OPERATED AT VOLTAGE IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER OF PERSONAL INJURY FROM PROLONGED EXPOSURE AT CLOSE RANGE.

[B] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MIDTAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	12 000	VOLTS
DC ANODE #1 VOLTAGE (FOCUSING ELECTRODE)[C]	2300 TO 3550	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[D]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.
ION TRAP FIELD INTENSITY (APPROX.)	35	GAUSSES

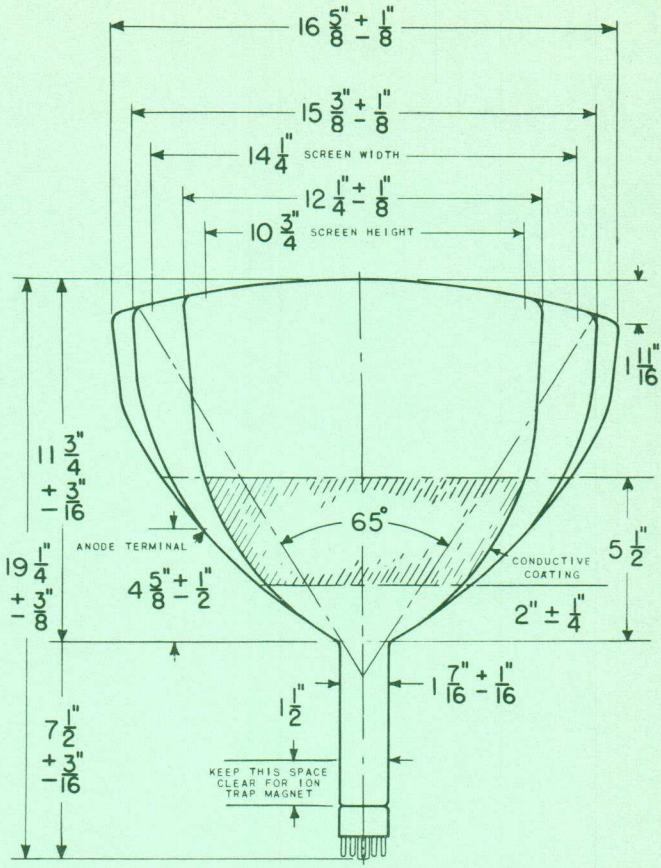
[C] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE CURRENT OF 100 MICROAMPERES ON A 10 3/4" X 14 1/4" PICTURE SIZE.

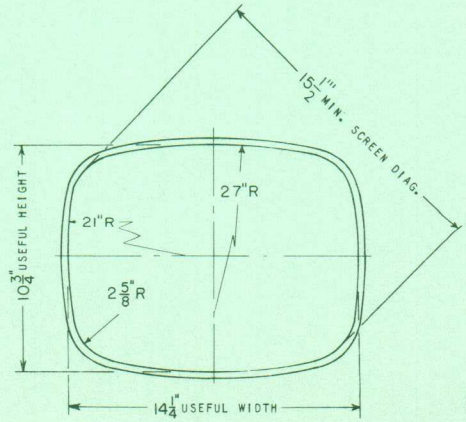
[D] VISUAL EXTINCTION OF UNDEFLECTED FOCUSING SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL





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CATHODE RAY

THE 17GP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION — **UNIPOTENTIAL CATHODE**
ELECTROSTATIC FOCUS — **FROSTED FILTERGLASS FACEPLATE**
RECTANGULAR METAL CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
14 5/8" X 11" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

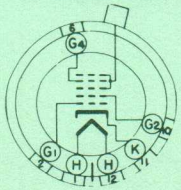
PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

MAXIMUM OVERALL LENGTH	19 5/16	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 13/16 ± 3/16	INCHES
WIDTH	15 15/16 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 1/2	INCHES
WIDTH	14 5/8	INCHES
HEIGHT	11	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M
BASE ALIGNMENT		
PIN #6 ALIGNS WITH HORIZONTAL PICTURE AXIS ± 10 DEGREES		

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 4
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	5 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
GRID #4 CURRENT	-15 TO +25	μAMP.
GRID #2 CURRENT	-15 TO +15	μAMP.
GRID #4 VOLTAGE FOR ANODE CURRENT OF 100 μAMP.	2670 TO 3620	VOLTS
FIELD STRENGTH OF ION TRAP MAGNET	40	GAUSSES
FIELD STRENGTH OF ADJUSTABLE CENTERING MAGNET	0 TO 8	GAUSSES

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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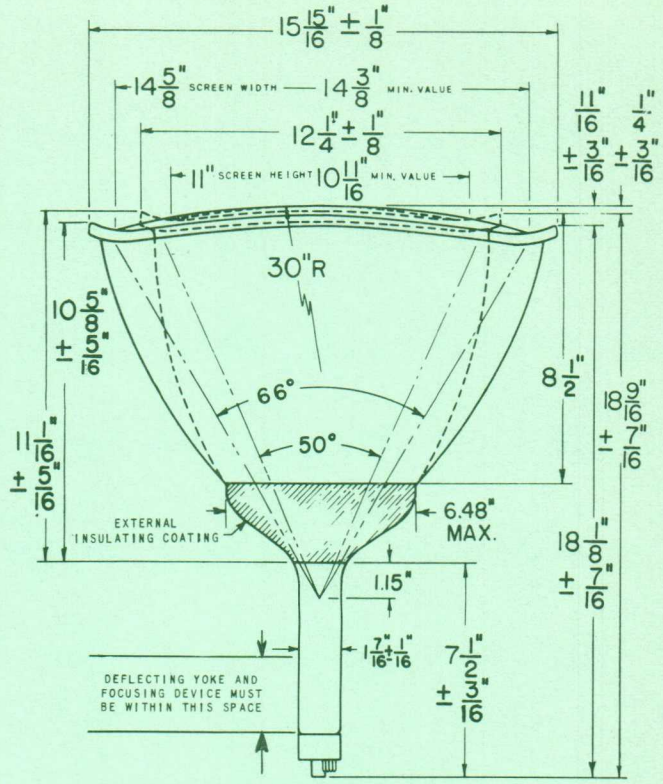

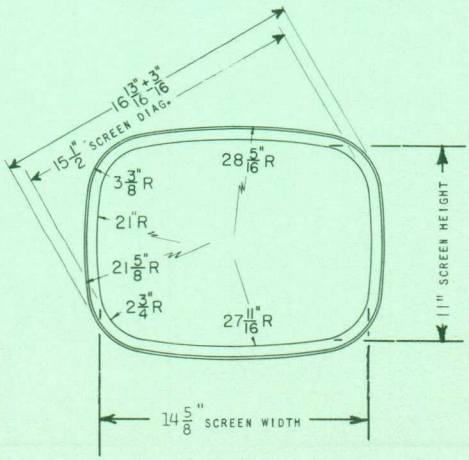

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CATHODE RAY

THE 17HP4, 17HP4A AND 17HP4B ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING *EXCEPTIONS:*

17HP4 - GREY FILTER FACEPLATE *17HP4A - GREY FROSTED FILTER FACEPLATE*
17HP4B - ALUMINIZED SCREEN

THEIR COMMON FEATURES INCLUDE:

ELECTROSTATIC FOCUS **MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE **EXTERNAL CONDUCTIVE COATING**
RECTANGULAR GLASS CONSTRUCTION **EXTERNAL SINGLE FIELD ION TRAP**
10 3/4" X 14 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	500	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-56 TO 310	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	85	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

→ INDICATES A CHANGE.

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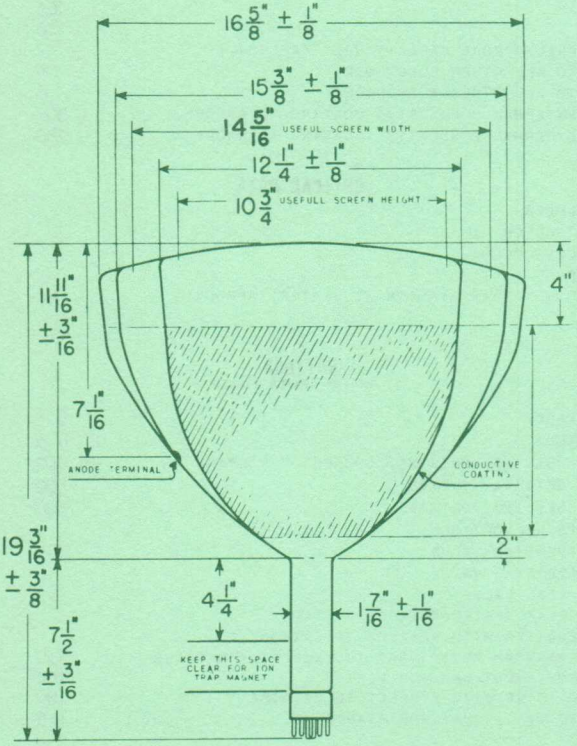
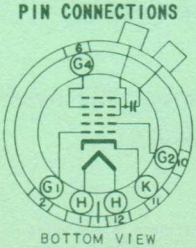
MECHANICAL DATA

OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
WIDTH	14 5/16 ←	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L
BULB CONTACT ALIGNMENT		
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES		



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID #3,
GRID #5,
COLLECTOR

TUNG-SOL

CATHODE RAY

THE 17JP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

NEUTRAL DENSITY FACEPLATE — **UNIPOTENTIAL CATHODE**
EXTERNAL CONDUCTIVE COATING — **MAGNETIC FOCUS & DEFLECTION**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
10 3/4" X 14 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO COLLECTOR	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO COLLECTOR	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

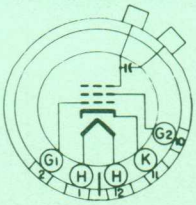
MECHANICAL DATA

OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 +1/8 −7/32	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 1/2	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
COLLECTOR

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3 & COLLECTOR VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3 & COLLECTOR VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	110 ± 10%	MA.
ION TRAP RATED STRENGTH STANDARD COIL #111	50	GAUSSES

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 14 1/4" BY 10 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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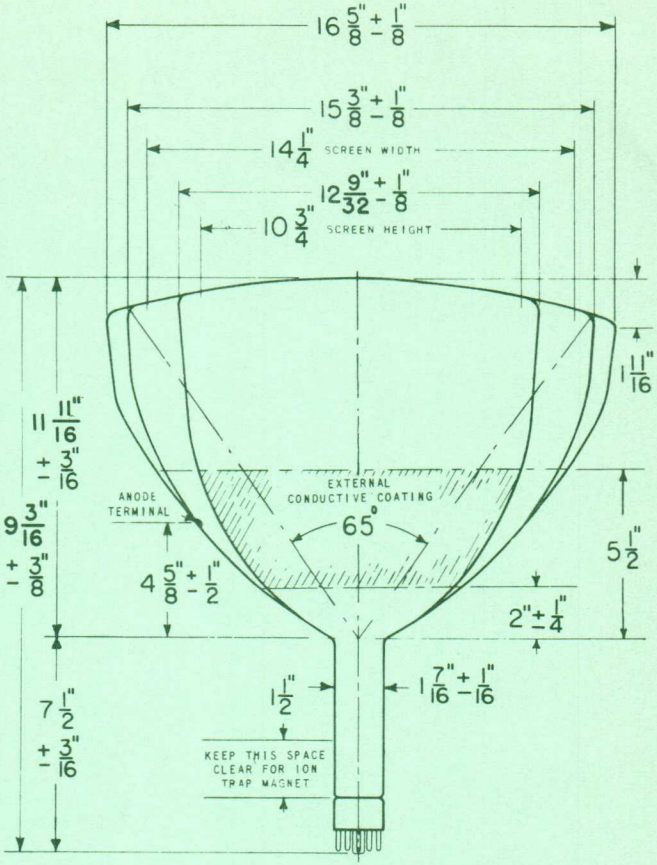

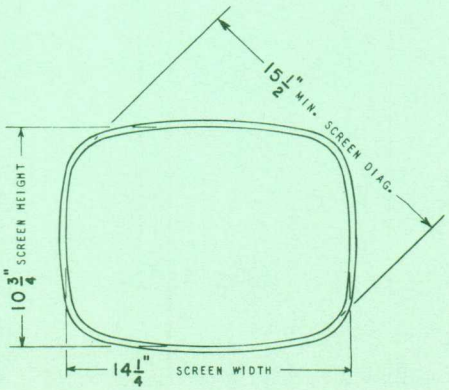

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CATHODE RAY

THE 17KP4 IS A DIRECT VIEW PICTURE TUBE INTENDED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION	**ELECTROSTATIC FOCUS**
UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
EXTERNAL CONDUCTIVE COATING	**14 1/4" X 10 3/4" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	6.0	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 000	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

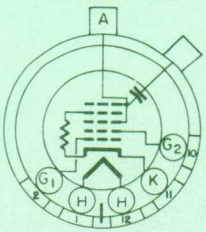
MECHANICAL DATA

OVERALL LENGTH	19 1/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12P

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN NO. 1 – HEATER
PIN NO. 2 – GRID NO. 1
PIN NO. 10 – GRID NO. 2



BOTTOM VIEW

PIN NO. 11 – CATHODE
PIN NO. 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	50 ± 50%	MA.
FIELD STRENGTH OF CENTERING MAGNET	0 TO 8	GAUSSES

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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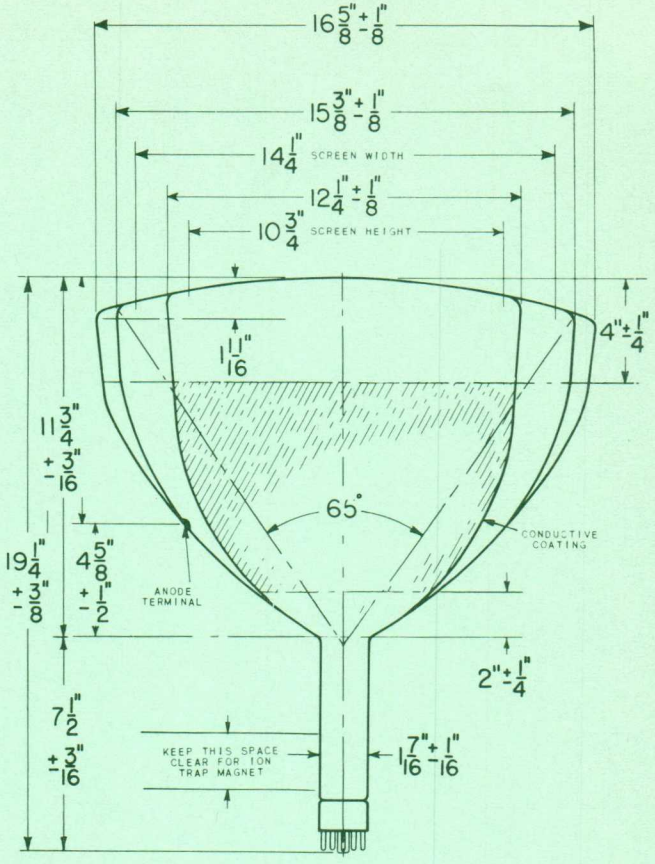

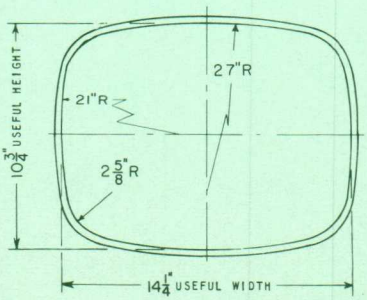

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CATHODE RAY

THE 17LP4 AND 17LP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING *EXCEPTION:*

17LP4 - ALUMINIZED SCREEN

THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION	GREY FILTER FACEPLATE
CYLINDRICAL FACEPLATE	14 1/4" X 10 3/4" RASTER SIZE
EXTERNAL CONDUCTIVE COATING	EXTERNAL SINGLE FIELD ION TRAP
RECTANGULAR GLASS CONSTRUCTION	LOW VOLTAGE ELECTROSTATIC FOCUS

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO COLLECTOR	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO COLLECTOR	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
PEAK POSITIVE VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC GRID #4 VOLTAGE (APPROX.)[C]	-48 TO +260	VOLTS
GRID #4 CURRENT	-15 TO +25	μAMP.
GRID #2 CURRENT	-15 TO +15	μAMP.
ION TRAP FIELD STRENGTH (APPROX.)[D]	35	GAUSSES

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] OVER THE USEFUL RANGE OF COLLECTOR VOLTAGE, GRID #4 REQUIRED FOR FOCUS OF FROM -0.4 TO +2.2% OF THE COLLECTOR VOLTAGE.

[D] FOR SINGLE FIELD ION TRAP MAGNET, RETMA #111 OR EQUIVALENT.

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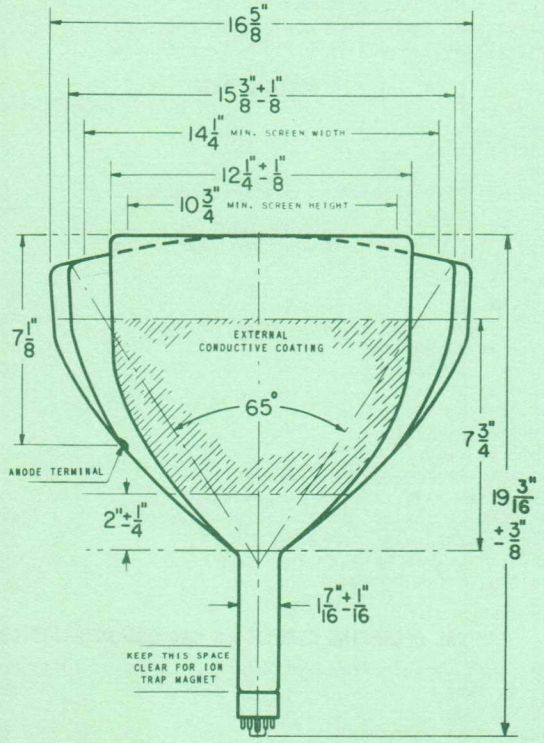
MECHANICAL DATA

OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 5/16	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

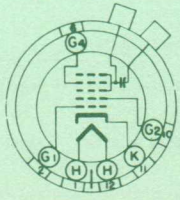
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5
COLLECTOR

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CATHODE RAY

THE 17QP4 AND 17QP4A ARE DIRECT VIEW PICTURE TUBES INTENDED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 17QP4A.

GREY FILTER FACEPLATE	UNIPOTENTIAL CATHODE
EXTERNAL CONDUCTIVE COATING	CYLINDRICAL FACEPLATE
MAGNETIC FOCUS AND DEFLECTION	10 3/4" X 14 1/4" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION	EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR	SULFIDE TYPE	NO. 4.
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	18 000 ←	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500 ←	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	14 000 ←	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72 ←	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	95 ←	MA.
ION TRAP FIELD INTENSITY STANDARD COIL #111 (APPROX.)	30 ←	GAUSSES

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 14 1/4" BY 10 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

→ INDICATES A CHANGE.

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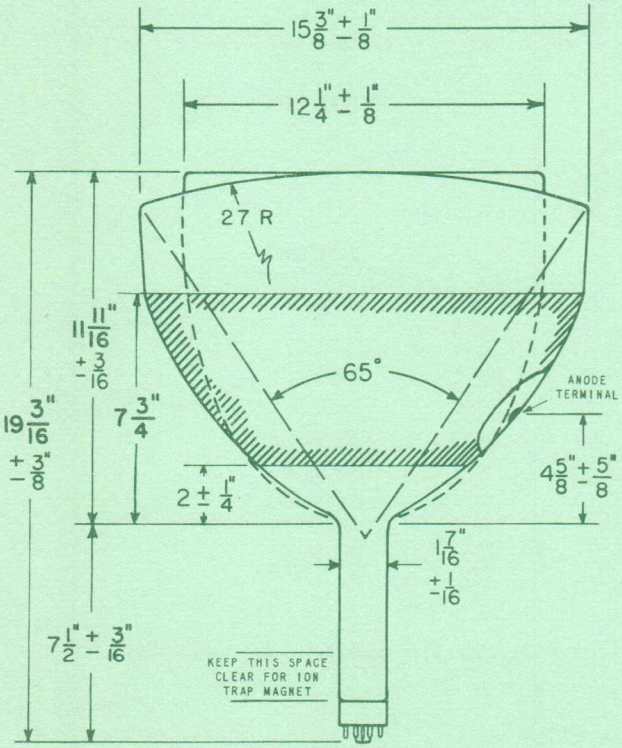
MECHANICAL DATA

OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 5/16	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

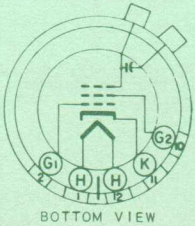
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH VACANT PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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CATHODE RAY

THE 17RP4 AND 17RP4C ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 17RP4C. THEIR COMMON FEATURES INCLUDE.

ELECTROSTATIC FOCUS	MAGNETIC DEFLECTION
UNIPOTENTIAL CATHODE	GREY FILTER FACEPLATE
EXTERNAL CONDUCTIVE COATING	14 1/4" X 10 3/4" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION	EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	16 000	VOLTS
MAXIMUM DC ANODE #1 VOLTAGE	−500 TO +1000 ←	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	12 000	VOLTS
DC ANODE #1 VOLTAGE (FOCUSING ELECTRODE)[A]	0	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	−33 TO −77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

[A] THE FOCUS ELECTRODE MAY BE MODULATED FOR IMPROVED OVERALL FOCUS.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

→ INDICATES A CHANGE.

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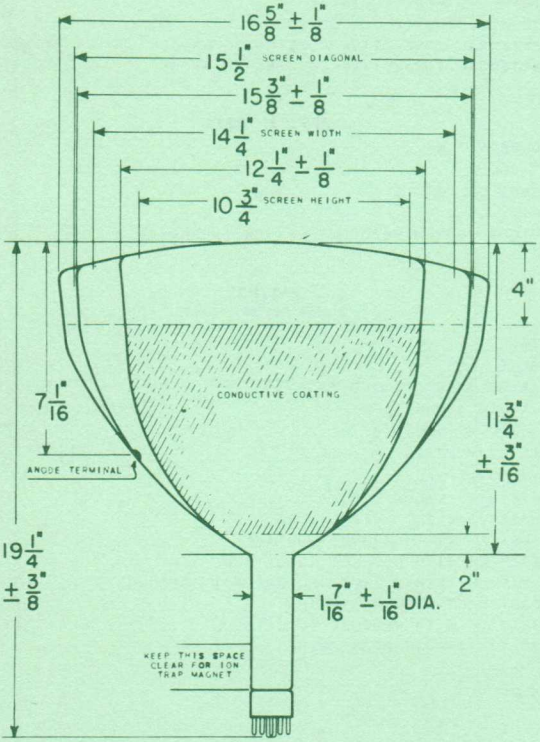
MECHANICAL DATA

OVERALL LENGTH	19 1/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 1/2	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

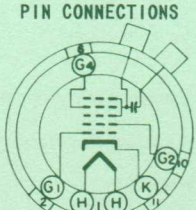
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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CATHODE RAY

THE 17SP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS — **MAGNETIC DEFLECTION**
CYLINDRICAL FACEPLATE — **UNIPOTENTIAL CATHODE**
EXTERNAL CONDUCTIVE COATING — **GREY FILTER FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
14 1/2" X 10 7/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

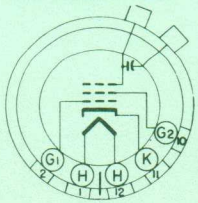
MECHNICAL DATA

OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 13/16	INCHES
WIDTH	14 1/2	INCHES
HEIGHT	10 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11-CATHODE
PIN 12-HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MIDTAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	120	MA.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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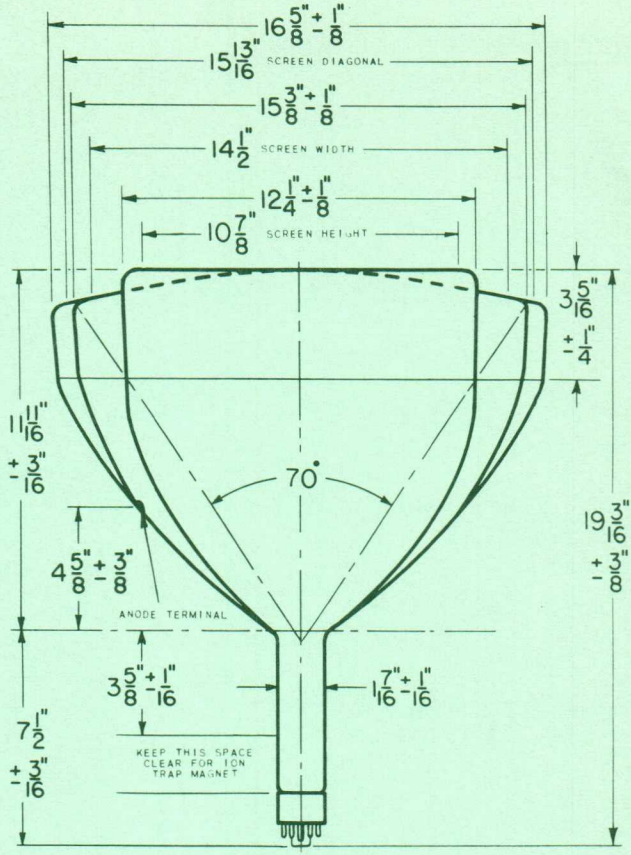

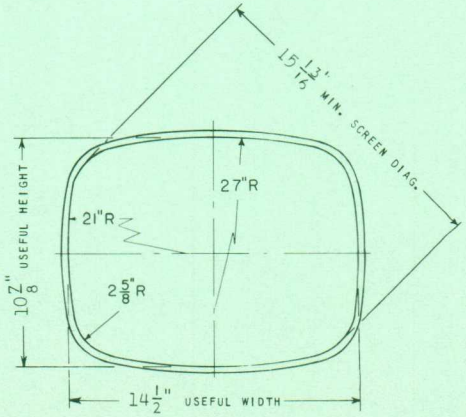

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CATHODE RAY

THE 17TP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION — **UNIPOTENTIAL CATHODE**
FROSTED FILTERGLASS FACEPLATE — **EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR METAL CONSTRUCTION — **LOW VOLTAGE ELECTROSTATIC FOCUS**
14 5/8" X 11" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

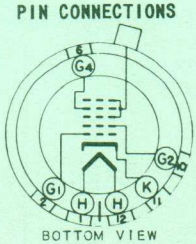
MECHANICAL DATA

OVERALL LENGTH	19 5/16	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 13/16 ± 3/16	INCHES
WIDTH	15 15/16 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 1/2	INCHES
WIDTH	14 5/8	INCHES
HEIGHT	11	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

BASE ALIGNMENT
PIN #6 ALIGNS WITH HORIZONTAL PICTURE AXIS ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	−500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	−33 TO −77	VOLTS
ION TRAP MAGNET (RATED STRENGTH)	35	GAUSSES
DC GRID #4 VOLTAGE	0 TO 350	VOLTS

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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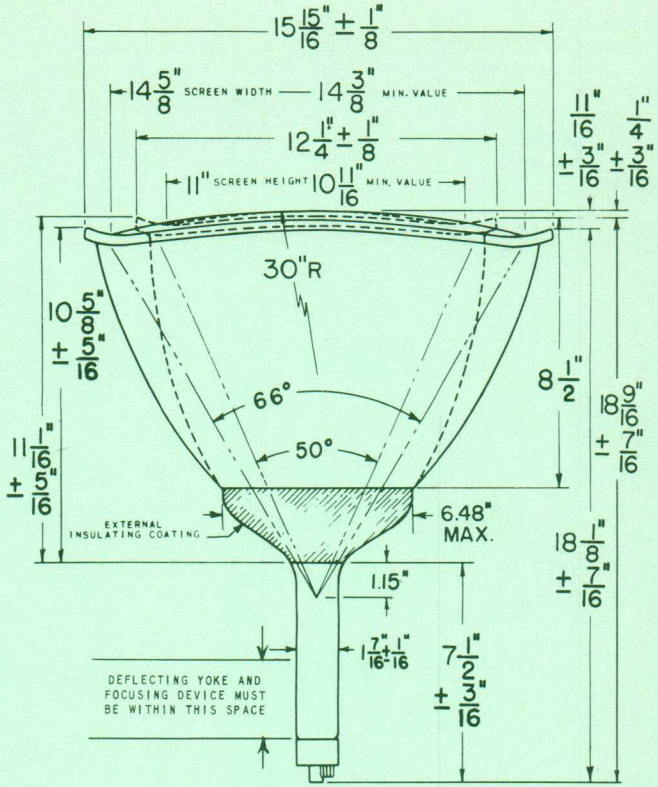
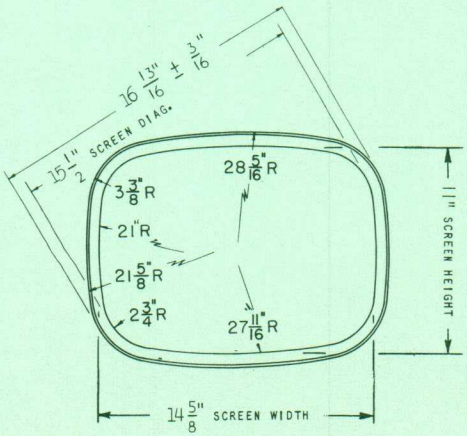

15 15/16" ± 1/8"
14 5/8" SCREEN WIDTH
14 3/8" MIN. VALUE
12 1/4" ± 1/8"
11" SCREEN HEIGHT
10 11/16" MIN. VALUE
11/16" ± 3/16"
1/4" ± 3/16"
30"R
10 5/8" ± 5/16"
66°
50°
8 1/2"
18 9/16" ± 7/16"
11 1/16" ± 5/16"
EXTERNAL INSULATING COATING
6.48" MAX.
18 1/8" ± 7/16"
1.15"
1 7/16" ± 1/16"
7 1/2" ± 3/16"
DEFLECTING YOKE AND FOCUSING DEVICE MUST BE WITHIN THIS SPACE


16 13/16" ± 3/16" SCREEN DIAG.
15 1/2"
28 5/16"R
3 3/8"R
21"R
21 5/8"R
2 3/4"R
27 11/16"R
11" SCREEN HEIGHT
14 5/8" SCREEN WIDTH

TUNG-SOL

CATHODE RAY

THE 17UP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE	**UNIPOTENTIAL CATHODE**
EXTERNAL CONDUCTIVE COATING	**CYLINDRICAL FACEPLATE**
MAGNETIC FOCUS AND DEFLECTION	**14 1/2" X 10 7/8" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	70	PERCENT

MECHANICAL DATA

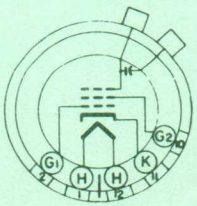
OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 13/16	INCHES
WIDTH	14 1/2	INCHES
HEIGHT	10 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	14 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

[A] THE CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MIDTAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	110	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	120	MA.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 7 1/2" BY 10" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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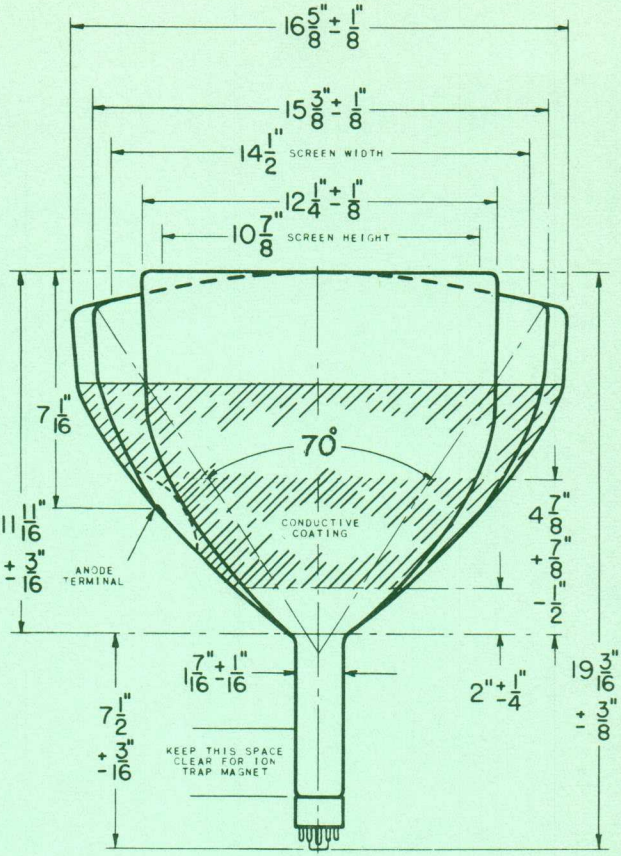

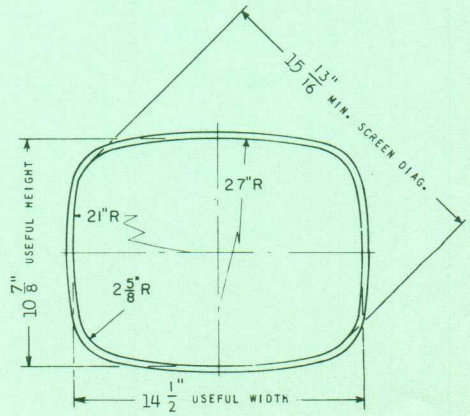

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TUNG-SOL

CATHODE RAY

THE 17VP4 AND 17VP4B ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 17VP4B. THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION	**UNIPOTENTIAL CATHODE**
EXTERNAL CONDUCTIVE COATING	**CYLINDRICAL FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION	**NEUTRAL DENSITY FACEPLATE**
LOW VOLTAGE ELECTROSTATIC FOCUS	**EXTERNAL SINGLE FIELD ION TRAP**

10 7/8" X 14 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	58 - 72	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE #2, GRID #3 VOLTAGE (WITH PROTECTIVE FACE VIEWING WINDOW)[A]	16 000	VOLTS
MAXIMUM ANODE #1 VOLTAGE RANGE FOR FOCUS[B]	-64 TO +350	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC ANODE #1 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC ANODE #1 CURRENT RANGE	-15 TO +25	μAMP.
* MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

[B] WITH THE COMBINED GRID #1 VOLTAGE AND VIDEO-DRIVE VOLTAGE ADJUSTED, USING AN INDIAN HEAD TEST PATTERN WITH THE BLACKS JUST BLACK, TO GIVE AN AVERAGE BEAM CURRENT OF 100 MICROAMPERES ON A 10 3/4" BY 14 1/4" PICTURE AREA.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE #2,, GRID #3 VOLTAGE	12 000	VOLTS
DC ANODE #1 VOLTAGE (FOCUSING ELECTRODE)	-48 TO +260	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111	75 ± 50%	MA.
ION TRAP FIELD INTENSITY (APPROX.)[D]	35	GAUSSES

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[D] SINGLE FIELD ION-TRAP ADJUSTED TO OPTIMUM POSITION.

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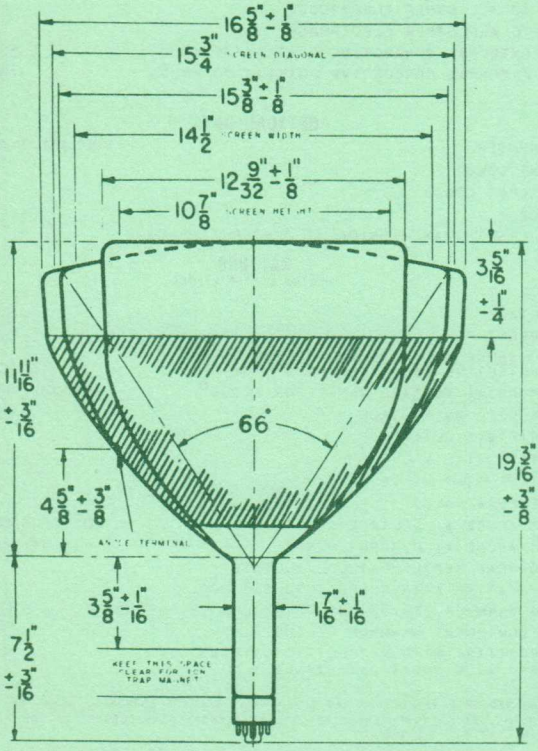
MECHANICAL DATA

OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 9/32 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 3/4	INCHES
WIDTH	14 1/2	INCHES
HEIGHT	10 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

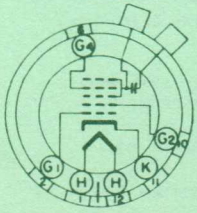
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

TUNG-SOL

CATHODE RAY

THE 17YP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE	**UNIPOTENTIAL CATHODE**
EXTERNAL CONDUCTIVE COATING	**CYLINDRICAL FACEPLATE**
MAGNETIC FOCUS AND DEFLECTION	**10 3/4" X 14 1/4" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	55	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO COLLECTOR	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO COLLECTOR	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

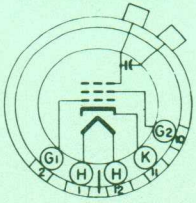
OVERALL LENGTH	19 3/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	16 5/8 ± 1/8	INCHES
WIDTH	15 3/8 ± 1/8	INCHES
HEIGHT	12 1/4 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	15 3/4	INCHES
WIDTH	14 1/4	INCHES
HEIGHT	10 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
COLLECTOR

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC COLLECTOR VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE BIASE VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC COLLECTOR VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)	100	MA.
ION TRAP FIELD INTENSITY (APPROX.)	45	GAUSSES

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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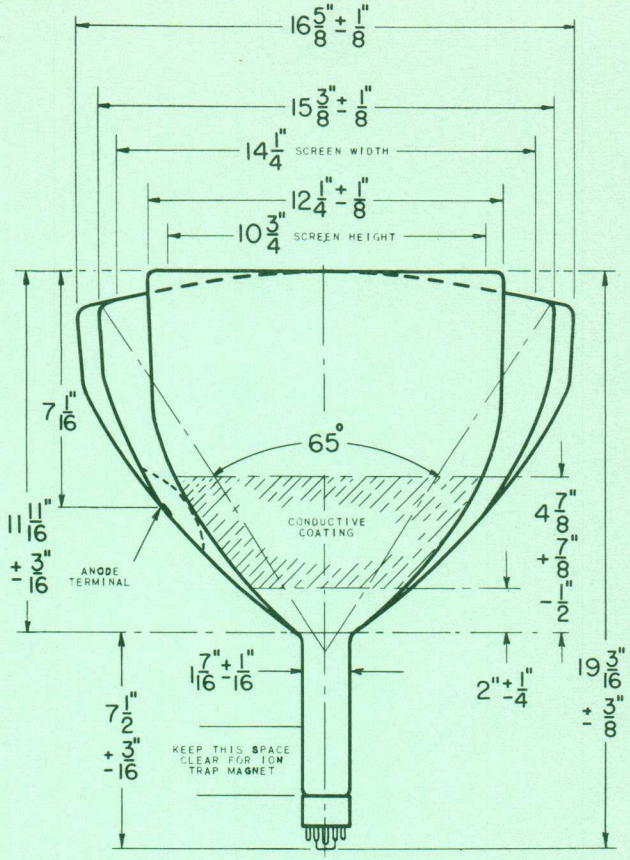

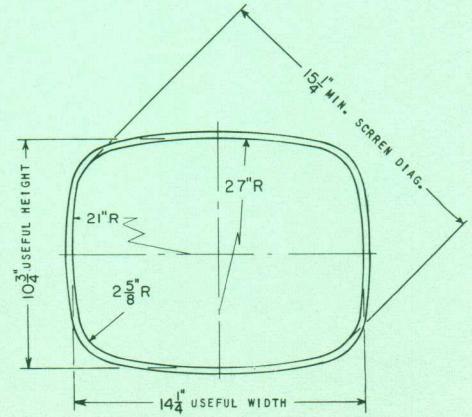

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CATHODE RAY

THE 19AP4, 19AP4A, 19AP4B, 19AP4C, AND 19AP4D ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL EXCEPT FOR THE FOLLOWING DIFFERENCES IN THEIR FACEPLATES.

19AP4 - CLEAR GLASS FACEPLATE
19AP4A - GREY FILTER FACEPLATE
19AP4B - FROSTED FILTER FACEPLATE
19AP4C - GREY FILTER FACEPLATE ALUMINIZED SCREEN
19AP4D - CLEAR FROSTED FACEPLATE

THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE **ROUND METAL CONSTRUCTION**
MAGNETIC FOCUS AND DEFLECTION **EXTERNAL SINGLE FIELD ION TRAP**
11 3/4" X 15 3/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	66	DEGREES
DIRECT INTERELECTRODE CAPACITANCES, (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	7	μμf

OPTICAL DATA

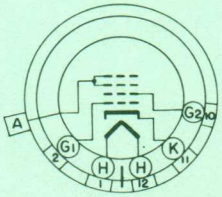
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

OVERALL LENGTH	21 1/2 ± 1/2	INCHES
GREATEST DIAMETER OF BULB	18 5/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	17 3/8	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 10 - GRID NO. 2
PIN 11 - CATHODE



PIN 12 - HEATER
METAL SHELL LIP: GRID NO. 3
ANODE

BOTTOM VIEW

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE[A]	19 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

[A] IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER OF PERSONAL INJURY FROM PROLONGED EXPOSURE AT CLOSE RANGE.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12.000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	140 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

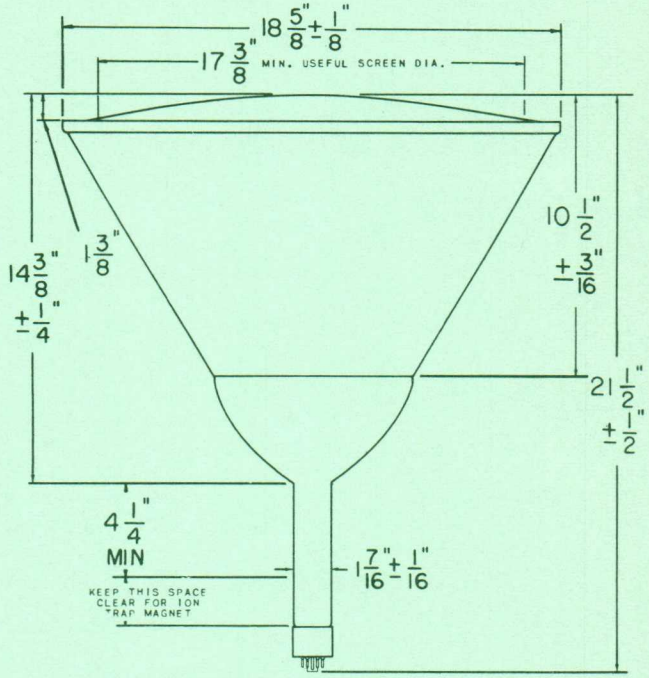
[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #106, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 18 FOOT LAMBERTS ON A 11 3/4" X 15 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 19DP4 AND 19DP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL EXCEPT FOR THE FOLLOWING DIFFERENCE IN THEIR FACEPLATES:

19DP4 - CLEAR GLASS FACEPLATE *19DP4A - GREY FILTER FACEPLATE*

THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
11 3/4" X 15 3/4" RASTER SIZE
ROUND GLASS CONSTRUCTION
EXTERNAL CONDUCTIVE COATING
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	66	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.) **19DP4A**	70	PERCENT

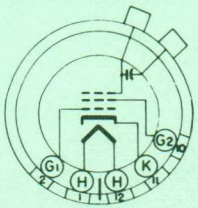
MECHANICAL DATA

OVERALL LENGTH	21 1/2 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	18 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	17 3/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	17 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-26 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	146	MA.
DC ION TRAP CURRENT STANDARD COIL (APPROX.)	75 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 25 FOOT LAMBERTS ON A 11 3/4" BY 15 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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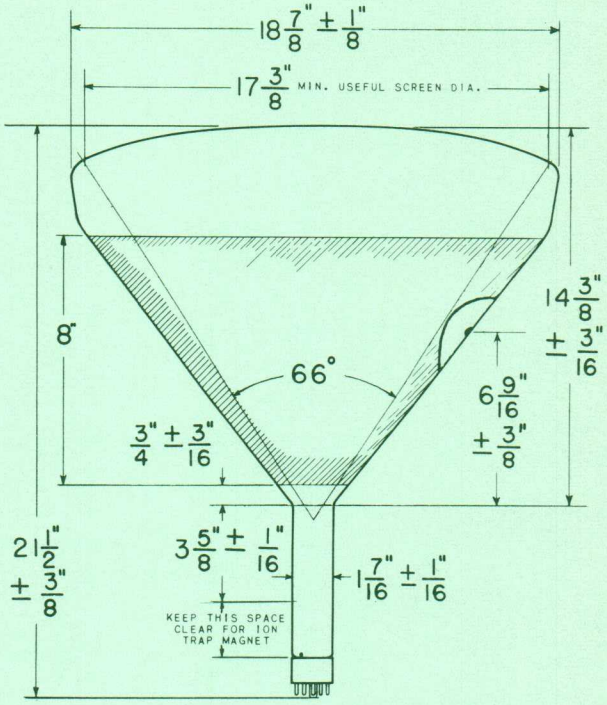

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CATHODE RAY

THE 19EP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE
MAGNETIC FOCUS AND DEFLECTION
RECTANGULAR GLASS CONSTRUCTION
UNIPOTENTIAL CATHODE
12" X 16" RASTER SIZE
EXTERNAL DOUBLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

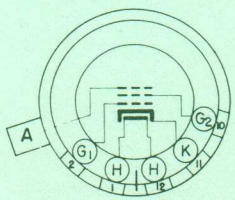
MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIAMETER OF BULB	18 5/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	17 21/32	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	19 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-26 TO -63	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	95 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	75 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 25 FOOT LAMBERTS ON A 12" X 16" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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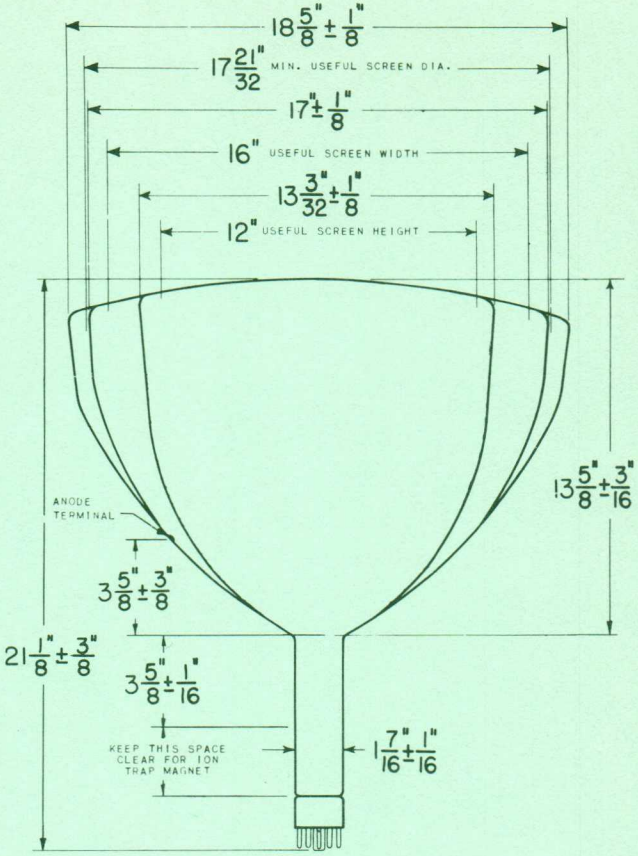

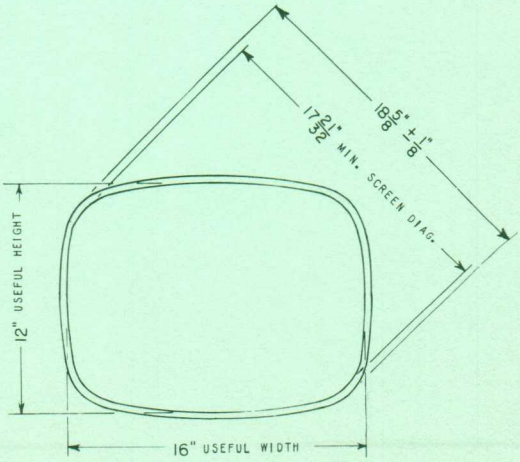

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CATHODE RAY

THE 19FP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE
ROUND GLASS CONSTRUCTION
11 3/4" X 15 3/4" RASTER SIZE
UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL DOUBLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	66	DEGREES

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

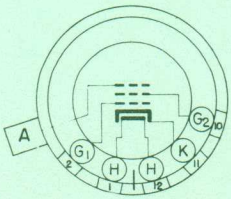
MECHANICAL DATA

OVERALL LENGTH	22 ± 1/2	INCHES
GREATEST DIAMETER OF BULB	18 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	17 3/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	19 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	130	MA.
DC ION TRAP CURRENT STANDARD COIL #108 (APPROX.)	110	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 11 3/4" X 15 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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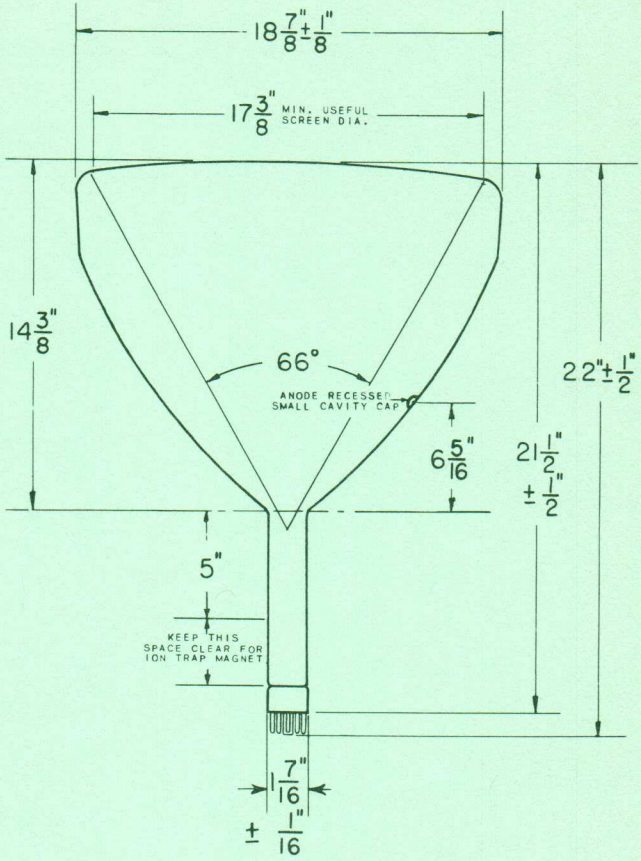

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CATHODE RAY

THE 19GP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE
ROUND GLASS CONSTRUCTION
MAGNETIC FOCUS AND DEFLECTION
UNIPOTENTIAL CATHODE
11 3/4" X 15 3/4" RASTER SIZE
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	66	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

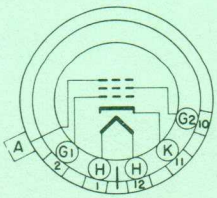
MECHANICAL DATA

OVERALL LENGTH	21 1/4 ± 1/2	INCHES
GREATEST DIAMETER OF BULB	18 7/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	17 3/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	19 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	125	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	125	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	13 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	130	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	105	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 11 3/4" x 15 3/4" PCITURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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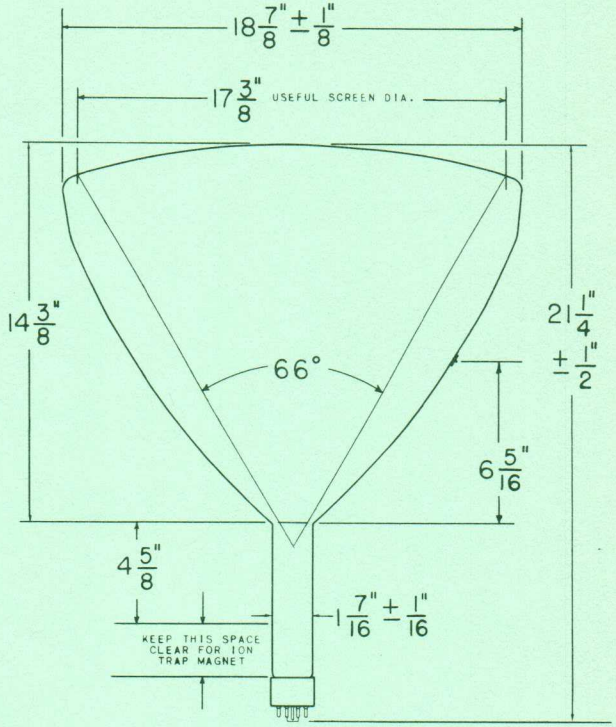

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CATHODE RAY

THE 19JP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE
MAGNETIC FOCUS AND DEFLECTION
RECTANGULAR GLASS CONSTRUCTION
UNIPOTENTIAL CATHODE
12" X 16" RASTER SIZE
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

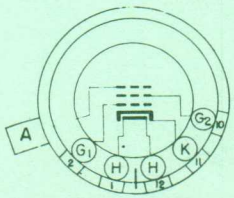
MECHANICAL DATA

OVERALL LENGTH	20 13/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	18 5/8 ± 1/8	INCHES
WIDTH	17 1/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	17 21/32	INCHES
WIDTH	16	INCHES
HEIGHT	12	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

BOTTOM VIEW

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	95 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111	75 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 12" X 16" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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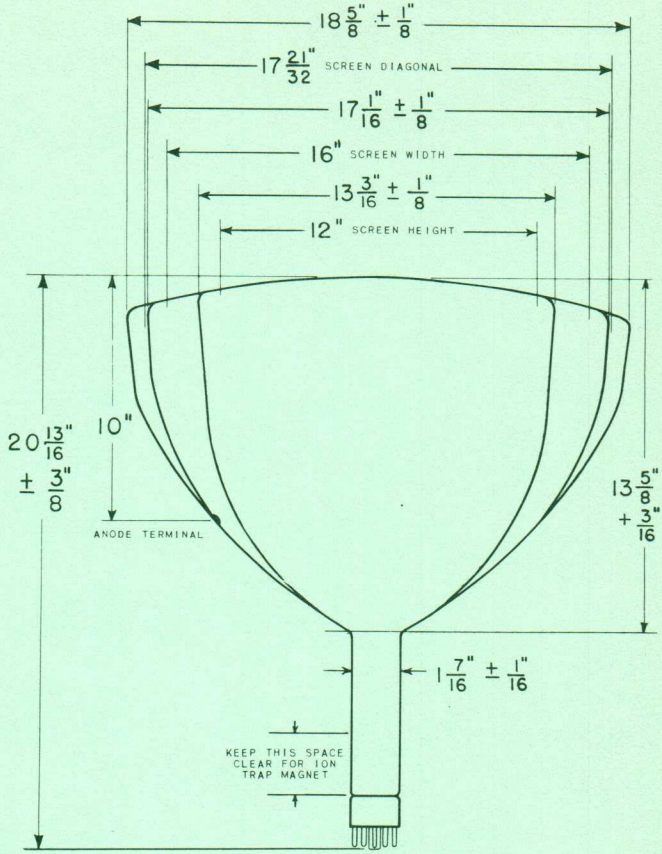

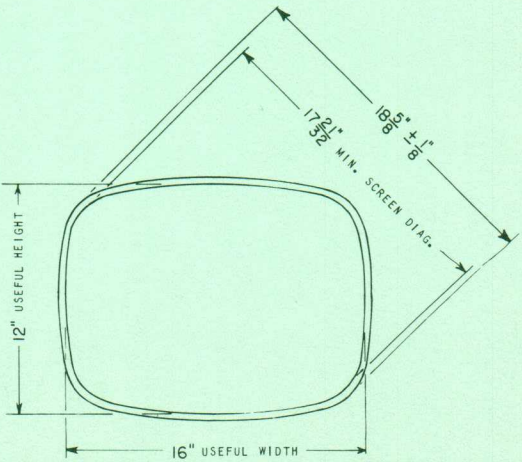

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CATHODE RAY

THE 19QP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION	**UNIPOTENTIAL CATHODE**
GREY FILTER FACEPLATE	**12" X 16" RASTER SIZE**
EXTERNAL CONDUCTIVE COATING	**EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR GLASS CONSTRUCTION	**LOW VOLTAGE ELECTROSTATIC FOCUS**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

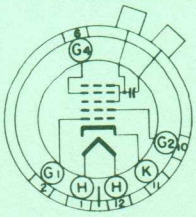
MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB		
DIAGONAL	18 5/8 ± 1/8	INCHES
WIDTH	17 1/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS		
DIAGONAL	17 21/32	INCHES
WIDTH	16	INCHES
HEIGHT	12	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	500	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #4 VOLTAGE[A]	-50 TO +350	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

[A] I_b SET FOR 100 UAMP.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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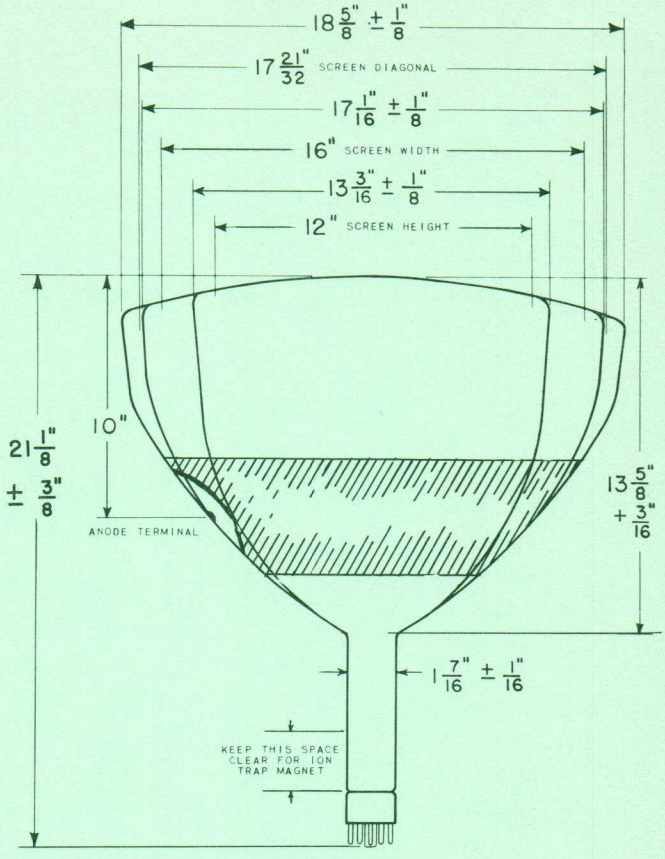

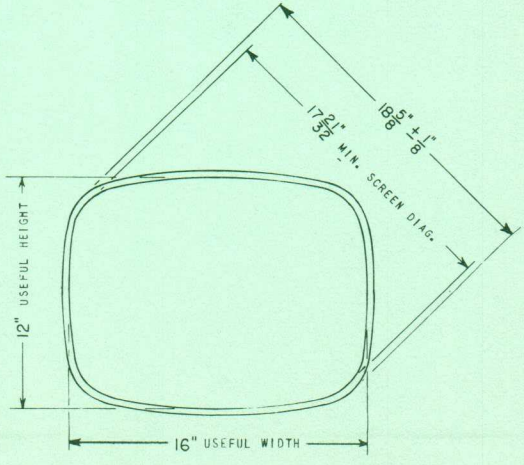

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CATHODE RAY

THE 20BP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ROUND GLASS CONSTRUCTION — **UNIPOTENTIAL CATHODE**
MAGNETIC FOCUS AND DEFLECTION — **EXTERNAL SINGLE FIELD ION TRAP**
17" X 12 3/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	54	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	7	μμf
GRID #1 TO ALL OTHER ELECTRODES	8	μμf

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

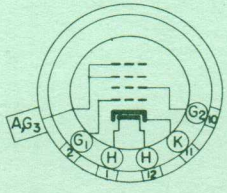
MECHANICAL DATA

OVERALL LENGTH	28 ± 3/4	INCHES
GREATEST DIAMETER OF BULB	20 ± 3/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	18 3/4	INCHES
BULB CONTACT	MEDIUM METAL CAP	C1-5
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
C1-5 CONTACT ALIGNS WITH PIN POSITION #3 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE:		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	140	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE:	140	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	15 000	VOLTS
DC GRID #2 VOLTAGE	250	VOLTS
DC GRID #1 VOLTAGE[A]	-27 TO -63	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	135	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #106, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 25 FOOT LAMBERTS ON A 12 3/4" X 17" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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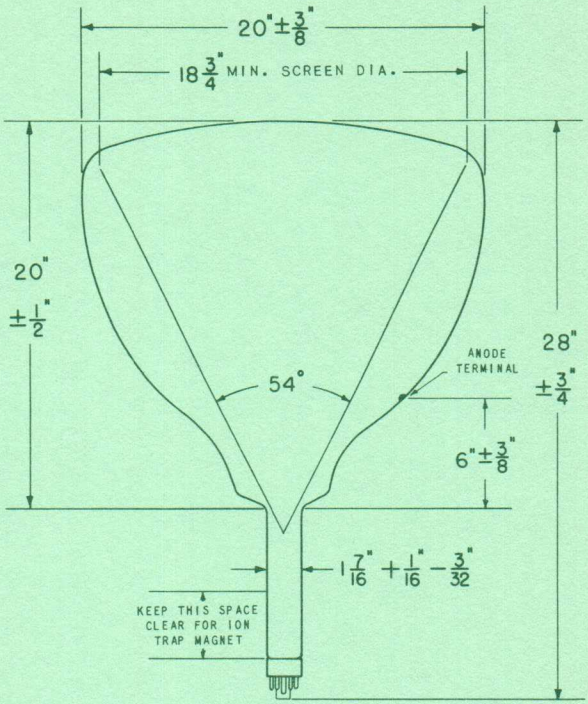

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CATHODE RAY

THE 20CP4, 20CP4A, 20CP4B, 20CP4C AND 20CP4D ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING EXCEPTIONS.

20CP4A & 20CP4D – *External conductive coating*

20CP4B & 20CP4D – *Aluminized*

20CP4C – *Faceplate has been treated with a specular reflection reducing surface.*

THEIR COMMON FEATURES INCLUDE:

GREY FILTER FACEPLATE	**UNIPOTENTIAL CATHODE**
MAGNETIC FOCUS & DEFLECTION	**17" X 12 3/4" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **20CP4A**	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **20CP4D**	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	95 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 12 3/4" BY 17" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

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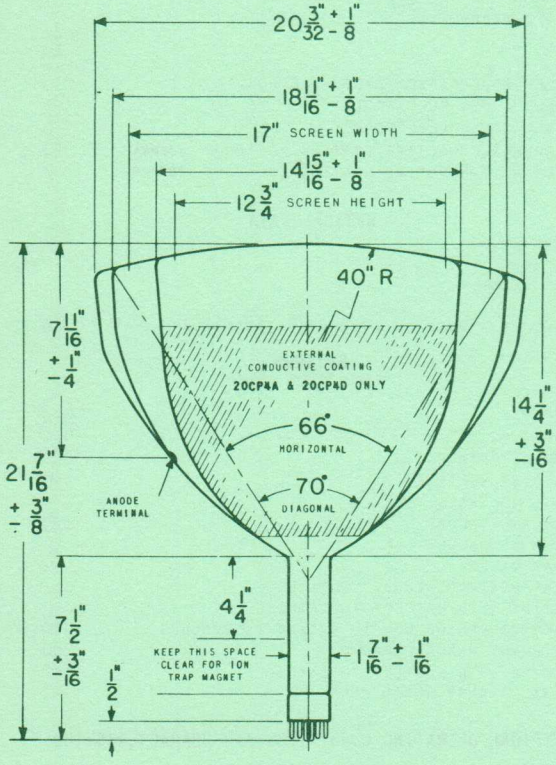
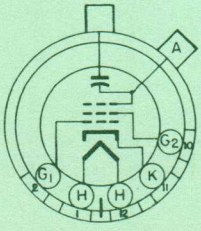
MECHANICAL DATA

OVERALL LENGTH	21 7/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 1/8	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
HEIGHT	14 15/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	18 3/4	INCHES
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING	20CP4A, 20CP4D - 12N OTHERS	12D
BULB CONTACT ALIGNMENT		
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES		



20CP4A & 20CP4D

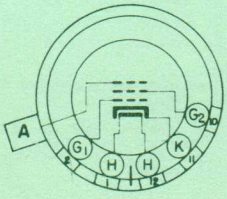


BOTTOM VIEW

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 10 - GRID NO. 2
PIN 11 - CATHODE
PIN 12 - HEATER
ANODE CAP

20CP4, 20CP4B & 20CP4C



BOTTOM VIEW

TUNG-SOL

CATHODE RAY

THE 20DP4, 20DP4A, 20DP4B, AND 20DP4C ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING EXCEPTIONS:

20DP4A & 20DP4C - *EXTERNAL CONDUCTIVE COATINGS*
20DP4B & 20DP4C - *ALUMINIZED SCREENS*

THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **SPHERICAL FACEPLATE**
MAGNETIC FOCUS AND DEFLECTION — **GREY FILTER FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
12 3/4" X 17" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE: (APPROX.)		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES: (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
20DP4A AND 20DP4C		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	$\mu\mu f$

OPTICAL DATA

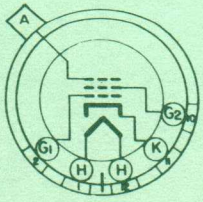
PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	73	PERCENT

MECHANICAL DATA

OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 3/16	INCHES
WIDTH	18 11/16 ± 3/16	INCHES
HEIGHT	14 15/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING	**20DP4 AND 20DP4B**	12D
	20DP4A AND 20DP4C	12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

20DP4 AND 20DP4B

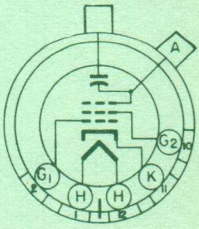


BOTTOM VIEW

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

20DP4A AND 20DP4C



BOTTOM VIEW

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[A]	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	95	MA.
ION TRAP FIELD STRENGTH (APPROX.)	35	GAUSSES

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN THIS VALUE.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 12 3/4" BY 17" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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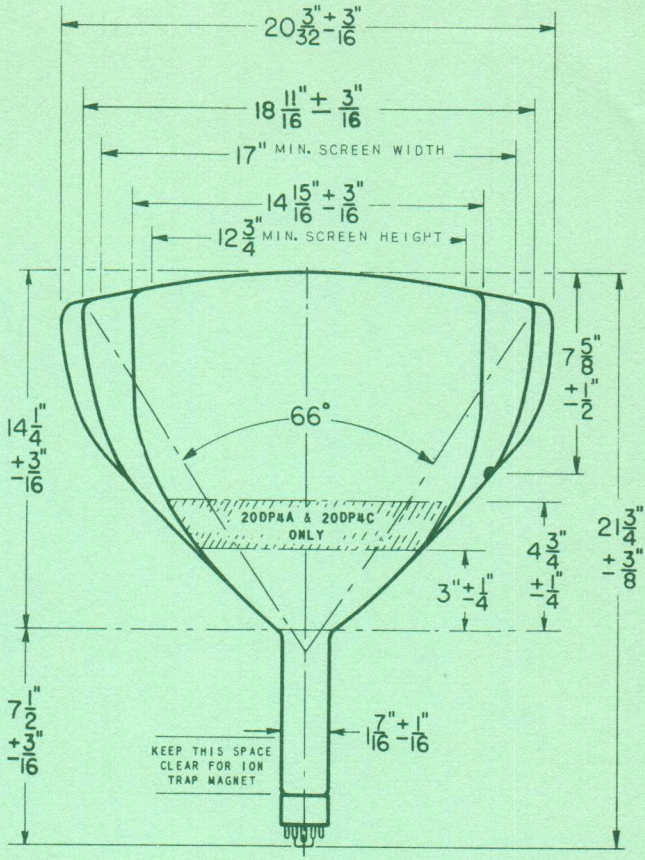

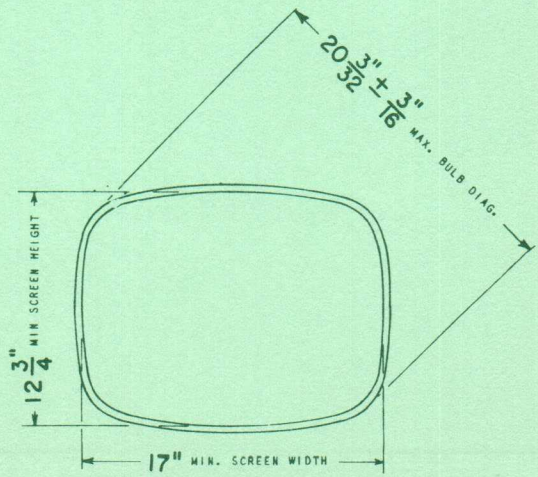

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CATHODE RAY

THE 20FP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS — **MAGNETIC DEFLECTION**
GREY FILTER FACEPLATE — **UNIPOTENTIAL CATHODE**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
17 1/4" X 13 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

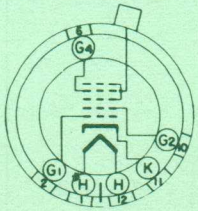
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 1/8	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	18 3/8	INCHES
WIDTH	17 1/4	INCHES
HEIGHT	13 1/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER ANODE CAP:
GRID NO. 3
GRID NO. 5
COLLECTOR

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC COLLECTOR, GRID #3, GRID #5 VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	5 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC LECTOR, GRID #3, GRID #5 VOLTAGE	12 000	VOLTS
DC GRID #4 VOLTAGE	2300 TO 3200	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.
DC GRID #4 CURRENT	-15 TO +25	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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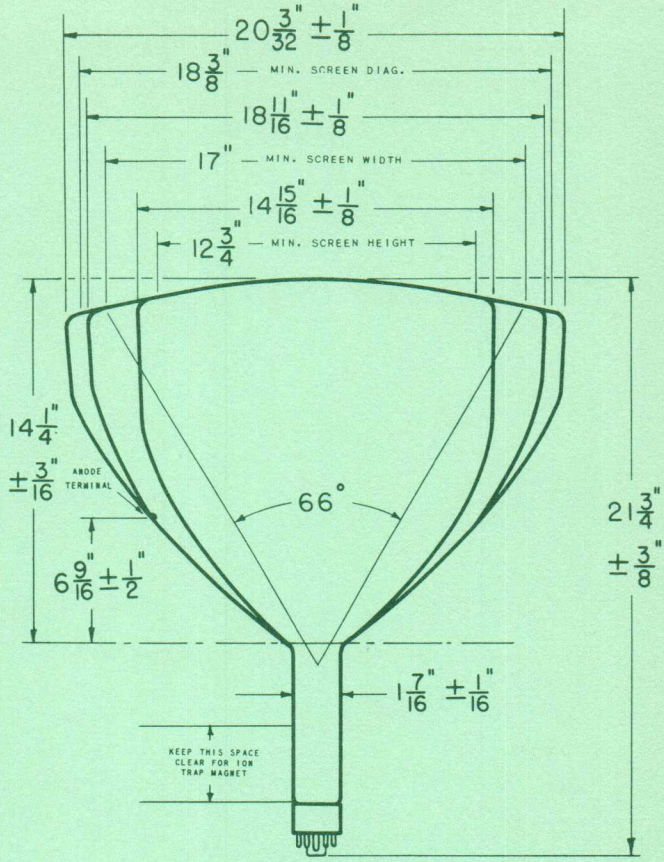

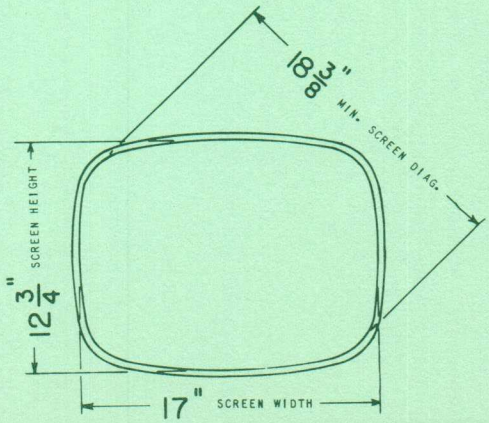

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CATHODE RAY

THE 20GP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
GREY FILTER FACEPLATE	**UNIPOTENTIAL CATHODE**
EXTERNAL CONDUCTIVE COATING	**17 1/4" X 13 1/4" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
EXTERNAL CONDUCTIVE COATING TO ANODE (MAX.)	750	μμf
EXTERNAL CONDUCTIVE COATING TO ANODE (MIN.)	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

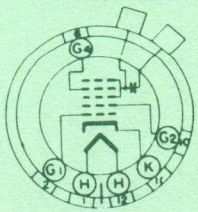
OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 3/16	INCHES
WIDTH	18 11/16 ± 3/16	INCHES
HEIGHT	14 15/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	18 5/8	INCHES
WIDTH	17 1/4	INCHES
HEIGHT	13 1/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5
COLLECTOR

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC COLLECTOR, GRID #3, GRID #5 VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	5 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC COLLECTOR, GRID #3, GRID #5 VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	2750 TO 3740	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75	MA.
GRID #4 CURRENT	-15 TO +25	μAMP.
GRID #2 CURRENT	-15 TO +15	μAMP.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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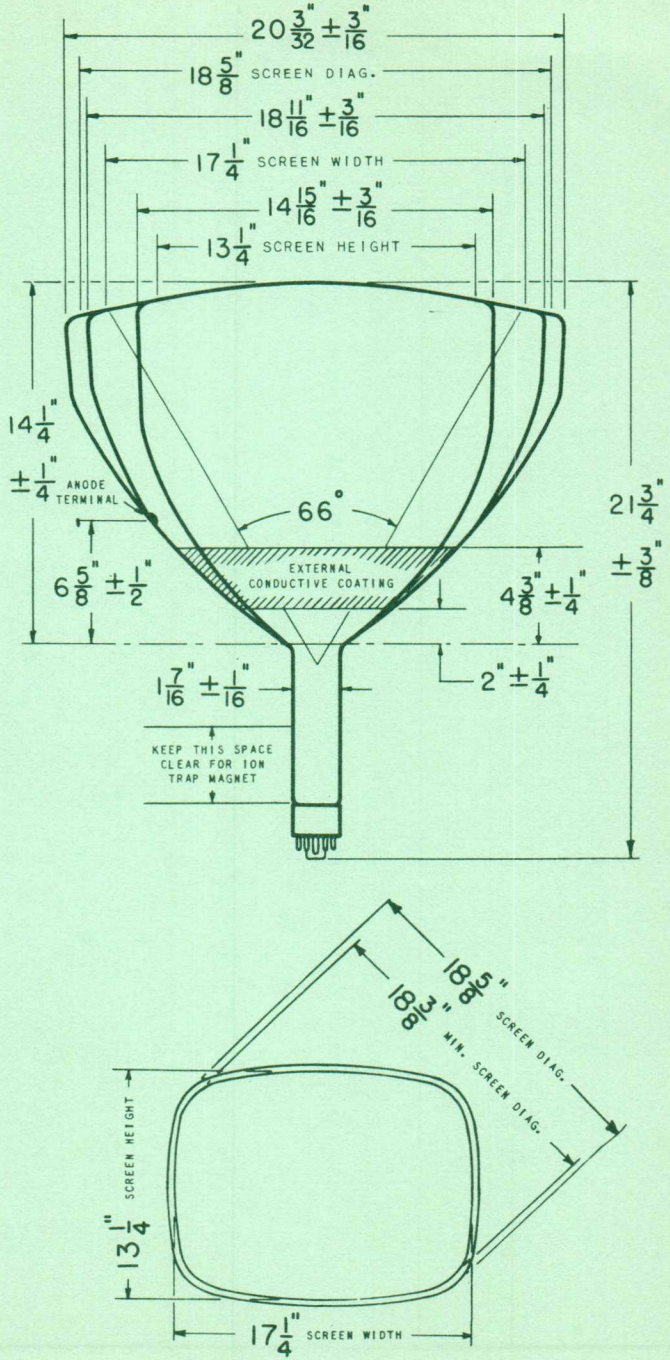

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CATHODE RAY

THE 20HP4, 20HP4A, 20HP4B, 20HP4C, AND 20HP4D ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL WITH THE FOLLOWING EXCEPTIONS:

20HP4A & 20HP4D – *EXTERNAL CONDUCTIVE COATINGS*
20HP4C & 20HP4D – *ALUMINIZED SCREENS*
20HP4B – *FROSTED FACEPLATE*

THEIR COMMON FEATURES INCLUDE:

SPHERICAL FACEPLATE
GREY FILTER FACEPLATE
EXTERNAL SINGLE FIELD ION TRAP
LOW VOLTAGE ELECTROSTATIC FOCUS
MAGNETIC DEFLECTION
UNIPOTENTIAL CATHODE
12 3/4" X 17" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
20HP4A AND 20HP4D ONLY		
MAXIMUM EXTERNAL CONDUCTIVE COATING[A]	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING[A]	750	μμf

[A]EXTERNAL CONDUCTIVE COATING MUST BE GROUNDED.

OPTICAL DATA

PHOSPHOR NUMBER		P4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	73	PERCENT

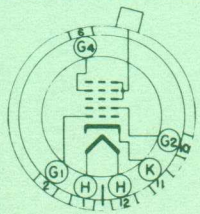
MECHANICAL DATA

OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 3/16	INCHES
WIDTH	18 11/16 ± 3/16	INCHES
HEIGHT	14 15/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING	**20HP4, 20HP4B AND 20HP4C**	12M
	20HP4A AND 20HP4D	12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

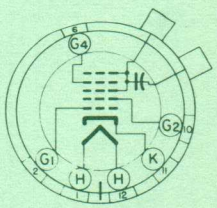
20HP4, 20HP4B & 20HP4C



BOTTOM VIEW

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

20HP4A & 20HP4D



BOTTOM VIEW

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)	-500 TO +1000	VOLTS
MAXIMUM GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
NEGATIVE-BIAS VALUE (DC)	125	VOLTS
POSITIVE-BIAS VALUE (DC)	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[B]	14 000	VOLTS
DC GRID #4 VOLTAGE[C]	-56 TO +310	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[D]	-28 TO -72	VOLTS
ION TRAP MAGNET FIELD STRENGTH (APPROX.)	30	GAUSSES

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN THIS VALUE.

[C] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE CURRENT OF 100 MICROAMPERES ON A 10 3/4" X 14 1/4" PICTURE SIZE.

[D] VISUAL EXTINCTION OF FOCUSED RASTER.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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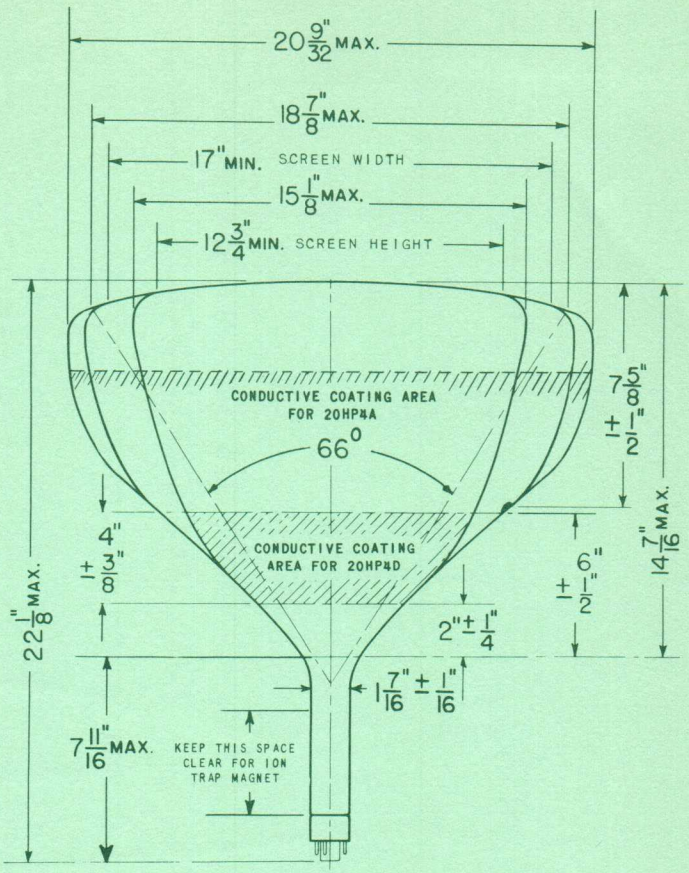

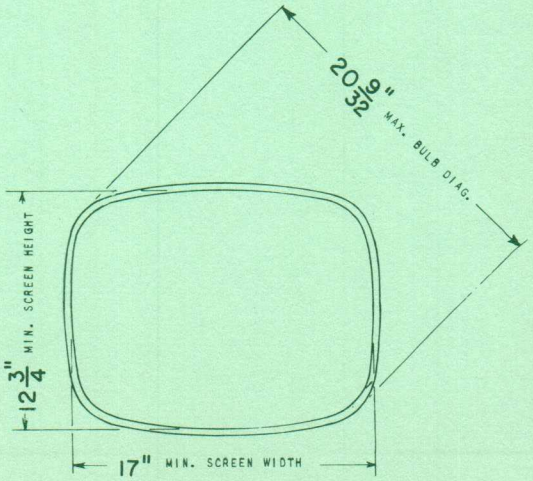

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CATHODE RAY

THE 20JP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
GREY FILTER FACEPLATE	**UNIPOTENTIAL CATHODE**
EXTERNAL CONDUCTIVE COATING	**17" X 12 3/4" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	6.0	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

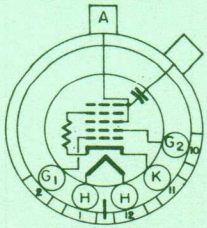
OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 1/8	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
HEIGHT	14 15/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12P

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 10 - GRID NO. 2



BOTTOM VIEW

PIN 11 - CATHODE
PIN 12 - HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	50 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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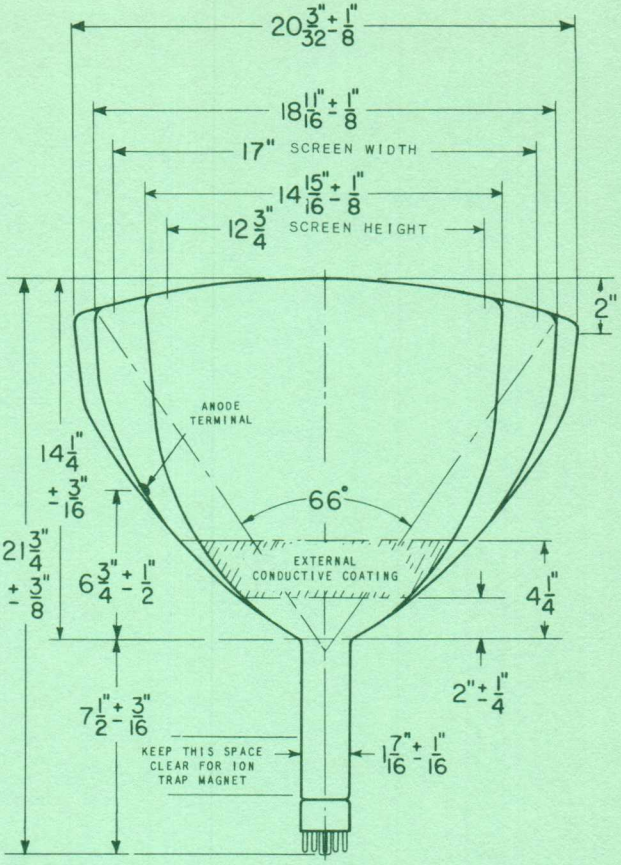

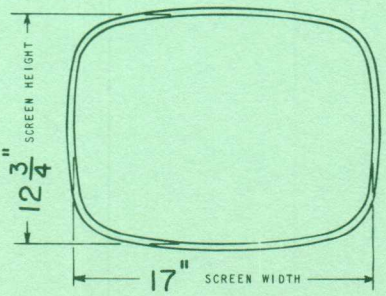

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CATHODE RAY

THE 20LP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION	**UNIPOTENTIAL CATHODE**
GREY FILTER FACEPLATE	**17" X 13 1/8" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL CONDUCTIVE COATING**
LOW VOLTAGE ELECTROSTATIC FOCUS.	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	64 TO 72.5	PERCENT

MECHANICAL DATA

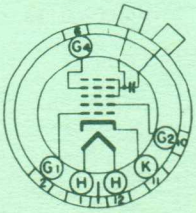
OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 1/8	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
HEIGHT	14 15/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	13 1/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #2 VOLTAGE (WITH PROTECTIVE FACE VIEWING WINDOW)[A]	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE[B]	-1000 TO +2000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	

[A] IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER OF PERSONAL INJURY FROM PROLONGED EXPOSURE AT CLOSE RANGE.

[B] THE FOCUSING ELECTRODE MAY BE MODULATED WITHIN THE MAXIMUM RANGE GIVEN WITHOUT DAMAGING THE TUBE.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

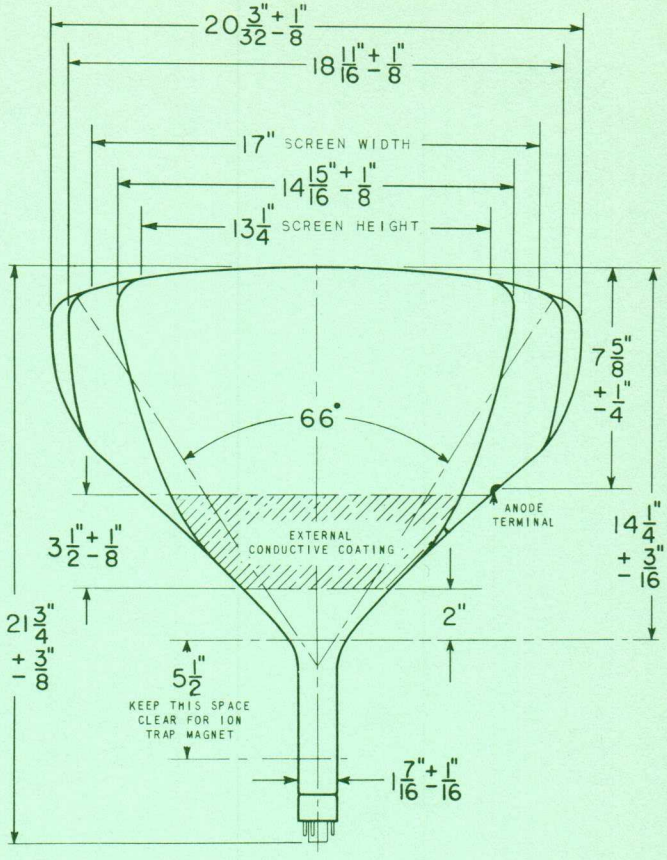
DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	0	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
ION TRAP FIELD INTENSITY (APPROX.)	35	GAUSSES

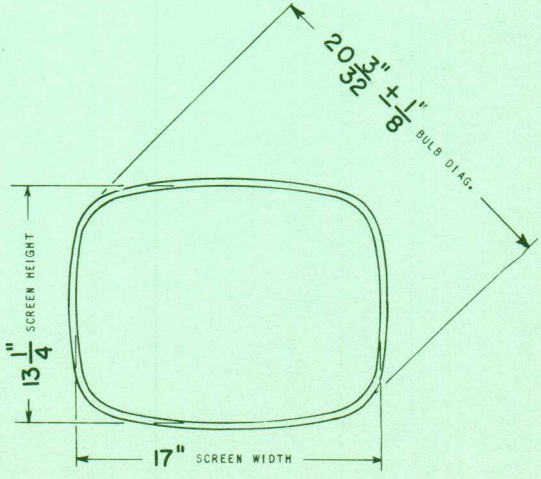
[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL





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CATHODE RAY

THE 20MP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION	**UNIPOTENTIAL CATHODE**
GREY FILTER FACEPLATE	**EXTERNAL CONDUCTIVE COATING**
RECTANGULAR GLASS CONSTRUCTION	**17 1/4" X 13 1/4" RASTER SIZE**
LOW VOLTAGE ELECTROSTATIC FOCUS	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

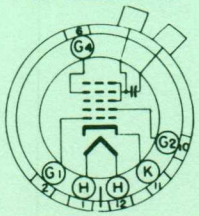
OVERALL LENGTH	21 3/4 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/32 ± 3/16	INCHES
WIDTH	18 11/16 ± 3/16	INCHES
HEIGHT	14 15/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	18 5/8	INCHES
WIDTH	17 1/4	INCHES
HEIGHT	13 1/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 6 - GRID NO. 4
PIN 10 - GRID NO. 2
PIN 11 - CATHODE



BOTTOM VIEW

PIN 12 - HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5
COLLECTOR

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)[A]	-55 TO +300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
ION TRAP MAGNET (RATED STRENGTH)	45	GAUSSES

[A] FOR ANODE CURRENT OF 100 UAMP.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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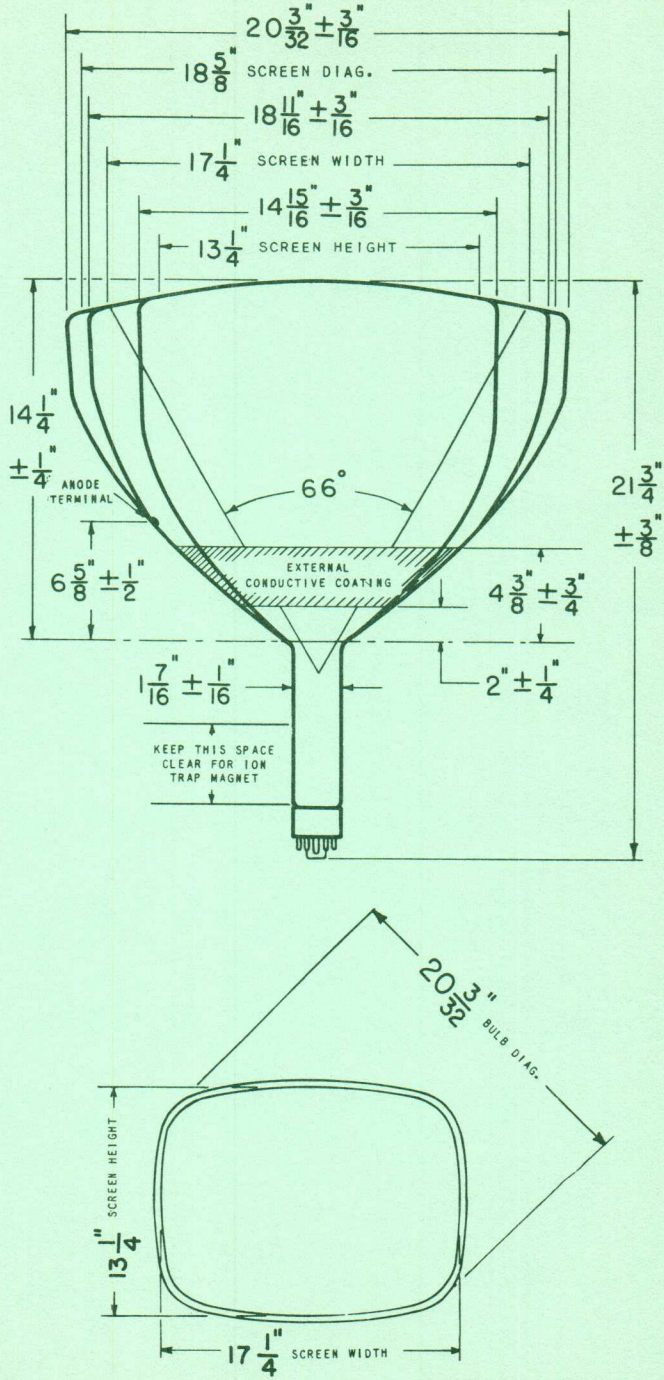

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PLATE 554-3

TUNG-SOL

CATHODE RAY

THE 21ACP4 AND 21ACP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 21ACP4A. THEIR COMMON FEATURES INCLUDE:

- UNIPOTENTIAL CATHODE
- EXTERNAL CONDUCTIVE COATING
- MAGNETIC FOCUS AND DEFLECTION
- RECTANGULAR GLASS CONSTRUCTION
- SPHERICAL FACEPLATE
- GREY FILTER FACEPLATE
- EXTERNAL SINGLE FIELD ION TRAP
- 14 7/8" X 18 15/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.)	71	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS[B]

DC ANODE, GRID #3 VOLTAGE[C]	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[D]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[E]	117	MA.
ION TRAP FIELD INTENSITY (APPROX.)	40	GAUSSES

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

[B] IF THIS TUBE IS OPERATED IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER FROM PROLONGED EXPOSURE.

[C] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE, IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[D] VISUAL EXTINCTION OF FOCUSED RASTER.

[E] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 14 7/8" BY 18 15/16" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.75 INCHES.

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→ INDICATES A CHANGE.

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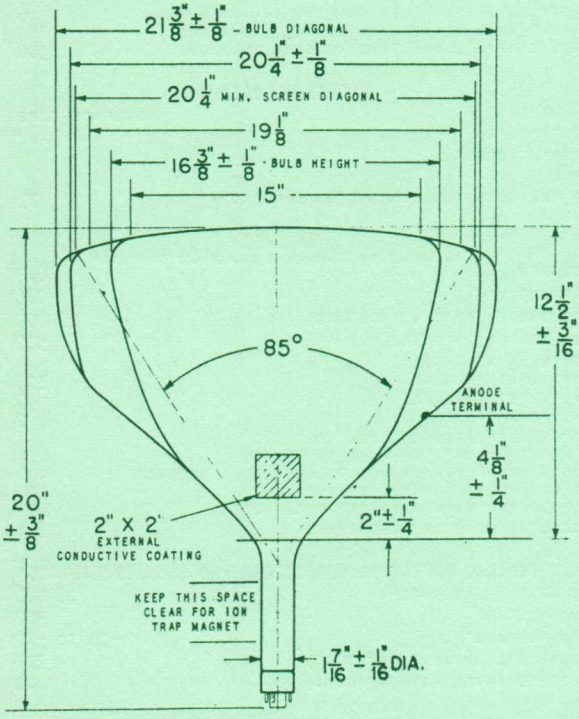
MECHANICAL DATA

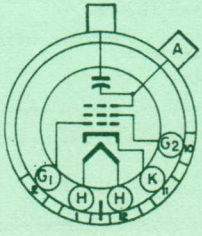
OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

→INDICATES A CHANGE.

TUNG-SOL

CATHODE RAY

THE 21ALP4, 21ALP4A, AND 21ALP4B ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 21ALP4A AND 21ALP4B HAVE METAL-BACKED SCREENS. THE 21ALP4B ALSO HAS AN INCREASED ANODE VOLTAGE. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
15" X 19 1/8" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION
SPHERICAL GREY FILTER FACEPLATE
MAGNETIC DEFLECTION
EXTERNAL CONDUCTIVE COATING
EXTERNAL SINGLE FIELD ION TRAP
LOW VOLTAGE ELECTROSTATIC FOCUS

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	75	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

		21ALP4B ONLY	
HEATER VOLTAGE	6.3		VOLTS
HEATER CURRENT	0.6		AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5, VOLTAGE[B]	20 000	18 000	VOLTS *
MAXIMUM DC GRID #4 VOLTAGE[C]	−500 TO +1000		VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500		VOLTS
MAXIMUM GRID #1 VOLTAGE:			
DC NEGATIVE-BIAS VALUE	125		VOLTS
DC POSITIVE-BIAS VALUE	0		VOLTS
POSITIVE-PEAK VALUE	2		VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410		VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180		VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5		MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE[B]	14 000	VOLTS
DC GRID #4 VOLTAGE[D]	−55 TO +300	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[E]	−28 TO −72	VOLTS
DC ION TRAP MAGNET (RATED STRENGTH)	40	GAUSSES

[A] EXTERNAL CONDUCTIVE COATING MUST BE GROUNDED.

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS

[C] THIS VALUE APPLIES WHERE AN AC VOLTAGE IS PROVIDED FOR DYNAMIC FOCUSING.

[D] WITH ANODE CURRENT OF 100 μAMP.

[E] VISUAL EXTINCTION OF FOCUSED RASTER.

INASMUCH AS THE TUBE RATING PERMITS OPERATION AT VOLTAGES AS HIGH AS 19.8 KILOVOLTS (ABSOLUTE VALUE), SHIELDING OF THE TUBE FOR X-RAY RADIATION MAY BE NEEDED WHEREVER THE OPERATING CONDITIONS INVOLVE VOLTAGE IN EXCESS OF 16 KILOVOLTS.

CONTINUED ON FOLLOWING PAGE

* INDICATES AN ADDITION.

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PLATE 5364-3

TUNG-SOL

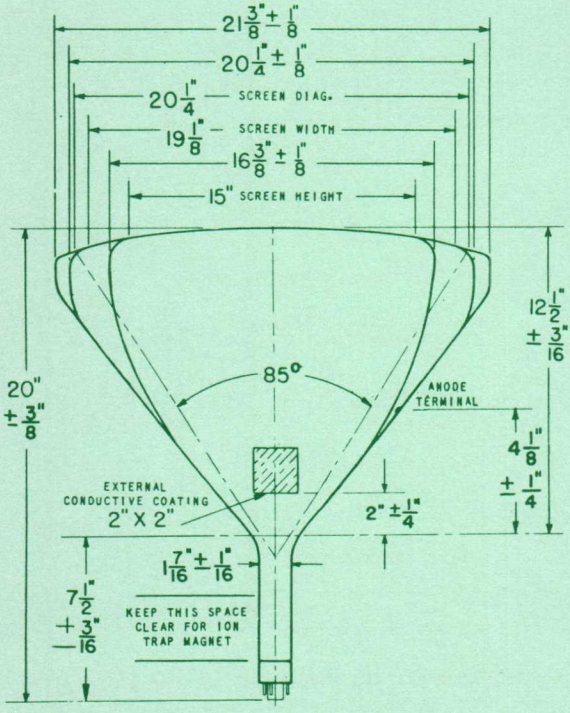
CONTINUED FROM PRECEDING PAGE

MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES.
HEIGHT	16 3/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

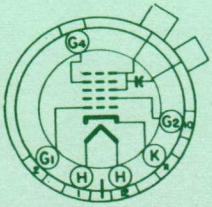
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5
COLLECTOR

THE SOCKET SHOULD NOT BE MOUNTED RIGIDLY BUT IT SHOULD BE ALLOWED TO MOVE FREELY AND IT SHOULD HAVE FLEXIBLE LEADS.

→INDICATES A CHANGE.

TUNG-SOL

CATHODE RAY

THE 21AMP4 AND 21AMP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE METAL-BACKED SCREEN ON THE 21AMP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **EXTERNAL CONDUCTIVE COATING**
RECTANGULAR GLASS CONSTRUCTION — **MAGNETIC FOCUS AND DEFLECTION**
SPHERICAL GREY FILTER FACEPLATE — **EXTERNAL SINGLE FIELD ION TRAP**
15" X 19 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX..):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	75	PERCENT

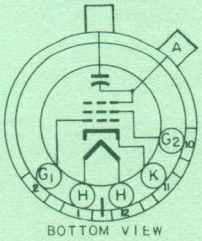
MECHANICAL DATA

OVERALL LENGTH	20 7/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 3/16	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	16 3/8 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH VACANT PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
COLLECTOR

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TUNG-SOL

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, COLLECTOR VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, COLLECTOR VOLTAGE[A]	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	102 ± 20%	MA.
DC ION TRAP MAGNET FIELD INTENSITY (APPROX.) STANDARD COIL #111	95 ± 50%	MA.
ION TRAP MAGNET (RATED STRENGTH)	45	GAUSSES

CIRCUIT VALUES

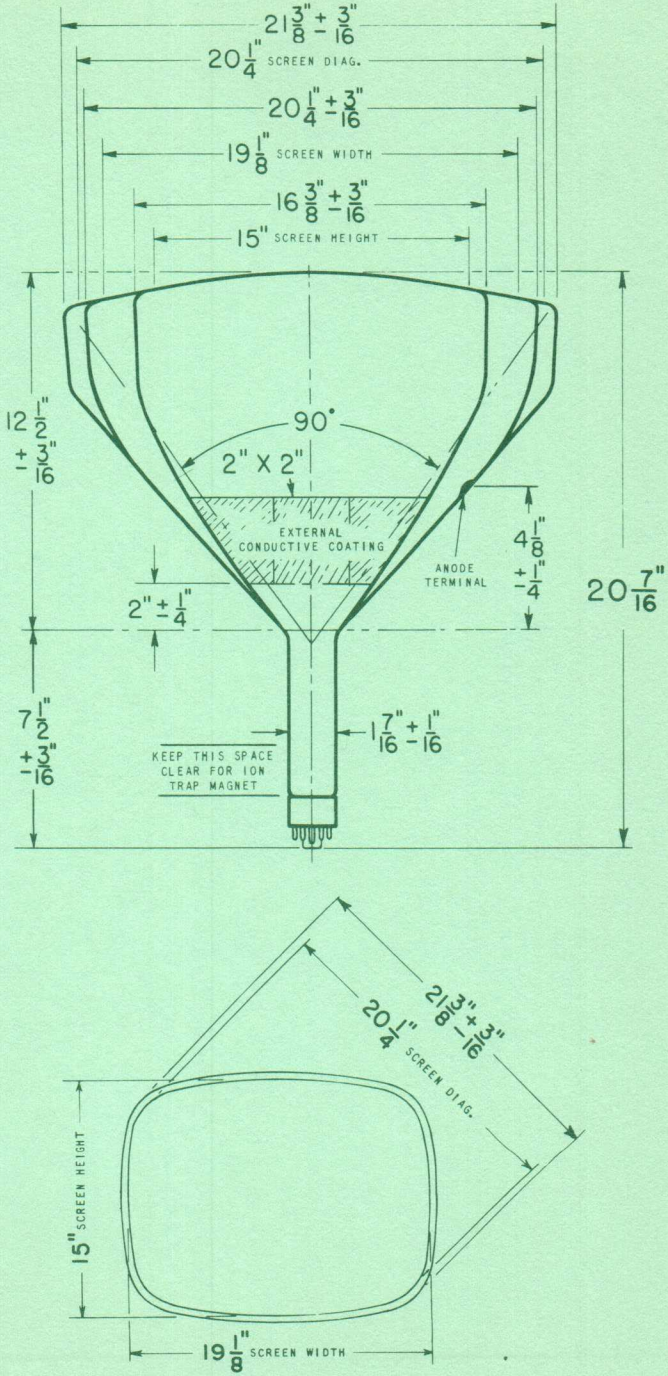
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	VOLTS

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 15" BY 19 1/8" PICTURE. SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

TUNG-SOL


21 3/8" + 3/16"
20 1/4" SCREEN DIAG.
20 1/4" + 3/16"
19 1/8" SCREEN WIDTH
16 3/8" + 3/16"
15" SCREEN HEIGHT
12 1/2" + 3/16"
90°
2" X 2"
EXTERNAL CONDUCTIVE COATING
ANODE TERMINAL
4 1/8" + 1/4"
20 7/16"
2" + 1/4"
7 1/2" + 3/16"
1 7/16" + 1/16"
KEEP THIS SPACE CLEAR FOR ION TRAP MAGNET
21 3/8" + 3/16"
20 1/4" SCREEN DIAG.
15" SCREEN HEIGHT
19 1/8" SCREEN WIDTH

TUNG-SOL

CATHODE RAY

THE 21ANP4 AND 21ANP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 21ANP4A HAS A METAL BACKED SCREEN. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **MAGNETIC DEFLECTION**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
SPHERICAL GREY FILTER FACEPLATE — **LOW VOLTAGE ELECTROSTATIC FOCUS**
15" X 19 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$

OPTICAL DATA

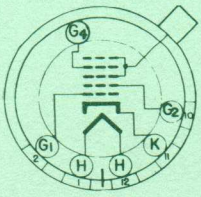
PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	75	PERCENT

MECHANICAL DATA

OVERALL LENGTH	20 7/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 3/16	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	16 3/8 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

PIN CONNECTIONS

PIN #1 – HEATER
PIN #2 – GRID NO. 1
PIN #6 – GRID NO. 4
PIN #10 – GRID NO. 2



BOTTOM VIEW

PIN #11 – CATHODE
PIN #12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

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TUNG-SOL

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RRSPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE[B]	-55 TO +300	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS
ION TRAP MAGNET (RATED STRENGTH)	40	GAUSSES

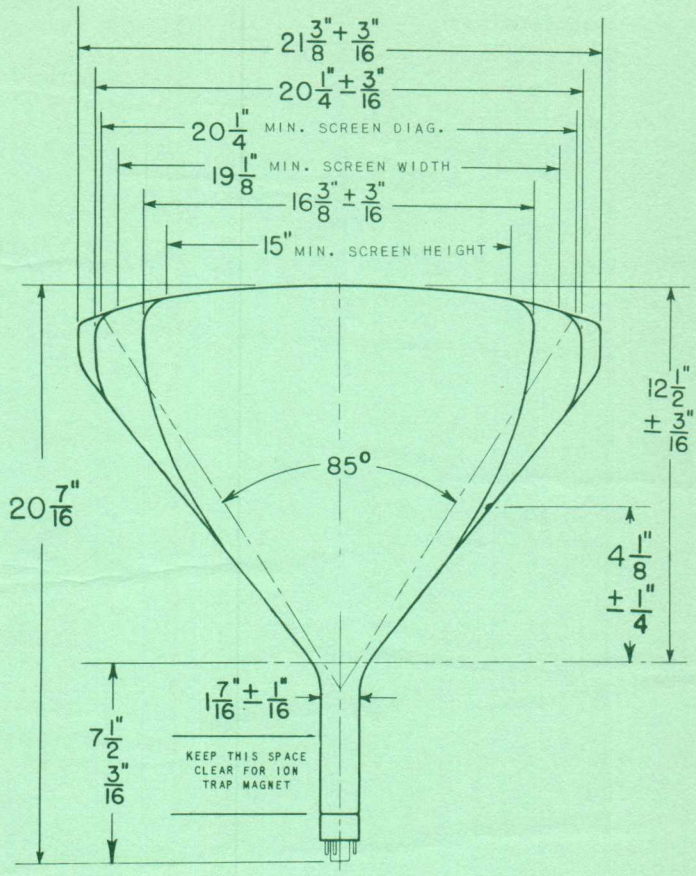
[B] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE CURRENT OF 100 MICROAMPERES ON A 15" X 19 1/8" PICTURE SIZE.

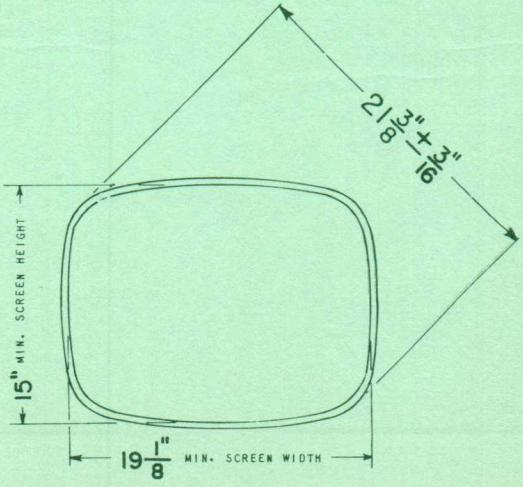
[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL





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TUNG-SOL

CATHODE RAY

THE 21AP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
RECTANGULAR METAL CONSTRUCTION
EXTERNAL SINGLE FIELD ION TRAP
MAGNETIC FOCUS & DEFLECTION
FROSTED FILTERGLASS FACEPLATE
18 3/8" X 13 15/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

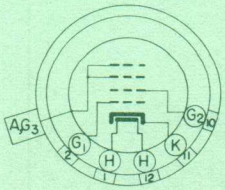
MECHANICAL DATA

OVERALL LENGTH	22 5/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/4 ± 1/4	INCHES
WIDTH	19 23/32 ± 1/8	INCHES
HEIGHT	15 5/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	18 3/8	INCHES
HEIGHT	13 15/16	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
METAL SHELL LIP CONTACT ALIGNS WITH PIN POSITION #6 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	104 ± 6%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	90	MA.

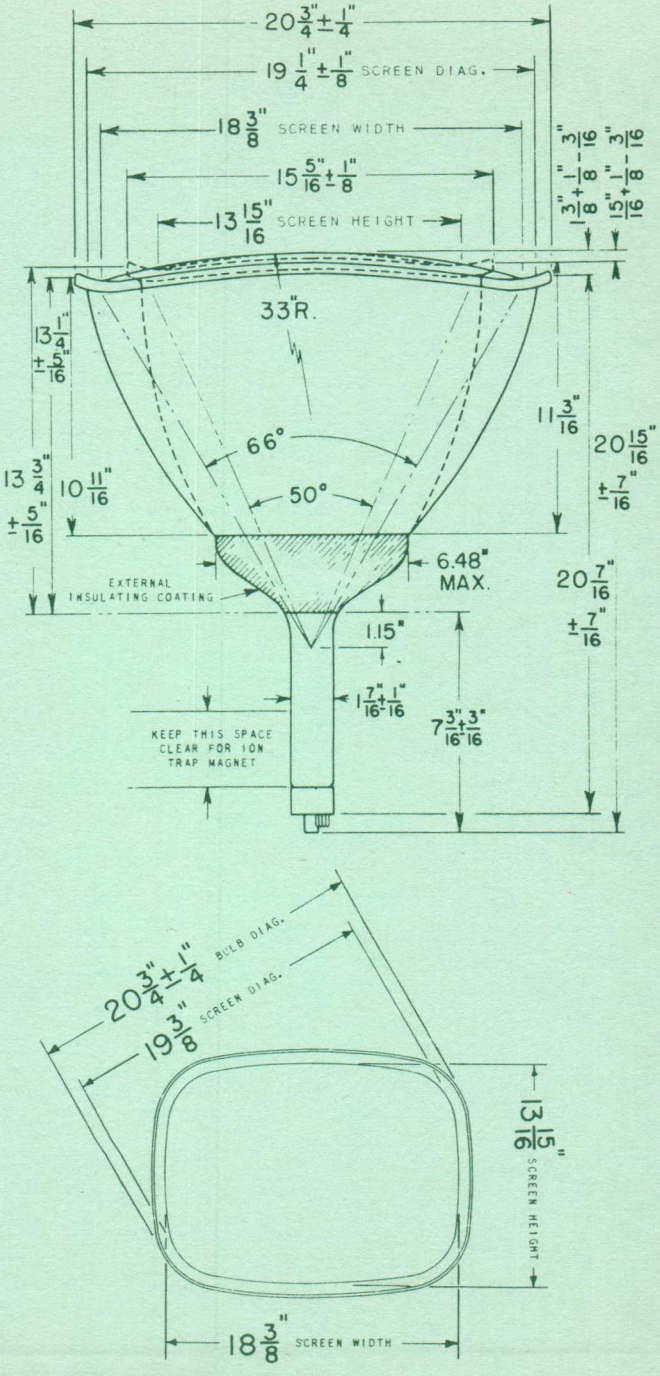
[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 18 3/8" BY 13 15/16" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL


20 3/4" ± 1/4"
19 1/4" ± 1/8" SCREEN DIAG.
18 3/8" SCREEN WIDTH
15 5/16" ± 1/8"
13 15/16" SCREEN HEIGHT
3/16" ± 1/8"
3/16" ± 1/8"
5/16" ± 1/16"
33"R.
13 1/4" ± 5/16"
66°
50°
11 3/16"
20 15/16" ± 7/16"
13 3/4" ± 5/16"
10 11/16"
6.48" MAX.
EXTERNAL INSULATING COATING
20 7/16" ± 7/16"
1.15"
1 7/16" ± 1/16"
7 3/16" ± 3/16"
KEEP THIS SPACE CLEAR FOR ION TRAP MAGNET
20 3/4" ± 1/4" BULB DIAG.
19 3/8" SCREEN DIAG.
13 15/16" SCREEN HEIGHT
18 3/8" SCREEN WIDTH

TUNG-SOL

CATHODE RAY

THE 21AQP4 AND 21AQP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE METAL-BACKED SCREEN ON THE 21AQP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
RECTANGULAR GLASS CONSTRUCTION
SPHERICAL GREY FILTER FACEPLATE
15" X 19 1/8" RASTER SIZE
MAGNETIC FOCUS AND DEFLECTION
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	75	PERCENT

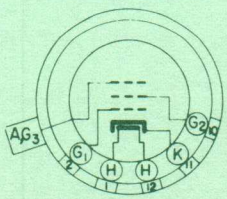
MECHANICAL DATA

OVERALL LENGTH	20 7/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 3/16	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	16 3/8 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH VACANT PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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TUNG-SOL

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE[AB]	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE[AB]	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[D]	102 ± 20%	MA.
DC ION TRAP MAGNET FIELD INTENSITY (APPROX.) STANDARD COIL #111	95 ± 50%	MA.
ION TRAP MAGNET (RATED STRENGTH)	45	GAUSSES

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

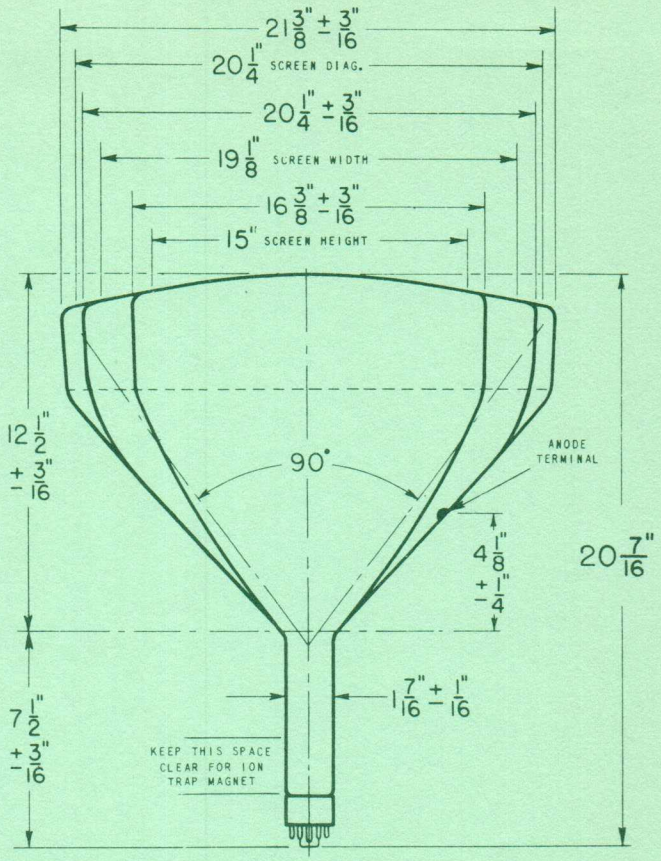
[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS

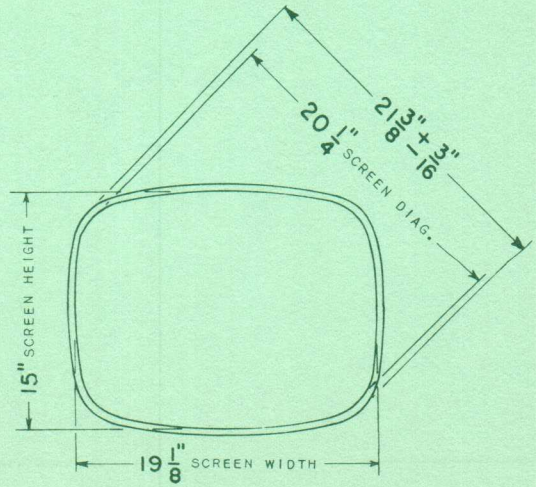
[B] INASMUCH AS THE TUBE RATING PERMITS OPERATION AT VOLTAGES AS HIGH AS 19.8 KILOVOLTS (ABSOLUTE VALUE), SHIELDING OF THE TUBE FOR X-RAY RADIATION MAY BE NEEDED WHEREVER THE OPERATING CONDITIONS INVOLVE VOLTAGES IN EXCESS OF 16 KILOVOLTS.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 15" BY 19 1/8" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

TUNG-SOL





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CATHODE RAY

THE 21ASP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. IT IS IDENTICAL TO THE 21XP4 IN ALL RESPECTS *EXCEPT* THAT THE EXTERNAL CONDUCTIVE COATING IS NOT APPLIED. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION	**SPHERICAL FACEPLATE**
ELECTROSTATIC FOCUS	**GREY FILTER FACEPLATE**
UNIPOTENTIAL CATHODE	**12 3/4" X 17" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	72	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE[A]	-64 TO +352	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC ION TRAP MAGNET STANDARD COIL #117 (APPROX.)	30 ±40%	MA.
DC ION TRAP MAGNET RATED STRENGTH	35	GAUSSES

[A] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE CURRENT OF 100 MICROAMPERES ON 17" BY 12 3/4" PICTURE SIZE.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

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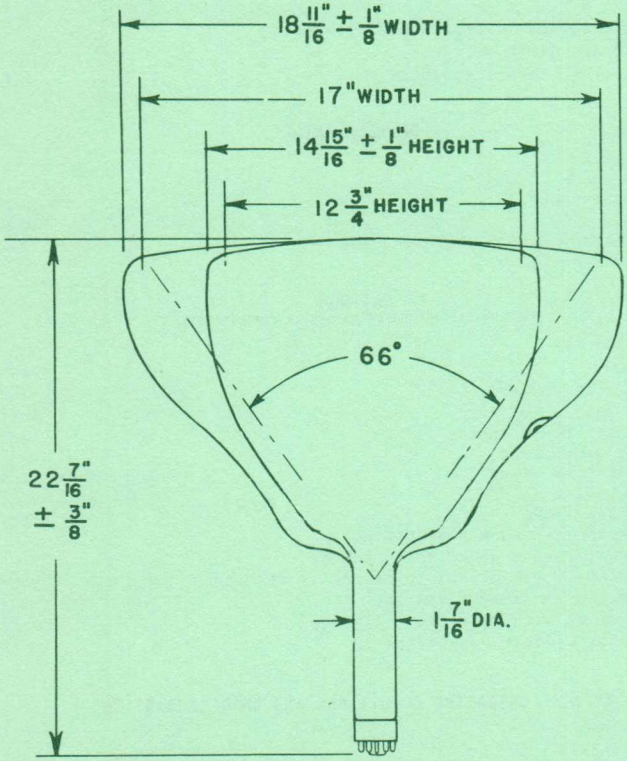
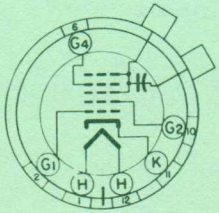
MECHANICAL DATA

OVERALL LENGTH	22 7/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 5/8 ± 3/16	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
HEIGHT	14 15/16 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BULB CONTACT ALIGNMENT		
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES		
BASING		12L



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO.3
GRID NO.5

TUNG-SOL

CATHODE RAY

THE 21ATP4, 21ATP4A AND 21ATP4B ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL EXCEPT FOR THE NON ALUMINIZED SCREEN ON THE 21ATP4B. THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION	ALUMINIZED SCREEN
UNIPOTENTIAL CATHODE	SPHERICAL FACEPLATE
GREY FILTER FACEPLATE	19 1/8" X 15" RASTER SIZE
EXTERNAL CONDUCTIVE COATING	EXTERNAL SINGLE FIELD ION TRAP
RECTANGULAR GLASS CONSTRUCTION	LOW VOLTAGE ELECTROSTATIC FOCUS

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	1 200	μμf

[A] EXTERNAL CONDUCTIVE COATING MUST BE GROUNDED.

OPTICAL DATA

PHOSPHOR NUMBER	ALUMINIZED	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	71	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE *	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

* VALUE FOR 21ATP4A 20,000 VOLTS.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE[B]	16 000	VOLTS
DC GRID #4 VOLTAGE[C]	-64 TO +350	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[D]	-28 TO -72	VOLTS
ION TRAP MAGNET FIELD STRENGTH (APPROX.)	35	GAUSSES

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN THIS VALUE.

[C] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE CURRENT OF 100 MICROAMPERES ON A 19 1/8" X 15" PICTURE SIZE.

[D] VISUAL EXTINCTION OF FOCUSED RASTER.

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21ATP4, 21ATP4A, 21ATP4B

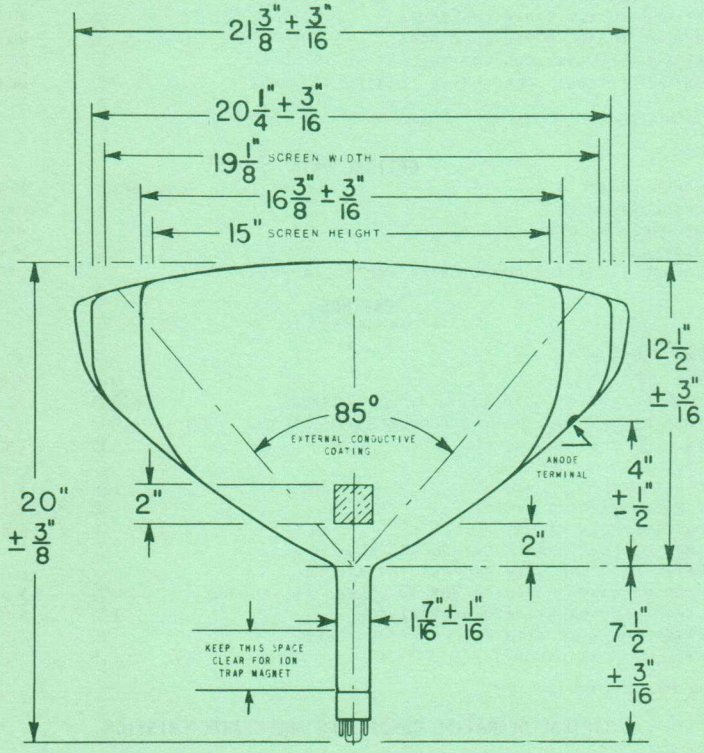
TUNG-SOL

MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 3/16	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	16 3/8 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

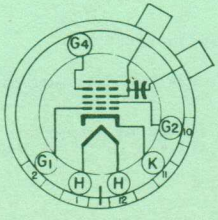
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21AUP4, 21AUP4A, AND 21AUP4B ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE METAL BACKED SCREENS ON THE 21AUP4A AND 21AUP4B. THE 21AUP4B ALSO HAS AN INCREASED ANODE VOLTAGE. THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION
UNIPOTENTIAL CATHODE
RECTANGULAR GLASS CONSTRUCTION
LOW VOLTAGE ELECTROSTATIC FOCUS
SPHERICAL FACEPLATE
GREY FILTER FACEPLATE
EXTERNAL CONDUCTIVE COATING
EXTERNAL SINGLE FIELD ION TRAP
15" X 19 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	67	DEGREES
VERTICAL	53	DEGREES
DIAGONAL	72	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu$f
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu$f
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	$\mu\mu$f
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	$\mu\mu$f

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.)	71	PERCENT

RATINGS

DESIGN CENTER VALUES

		21AUP4B ONLY	
HEATER VOLTAGE	6.3		VOLTS
HEATER CURRENT	0.6		AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE[A]	20 000	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE:			
POSITIVE	1 000		VOLTS
NEGATIVE	500		VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500		VOLTS
MAXIMUM GRID #1 VOLTAGE:			
DC NEGATIVE-BIAS VALUE	125		VOLTS
DC POSITIVE-BIAS VALUE	0		VOLTS
POSITIVE-PEAK VALUE	2		VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410		VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180		VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5		MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE[A]	18 000		VOLTS
DC GRID #4 VOLTAGE[B]	−72 TO 396		VOLTS
DC GRID #2 VOLTAGE	300		VOLTS
DC GRID #1 VOLTAGE[C]	−28 TO −72		VOLTS
DC ION TRAP MAGNET (RATED STRENGTH)[D]	46		GAUSSES

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NO BE LESS THAN 14,000 VOLTS.

[B] FOR FOCUS WITH ANODE CURRENT OF 100 μAMPS.

[C] VISUAL EXTINCTION OF FOCUSED RASTER.

[D] THE NON-UNIFORM MAGNETIC FIELD INHERENT IN THE DESIGN OF SOME EXTERNAL ION-TRAP MAGNETS USUALLY REQUIRES FOR OPTIMUM ADJUSTMENT THAT THE MAGNET SLUG BE LOCATED ON THE SAME SIDE OF THE TUBE NECK AS PIN 6.

INASMUCH AS THE TUBE RATING PERMITS OPERATION AT VOLTAGES AS HIGH AS 19.8 KILOVOLTS (ABSOLUTE VALUE), SHIELDING OF THE TUBE FOR X-RAY RADIATION MAY BE NEEDED WHEREVER THE OPERATING CONDITIONS INVOLVE VOLTAGE IN EXCESS OF 16 KILOVOLTS.

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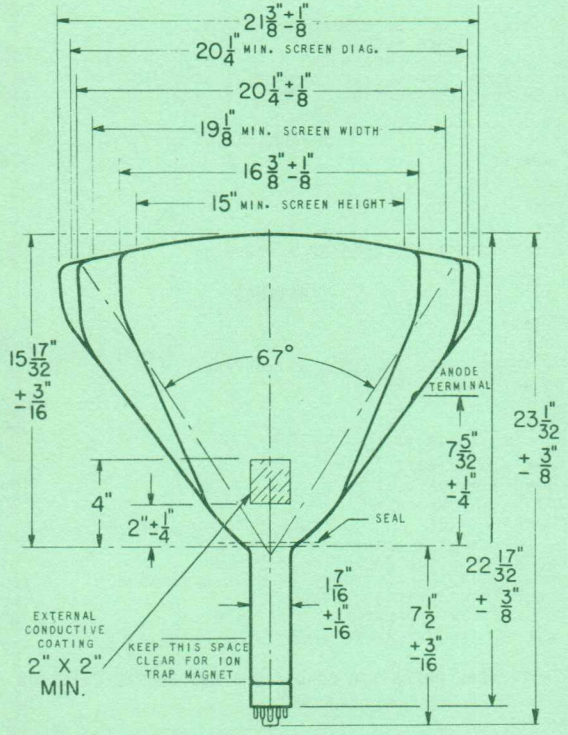
MECHANICAL DATA

OVERALL LENGTH	23 1/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 1/2	INCHES
WIDTH	20 3/8	INCHES
HEIGHT	16 1/2	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

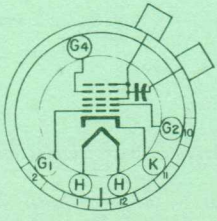
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



PIN 12 – HEATER
ANODE CAP:
GRID #3
GRID #5
COLLECTOR

BOTTOM VIEW

SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY.

TUNG-SOL

CATHODE RAY

THE 21AVP4, 21AVP4A, AND 21AVP4B ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE METAL BACKED SCREENS ON THE 21AVP4A AND 21AVP4B. THE 21AVP4B ALSO HAS AN INCREASED ANODE VOLTAGE. THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION — **SPHERICAL FACEPLATE**
UNIPOTENTIAL CATHODE — **GREY FILTER FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL CONDUCTIVE COATING**
LOW VOLTAGE ELECTROSTATIC FOCUS — **EXTERNAL SINGLE FIELD ION TRAP**
15" X 19 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	67	DEGREES
VERTICAL	53	DEGREES
DIAGONAL	72	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	$\mu\mu f$

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.)	71	PERCENT

RATINGS

DESIGN CENTER VALUES

		21AVP4B ONLY	
HEATER VOLTAGE	6.3		VOLTS
HEATER CURRENT	0.6		AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE[A]	20 000	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE:			
POSITIVE	1 000		VOLTS
NEGATIVE	500		VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500		VOLTS
MAXIMUM GRID #1 VOLTAGE:			
DC NEGATIVE-BIAS VALUE	125		VOLTS
DC POSITIVE-BIAS VALUE	0		VOLTS
POSITIVE-PEAK VALUE	2		VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:			
HEATER NEGATIVE WITH RESPECT TO CATHODE			
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410		VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180		VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180		VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5		MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE[A]	18 000	VOLTS
DC GRID #4 VOLTAGE[B]	-72 TO 396	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS
DC ION TRAP MAGNET (RATED STRENGTH)[D]	46	GAUSSES

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NO BE LESS THAN 14,000 VOLTS.

[B] FOR FOCUS WITH ANODE CURRENT OF 100 μAMPS.

[C] VISUAL EXTINCTION OF FOCUSED RASTER.

[D] THE NON-UNIFORM MAGNETIC FIELD INHERENT IN THE DESIGN OF SOME EXTERNAL ION-TRAP MAGNETS USUALLY REQUIRES FOR OPTIMUM ADJUSTMENT THAT THE MAGNET SLUG BE LOCATED ON THE SAME SIDE OF THE TUBE NECK AS PIN 6.

INASMUCH AS THE TUBE RATING PERMITS OPERATION AT VOLTAGES AS HIGH AS 19.8 KILOVOLTS (ABSOLUTE VALUE), SHIELDING OF THE TUBE FOR x-RAY RADIATION MAY BE NEEDED WHEREVER THE OPERATING CONDITIONS INVOLVE VOLTAGE IN EXCESS OF 16 KILOVOLTS.

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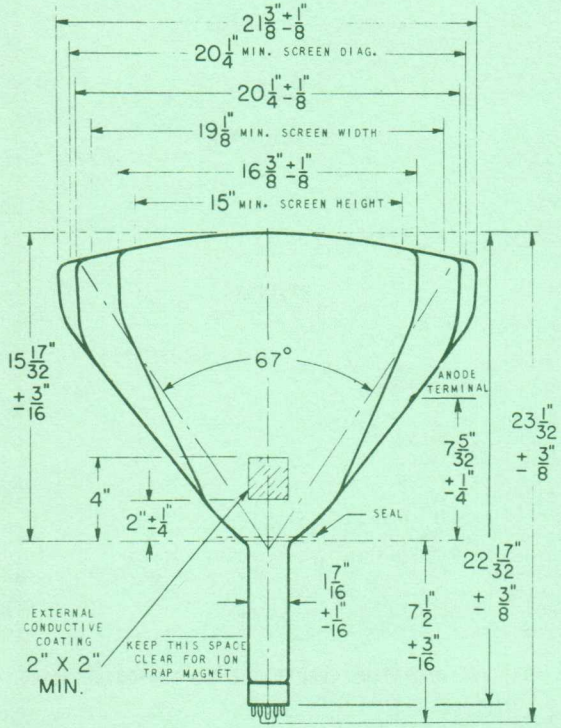
CONTINUED FROM PRECEDING PAGE

MECHANICAL DATA

OVERALL LENGTH	23 1/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 1/2	INCHES
WIDTH	20 3/8	INCHES
HEIGHT	16 1/2	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

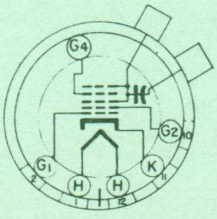
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



PIN 12 – HEATER
ANODE CAP:
GRID #3
GRID #5
COLLECTOR

BOTTOM VIEW

SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY.

TUNG-SOL

CATHODE RAY

THE 21AWP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE	ALUMINIZED SCREEN
GREY FILTER FACEPLATE	SPHERICAL FACEPLATE
MAGNETIC FOCUS AND DEFLECTION	EXTERNAL CONDUCTIVE COATING
RECTANGULAR GLASS CONSTRUCTION	EXTERNAL SINGLE FIELD ION TRAP

19 1/8" X 15" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	67	DEGREES
VERTICAL	53	DEGREES
DIAGONAL	72	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu$f
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu$f
EXTERNAL CONDUCTIVE COATING TO ANODE (MAX.)[A]	1 500	$\mu\mu$f
EXTERNAL CONDUCTIVE COATING TO ANODE (MIN.)[A]	1 200	$\mu\mu$f

OPTICAL DATA

PHOSPHOR NUMBER	ALUMINIZED	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	71	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	108 ± 20%	MA.
ION TRAP MAGNET STRENGTH (APPROX.)	35	GAUSSES

[A] EXTERNAL CONDUCTIVE COATING MUST BE GROUNDED.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 19 1/8" BY 15" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3 INCHES.

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→INDICATES A CHANGE.

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TUNG-SOL

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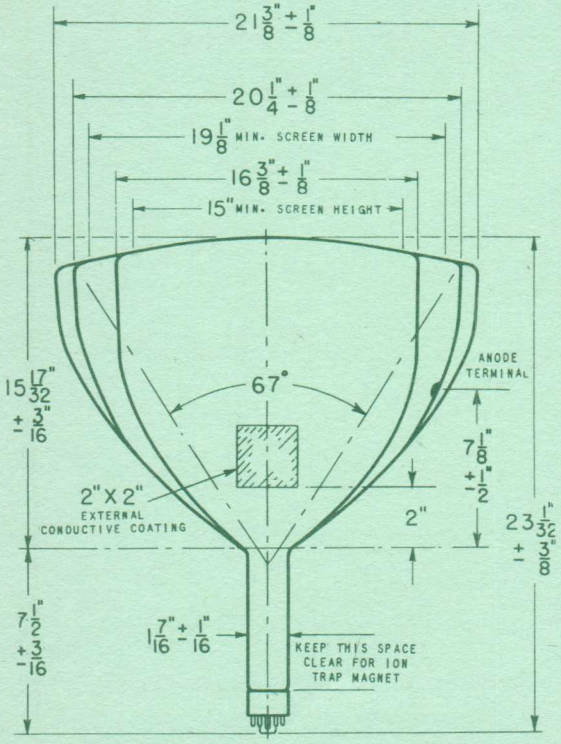
MECHANICAL DATA

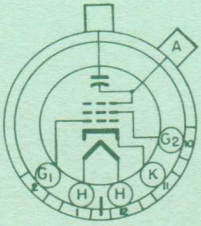
OVERALL LENGTH	23 1/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP.	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID #3

→INDICATES A CHANGE.

TUNG-SOL

CATHODE RAY

THE 21AYP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. *EXCEPT* FOR INCREASED EXTERNAL CONDUCTIVE COATING TO ANODE CAPACITANCE VALUES, IT IS IDENTICAL TO THE 21XP4. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION	SPHERICAL FACEPLATE
ELECTROSTATIC FOCUS	GREY FILTER FACEPLATE
UNIPOTENTIAL CATHODE	12 3/4" X 17" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION	EXTERNAL SINGLE FIELD ION TRAP

EXTERNAL CONDUCTIVE COATING

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	77	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	72	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE[A]	-64 TO +352	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC ION TRAP MAGNET STANDARD COIL #117 (APPROX.)	30 ±40%	MA.
DC ION TRAP MAGNET RATED STRENGTH	35	GAUSSES

[A] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE CURRENT OF 100 MICROAMPERES ON 17" BY 12 3/4" PICTURE SIZE.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

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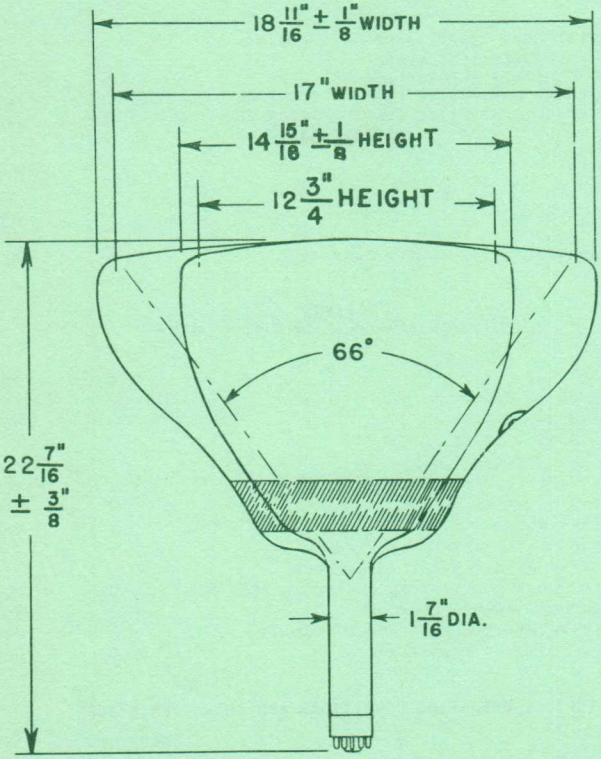
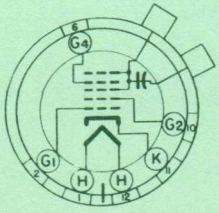
MECHANICAL DATA

OVERALL LENGTH	22 7/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 5/8 ± 3/16	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
HEIGHT	14 15/16 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BULB CONTACT ALIGNMENT		
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES		
BASING		12L



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO.3
GRID NO.5

TUNG-SOL

CATHODE RAY

THE 21BAP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	ALUMINIZED SCREEN
MAGNETIC DEFLECTION	GRAY FILTER FACEPLATE
UNIPOTENTIAL CATHODE	19 1/8" X 15" RASTER SIZE
RECTANGULAR GLASS CONSTRUCTION	EXTERNAL CONDUCTIVE COATING

DOES NOT REQUIRE ION TRAP MAGNET

ELECTRICAL DATA

FOCUSING METHOD	ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	71	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ± 10%	AMP.
MAXIMUM DC ANODE VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE*	16 000	VOLTS
DC GRID #4 VOLTAGE	0 TO 500	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC GRID #4 CURRENT	-15 TO +25	μAMP

*BRIGHTNESS AND FOCUS QUALITY DDCREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

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TUNG-SOL

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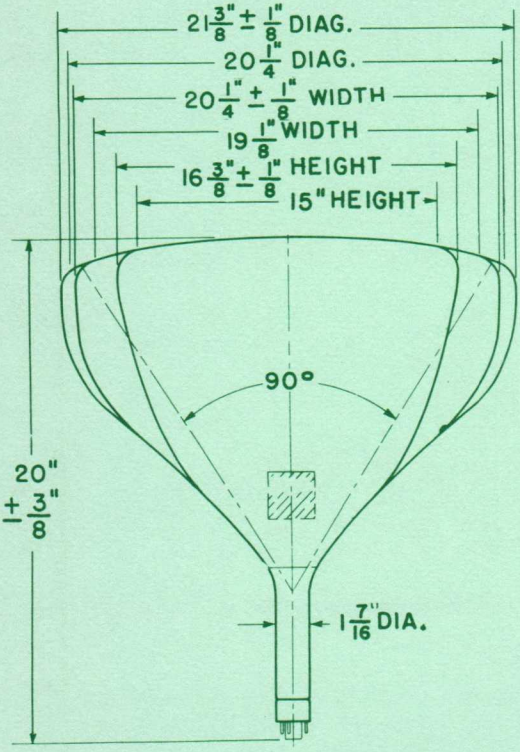
MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

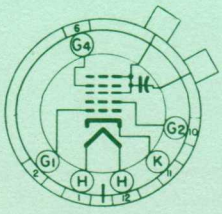
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE

PIN CONNECTIONS



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21BCP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	ALUMINIZED SCREEN
MAGNETIC DEFLECTION	GRAY FILTER FACEPLATE
UNIPOTENTIAL CATHODE	EXTERNAL CONDUCTIVE COATING
RECTANGULAR GLASS CONSTRUCTION	19 1/8" X 14 3/16" RASTER SIZE

DOES NOT REQUIRE ION TRAP MAGNET

ELECTRICAL DATA

FOCUSING METHOD	ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	71	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ± 10%	AMP.
MAXIMUM DC ANODE VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	−500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[A]:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[B]	16 000	VOLTS
DC GRID #4 VOLTAGE	+50 TO +550	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	−28 TO −72	VOLTS
DC GRID #4 CURRENT	−15 TO +25	μAMP

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MIDTAP OF THE HEATER TRANSFORMER WINDING.

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[C] VISUAL EXTINCTION OF FOCUSED RASTER.

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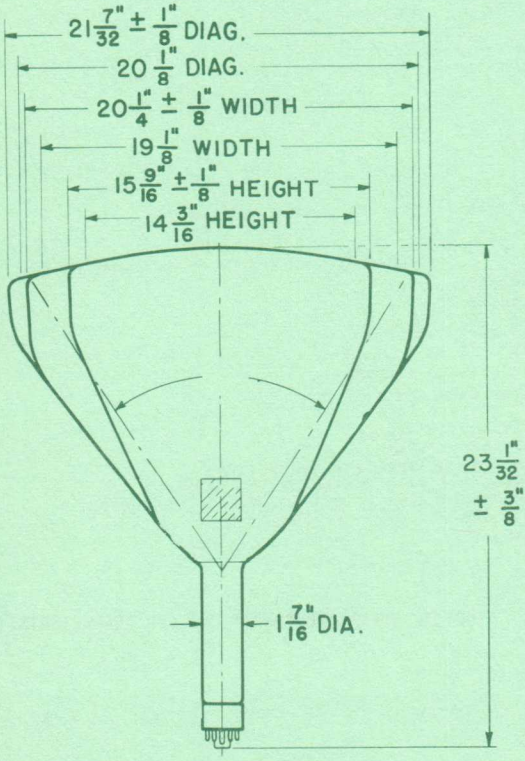
MECHANICAL DATA

OVERALL LENGTH	23 1/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 7/32 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	15 9/16 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/8	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	14 3/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

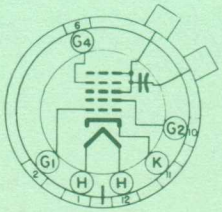
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE

PIN CONNECTIONS



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21BDP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	ELECTROSTATIC FOCUS
MAGNETIC DEFLECTION	UNIPOTENTIAL CATHODE
GRAY FILTER FACEPLATE	19 1/8" X 15" RASTER SIZE
EXTERNAL CONDUCTIVE COATING	RECTANGULAR GLASS CONSTRUCTION

DOES NOT REQUIRE ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	67	DEGREES
VERTICAL	53	DEGREES
DIAGONAL	72	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	71	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[B]	16 000	VOLTS
DC GRID #4 VOLTAGE	+50 TO +550	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS
DC GRID #4 CURRENT	-15 TO +25	μAMP.

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MIDTAP OF THE HEATER TRANSFORMER WINDING.

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[C] VISUAL EXTINCTION OF FOCUSED RASTER.

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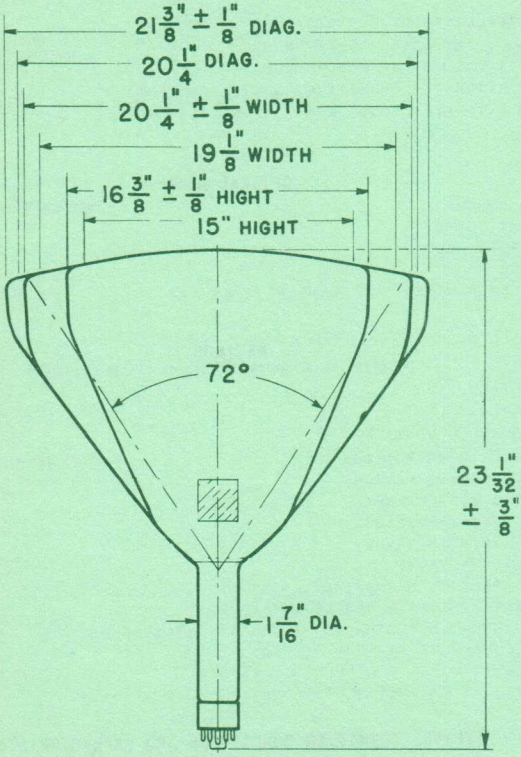
MECHANICAL DATA

OVERALL LENGTH	23 1/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

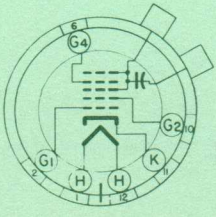
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 — HEATER
PIN 2 — GRID #1
PIN 6 — GRID #4
PIN 10 — GRID #2
PIN 11 — CATHODE



BOTTOM VIEW

PIN 12 — HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21BNP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	UNIPOTENTIAL CATHODE
MAGNETIC DEFLECTION	ALUMINIZED SCREEN
19 1/8" X 15" RASTER SIZE	EXTERNAL CONDUCTIVE COATING
GREY FILTERGLASS FACEPLATE	REQUIRES NO ION TRAP MAGNET

ELECTRICAL DATA

FOCUSING METHOD	ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1200	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	71	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	−500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE	+50 TO +550	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	−28 TO −72	VOLTS
DC GRID #4 CURRENT	−15 TO +25	μAMP

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

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TUNG-SOL

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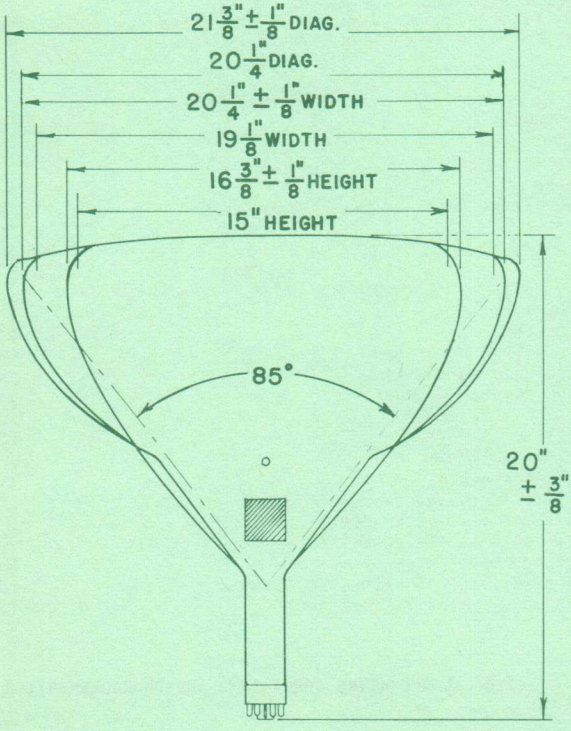
MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	15	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

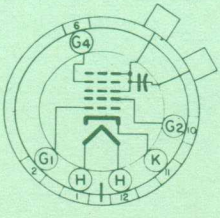
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ±30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21BSP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GRAY FILTER FACEPLATE — ALUMINIZED SCREEN
MAGNETIC FOCUS AND DEFLECTION — EXTERNAL CONDUCTIVE COATING
RECTANGULAR GLASS CONSTRUCTION — EXTERNAL SINGLE FIELD ION TRAP
19 1/16" X 15 1/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE	SHORT TO MEDIUM	
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±5%	AMP.
MAXIMUM DC ANODE VOLTAGE	22 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	155	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS
HEATER WARM-UP TIME (APPROX.)*	11.0	SECONDS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	116 ±15%	MA.
DC ION TRAP MAGNET STANDARD COIL #117 (APPROX.)	30	MA.
DC ION TRAP MAGNET RATED STRENGTH	33	GAUSSES

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 15 1/16" BY 19 1/16" PICTURE SIZE.

*HEATER WARM-UP TIME IS THE TIME REQUIRED FOR THE VOLTAGE ACROSS THE HEATER TERMINALS TO INCREASE TO 5.0 VOLTS IN THE JETEC TEST CIRCUIT, WITH E=25 VOLTS AND SERIES R=31.5 OHMS.

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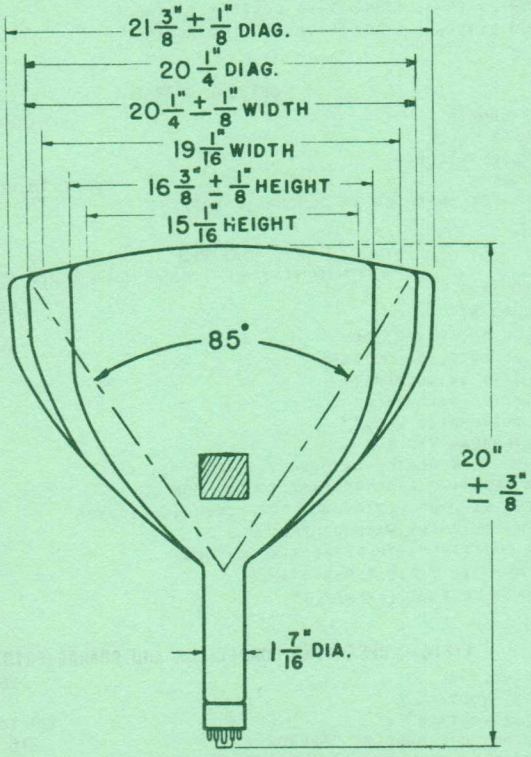
MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

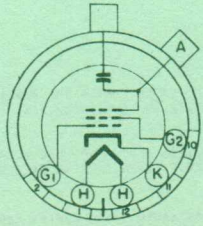
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 10 – GRID #2
PIN 11 – CATHODE



PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

TUNG-SOL

CATHODE RAY

THE 21CBP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	UNIPOTENTIAL CATHODE
MAGNETIC DEFLECTION	ALUMINIZED SCREEN
GREY FILTER FACEPLATE	EXTERNAL CONDUCTIVE COATING
19 1/16" X 15 1/16" RASTER SIZE	REQUIRES NO ION TRAP MAGNET

ELECTRICAL DATA

FOCUSING METHOD	ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6±10%	AMP.
MAXIMUM DC ANODE VOLTAGE *	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	140	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-55 TO 300	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

*BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

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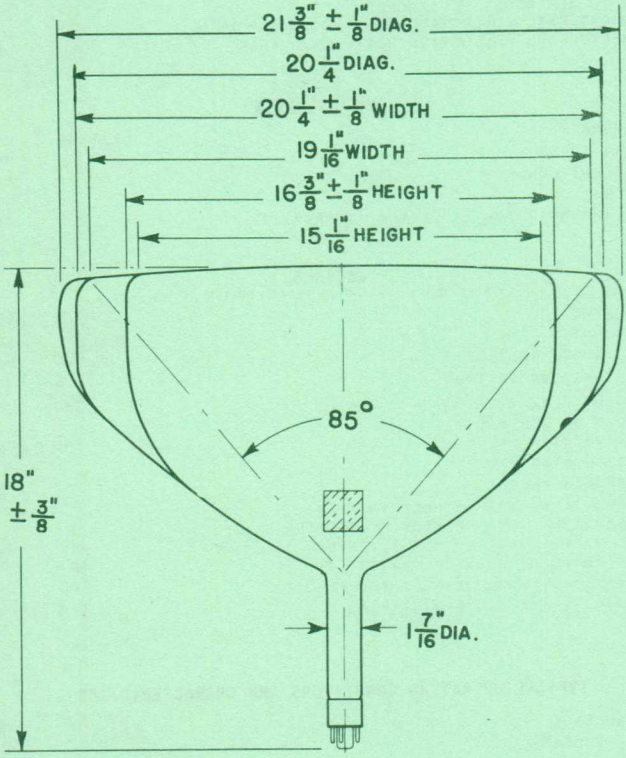
MECHANICAL DATA

OVERALL LENGTH	18 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

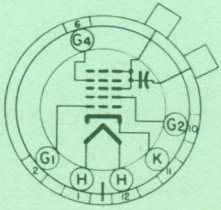
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ±30 DEGREES



PIN CONNECTIONS

PIN 1 — HEATER
PIN 2 — GRID #1
PIN 6 — GRID #4
PIN 10 — GRID #2
PIN 11 — CATHODE



BOTTOM VIEW

PIN 12 — HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21CDP4 AND 21CDP4A ARE DIRECT VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THE TUBES ARE IDENTICAL EXCEPT FOR THE ALUMINIZED SCREEN ON THE 21CDP4A.
THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION	ELECTROSTATIC FOCUS
UNIPOTENTIAL CATHODE	GRAY FILTER FACEPLATE
EXTERNAL CONDUCTIVE COATING	EXTERNAL SINGLE FIELD ION TRAP
RECTANGULAR GLASS CONSTRUCTION	19" 1/16" X 15 1/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE	SHORT TO MEDIUM	
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.45 ±5%	AMP.
MAXIMUM DC ANODE VOLTAGE	22 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-550 TO +1100	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	155	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS
HEATER WARM-UP TIME (APPROX.) *	11.0	SECONDS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE	-64 TO +352	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC ION TRAP MAGNET STANDARD COIL #117 (APPROX.)	30	MA.
DC ION TRAP MAGNET RATED STRENGTH	33	GAUSES

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

* HEATER WARM-UP TIME IS THE TIME REQUIRED FOR THE VOLTAGE ACROSS THE HEATER TERMINALS TO INCREASE TO 5.0 VOLTS IN THE JETEC TEST CIRCUIT, WITH E=25 VOLTS AND SERIES R=42 OHMS.

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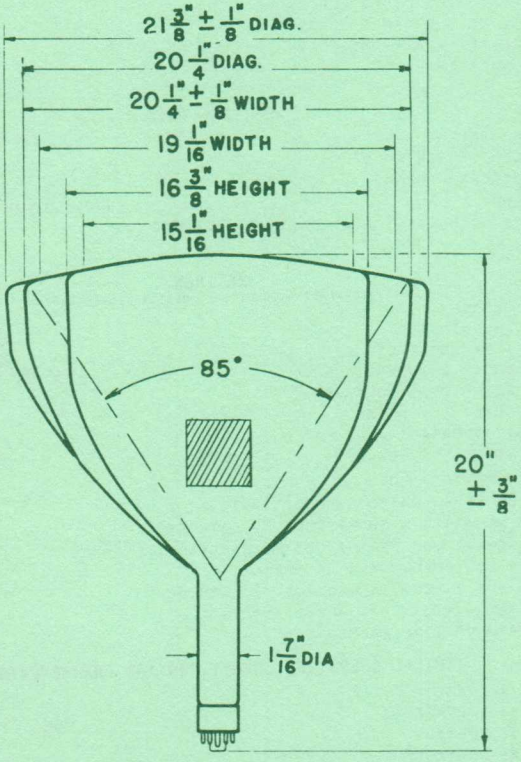
MECHANICAL DATA

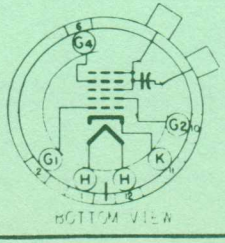
OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENTSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL CUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS



PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE

PIN 12 – HEATER
ANODE CAP:
GRID NO.3
GRID NO.5

TUNG-SOL

CATHODE RAY

THE 21CGP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	ELECTROSTATIC FOCUS
MAGNETIC DEFLECTION	UNIPOTENTIAL CATHODE
GRAY FILTER FACEPLATE	EXTERNAL CONDUCTIVE COATING
EXTERNAL SINGLE FIELD ION TRAP	RECTANGULAR GLASS CONSTRUCTION

19 1/16 X 15 1/16 RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	75	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE[A]	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	200	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE*	18 000	VOLTS
DC GRID #4 VOLTAGE	-72 TO +396	VOLTS
DC GRID #2 VOLTAGE	110	VOLTS
DC GRID #1 VOLTAGE[B]	-32 TO -50	VOLTS
DC ION TRAP MAGNET RATED STRENGTH	46	GAUSSES

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

* THIS TUBE MAY BE OPERATED IN GRID DRIVE IF DESIRED, WITH SOME LOSS IN EFFICIENCY. AVERAGE RASTER CUTOFF, WITH GRID DRIVE, MAY BE CALCULATED: $E_{g1c} = .502\ E_{g2} + 5.8$

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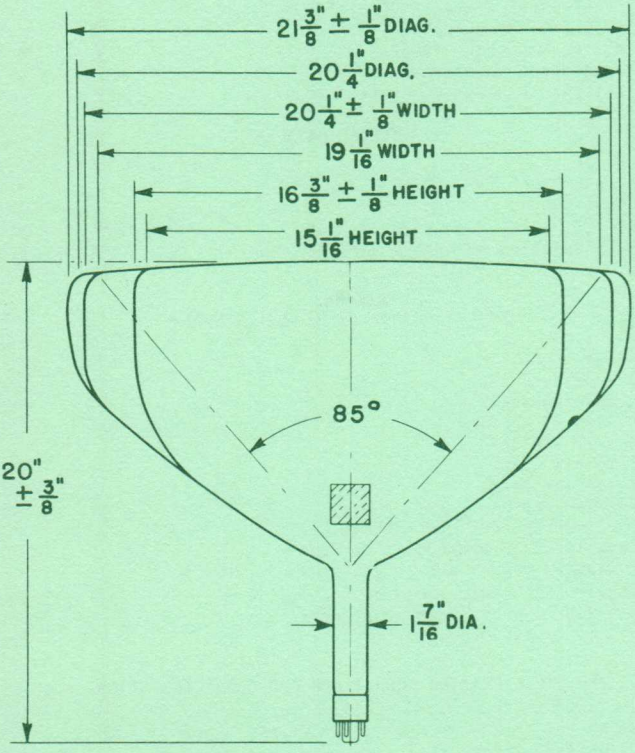
MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

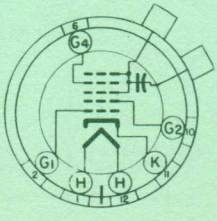
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ±30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21CHP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	ALUMINIZED SCREEN
UNIPOTENTIAL CATHODE	MAGNETIC DEFLECTION
GRAY FILTER FACEPLATE	EXTERNAL CONDUCTIVE COATING
RECTANGULAR GLASS CONSTRUCTION	19 1/16" X 15 1/16 RASTER SIZE

DOES NOT REQUIRE ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

CATHODE DRIVE SERVICE

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE*	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	200	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	0	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

CATHODE DRIVE[A]

DC ANODE VOLTAGE	18 000	VOLTS
DC GRID #4 VOLTAGE	-50 TO +350	VOLTS
DC GRID #2 VOLTAGE	110	VOLTS
DC GRID #1 VOLTAGE[B]	-37 TO -50	VOLTS

[A] THIS TUBE MAY BE OPERATED IN GRID DRIVE IF DESIRED, WITH SOME LOSS IN EFFICIENCY. AVERAGE RASTER CUTOFF, USING DRIVE, MAY BE CALCULATED: $E_{g1c} = .502\ E_{g2} + 5.8$

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

*BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

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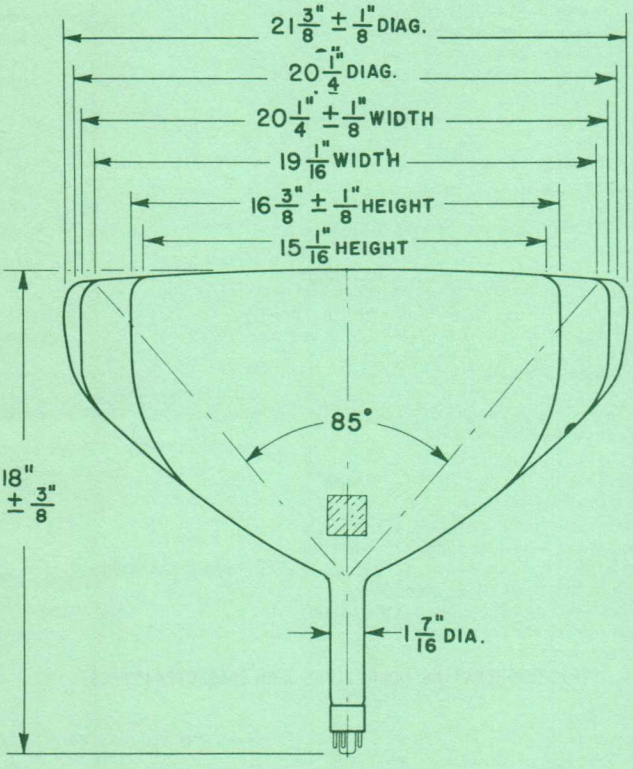
MECHANICAL DATA

OVERALL LENGTH	18 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

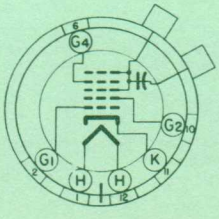
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ±30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

TUNG-SOL

CATHODE RAY

THE 21CUP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **ALUMINIZED SCREEN**
GRAY FILTER FACEPLATE — **EXTERNAL CONDUCTIVE COATING**
MAGNETIC FOCUS AND DEFLECTION — **EXTERNAL SINGLE FIELD ION TRAP**
19 1/16" X 15 1/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	22 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	155	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)	117	MA.
DC ION TRAP MAGNET RATED STRENGTH	40	GAUSSES

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

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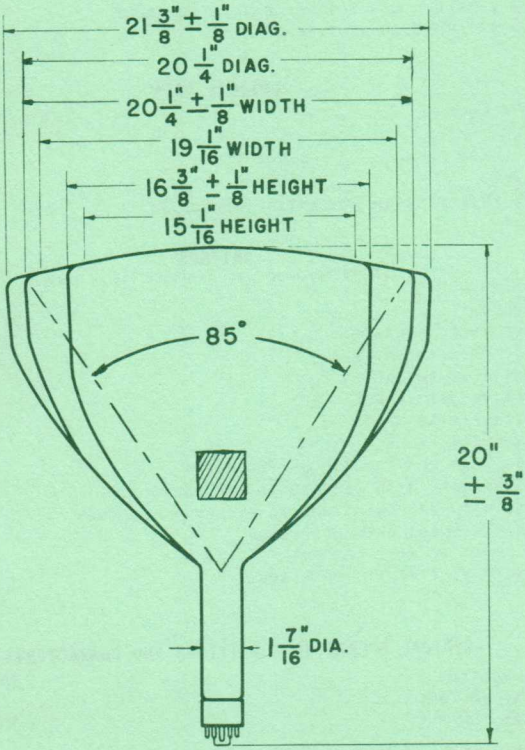
MECHANICAL DATA

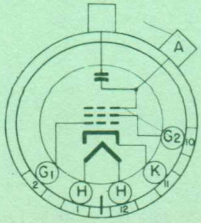
OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 10 – GRID #2
PIN 11 – CATHODE



PIN 12 – HEATER
ANODE CAP:
GRID NO.3

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CATHODE RAY

THE 21CVP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	ALUMINIZED SCREEN
MAGNETIC DEFLECTION	GRAY FILTER FACEPLATE
UNIPOTENTIAL CATHODE	RECTANGULAR GLASS CONSTRUCTION
EXTERNAL CONDUCTIVE COATING	19 1/16" X 15 1/16" RASTER SIZE

REQUIRES NO ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	22 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE[A]	-550 TO +1100	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	155	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE	-64 TO +352	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS

[A] THE FOCUS ELECTRODE MAY BE MODULATED TO IMPROVE OVERALL FOCUS.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

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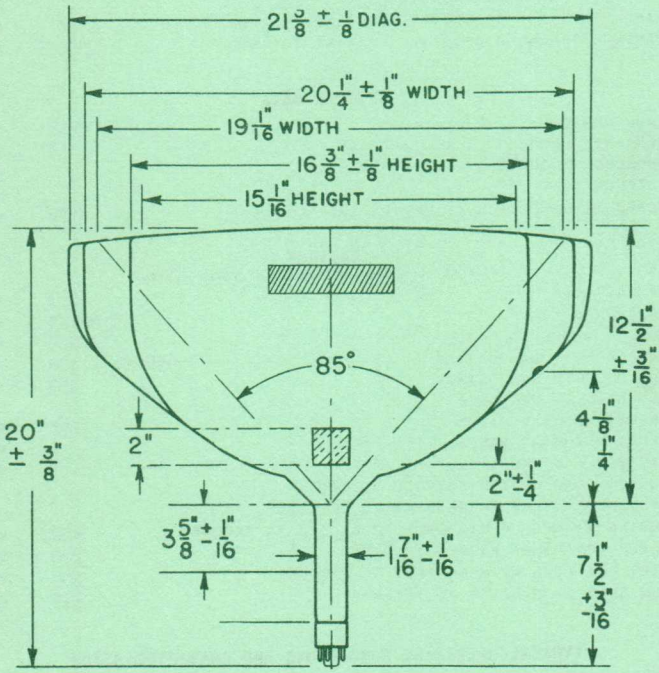
MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6-PIN	B6-63
BASING		12L

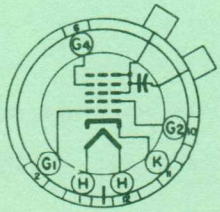
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

BOTTOM VIEW

TUNG-SOL

CATHODE RAY

THE 21CWP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS	ALUMINIZED SCREEN
MAGNETIC DEFLECTION	GRAY FILTER FACEPLATE
UNIPOTENTIAL CATHODE	RECTANGULAR GLASS CONSTRUCTION
EXTERNAL CONDUCTIVE COATING	19 1/16" X 15 1/16" RASTER SIZE

EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	74	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±5%	AMP.
MAXIMUM DC ANODE VOLTAGE	22 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE[A]	-550 TO +1100	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	550	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	155	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE	-64 TO +352	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC ION TRAP MAGNET RATED STRENGTH	40	GAUSSES

[A] THE FOCUS ELECTRODE MAY BE MODULATED TO IMPROVE OVERALL FOCUS.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

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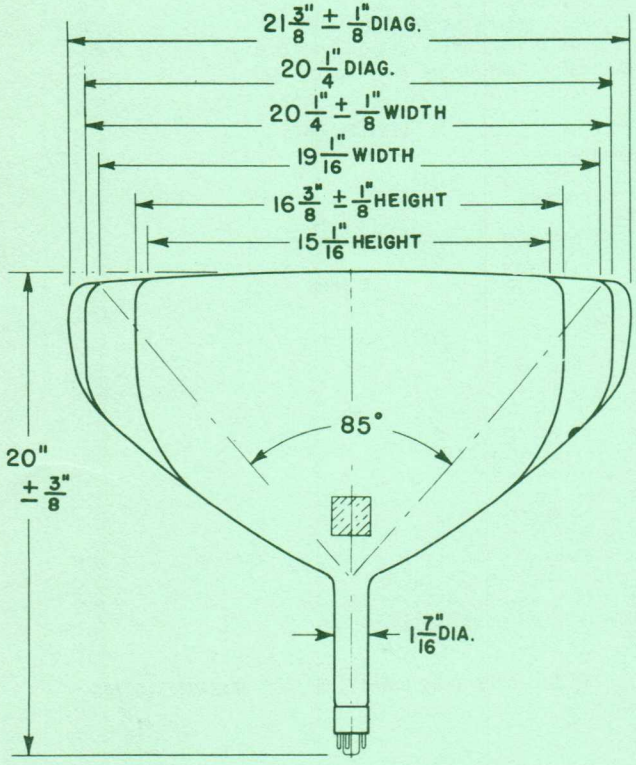
MECHANICAL DATA

OVERALL LENGTH	20 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	16 3/8 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/4	INCHES
WIDTH	19 1/16	INCHES
HEIGHT	15 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

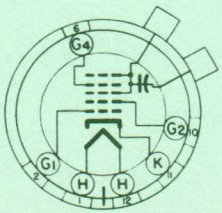
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

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CATHODE RAY

THE 21DP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS — **MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE — **FROSTED FILTERGLASS FACEPLATE**
RECTANGULAR METAL CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
18 3/8" X 13 15/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

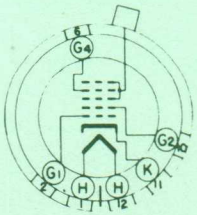
MECHANICAL DATA

OVERALL LENGTH	22 5/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/4 ± 1/4	INCHES
WIDTH	19 23/32 ± 1/8	INCHES
HEIGHT	15 5/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	19 3/8	INCHES
WIDTH	18 3/8	INCHES
HEIGHT	13 15/16	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

BULB CONTACT ALIGNMENT
METAL SHELL LIP CONTACT ALIGNS WITH PIN POSITION #6 ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	5 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT-WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT-TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC GRID #4 VOLTAGE[B]	2750 TO 3740	VOLTS
ION TRAP MAGNET (RATED STRENGTH)	40	GAUSSES

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] WITH GRID #3, GRID #5, COLLECTOR CURRENT OF 100 UAMP.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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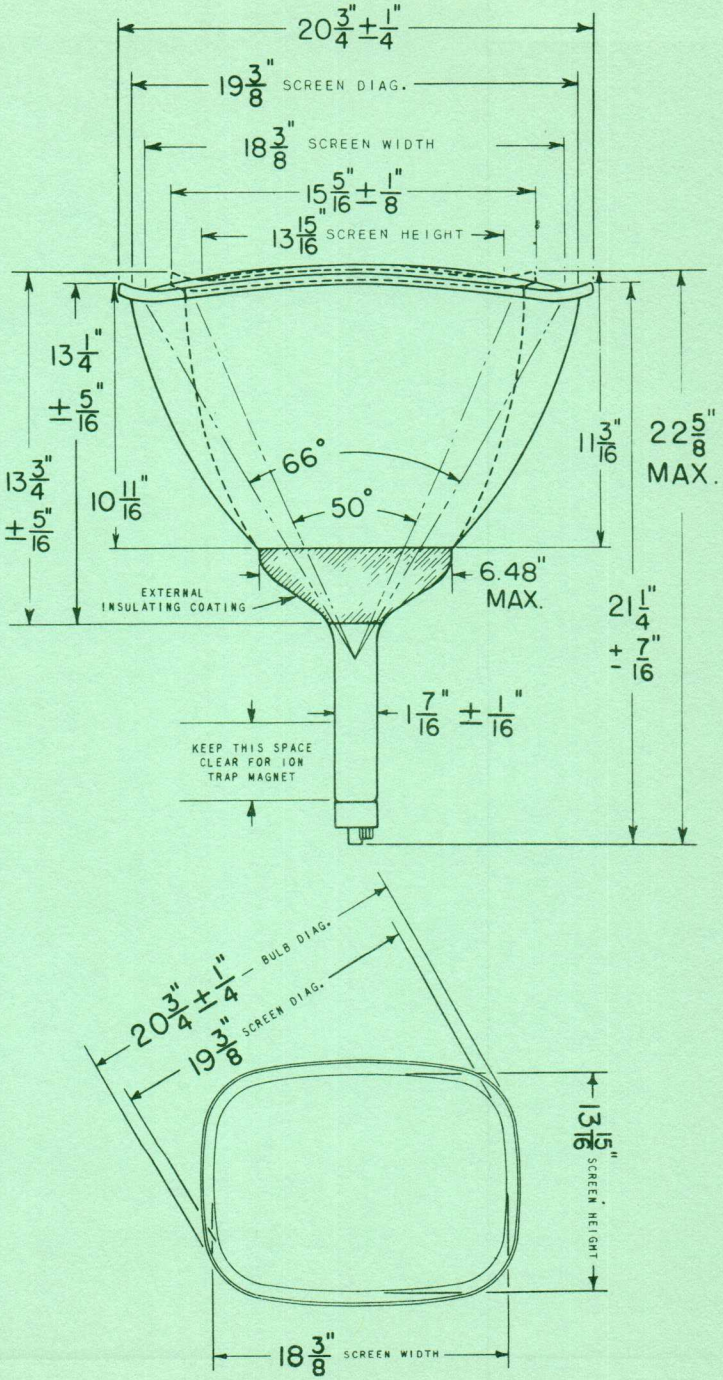

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

[A] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 19.8KV, SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16Kv.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	95 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.
ION TRAP FIELD INTENSITY (RATED STRENGTH)	35	GAUSSES

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 13 7/8" BY 19 1/8" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL

CATHODE RAY

THE 21EP4, 21EP4A AND 21EP4B ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THE 21EP4A AND 21EP4B HAVE EXTERNAL CONDUCTIVE COATINGS WITH THE 21EP4B ALSO HAVING AN ALUMINIZED SCREEN. IN ALL OTHER RESPECTS THESE TUBES ARE IDENTICAL. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **GREY FILTER FACEPLATE**
CYLINDRICAL FACEPLATE — **MAGNETIC FOCUS & DEFLECTION**
EXTERNAL SINGLE FIELD ION TRAP — **19 1/8" X 13 7/8" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD			MAGNETIC
DEFLECTING METHOD			MAGNETIC
DEFLECTION ANGLE (APPROX.):			
HORIZONTAL		65	DEGREES
DIAGONAL		70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):			
CATHODE TO ALL OTHER ELECTRODES		5	μμf
GRID #1 TO ALL OTHER ELECTRODES		6	μμf
EXTERNAL CONDUCTIVE COATING TO ANODE (MAX.)	**21EP4A & 21EP4B**	750	μμf
EXTERNAL CONDUCTIVE COATING TO ANODE (MIN.)	**21EP4B**	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

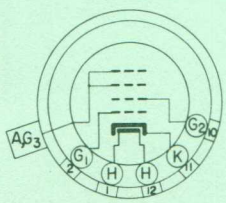
MECHANICAL DATA

OVERALL LENGTH	23 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 1/4 ± 3/16	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	15 9/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	19 1/8	INCHES
HEIGHT	13 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING	**21EP4A & 21EP4B**— 12N 21EP4	12D
BULB CONTACT ALIGNMENT		
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES		

PIN CONNECTIONS

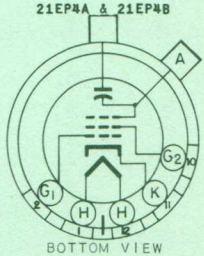
PIN 1 — HEATER
PIN 2 — GRID NO. 1
PIN 10 — GRID NO. 2
PIN 11 — CATHODE
PIN 12 — HEATER
ANODE CAP:
GRID NO. 3

21EP4



BOTTOM VIEW

21EP4A & 21EP4B



BOTTOM VIEW

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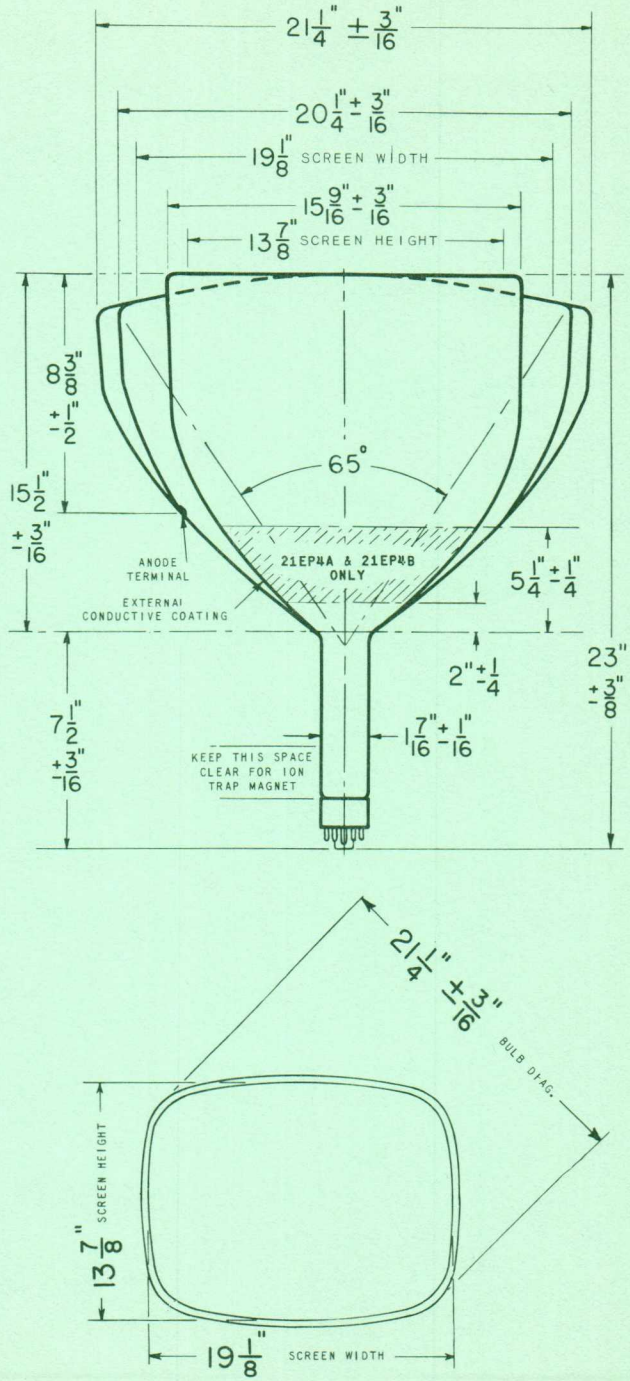

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CATHODE RAY

THE 21FP4, 21FP4A AND 21FP4C ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THE 21FP4A AND 21FP4C HAVE EXTERNAL CONDUCTIVE COATINGS WITH THE 21FP4C ALSO HAVING AN ALUMINIZED SCREEN. IN ALL OTHER RESPECTS THESE TUBES ARE IDENTICAL. THEIR COMMON FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
CYLINDRICAL FACEPLATE	**19 1/8" X 13 7/8" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **21FP4A & 21FP4C**	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **21FP4A & 21FP4C**	500	μμf

OPTICAL DATA

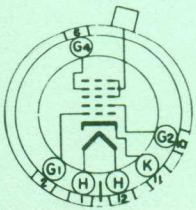
PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

OVERALL LENGTH	23 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 1/4 ± 3/16	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	15 9/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	19 1/8	INCHES
HEIGHT	13 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING	**21FP4A & 21FP4C**-12L 21FP4	12M
BULB CONTACT ALIGNMENT		

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

21FP4

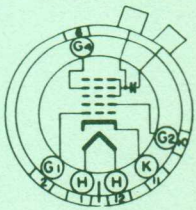


BOTTOM VIEW

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

21FP4A & 21FP4C



BOTTOM VIEW

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM GRID #4 CURRENT	-15 TO +25	μAMP.
MAXIMUM GRID #2 CURRENT	-15 TO +25	μAMP.
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 19.8KV, SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16KV.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE	-56 TO +310	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
ION TRAP MAGNET (RATED STRENGTH) STANDARD COIL #111	35	GAUSSES

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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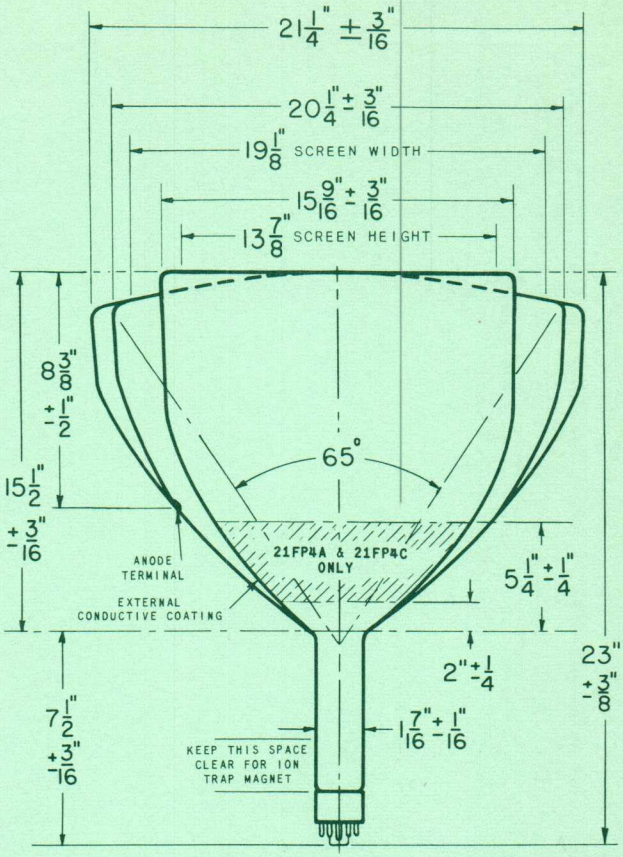

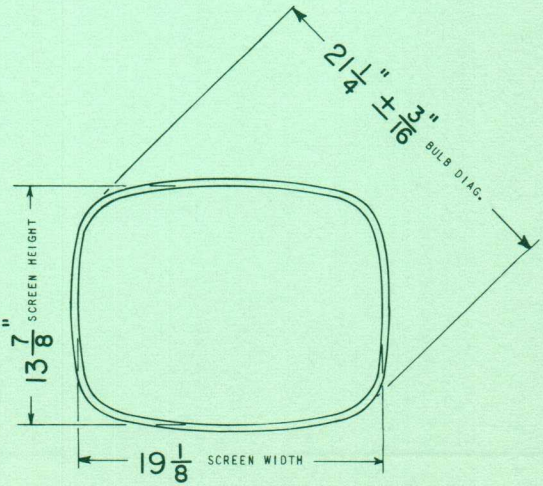

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CATHODE RAY

THE 21JP4 AND 21JP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 21JP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
CYLINDRICAL FACEPLATE
RECTANGULAR GLASS CONSTRUCTION
BUILT-IN ION TRAP & FOCUSING UNIT
GREY FILTER FACEPLATE
EXTERNAL CONDUCTIVE COATING
MAGNETIC FOCUS AND DEFLECTION
19 1/8" X 13 7/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	$\mu\mu f$

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	71	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM[A]

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	20 000	VOLTS
MAXIMUM ANODE INPUT[B]	6	WATTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE BIAS VALUE	125	VOLTS
DC POSITIVE BIAS VALUE	0	VOLTS
POSITIVE PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[C]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE[D]	16 000 ± 3 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[E]	-28 TO -72	VOLTS

[A] THE MAXIMUM RATINGS PROVIDE A 10% SAFETY FACTOR IN ACCORDANCE WITH THE STANDARD DESIGN-CENTER SYSTEM OF RATING CATHODE-RAY TUBES. THE TUBE WILL WITHSTAND THE COMBINED EFFECTS OF VARIATIONS IN LINE VOLTAGE AND COMPONENTS PROVIDED THE MAXIMUM DESIGN-CENTER VALUES ARE NOT EXCEEDED BY MORE THAN 10%.

[B] ANODE INPUT EQUALS THE PRODUCT OF ANODE VOLTAGE AND AVERAGE CURRENT MEASURED AT THE TERMINAL.

[C] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

[D] OPTIMUM FOCUSING CONDITIONS REQUIRE THAT THE TUBE BE OPERATED WITHIN THE SPECIFIED VOLTAGE RANGE.

[E] VISUAL EXTINCTION OF FOCUSED RASTER.

IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER OF PERSONAL INJURY FROM PROLONGED EXPOSURE AT CLOSE RANGE. THE PROTECTIVE FACE-VIEWING WINDOW OF APPRATUS USING TUBES OF THIS TYPE MAY PROVIDE SUCH A SAFEGUARD. IF THE RADIATION MEASURED IN CONTACT WITH THIS WINDOW DOES NOT EXCEED 6.25 MILLIROENTGENS PER HOUR, THE WINDOW WILL NORMALLY PROVIDE ADEQUATE PROTECTION.

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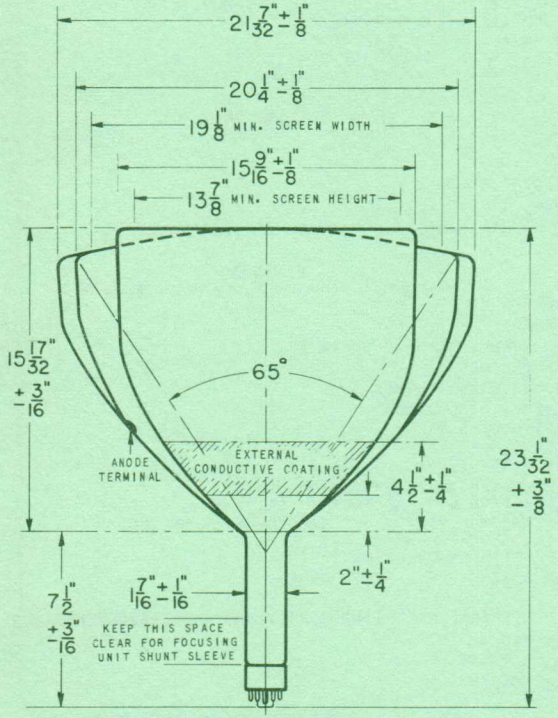
MECHANICAL DATA

OVERALL LENGTH	23 1/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 7/32 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	15 9/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/8	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	13 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

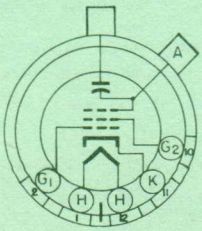
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID #3

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CATHODE RAY

THE 21KP4 AND 21KP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE EXTERNAL CONDUCTIVE COATING ON THE 21KP4A. THEIR COMMON FEATURES INCLUDE:

ELECTROSTATIC FOCUS	**MAGNETIC DEFLECTION**
UNIPOTENTIAL CATHODE	**CYLINDRICAL FACEPLATE**
GREY FILTER FACEPLATE	**13 7/8" X 19 1/8" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	6	μμf
GRID #1 TO ALL OTHER ELECTRODES	6.5	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **21KP4A**	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE **ONLY**	500	μμf

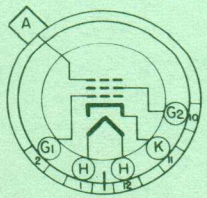
OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

OVERALL LENGTH	23 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 7/32 ± 1/8	INCHES
WIDTH	20 1/4 ± 1/8	INCHES
HEIGHT	15 9/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	19 1/8	INCHES
HEIGHT	13 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING	**21KP4A** – 12N 21KP4	12D
BULB CONTACT ALIGNMENT		
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES		

21KP4

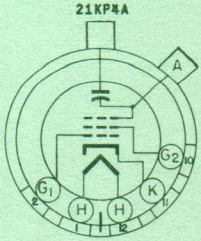


BOTTOM VIEW

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

21KP4A



BOTTOM VIEW

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	50 ± 50%	MA.
CENTERING MAGNET FIELD STRENGTH	0 TO 8	GAUSSES

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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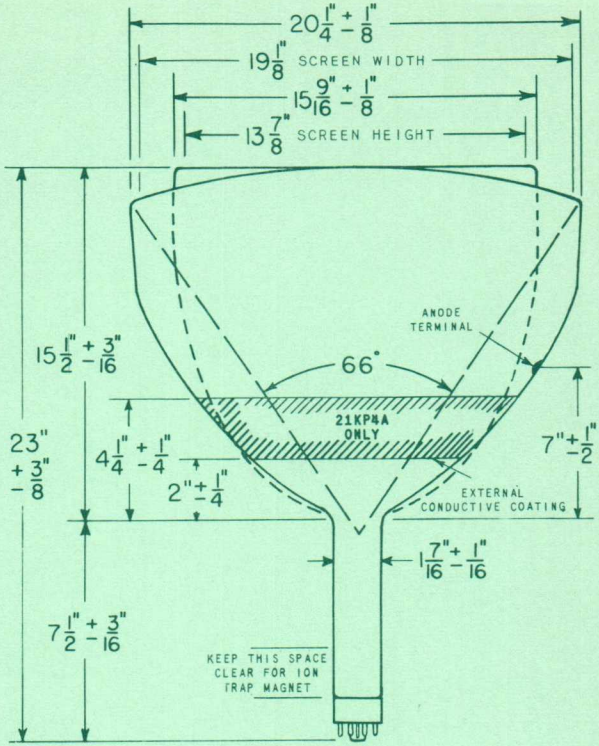

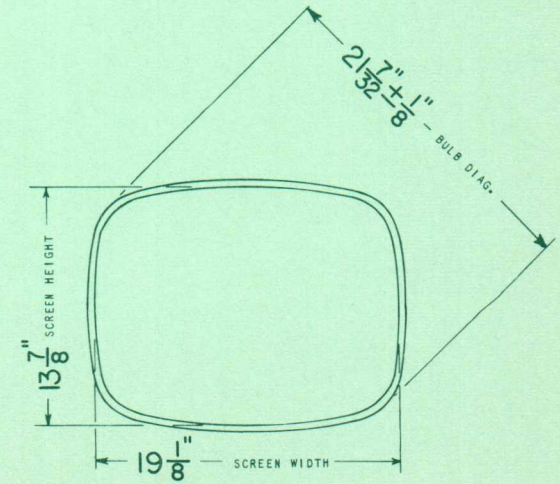

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CATHODE RAY

THE 21MP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

MAGNETIC DEFLECTION — **UNIPOTENTIAL CATHODE**
RECTANGULAR METAL CONSTRUCTION — **FROSTED FILTERGLASS FACEPLATE**
LOW VOLTAGE ELECTROSTATIC FOCUS — **EXTERNAL SINGLE FIELD ION TRAP**
18 3/8" X 14" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

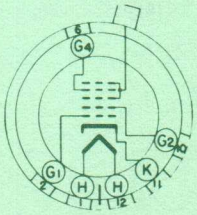
MECHANICAL DATA

OVERALL LENGTH	22 5/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 3/4 ± 1/4	INCHES
WIDTH	19 23/32 ± 1/8	INCHES
HEIGHT	15 5/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	19 3/8	INCHES
WIDTH	18 3/8	INCHES
HEIGHT	14	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

BASE ALIGNMENT
PIN #6 ALIGNS WITH HORIZONTAL PICTURE AXIS ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500[A] TO +1000	VOLTS
MAXIMUM DC PEAK HEATER CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] THIS VALUE HAS BEEN SPECIFIED TO TAKE CARE OF THE CONDITION WHERE AN AC VOLTAGE IS PROVIDED FOR DYNAMIC FOCUSING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	14 000	VOLTS
DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)[B]	-55 TO +300	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
ION TRAP MAGNET (RATED STRENGTH)	45	GAUSSES

[B] WITH GRID #3, GRID #5, COLLECTOR CURRENT OF 100 UAMP.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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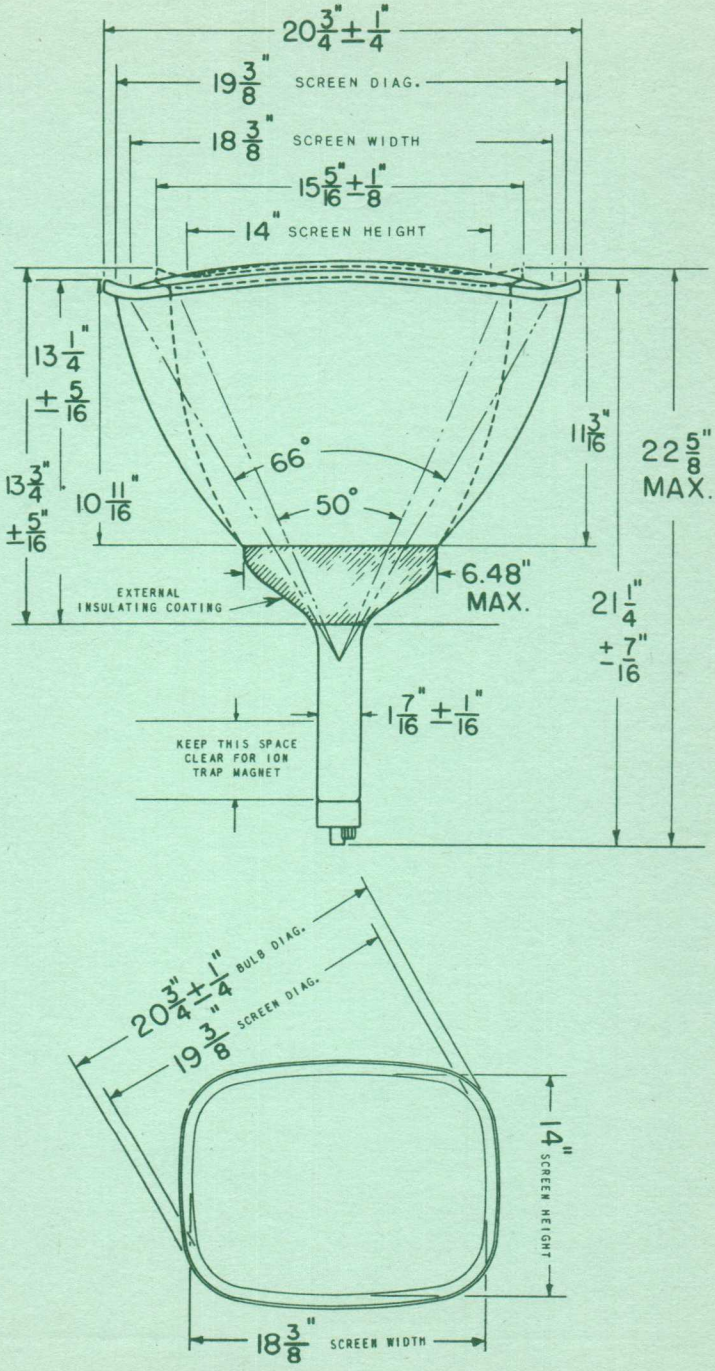

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CATHODE RAY

THE 21WP4 AND 21WP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 21WP4A. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE	**SPHERICAL FACEPLATE**
GREY FILTER FACEPLATE	**12 3/4" X 17" RASTER SIZE**
MAGNETIC FOCUS & DEFLECTION	**EXTERNAL CONDUCTIVE COATING**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		P4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	72	PERCENT

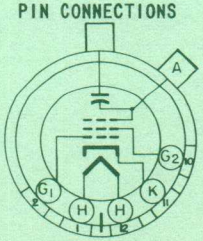
MECHANICAL DATA

OVERALL LENGTH	22 7/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 5/8 ± 3/16	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
HEIGHT	14 15/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

TUNG-SOL

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	100 ± 20%	MA.
ION TRAP CURRENT STANDARD COIL #117 (APPROX.)	30 ± 40%	MA.
ION TRAP MAGNET FIELD STRENGTH (APPROX.)	35	GAUSSES

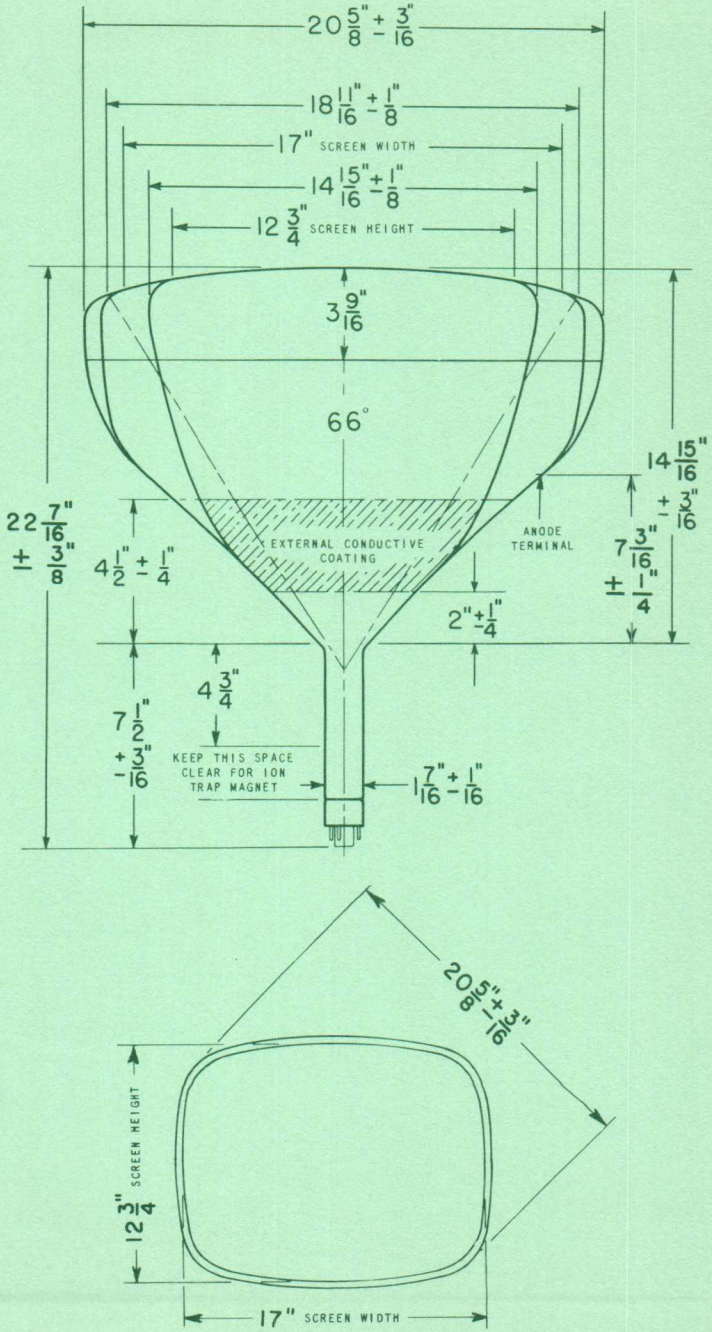
[A] VISUAL EXTINCTION OF FOCUSED RASTER.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 12 3/4" BY 17" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 21XP4 AND 21XP4A ARE DIRECT-VIEW PICTURE TUBES INTENDED FOR TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 21XP4A. THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION	**SPHERICAL FACEPLATE**
UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL CONDUCTIVE COATING**
LOW VOLTAGE ELECTROSTATIC FOCUS	**EXTERNAL SINGLE FIELD ION TRAP**

12 3/4" X 17" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	66	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	72	PERCENT

MECHANICAL DATA

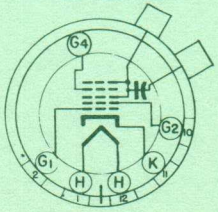
OVERALL LENGTH	22 7/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	20 5/8 ± 3/16	INCHES
WIDTH	18 11/16 ± 1/8	INCHES
HEIGHT	14 15/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	17	INCHES
HEIGHT	12 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 6 - GRID NO. 4
PIN 10 - GRID NO. 2
PIN 11 - CATHODE



BOTTOM VIEW

PIN 12 - HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 GRID #5 VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)	−500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)[A]	−64 TO +352	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	−28 TO −72	VOLTS
DC ION TRAP CURRENT STANDARD COIL #117 (APPROX.)	30 ± 40%	MA.
ION TRAP MAGNET FIELD STRENGTH (APPROX.)	35	GAUSSES

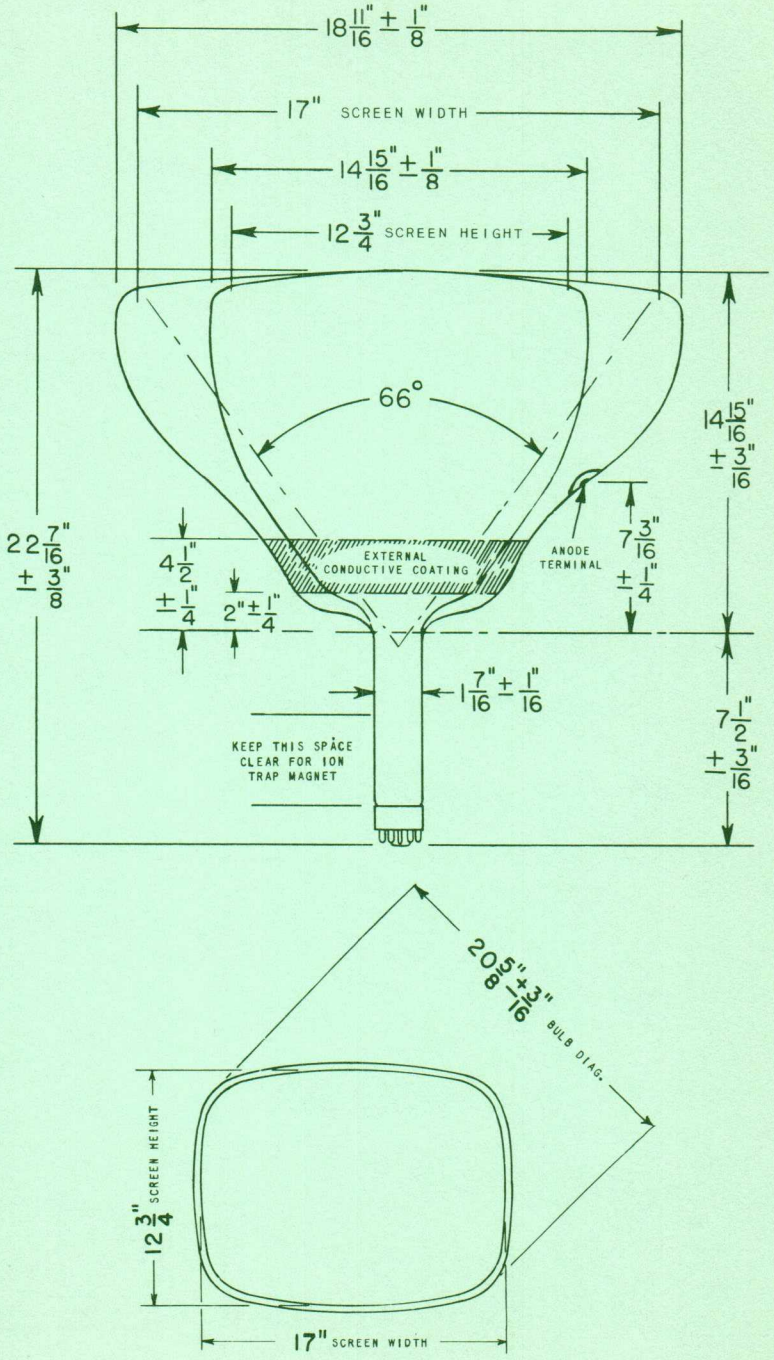
[A] WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO GIVE AN ANODE CURRENT OF 100 MICROAMPERES ON A 12 3/4" X 17" PICTURE SIZE.

[B] VISUAL EXTINCTION OF FOCUSED RASTER.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 21YP4 AND 21YP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN USED ON THE 21YP4A. THEIR COMMON FEATURES INCLUDE:

MAGNETIC DEFLECTION — **UNIPOTENTIAL CATHODE**
SPHERICAL FACEPLATE — **GREY FILTER FACEPLATE**
EXTERNAL CONDUCTIVE COATING — **EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR GLASS CONSTRUCTION — **LOW VOLTAGE ELECTROSTATIC FOCUS**
19 1/8" X 14 3/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	75	PERCENT

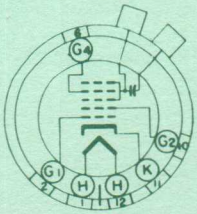
MECHANICAL DATA

OVERALL LENGTH	23 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 3/8	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	15 9/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	19 1/8	INCHES
HEIGHT	14 3/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE[B]	−500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[B] THIS VALUE APPLIES WHERE AN AC VOLTAGE IS PROVIDED FOR DYNAMIC FOCUSING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE[C]	16 000	VOLTS
DC GRID #4 VOLTAGE[D]	−64 TO +350	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[E]	−33 TO −77	VOLTS
ION TRAP MAGNET (RATED STRENGTH)	45	GAUSSES

[C] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 19.8 KV, SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16 KV.

[D] WITH ANODE CURRENT OF 100 UAMP.

[E] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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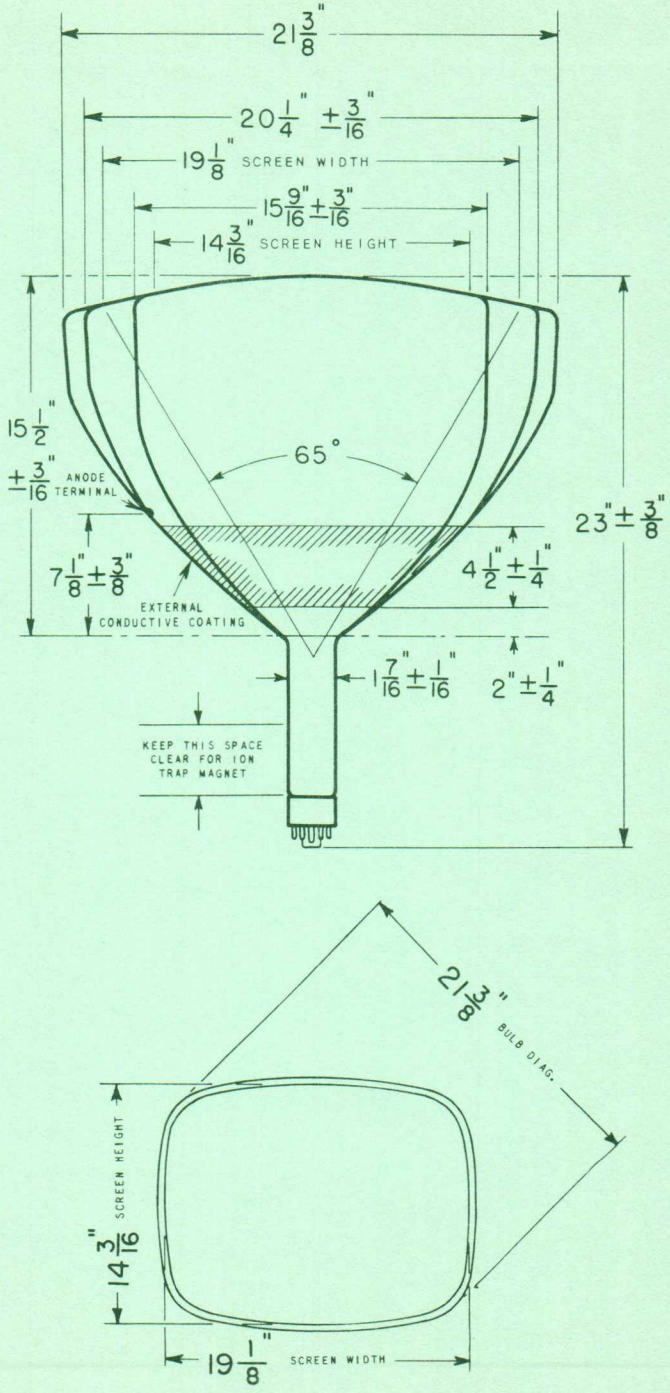

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CATHODE RAY

THE 21ZP4, 21ZP4A AND 21ZP4B ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 21ZP4A AND 21ZP4B HAVE EXTERNAL CONDUCTIVE COATINGS AND THE 21ZP4B ALSO HAS AN ALUMINIZED SCREEN. THEIR COMMON FEATURES INCLUDE:

SPHERICAL FACEPLATE — **UNIPOTENTIAL CATHODE**
GREY FILTER FACEPLATE — **MAGNETIC FOCUS & DEFLECTION**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
19 1/8" X 14 3/16" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	65	DEGREES
VERTICAL	50	DEGREES
DIAGONAL	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
21ZP4A AND 21ZP4B ONLY		
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE **21ZP4B** – SHORT	21ZP4 & 21ZP4A	MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	75	PERCENT

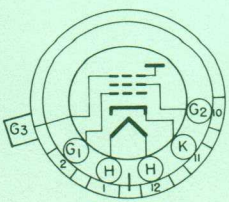
MECHANICAL DATA

OVERALL LENGTH	23 1/32 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	21 7/32 ± 1/8	INCHES
WIDTH	20 1/4 ± 3/16	INCHES
HEIGHT	15 9/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	20 1/8	INCHES
WIDTH	19 1/8	INCHES
HEIGHT	14 3/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING **21ZP4** – 12D	21ZP4A & 21ZP4B	12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

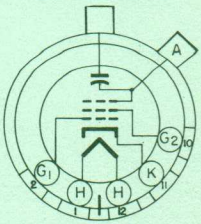
21ZP4



BOTTOM VIEW

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

21ZP4A & 21ZP4B



BOTTOM VIEW

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[A]:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE[BC]	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[E]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[D] (APPROX.)	100 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	95 ± 50%	MA.
ION TRAP MAGNET (RATED STRENGTH) APPROX.	45	GAUSSES

[B] BRIGHTNESS AND FOCUS QUALITY DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[C] IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER FROM PROLONGED EXPOSURE AT CLOSE RANGE.

[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 19 3/16" BY 14 5/16" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

[E] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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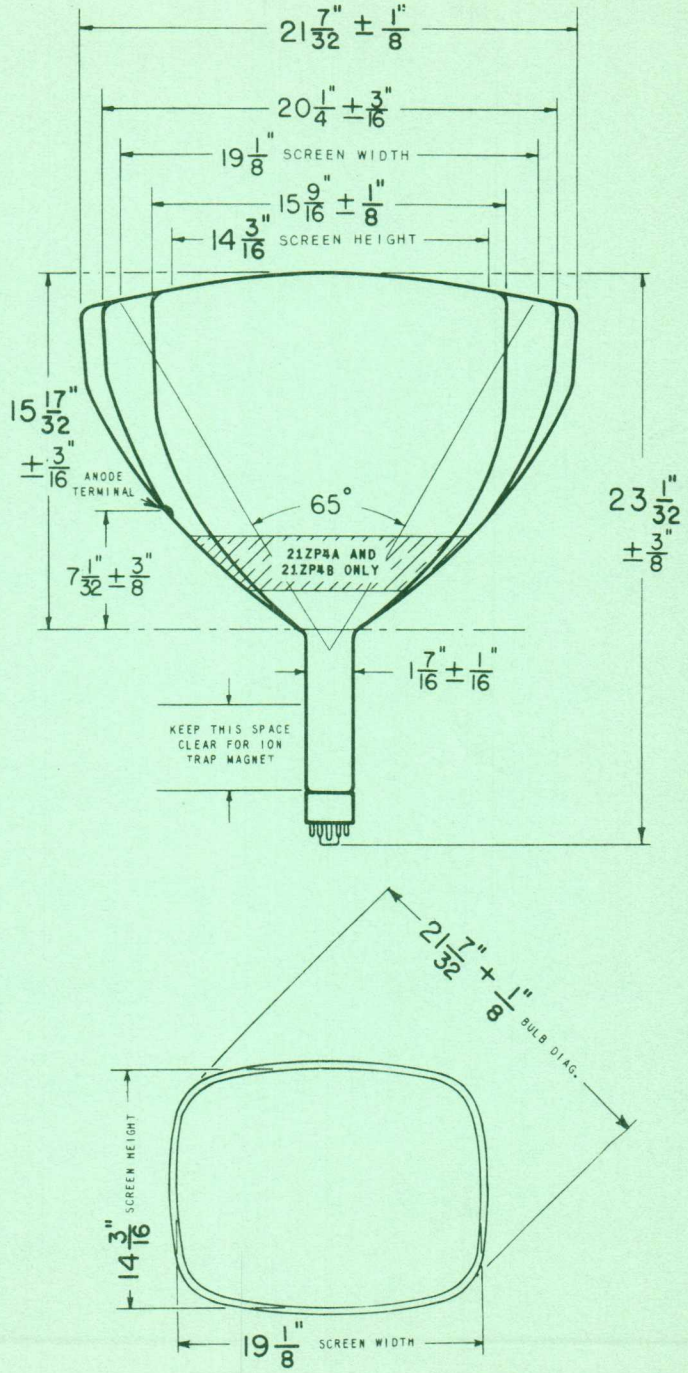

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CATHODE RAY

THE 22AP4 AND 22AP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 22AP4A HAS A GREY FILTER FACEPLATE. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE — **ROUND METAL CONSTRUCTION**
MAGNETIC FOCUS AND DEFLECTION — **EXTERNAL SINGLE FIELD ION TRAP**
13 1/2" X 18" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

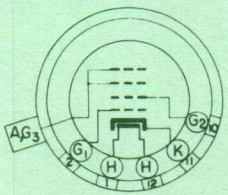
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.) **22AP4A**	66	PERCENT

MECHANICAL DATA

OVERALL LENGTH	22 7/8 ± 1/2	INCHES
GREATEST DIAMETER OF BULB	21 11/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIAMETER	20 1/4	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
ANODE
GRID NO. 3

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[A]:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	140	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	140	VOLTS

[A] THE CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	117	MA.
ION TRAP MAGNET (RATED STRENGTH) APPROX.	35	GAUSSES

[B] FOR VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 25 FOOT LAMBERTS ON A 18" BY 13 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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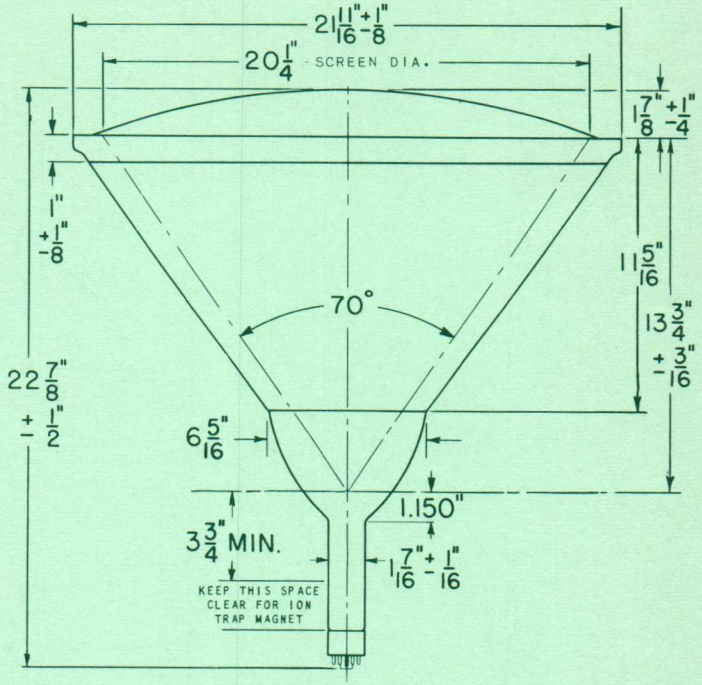

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CATHODE RAY

THE 24ADP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GRAY FILTER FACEPLATE	ALUMINIZED SCREEN
MAGNETIC FOCUS AND DEFLECTION	UNIPOTENTIAL CATHODE
RECTANGULAR GLASS CONSTRUCTION	EXTERNAL CONDUCTIVE COATING
21 7/16" X 16 7/8" RASTER SIZE	EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	2000	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE	SHORT TO MEDIUM	
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	75	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±5%	AMP.
MAXIMUM DC ANODE VOLTAGE	24 200	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	660	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	155	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	450	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	200	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS
HEATER WARM-UP TIME (APPROX.)*	11.0	SECONDS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	18 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)	125 ±15%	MA.
DC ION TRAP MAGNET STANDARD COIL #117 (APPROX.)	32	MA.
DC ION TRAP MAGNET RATED STRENGTH	36	GAUSSES

[A] VISUAL EXTINCTION OF FOCUSED RASTER.

*HEATER WARM-UP TIME IS THE TIME REQUIRED FOR THE VOLTAGE ACROSS THE HEATER TERMINALS TO INCREASE TO 5.0 VOLTS IN THE JETEC TEST CIRCUIT, WITH E=25 VOLTS AND SERIES R=31.5 OHMS.

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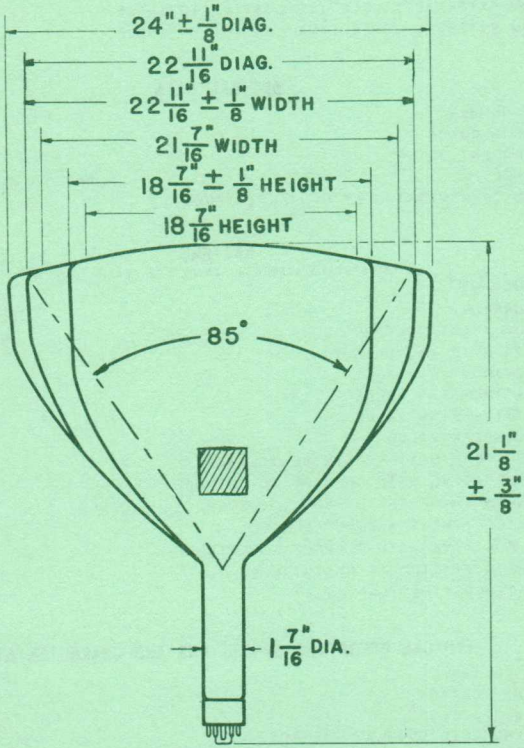
MECHANICAL DATA

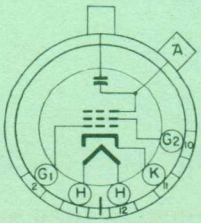
OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24 ± 1/8	INCHES
WIDTH	22 11/16 ± 1/8	INCHES
HEIGHT	18 7/16 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	22 11/16	INCHES
WIDTH	21 7/16	INCHES
HEIGHT	18 7/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS



BOTTOM VIEW

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 10 – GRID #2
PIN 11 – CATHODE

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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CATHODE RAY

THE 24AP4, 24AP4A AND 24AP4B ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* FOR THE ALUMINIZED SCREEN ON THE 24AP4A AND THE FACEPLATE TREATED TO ELIMINATE SPECULAR REFLECTION ON THE 24AP4B. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE	**GREY FILTER FACEPLATE**
ROUND METAL CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**
MAGNETIC FOCUS & DEFLECTION	**16 9/16" X 22 1/8" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

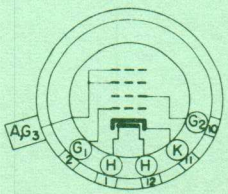
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	62	PERCENT

MECHANICAL DATA

OVERALL LENGTH	23 15/16 ± 1/2	INCHES
GREATEST DIAMETER OF BULB	24 ± 1/4	INCHES
MINIMUM USEFUL SCREEN DIAMETER	22 1/8	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
ANODE
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE[A]	16 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[B]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

[A] IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO AVERT POSSIBLE DANGER FROM PROLONGED EXPOSURE AT CLOSE RANGE.

[B] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	15 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)	114	MA.
ION TRAP (RATED STRENGTH) APPROX.	36	GAUSSES

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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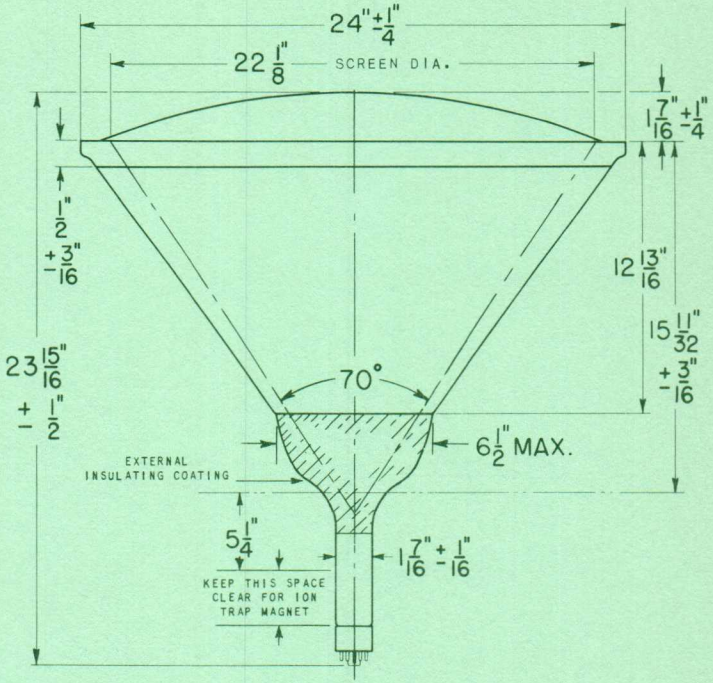

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CATHODE RAY

THE 24BP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS
GREY FILTER FACEPLATE
ROUND METAL CONSTRUCTION
MAGNETIC DEFLECTION
UNIPOTENTIAL CATHODE
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	70	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

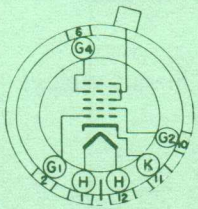
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	62	PERCENT

MECHANICAL DATA

OVERALL LENGTH	24 1/4 ± 1/2	INCHES
GREATEST DIAMETER OF BULB	24	INCHES
MINIMUM USEFUL SCREEN DIAMETER	22 1/4	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
GRID NO. 3,
GRID NO. 5,
COLLECTOR

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	16 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE RANGE (FOCUSING ELECTRODE)	-64 TO 350	VOLTS
MAXIMUM DC GRID #4 VOLTAGE[A]	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] FOCUS ELECTRODE MAY BE MODULATED TO IMPROVE OVERALL FOCUS.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	12 000	VOLTS
DC GRID #4 VOLTAGE RANGE[B]	-48 TO 260	VOLTS
DC GRID #4 CURRENT	-15 TO +25	μA.
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75	MA.

[B] MEASURED AT 100 uA. ANODE CURRENT AND EQUAL VERTICAL AND HORIZONTAL RESOLUTION.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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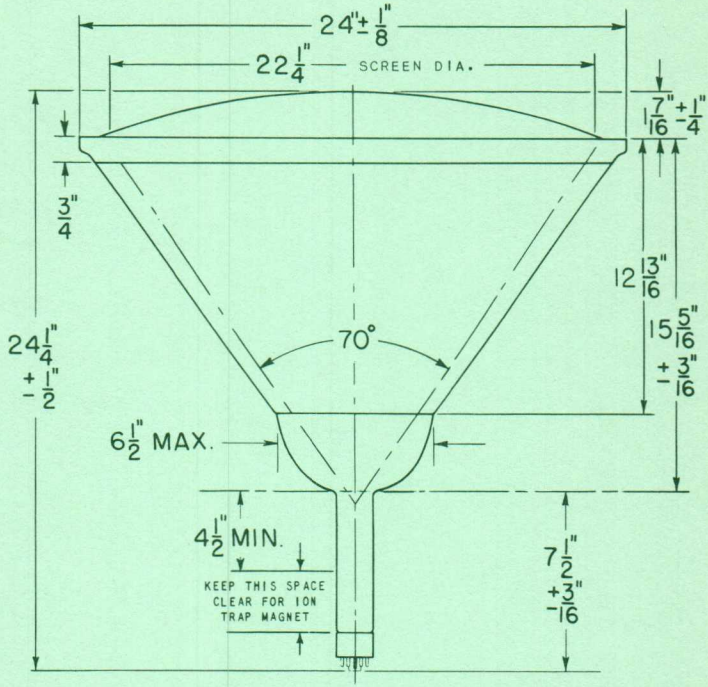

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CATHODE RAY

THE 24CP4 AND 24CP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 24CP4A HAS AN ALUMINIZED SCREEN. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE	**SPHERICAL FACEPLATE**
GREY FILTER FACEPLATE	**EXTERNAL CONDUCTIVE COATING**
MAGNETIC FOCUS AND DEFLECTION	**16 1/4" X 21 1/4" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
DIAGONAL	90	DEGREES
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	73	PERCENT

MECHANICAL DATA

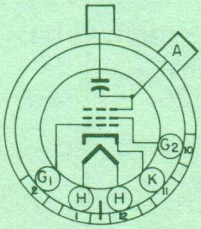
OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24 ± 1/8	INCHES
WIDTH	22 11/16	INCHES
HEIGHT	18 7/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	21 1/4	INCHES
HEIGHT	16 1/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[A]:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	18 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	115 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	100 ± 50%	MA.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 21 1/4" BY 16 3/4" PICTURE SIZE, DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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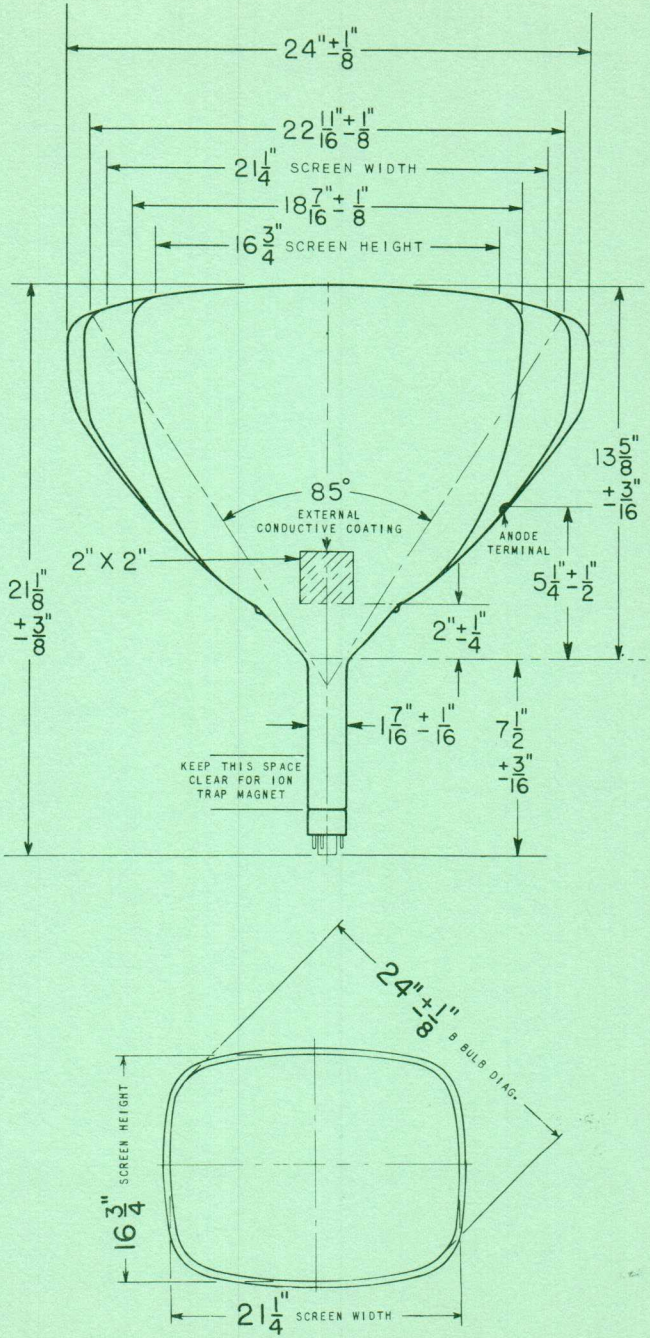

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CATHODE RAY

THE 24DP4 AND 24DP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 24DP4A HAS AN ALUMINIZED SCREEN. THEIR COMMON FEATURES INCLUDE:

ELECTROSTATIC FOCUS — **MAGNETIC DEFLECTION**
SPHERICAL FACEPLATE — **UNIPOTENTIAL CATHODE**
GREY FILTER FACEPLATE — **EXTERNAL CONDUCTIVE COATING**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
21 7/8" X 16 7/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	73	PERCENT

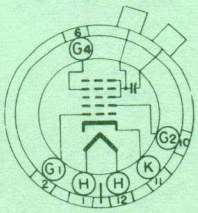
MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24	INCHES
WIDTH	22 11/16	INCHES
HEIGHT	18 7/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	21 7/8	INCHES
HEIGHT	16 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE:	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	18 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC GRID #4 VOLTAGE	-72 TO +400	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	100 ± 50%	MA.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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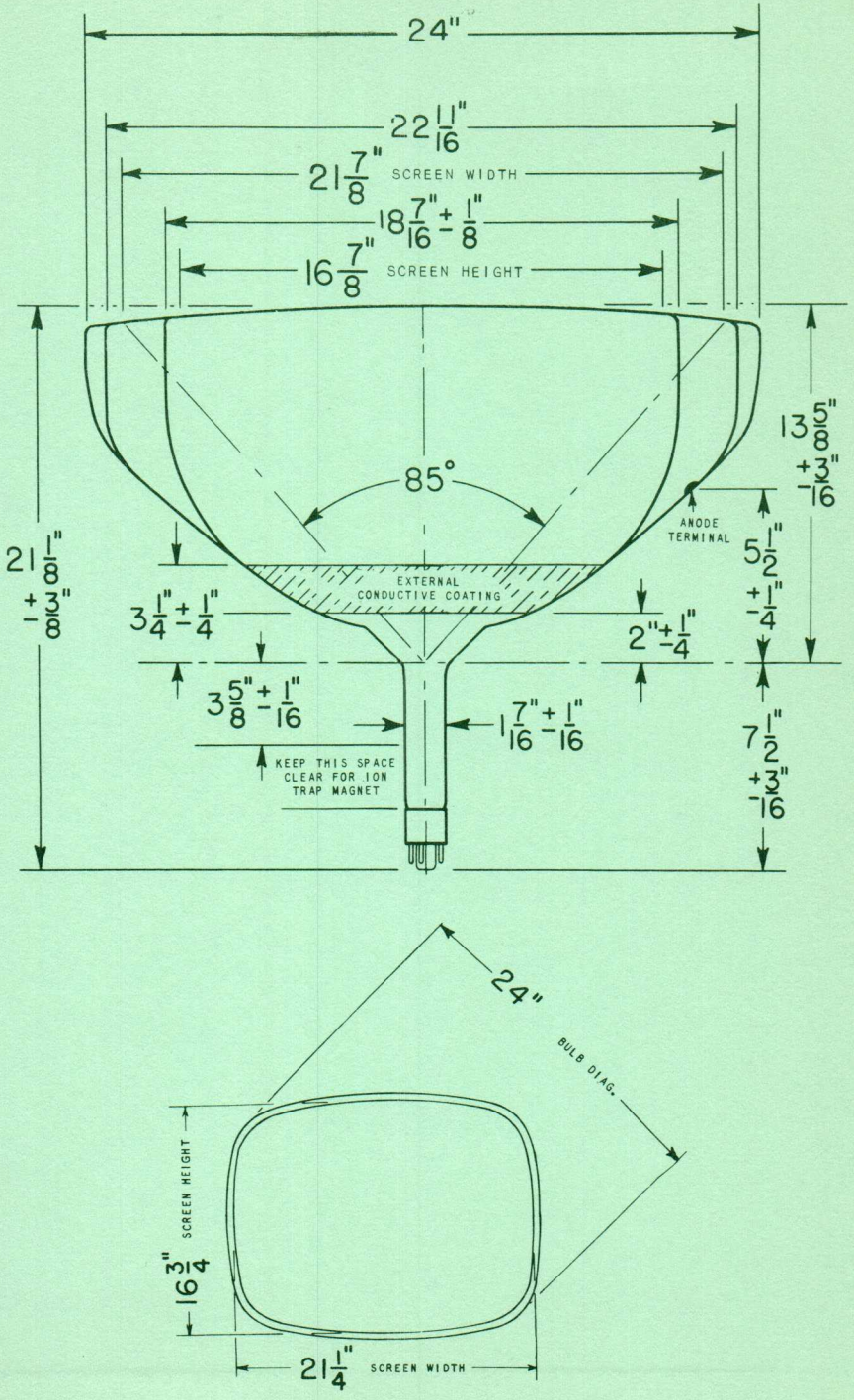

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CATHODE RAY

THE 24QP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

SPHERICAL FACEPLATE	**UNIPOTENTIAL CATHODE**
GREY FILTER FACEPLATE	**EXTERNAL CONDUCTIVE COATING**
MAGNETIC FOCUS & DEFLECTION	**21 7/8" X 16 7/8" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	72	PERCENT

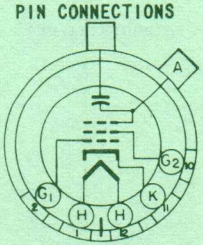
MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24 ± 3/16	INCHES
WIDTH	22 11/16 ± 1/8	INCHES
HEIGHT	18 7/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	21 7/8	INCHES
HEIGHT	16 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 10 - GRID NO. 2



BOTTOM VIEW

PIN 11 - CATHODE
PIN 12 - HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 19.8KV, SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16Kv.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	100 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	100 ± 50%	MA.

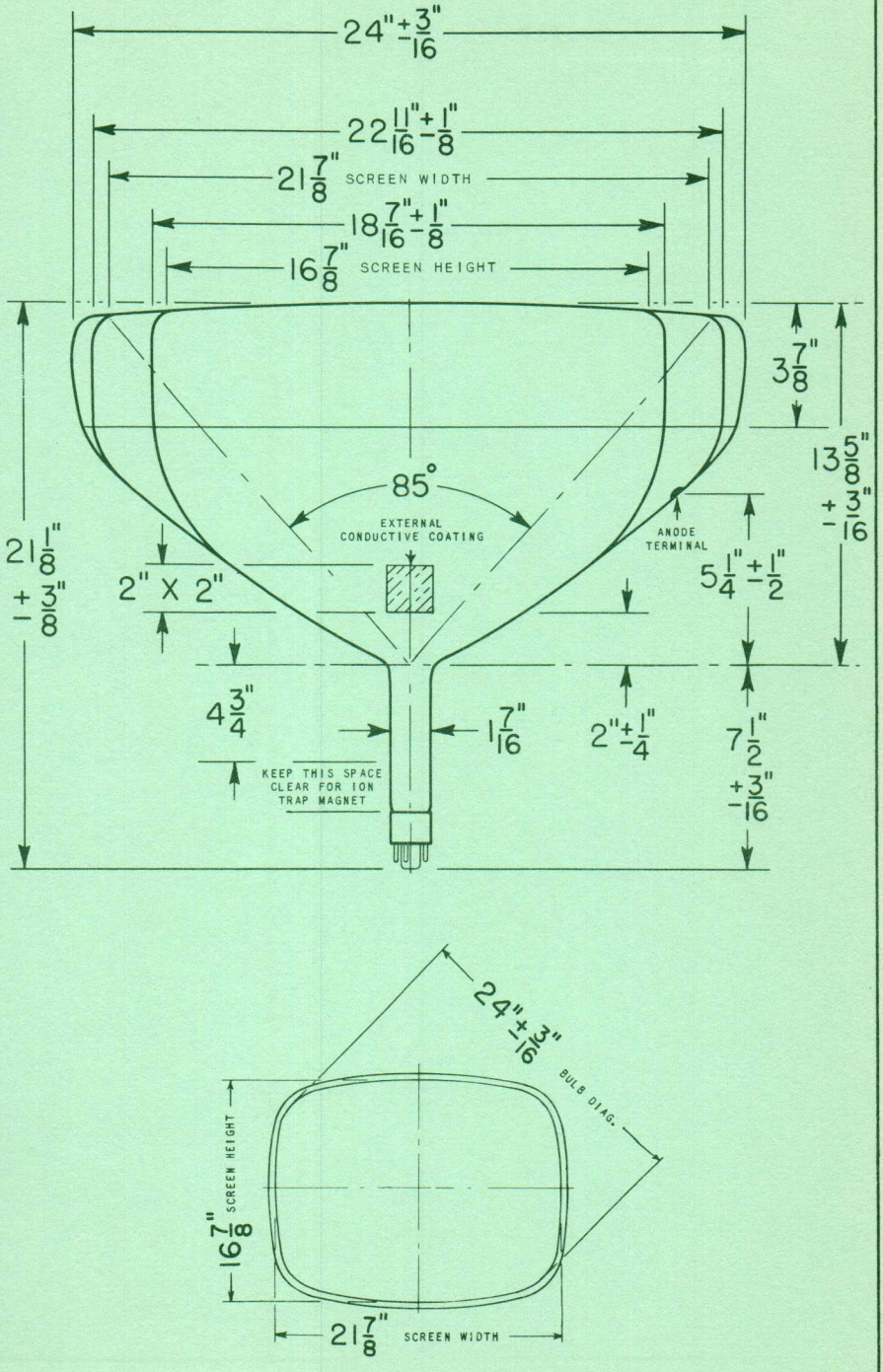
[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 21 7/8" BY 16 7/8" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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TUNG-SOL

CATHODE RAY

THE 24TP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

SPHERICAL FACEPLATE
ALUMINIZED FACEPLATE
MAGNETIC FOCUS & DEFLECTION
RECTANGULAR GLASS CONSTRUCTION
UNIPOTENTIAL CATHODE
GREY FILTER FACEPLATE
EXTERNAL CONDUCTIVE COATING
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTING ANGLE (APPROX.) DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	250	μμf

OPTICAL DATA

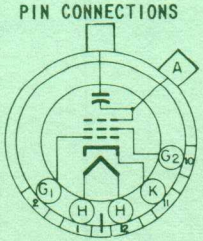
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	72	PERCENT

MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24	INCHES
WIDTH	22 11/16	INCHES
HEIGHT	18 7/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	21 7/16	INCHES
HEIGHT	17 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	14 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[B] (APPROX.)	110 ± 10	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	85 ± 50%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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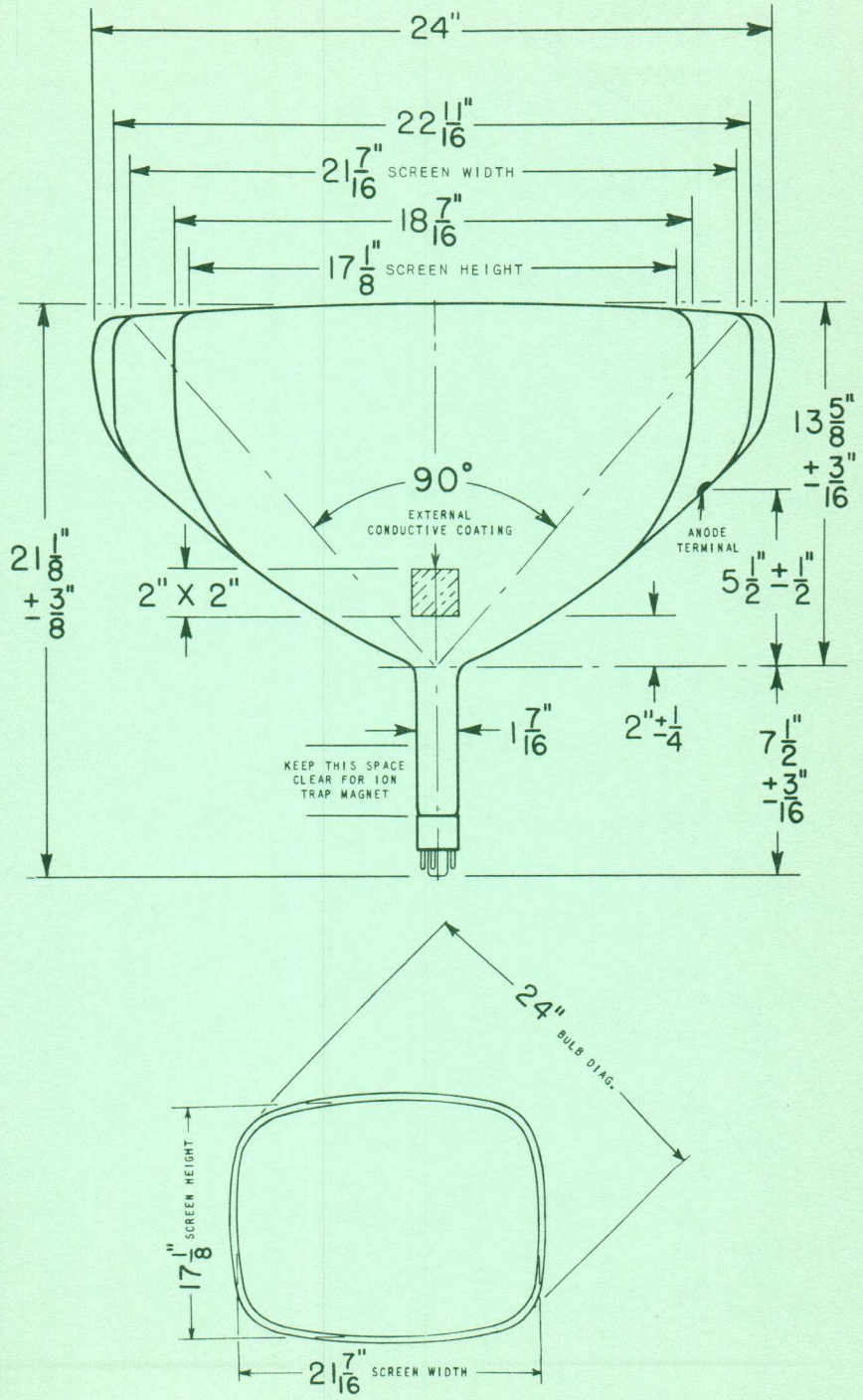

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CATHODE RAY

THE 24VP4 AND 24VP4A ARE DIRECT-VIEW PICTURE TUBES DESIGNED FOR USE IN TELEVISION APPLICATIONS. THEY ARE IDENTICAL *EXCEPT* THAT THE 24VP4A HAS AN ALUMINIZED SCREEN. THEIR COMMON FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
EXTERNAL CONDUCTIVE COATING
MAGNETIC FOCUS AND DEFLECTION
GREY FILTER FACEPLATE
21 3/8" X 16 1/6" RASTER SIZE
EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	87	DEGREES
VERTICAL	73	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	68	PERCENT

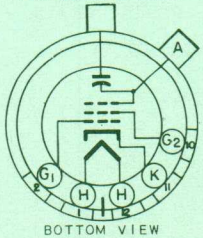
MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24 ± 1/8	INCHES
WIDTH	22 43/64 ± 1/8	INCHES
HEIGHT	18 7/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	22 13/16	INCHES
WIDTH	21 3/8	INCHES
HEIGHT	16 1/16	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE	22 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	600	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[A]	20 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	125	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	135	MA.

[A] WHEN THE TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 20,000 VOLTS PEAK, THE STORED ENERGY IN THE HIGH VOLTAGE CIRCUIT WILL BE OVER THE MAXIMUM PERMITTED BY THE UNDERWRITERS LABORATORY. THIS CONDITION WILL REQUIRE THAT PROVISION BE MADE FOR GROUNDING THE HIGH VOLTAGE SUPPLY WHEN THE BACK OF THE SET IS REMOVED FOR MAINTENANCE PURPOSES.

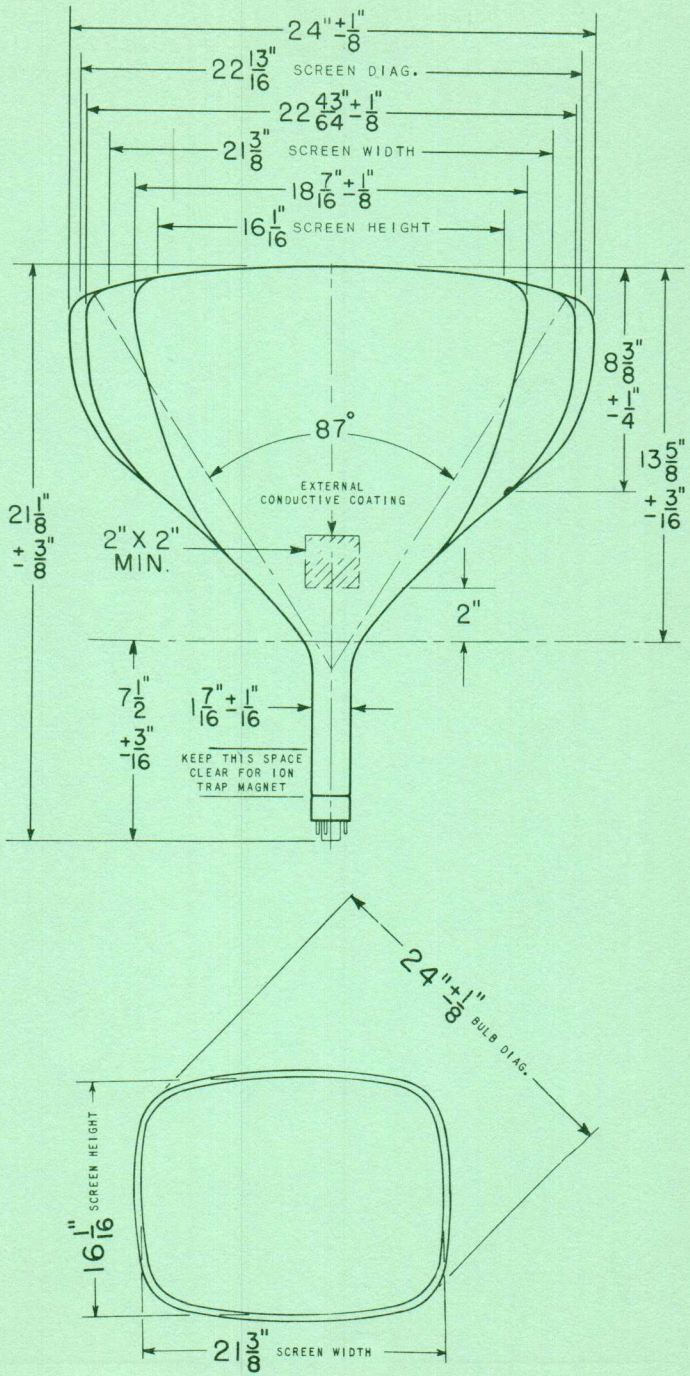
[B] FOR VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 21 3/8" BY 16 1/16" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 24XP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

UNIPOTENTIAL CATHODE
RECTANGULAR GLASS
16 3/4" X 21 1/4" RASTER SIZE
GREY FILTER FACEPLATE
EXTERNAL SINGLE FIELD ION TRAP
MAGNETIC FOCUS & DEFLECTION

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

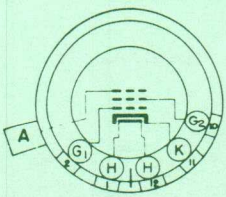
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	68	PERCENT

MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24 ± 3/16	INCHES
WIDTH	22 11/16 ± 3/16	INCHES
HEIGHT	18 7/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	21 1/4	INCHES
HEIGHT	16 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	18 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[A]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[B]	125 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #117 (APPROX.)	35 ± 40%	MA.

[A] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[B] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 21 1/4" BY 16 3/4" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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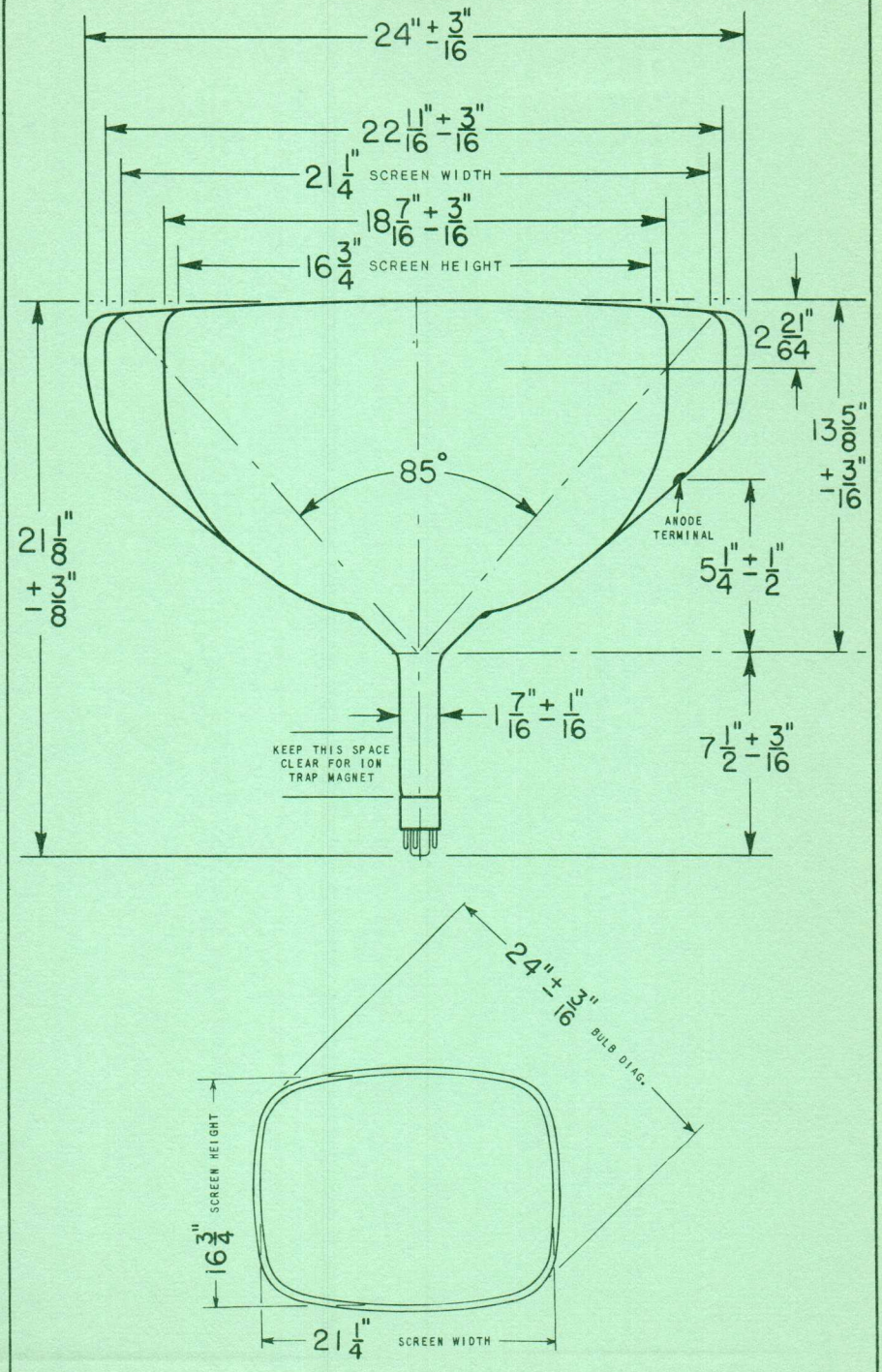

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CATHODE RAY

THE 24YP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

- SPHERICAL FACEPLATE
- UNIPOTENTIAL CATHODE
- EXTERNAL CONDUCTIVE COATING
- RECTANGULAR GLASS CONSTRUCTION
- LOW VOLTAGE ELECTROSTATIC FOCUS
- ALUMINIZED SCREEN
- MAGNETIC DEFLECTION
- GREY FILTER FACEPLATE
- 16 7/8" X 21 7/8" RASTER SIZE
- EXTERNAL SINGLE FIELD ION TRAP

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	68	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 500	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	1 200	$\mu\mu f$

OPTICAL DATA

PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.)	73	PERCENT

RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	18 000	VOLTS
DC GRID #4 VOLTAGE	-72 TO +400	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC ION TRAP MAGNET STANDARD COIL #111 (APPROX.)	100 ± 50%	MA.

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

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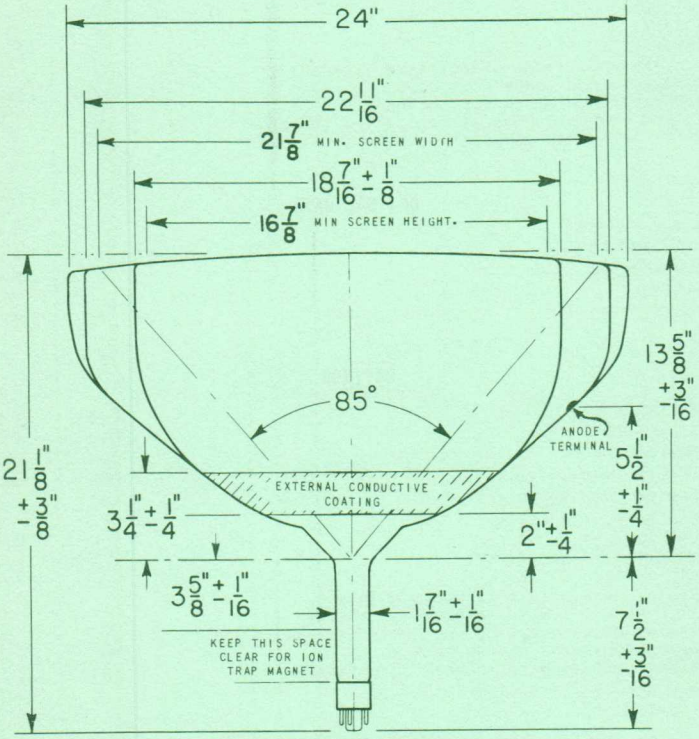
MECHANICAL DATA

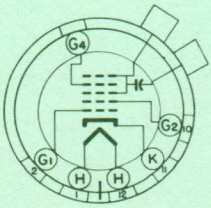
OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24	INCHES
WIDTH	22 11/16	INCHES
HEIGHT	18 7/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	21 7/8	INCHES
HEIGHT	16 7/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP:
GRID #3

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CATHODE RAY

THE 24ZP4 IS A DIRECT VIEW PICTURE TUBE DESIGNED FOR TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	**ELECTROSTATIC FOCUS**
MAGNETIC DEFLECTION	**UNIPOTENTIAL CATHODE**
GRAY FILTER FACEPLATE	**21 1/4" X 16 3/4" RASTER SIZE**
EXTERNAL CONDUCTIVE COATING	**RECTANGULAR GLASS CONSTRUCTION**

DOES NOT REQUIRE ION TRAP

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	70	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE TRANSMISSION AT CENTER (APPROX.):	68	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6 ±10%	AMP.
MAXIMUM DC ANODE VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE[B]	16 000	VOLTS
DC GRID #4 VOLTAGE	0 TO 500	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MIDTAP OF THE HEATER TRANSFORMER WINDING.

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, THE ANODE VOLTAGE SHOULD NOT BE LESS THAN 14,000 VOLTS.

[C] VISUAL EXTINCTION OF FOCUSED RASTER.

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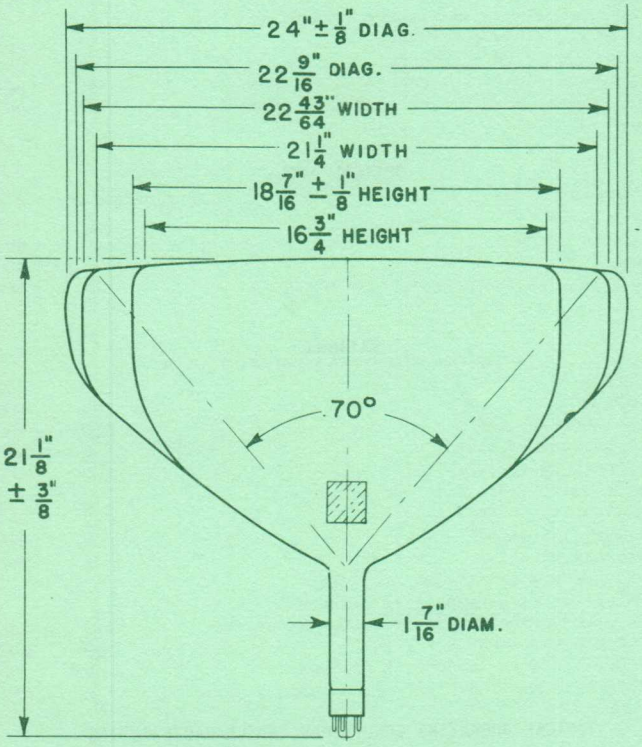
MECHANICAL DATA

OVERALL LENGTH	21 1/8 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	24 ± 1/8	INCHES
WIDTH	22 43/64 ± 1/8	INCHES
HEIGHT	18 7/16 ± 1/8	INCHES
MIN. USEFUL SCREEN DIMENSIONS:		
DIAGONAL	22 9/16	INCHES
WIDTH	21 1/4	INCHES
HEIGHT	16 3/4	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

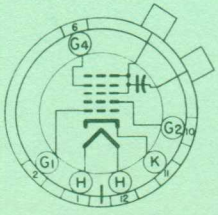
BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 — HEATER
PIN 2 — GRID #1
PIN 6 — GRID #4
PIN 10 — GRID #2
PIN 11 — CATHODE



BOTTOM VIEW

PIN 12 — HEATER-ANODE CAP:
GRID NO. 3
GRID NO. 5

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CATHODE RAY

THE 27AP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ELECTROSTATIC FOCUS — **MAGNETIC DEFLECTION**
GREY FILTER FACEPLATE — **UNIPOTENTIAL CATHODE**
RECTANGULAR METAL CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
23 7/16" X 18 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		ELECTROSTATIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
DIAGONAL	90	DEGREES
HORIZONTAL	85	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

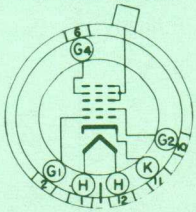
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT
SPECULAR REFLECTION OF AMBIENT LIGHT	2.5	PERCENT

MECHANICAL DATA

OVERALL LENGTH	21 5/8 ± 9/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 7/8 ± 3/16	INCHES
WIDTH	25 1/4 ± 1/8	INCHES
HEIGHT	19 15/16 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	23 7/16	INCHES
HEIGHT	18 1/8	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12M

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
METAL SHELL LIP:
GRID NO. 3
GRID NO. 5
COLLECTOR

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, GRID #5, COLLECTOR VOLTAGE	18 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE[A]	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] THE FOCUS ELECTRODE MAY BE MODULATED TO IMPROVE OVERALL FOCUS.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC GRID #3, GRID #5, COLLECTOR VOLTAGE	15 000	VOLTS
DC GRID #4 VOLTAGE[B]	-60 TO +300	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	85	MA.
DC GRID #4 CURRENT	-15 TO +25	μAMP.

[B] MEASURED AT 100 UAMP. ANODE CURRENT AND EQUAL VERTICAL AND HORIZONTAL RESOLUTION.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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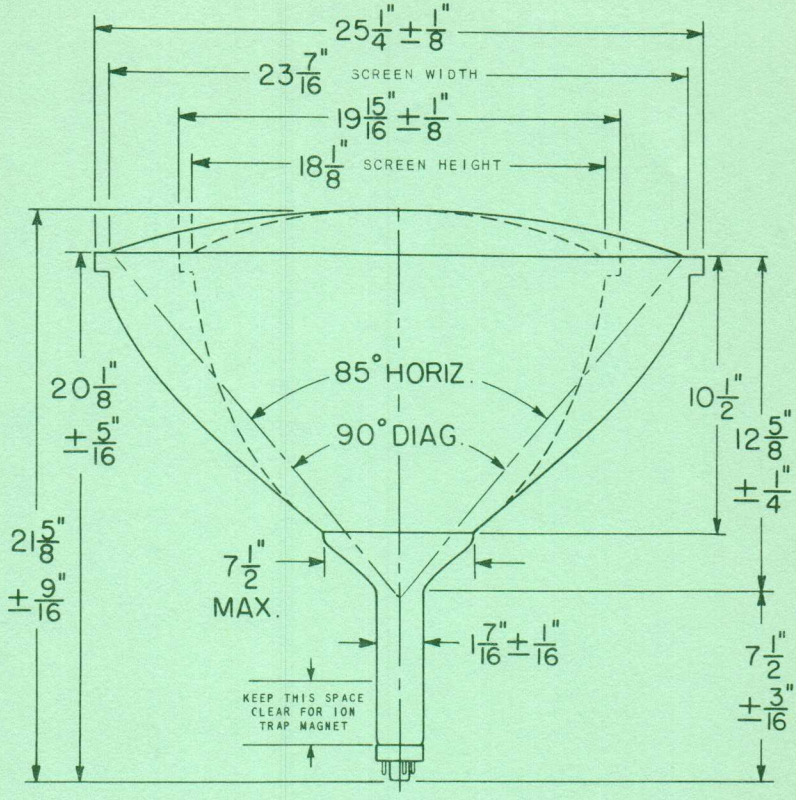

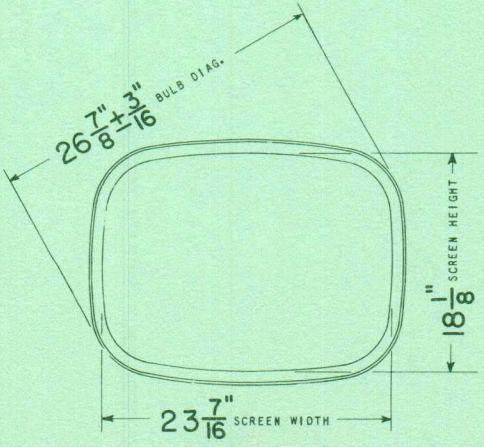

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CATHODE RAY

THE 27EP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

SPHERICAL FACEPLATE	**ALUMINIZED SCREEN**
GREY FILTER FACEPLATE	**UNIPOTENTIAL CATHODE**
MAGNETIC FOCUS & DEFLECTION	**24" X 18 1/2" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.):	70	PERCENT

MECHANICAL DATA

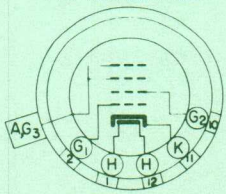
OVERALL LENGTH	23 1/16 ± 1/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 13/16 ± 3/16	INCHES
WIDTH	25 9/32 ± 3/16	INCHES
HEIGHT	20 7/32 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	25 3/4	INCHES
WIDTH	24	INCHES
HEIGHT	18 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 –HEATER
ANODE CAP:
GRID NO. 3

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RATINGS[A]
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE[B]	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[C]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] THESE MAXIMUM RATINGS CONTAIN A 10% SAFETY FACTOR IN ACCORDANCE WITH THE STANDARD DESIGN CENTER SYSTEM IN RATING CATHODE-RAY TUBES. CONSEQUENTLY, THE TUBE WILL WITHSTAND VARIATIONS IN SUPPLY LINE VOLTAGE WHICH DO NOT CAUSE THE MAXIMUM RATINGS TO BE EXCEEDED BY MORE THAN 10%.

[B] IF THE TUBE IS OPERATED AT VOLTAGE IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO PREVENT DANGER FROM PROLONGED EXPOSURE AT CLOSE RANGE.

[C] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[D]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[E]	87 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.
ION TRAP MAGNET (RATED STRENGTH) APPROX.	38	GAUSSES

[D] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[E] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 24" BY 18 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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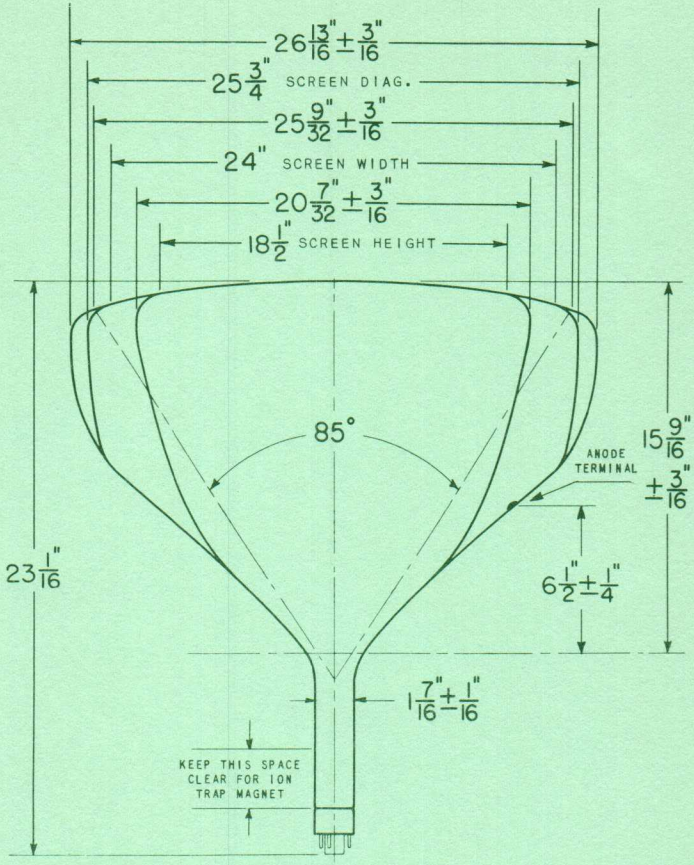

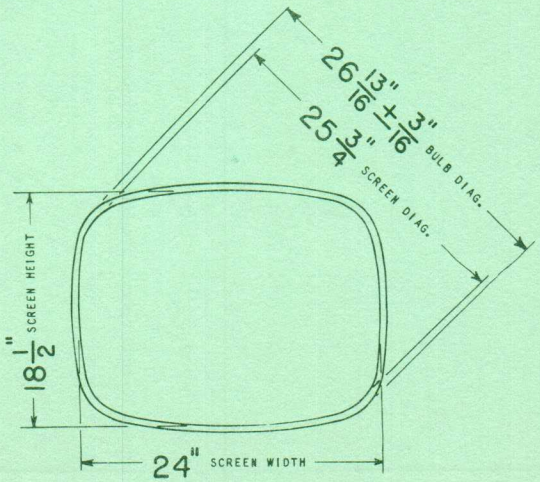

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CATHODE RAY

THE 27GP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE — **SPHERICAL FACEPLATE**
MAGNETIC FOCUS & DEFLECTION — **UNIPOTENTIAL CATHODE**
RECTANGULAR GLASS CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
18 1/8" X 24 1/4" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.) DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

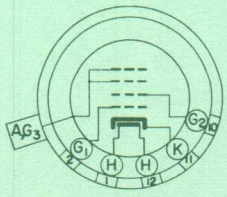
MECHANICAL DATA

OVERALL LENGTH	23 1/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 13/16	INCHES
WIDTH	25 9/32	INCHES
HEIGHT	20 7/32	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	24 1/4	INCHES
HEIGHT	18 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 10 - GRID NO. 2
PIN 11 - CATHODE



BOTTOM VIEW

PIN 12 - HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	22 500	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:[A]		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] CATHODE SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE[B]	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[D]	95 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	100	MA.

[B] IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO PROTECT AGAINST POSSIBLE INJURY FROM PROLONGED EXPOSURE AT CLOSE RANGE. SUCH PROTECTION MAY BE PROVIDED BY THE PROTECTIVE FACE VIEWING WINDOW OF APPARATUS USING TUBES OF THIS TYPE.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 24 1/4" BY 18 1/8" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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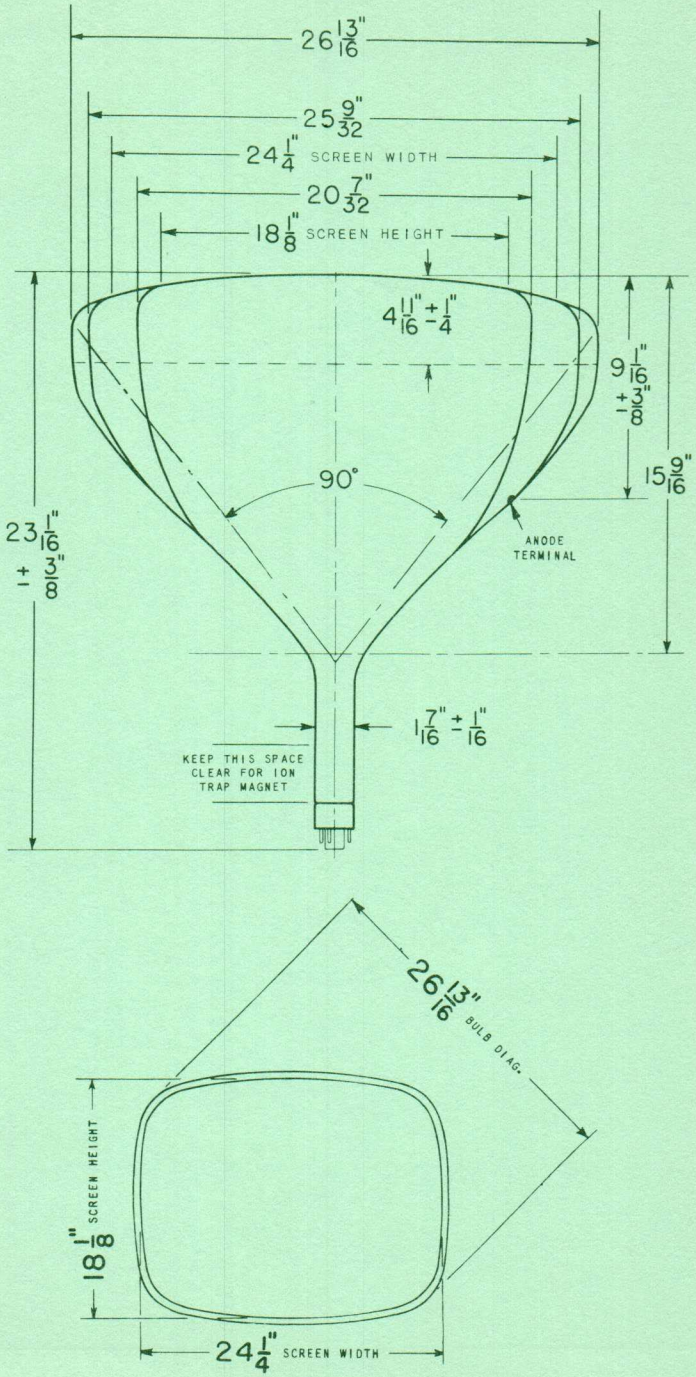

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CATHODE RAY

THE 27LP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE	**ALUMINIZED SCREEN**
EXTERNAL CONDUCTIVE COATING	**UNIPOTENTIAL CATHODE**
MAGNETIC FOCUS AND DEFLECTION	**EXTERNAL SINGLE FIELD ION TRAP**
RECTANGULAR GLASS CONSTRUCTION	**18 15/32" X 23 17/32" RASTER SIZE**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	400	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	250	μμf

OPTICAL DATA

PHOSPHOR NUMBER	NO. 4
FLUORESCENT COLOR	WHITE
PHOSPHORESCENT COLOR	WHITE
PERSISTENCE	MEDIUM

MECHANICAL DATA

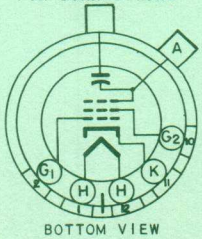
OVERALL LENGTH	24 23/64 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 13/16 ± 1/4	INCHES
WIDTH	25 9/32 ± 1/4	INCHES
HEIGHT	20 7/32 ± 1/4	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	23 17/32	INCHES
HEIGHT	18 15/32	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3 VOLTAGE	22 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	600	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE[A]:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] HEATER SHOULD BE RETURNED TO ONE SIDE OR TO THE MID-TAP OF THE HEATER TRANSFORMER WINDING.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3 VOLTAGE	20 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)	148	MA.
ION TRAP MAGNET FIELD INTENSITY	45	GAUSSES

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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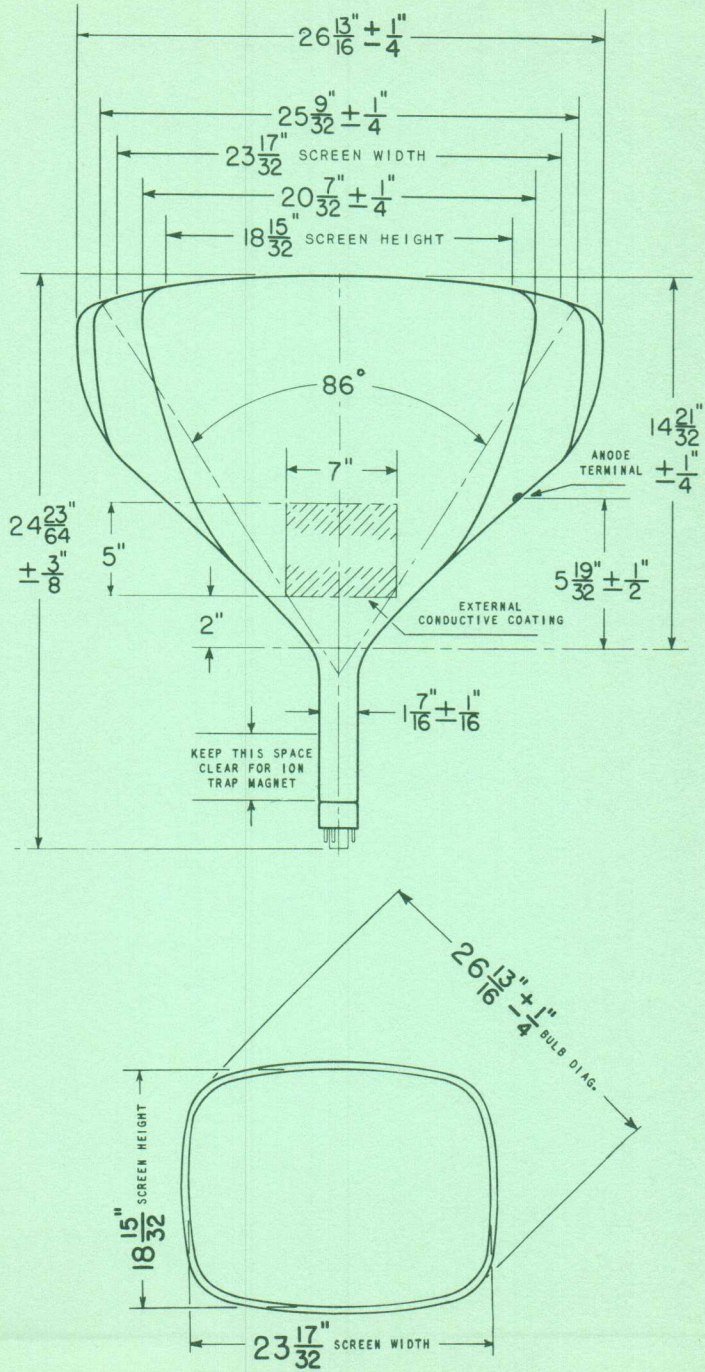

26 13/16" ± 1/4"
25 9/32" ± 1/4"
23 17/32" SCREEN WIDTH
20 7/32" ± 1/4"
18 15/32" SCREEN HEIGHT
86°
7"
14 21/32" ± 1/4"
ANODE TERMINAL
24 23/64" ± 3/8"
5"
5 19/32" ± 1/2"
EXTERNAL CONDUCTIVE COATING
2"
1 7/16" ± 1/16"
KEEP THIS SPACE CLEAR FOR ION TRAP MAGNET
26 13/16" ± 1/4" BULB DIAG.
18 15/32" SCREEN HEIGHT
23 17/32" SCREEN WIDTH

TUNG-SOL

CATHODE RAY

THE 27MP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN — **UNIPOTENTIAL CATHODE**
MAGNETIC FOCUS & DEFLECTION — **FROSTED FILTERGLASS FACEPLATE**
RECTANGULAR METAL CONSTRUCTION — **EXTERNAL SINGLE FIELD ION TRAP**
23 7/16" X 18 1/8" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
VERTICAL	69	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf

OPTICAL DATA

PHOSPHOR NUMBER	SULFIDE TYPE	NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		SHORT
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

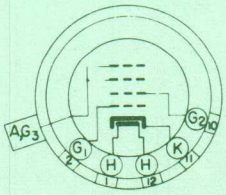
MECHANICAL DATA

OVERALL LENGTH	22 3/16	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 7/8 ± 1/4	INCHES
WIDTH	25 1/4 ± 3/16	INCHES
HEIGHT	19 15/16 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
DIAGONAL	25 1/16	INCHES
WIDTH	23 7/16	INCHES
HEIGHT	18 1/8	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

BASE ALIGNMENT
PIN #6 ALIGNS WITH HORIZONTAL PICTURE AXIS ± 10 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC GRID #3, COLLECTOR VOLTAGE[AB]	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING COLLECTOR VOLTAGE. IN GENERAL, THE COLLECTOR VOLTAGE SHOULD NOT BE LESS THAN 16,000 VOLTS.

[B] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 19.8 KV, SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16 KV.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC COLLECTOR, GRID #3 VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-37 TO -73	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[D]	110 ± 10%	MA.
ION TRAP MAGNET (RATED STRENGTH)	50	GAUSSES

[C] VISUAL EXTINCTION OF FOCUSED RASTER.

[D] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 30 FOOT LAMBERTS ON A 23 7/16" BY 18 1/8" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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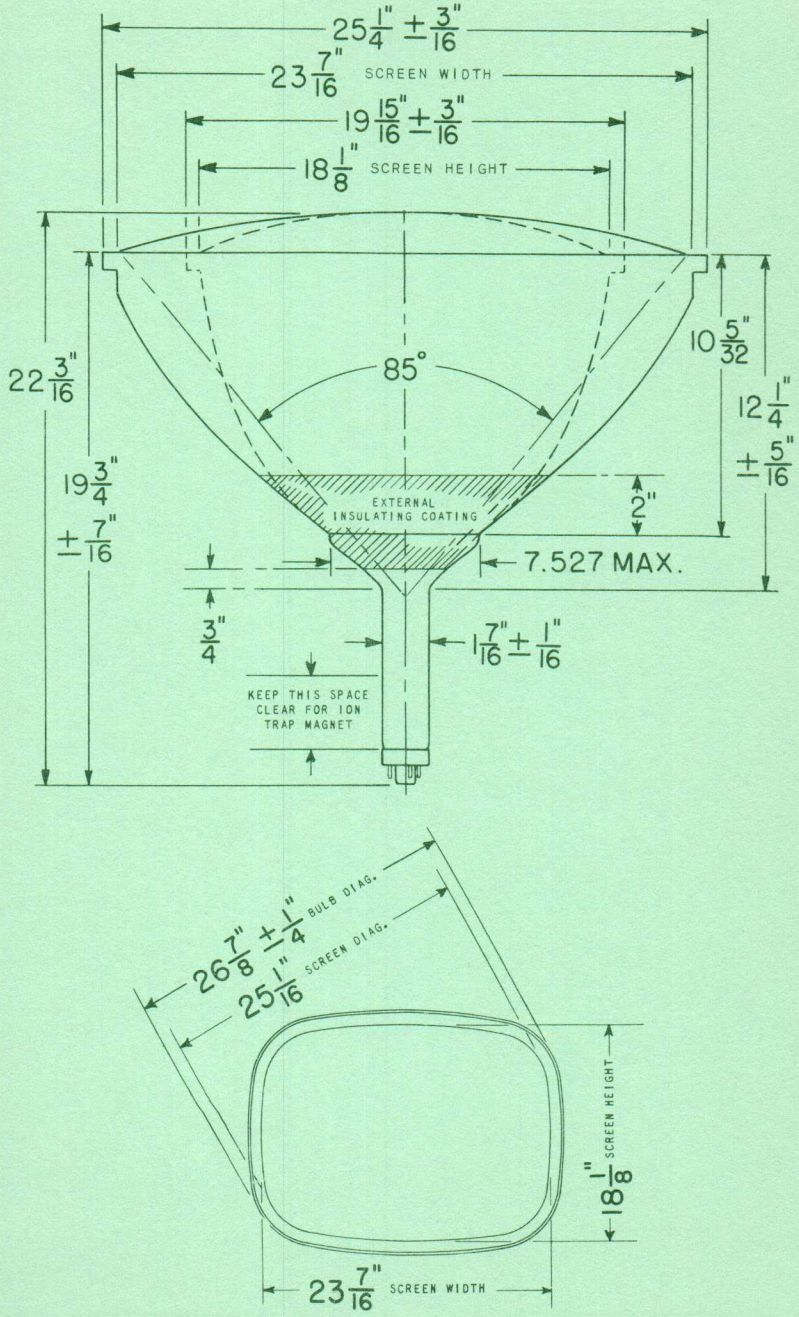

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CATHODE RAY

THE 27NP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

SPHERICAL FACEPLATE	**UNIPOTENTIAL CATHODE**
GREY FILTER FACEPLATE	**EXTERNAL CONDUCTIVE COATING**
MAGNETIC FOCUS & DEFLECTION	**24 1/4" X 18 1/8" RASTER SIZE**
RECTANGULAR GLASS CONSTRUCTION	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	68	PERCENT

MECHANICAL DATA

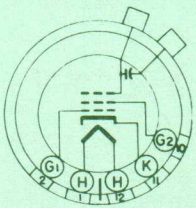
OVERALL LENGTH	23 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 13/16 ± 3/16	INCHES
WIDTH	25 9/32 ± 1/8	INCHES
HEIGHT	20 7/32 ± 1/8	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	24 1/4	INCHES
HEIGHT	18 1/8	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 - HEATER
PIN 2 - GRID NO. 1
PIN 10 - GRID NO. 2



BOTTOM VIEW

PIN 11 - CATHODE
PIN 12 - HEATER
ANODE CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE[A]	18 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
NEGATIVE-BIAS VALUE (DC)	125	VOLTS
POSITIVE-BIAS VALUE (DC)	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 19.8 KV, SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16 KV.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-28 TO -72	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	95 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	100 ± 50%	MA.

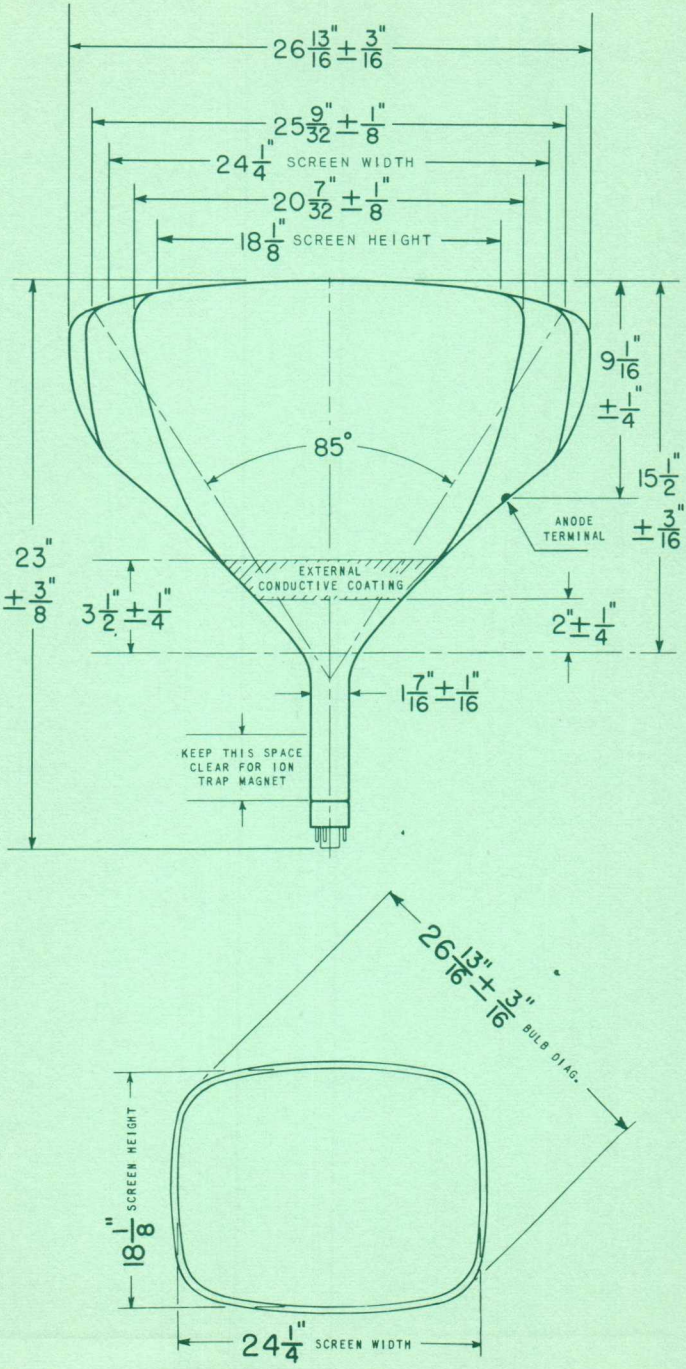
[B] VISUAL EXTINCTION OF FOCUSED RASTER.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 24 1/4" BY 18 1/8" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.25 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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CATHODE RAY

THE 27RP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

SPHERICAL FACEPLATE	ALUMINIZED SCREEN
GREY FILTER FACEPLATE	UNIPOTENTIAL CATHODE
MAGNETIC FOCUS & DEFLECTION	EXTERNAL CONDUCTIVE COATING
RECTANGULAR GLASS CONSTRUCTION	EXTERNAL SINGLE FIELD ION TRAP

24" X 18 1/2" RASTER SIZE

ELECTRICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	μμf

OPTICAL DATA

PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

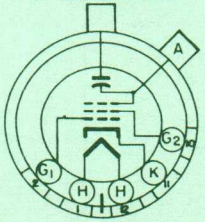
OVERALL LENGTH	23 1/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 13/16 ± 3/16	INCHES
WIDTH	25 9/32 ± 3/16	INCHES
HEIGHT	20 7/32 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	24	INCHES
HEIGHT	18 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12N

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ACCELERATOR CAP

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ACCELERATOR VOLTAGE[A]	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
*DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

[A] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 19.8 KV, SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16 KV.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ACCELERATOR VOLTAGE	16 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	-33 TO -77	VOLTS
DC FOCUSING COIL CURRENT (APPROX.)[C]	105 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	85 ± 50%	MA.

[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 20 FOOT LAMBERTS ON A 24" BY 18 1/2" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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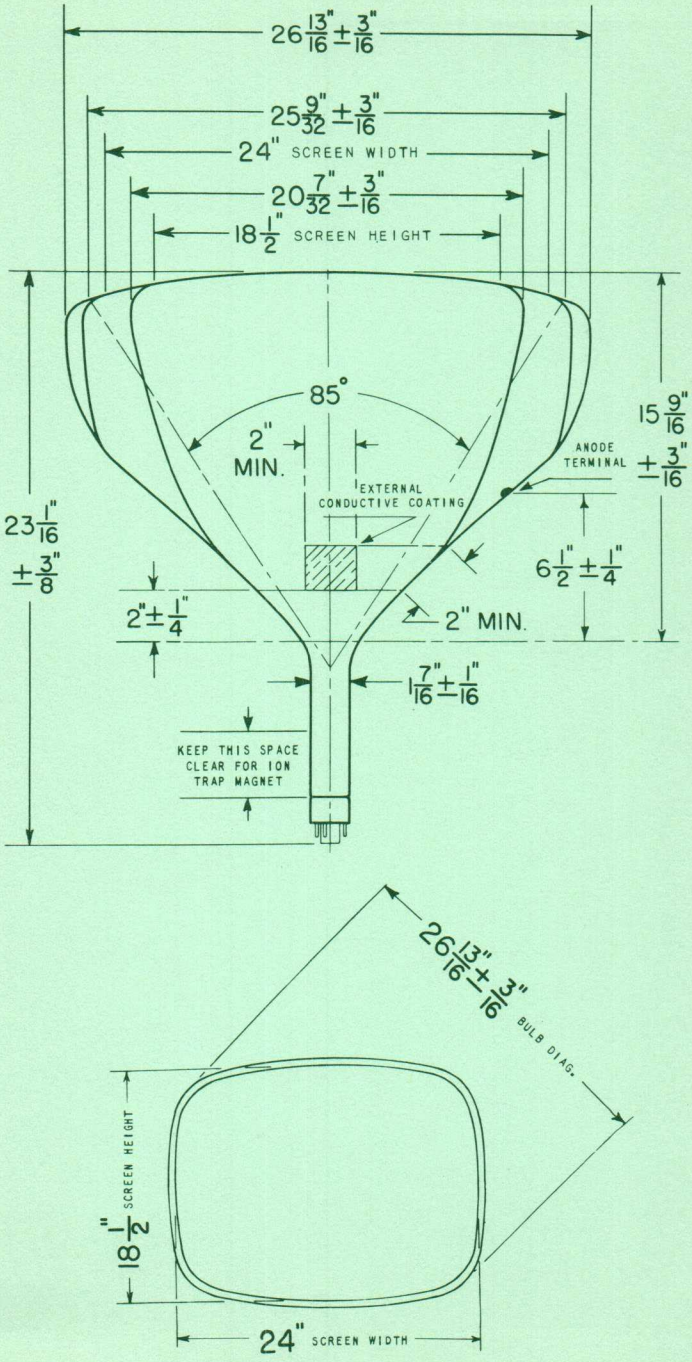

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CATHODE RAY

THE 27SP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

ALUMINIZED SCREEN	**SPHERICAL FACEPLATE**
UNIPOTENTIAL CATHODE	**MAGNETIC DEFLECTION**
EXTERNAL CONDUCTIVE COATING	**GREY FILTER FACEPLATE**
RECTANGULAR GLASS CONSTRUCTION	**24" X 18 1/2" RASTER SIZE**
LOW VOLTAGE ELECTROSTATIC FOCUS	**EXTERNAL SINGLE FIELD ION TRAP**

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTION ANGLE: (APPROX.)		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES: (APPROX.)		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	6	μμf
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	750	μμf
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE[A]	500	μμf

[A] EXTERNAL CONDUCTIVE COATING MUST BE GROUNDED.

OPTICAL DATA

PHOSPHOR NUMBER	P-4	
FLUORESCENT COLOR	WHITE	
PHOSPHORESCENT COLOR	WHITE	
PERSISTENCE	MEDIUM	
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	68	PERCENT

MECHANICAL DATA

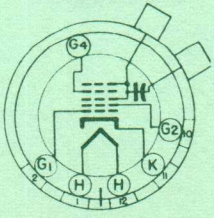
OVERALL LENGTH	23 1/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 13/16	INCHES
WIDTH	25 9/32 ± 3/16	INCHES
HEIGHT	20 7/32 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	24	INCHES
HEIGHT	18 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT

J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 6 – GRID NO. 4
PIN 10 – GRID NO. 2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID NO. 3
GRID NO. 5

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RATINGS
DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE	20 000	VOLTS
MAXIMUM DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)	-500 TO +1000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE[B]	18 000	VOLTS
DC GRID #4 VOLTAGE (FOCUSING ELECTRODE)	-72 TO +396	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE REQUIRED FOR CUTOFF[C]	-28 TO -72	VOLTS
ION TRAP MAGNET STRENGTH (APPROX.)	40	GAUSSES

[B] BRILLIANCE AND DEFINITION DECREASE WITH DECREASING ANODE VOLTAGE. IN GENERAL, ANODE VOLTAGE SHOULD NOT BE LESS THAN THIS VALUE.

[C] VISUAL EXTINCTION OF FOCUSED RASTER. EXTINCTION OF THE STATIONARY FOCUSED SPOT WILL REQUIRE THAT THESE VALUES BE ABOUT 5 VOLTS MORE NEGATIVE.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

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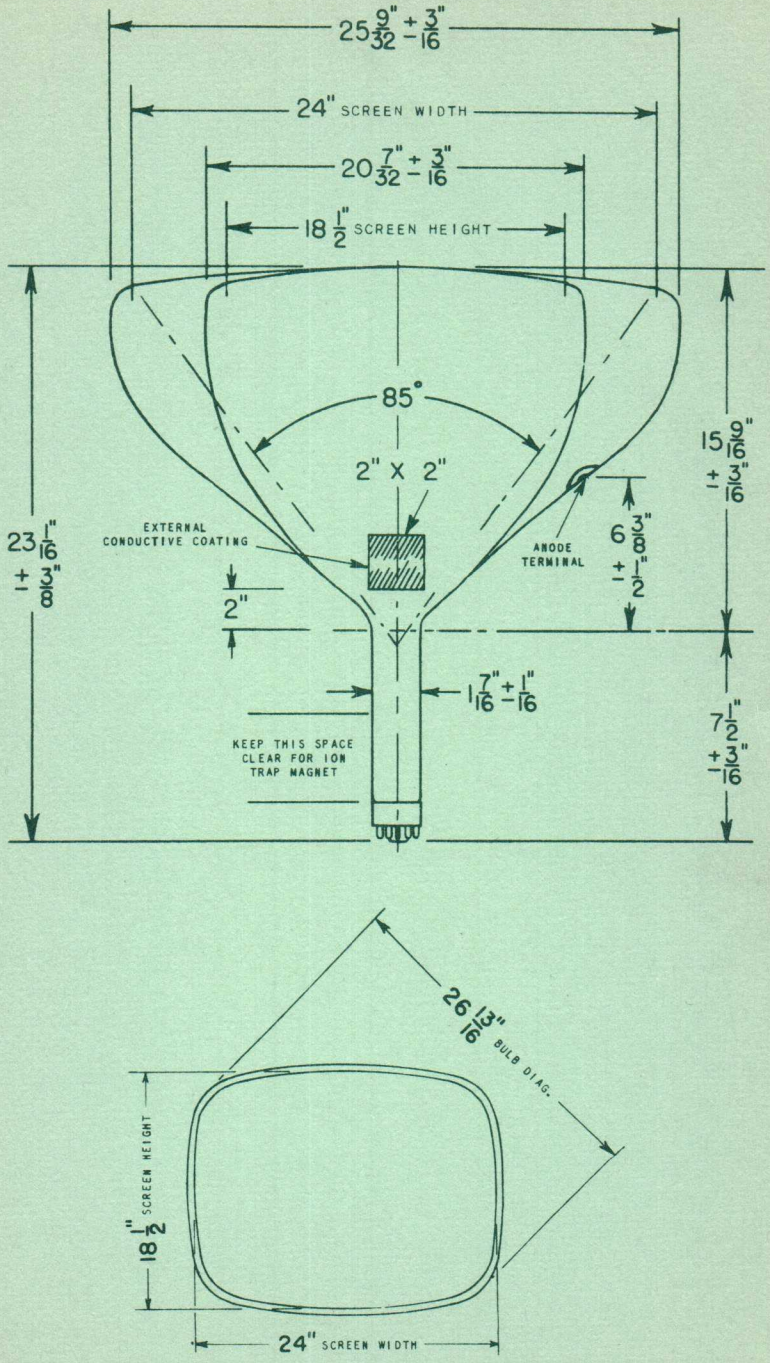

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CATHODE RAY

THE 27UP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

- UNIPOTENTIAL CATHODE
- EXTERNAL CONDUCTIVE COATING
- RECTANGULAR GLASS CONSTRUCTION
- SPHERICAL GREY FILTER FACEPLATE
- MAGNETIC DEFLECTION
- 18 1/2" X 24" RASTER SIZE
- EXTERNAL SINGLE FIELD ION TRAP
- LOW VOLTAGE ELECTROSTATIC FOCUS

ELECTRICAL DATA

FOCUSING METHOD	LOW VOLTAGE ELECTROSTATIC	
DEFLECTING METHOD	MAGNETIC	
DEFLECTING ANGLE (APPROX.):		
HORIZONTAL	85	DEGREES
DIAGONAL	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	$\mu\mu f$
GRID #1 TO ALL OTHER ELECTRODES	6	$\mu\mu f$
MAXIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	750	$\mu\mu f$
MINIMUM EXTERNAL CONDUCTIVE COATING TO ANODE	500	$\mu\mu f$

OPTICAL DATA

PHOSPHOR NUMBER		P-4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE TRANSMISSION AT CENTER (APPROX.)	68	PERCENT

RATINGS

INTERPRETED ACCORDING TO DESIGN CENTER SYSTEM

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE, GRID #3, GRID #5 VOLTAGE[A]	20 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	500	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	180	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	180	VOLTS
MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE, GRID #3, GRID #5 VOLTAGE	16 000	VOLTS
DC GRID #4 VOLTAGE (FOCUS CONTROL ELECTRODE)[B]	0 TO +396	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[C]	-28 TO -72	VOLTS
DC ION TRAP MAGNET	40	GAUSSES

[A] BECAUSE THE RATING OF THIS TUBE PERMITS ANODE VOLTAGES AS HIGH AS 20 KILOVOLTS (ABSOLUTE MAXIMUM), SHIELDING OF X-RAY RADIATION FROM THE TUBE MAY BE NECESSARY. THIS PRECAUTION SHOULD BE OBSERVED WHEN THE ANODE IS OPERATED IN EXCESS OF 16 KILOVOLTS.

[B] WITH THE COMBINED GRID #1 BIAS VOLTAGES AND VIDEO SIGNAL VOLTAGE ADJUSTED TO PRODUCE AN ANODE CURRENT OF 100 μA. ON A 24" X 18 1/2" PICTURE ADJUSTED FOR BEST OVERALL FOCUS. FOR OTHER ANODE VOLTAGES, THE FOCUS VOLTAGE WILL BE FROM -0.4% TO +2.2% OF THE ANODE VOLTAGE.

[C] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED RASTER.

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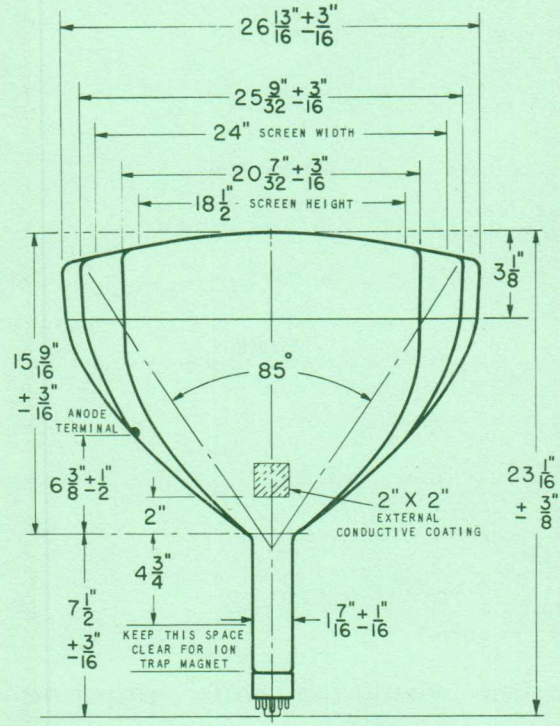
MECHANICAL DATA

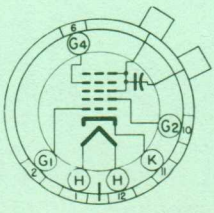
OVERALL LENGTH	23 1/16 ± 3/8	INCHES
GREATEST DIMENSIONS OF BULB:		
DIAGONAL	26 13/16 ± 3/16	INCHES
WIDTH	25 9/32 ± 3/16	INCHES
HEIGHT	20 7/32 ± 3/16	INCHES
MINIMUM USEFUL SCREEN DIMENSIONS:		
WIDTH	24	INCHES
HEIGHT	18 1/2	INCHES
BULB CONTACT	RECESSED SMALL CAVITY CAP	J1-21
BASE	SMALL SHELL DUODECAL 6 PIN	B6-63
BASING		12L

BULB CONTACT ALIGNMENT
J1-21 CONTACT ALIGNS WITH PIN POSITION #6 ± 30 DEGREES



PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID #1
PIN 6 – GRID #4
PIN 10 – GRID #2
PIN 11 – CATHODE



BOTTOM VIEW

PIN 12 – HEATER
ANODE CAP:
GRID #3
GRID #5

SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED. IT SHOULD HAVE FLEXIBLE LEADS AND BE FREE TO MOVE.

TUNG-SOL

CATHODE RAY

THE 30BP4 IS A DIRECT-VIEW PICTURE TUBE DESIGNED FOR USE IN TELEVISION APPLICATIONS. ITS FEATURES INCLUDE:

GREY FILTER FACEPLATE
MAGNETIC FOCUS & DEFLECTION
EXTERNAL SINGLE FIELD ION TRAP
UNIPOTENTIAL CATHODE
ROUND METAL CONSTRUCTION
25 9/16" X 19 1/4" RASTER SIZE

MECHANICAL DATA

FOCUSING METHOD		MAGNETIC
DEFLECTING METHOD		MAGNETIC
DEFLECTION ANGLE (APPROX.)	90	DEGREES
DIRECT INTERELECTRODE CAPACITANCES (APPROX.):		
CATHODE TO ALL OTHER ELECTRODES	5	μμf
GRID #1 TO ALL OTHER ELECTRODES	7	μμf

OPTICAL DATA

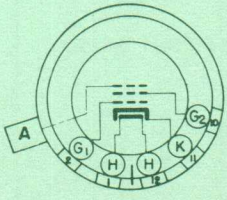
PHOSPHOR NUMBER		NO. 4
FLUORESCENT COLOR		WHITE
PHOSPHORESCENT COLOR		WHITE
PERSISTENCE		MEDIUM
FACEPLATE LIGHT TRANSMISSION AT CENTER (APPROX.)	66	PERCENT

MECHANICAL DATA

OVERALL LENGTH	23 9/16 ± 1/2	INCHES
GREATEST DIAMETER OF BULB	30 1/8 ± 1/4	INCHES
MINIMUM USEFUL SCREEN DIAMETER	28 1/4	INCHES
BULB CONTACT	METAL SHELL LIP	
BASE	SMALL SHELL DUODECAL 5 PIN	B5-57
BASING		12D

PIN CONNECTIONS

PIN 1 – HEATER
PIN 2 – GRID NO. 1
PIN 10 – GRID NO. 2



BOTTOM VIEW

PIN 11 – CATHODE
PIN 12 – HEATER
ANODE CAP

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RATINGS

DESIGN CENTER VALUES

HEATER VOLTAGE	6.3	VOLTS
HEATER CURRENT	0.6	AMP.
MAXIMUM DC ANODE VOLTAGE[A]	30 000	VOLTS
MAXIMUM DC GRID #2 VOLTAGE	410	VOLTS
MAXIMUM GRID #1 VOLTAGE:		
DC NEGATIVE-BIAS VALUE	125	VOLTS
DC POSITIVE-BIAS VALUE	0	VOLTS
POSITIVE-PEAK VALUE	2	VOLTS
MAXIMUM DC PEAK HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE		
DURING WARM-UP PERIOD NOT TO EXCEED 15 SECONDS	410	VOLTS
AFTER EQUIPMENT WARM-UP PERIOD	150	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	150	VOLTS

[A] IF THIS TUBE IS OPERATED AT VOLTAGES IN EXCESS OF 16,000 VOLTS, X-RAY RADIATION SHIELDING MAY BE NECESSARY TO PROTECT AGAINST POSSIBLE INJURY FROM PROLONGED EXPOSURE AT CLOSE RANGE. SUCH PROTECTION MAY BE PROVIDED BY THE PROTECTIVE FACE VIEWING WINDOW OF APPARATUS USING TUBES OF THIS TYPE.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

DC ANODE VOLTAGE	12 000	VOLTS
DC GRID #2 VOLTAGE	300	VOLTS
DC GRID #1 VOLTAGE[B]	−33 TO −77	VOLTS
DC FOCUSING COIL CURRENT[C] (APPROX.)	95 ± 20%	MA.
DC ION TRAP CURRENT STANDARD COIL #111 (APPROX.)	75 ± 50%	MA.

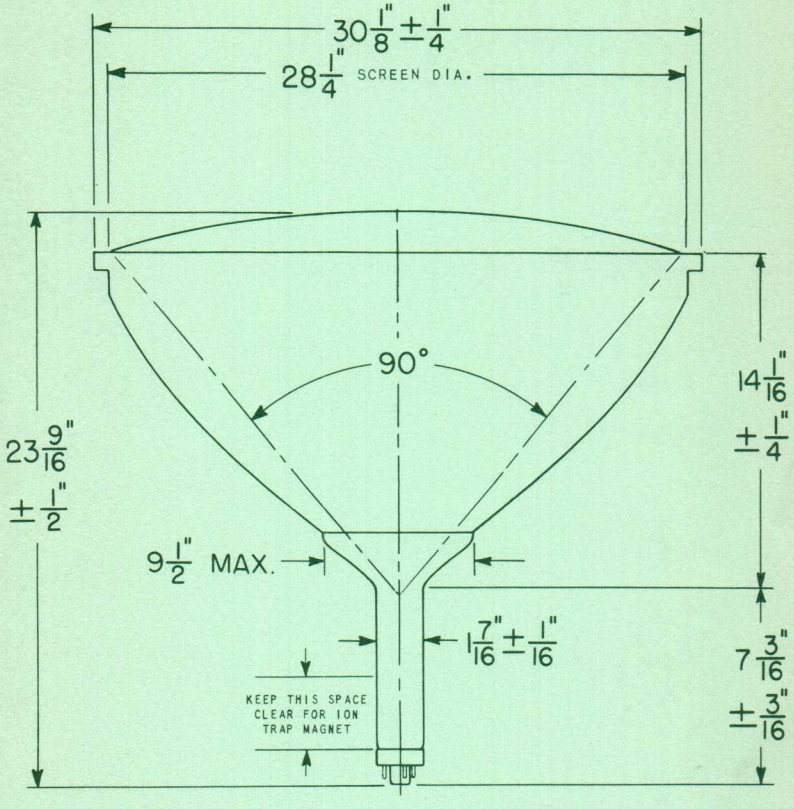
[B] VISUAL EXTINCTION OF UNDEFLECTED FOCUSED SPOT.

[C] FOR STANDARD FOCUS COIL #109, OR EQUIVALENT, WITH THE COMBINED GRID #1 BIAS VOLTAGE AND VIDEO-SIGNAL VOLTAGE ADJUSTED TO PRODUCE A HIGHLIGHT BRIGHTNESS OF 7 FOOT LAMBERTS ON A 19 1/4" BY 25 9/16" PICTURE SIZE. DISTANCE FROM REFERENCE LINE TO CENTER OF AIR GAP ON FOCUS COIL SHALL BE 3.0 INCHES.

CIRCUIT VALUES

MAXIMUM GRID #1 CIRCUIT RESISTANCE	1.5	MEGOHMS

TUNG-SOL



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