



# The Jersey Broadcaster

NEWSLETTER OF THE NEW JERSEY ANTIQUE RADIO CLUB

May 2026

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The *Jersey Broadcaster* is distributed to members of the New Jersey Antique Radio Club via email as a PDF file. Back issues of many of our newsletters are available on the club's website:

[www.njarc.org/broadcasterO](http://www.njarc.org/broadcasterO)

## Meeting Notice

Our May meeting will take place on Friday 5/15 at InfoAge. This month, member Leo Assur will present "Travels with Leo," a talk about his excursion via RV down to Hamcation in Florida this past Winter. We will also have a "Grab & Go" event in Storage Building 9036D featuring items surplus to our museum's needs starting at 5PM. Follow the signs! At our meeting, Bill Zukowski will have a number of radio-related items for sale at "giveaway" prices (and also maybe a few actual give-aways!)

## Meeting Review

Our April meeting was held at Bowen Hall in Princeton, where members brought in items or helpful restoration hints & kinks from their collection. The meeting was livestreamed on our YouTube channel and an on-demand recording is available for viewing at [www.youtube.com/njarc](http://www.youtube.com/njarc).

Many other past meetings are also viewable on YouTube as part of our "Throwback Thursday" series of archival meeting recordings curated by our NJARC Archivist Matt Reynolds.

## Kutztown Photo Album Events

<https://john-h.smugmug.com/Spring-2026-Kutztown-Vintage-Electronics-Expo>

## Calendar of Events

**May 15: NJARC monthly meeting, InfoAge**

May 22: HARPS meeting, Suffern NY

**June 12: NJARC monthly meeting, Princeton U.**

**July 10: NJARC monthly meeting, Princeton U.**

July 25: Summer Hamfest/Swapmeet, Infoage

**August 14: NJARC monthly meeting, Princeton U.**

August 22: NJARC Repair Clinic, InfoAge

**September 11: NJARC monthly meeting, InfoAge**

**October 9: NJARC monthly meeting, InfoAge**

October 24: Fall Repair Clinic, InfoAge

**November 13: NJARC monthly meeting, Princeton**

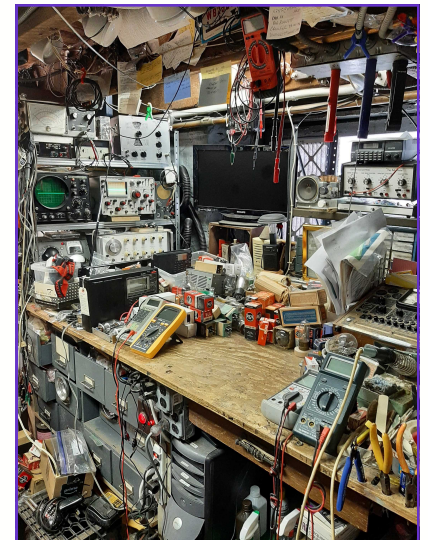
November 15: Fall Hamfest/Swapmeet, Parsippany

**December 12: NJARC Holiday Party, Jackson**

## From the President's Workbench

Greetings Fellow Enthusiasts!

Our club has been busy since our last meeting. We celebrated International Marconi Day (IMD) on Guglielmo Marconi's birthday, April 25th (1874) from amateur radio station W2RTM in the New Jersey Antique Radio Club's Radio Technology Museum (RTM) at InfoAge.



The President's Workbench.

Our intrepid operators manned the mic and the key through the night receiving QST's via voice and CW from all around the world! (So I'm exaggerating a little bit. See photos.) Concurrently, we held our Spring Repair Clinic in building 9032A. We had an interesting mix of clients and radios to repair. There was a military walkie-talkie BC-611, a Sears Silvertone wood tabletop radio, a Sparton wood tabletop, an early AM/SW portable radio, an interesting RCA (Grundig?) wood radio and a Heathkit tube tester. Two new potential members and their radios were brought to the clinic by Dr. Roberto Forte.

It was a very busy day with a special treat from member Ed Papson who generously dropped off every kind of donut, bun and cup cake available from the local Dunkin Donuts! Special thanks goes to our newest repair clinic Expert, Bill Sloma for joining the

(Continued on next page.)

## President's Workbench

(Continued)

**THE JERSEY BROADCASTER** is the newsletter of the New Jersey Antique Radio Club (NJARC) which is dedicated to preserving the history and enhancing the knowledge of radio and related disciplines. Dues are \$25 per year and meetings are held on the second Friday of each month either at InfoAge or at Princeton University. Neither the editor nor NJARC is liable for any other use of the contents of this publication other than for information.

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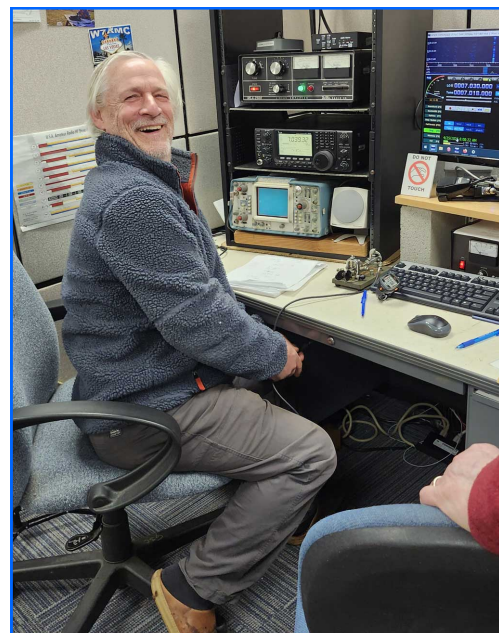
crew! See RadioWild's You Tube Video here: <https://youtu.be/eYWNDzslqQ8>

Last weekend was the Delaware Valley Historic Radio Club's hosting of the semiannual Kutztown Antique Radio Show at Renninger's Antique and Farmer's Market in Kutztown Pa.

It was a sold out show! There was still some grumbling about the loss of Thursday setup, but by now most vendors understand the excessive financial cost Renninger's has been carrying for all those previous years. I was a vendor, I did well, and was happy to see so many "old faces" to catch up with since last year. The weather was cold for early May but a very nice day nonetheless!



Gus and Davie on the Mike and Logging



A Delighted Rob Working

(Continued on next

**President's Workbench**  
(Continued)

**Repair Clinic**

**Kutztown**



**Aaron Fixed Tom's Piece of Vintage Equipment.  
(Does anyone know the use of this device?)**

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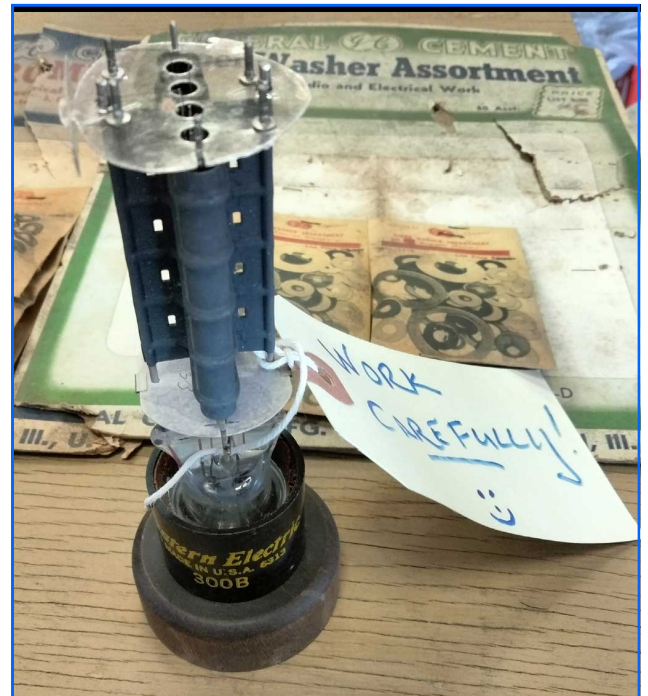
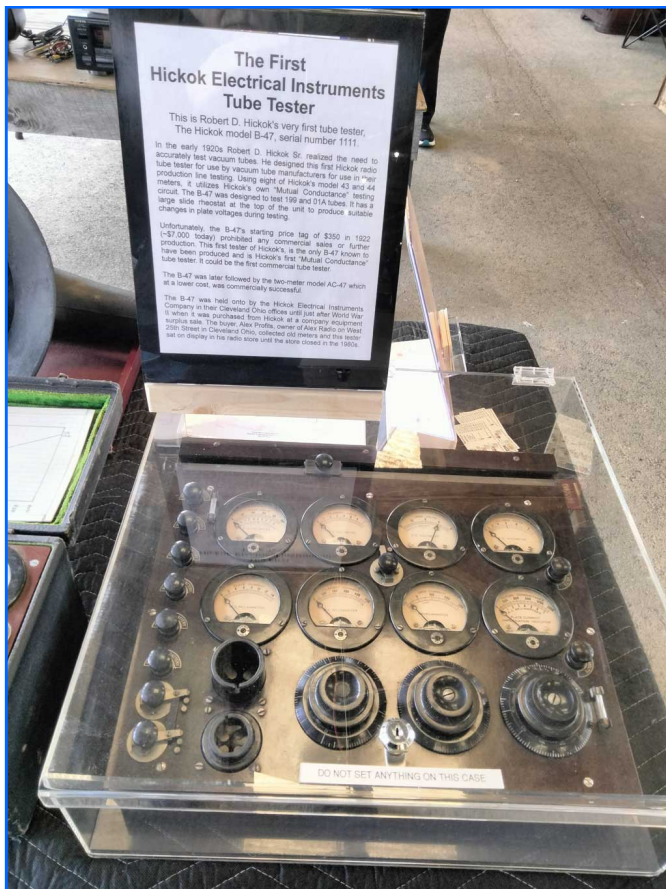
**Kutztown**



**K-Town Morning: Hurry Up and Wait!**

# President's Workbench (Continued)

## Kutztown



Work Carefully!

Hickok Model B047 Tube Tester

## President's Workbench

(Continued)

### Kutztown

(Check out Radio Wild's video coverage on YouTube here: <https://youtu.be/BYhOTBK3jFA>)



Hickok 6000A Tube Tester



Hickok I77B Tube Tester



A Real "Basket Case" Radio



Western Electric 15750 Tube Tester

## A Deep Dive Into the All-American Five (What About That Tingle?)

By Jim Whartenby

On occasion, someone will post a link on the NJARC reflector about the repair of a radio that was being discussed. Sometimes, I will watch that recommended video or read that article and on rare occasions, I will go down the rabbit hole and watch other videos made by either that same person or a video made by someone else about this or a similar radio.

If the radio happens to be an AA5, there is almost always a mention of the "hot chassis" due to the lack of a power transformer and how dangerous the radios have always been. Suggestions are then made on how to make the AA5 safe to repair and use. I would think that all of us, at one time or another, have seen these videos and read those articles.

### Background:

As we all know, the early AA5 radio was designed before WW2 with the radio chassis connected to one side of the AC line through the ON/OFF power switch. There was then a 50-50 chance that the chassis will be connected to the AC line "neutral" (ground) side of the AC line. There is also an equal chance that the chassis would be connected to the high or "hot" side of the AC line. This is potentially a dangerous situation especially if the AA5 is not in top physical condition. But who is when they are in their 80's and beyond?

For a newly manufactured AA5 radio, in original condition with the rear cover still in place, the electrical isolation of the chassis was effective in protecting the user from electrical shock. Most radio cases were either made of wood or Bakelite. Because both materials are relatively good insulators, the problem of isolating the chassis from the user was not a difficult problem to solve.

Some AA5 radios used a metal cabinet which is again isolated from the radio chassis by using plastic or other non-conductive fasteners that electrically isolate the chassis from the metal case. A capacitor is used to provide low frequency electrical isolation between the metal chassis and cabinet while allowing the chassis and cabinet to be RF coupled. The cabinet also acts as an electrostatic shield to reduce the chance of picking up hum and other interference from stray electric and magnetic fields.

With all of the cost reduction efforts to make the AA5 affordable, by eliminating the cost of the power transformer, it seems that the designers were still able to maintain a high level of performance while reducing the manufacturing and purchase price. This seems to be a contradiction, inexpensive but with good performance. Some AA5 radios sold for around \$10 in the 1950's but that was the better part of a day's average wage of \$1.50 per hour, if you had a good job!

Most of those videos and articles suggest replacing the old original line cord with a new one that has a polarized plug and rewiring the ON/OFF switch so that the "hot" side of the AC line is switched instead of the "neutral" side of the AC line to make the AA5 "safe" and prevent electric shock to the operator of the radio.

This modification has removed the 50-50 chance that the chassis would be at a high line voltage and guarantees that the chassis voltage can only be at or just above earth ground. This wiring change then seemingly requires that the ON/OFF switch be moved to the "hot" side of the AC line to conform to the latest editions of the National Electric Code.

Polarized plugs were mentioned by the NEC in the 1962 edition. They of course did not exist when the AA5 was designed. Wall outlets did not accept polarized plugs until they were required by the NEC for new construction, also in 1962. The manufacture of the AA5 continued up to the very early 1960s, about when solid state became the dominate technology and vacuum tube production started to decline.

To service these AA5 radios, an isolation transformer is recommended. It will disconnect the neutral AC line from the grounded (aka bonded) neutral found in the circuit breaker panel. The isolation transformer will allow both of the transformer's secondary leads to float so that the AA5 chassis has no reference to earth

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## A Deep Dive Into the All-American Five (What About That Tingle?)

(Continued)

ground. This protects both the repair technician and expensive test equipment.

If a dedicated isolation transformer is not available, one can be easily be fabricated by using two 24 volt "control" type of transformers or a similar low secondary voltage transformers. (See reference 1) The control transformers are wired so that the low voltage secondary of one transformer is connected only to the low voltage secondary of the second transformer. This will allow one primary winding to be connected to a grounded neutral receptacle and the second high voltage winding will then be isolated from the house wiring grounded neutral.

The only requirements for the above fabricated isolation transformer are that the turns ratios of both transformers are identical and that both transformers have a volt-ampere rating that is higher then the volt-ampere or power rating of the radio that is to be powered by it. This two transformer configuration will also slightly lower the second transformer's output voltage by a volt or two which may aid in troubleshooting by lowering the volt-ages measured in the AA5 radio to something closer to the published values. A small ferroresonant (aka constant voltage power transformer) would also accomplish the same thing.

The highest level of safety that will guarantee that there will not be a condition that will cause a shock (or worse) is to plug the AA5 into a Ground Fault Circuit Interrupter (GFCI) protected outlet. Any imbalance of current, greater then about 6 ma between the "hot" and neutral conductors will cause the GFCI to operate and disconnect the radio from the AC line. If your radio work space is in the basement and you are walking on a concrete floor, your bench power should be protected by a GFCI outlet for your own safety. Cheap insurance against electrical shock or worse.

### Looking deeper:

I have noticed that no one, in all of these videos and articles, has mentioned anything about the intent of the designers of the AA5. Nothing is said that explains why the AA5 power supply circuit is made the way that it is. This same power supply configuration, with some minor variations, is found in just about every AA5 radio ever made, regardless of the manufacturer. Why is this?

In the following discussion, the Hallicrafters S-38 series of radios will be used to illustrate the evolution of the AA5 radio power supply since it was first produced just after WW2 in 1946 and continued in production as the S-38E until about 1961. From the first to the last in the series, the S-38 had six variations. Only the original S-38 was a six tube radio using a separate BFO tube. All of those that followed were true AA5s that used a regenerative IF stage to provide the BFO function.

**The S-38, S38A and S-38B** radio schematics are slightly different from each other in three ways. See the schematic below. The chassis to cabinet coupling capacitor of the S-38 was reduced from 0.25uF to 0.1uF in the B & C models. The function of this cap is to RF couple the metal cabinet to the chassis while providing isolation at the line voltage frequency of 60Hz.

The 12SQ7 BFO was eliminated in the B & C models.

This then required that the 35L6 audio power amplifier be changed to a 50L6. This will then satisfy the requirement that the sum of all tube heater voltages equals the AC line voltage.

**The S-38C** schematic is different from the S-38A & S-38B in that the chassis to cabinet coupling capacitor value was again reduced from 0.1uF to 0.05uF. A 470k resistor was added in parallel to this capacitor to, I assume, equalize any potential differences between the cabinet and chassis. Evidently the quality of the new capacitor dielectric was high enough that an additional resistor was needed to increase the leakage current between the case and chassis.

## A Deep Dive Into the All-American Five (What About That Tingle?)

(Continued)

The 330 ohm resistor across the pilot light in the S-38, S-38A and S-38B was recommended in some tube manuals. It was eliminated and a series 15 ohm 1/2 watt resistor was added between the high side of the AC line and the #47 pilot light. This resistor will limit the surge current caused by the cold heater string when first powered and reduce the filter capacitor charging current. This one resistor will reduce the stress on both the #47 pilot light and the 35Z5 rectifier.

The 470 pf (uuf) capacitor that bypasses the cathode of the 35Z5 to the chassis was also eliminated. In its place is a 0.01 mfd capacitor that is connected across the 35Z5 rectifier from plate to cathode. (See Reference 2.) This more effectively reduces any noise voltage caused by the rectifier acting as a mixer. This mixing action multiplies the 60 cycle line frequency with any RF noise on the AC line that reaches this point. So the sum, difference and the original RF noises are attenuated but the 60 cycle half wave voltage is passed on to the three filter capacitors. Those three filter capacitors were also increased in value by approximately 50%. Since the new 15 ohm resistor helps to reduce the capacitor charging current, better power supply filtering is provided without overly increasing the stress on the 35Z5.

**The S-38D and S-38E** schematics differ from the S-38C in that the 22 ohm resistor between the cathode of the 35Z5 and the first filter capacitor is relocated to between the center tap of the 35Z5 heater and the plate. It still reduces the filter capacitor charging current but also limits the peak current to the rectifier thus reducing even more of the stress on the power supply rectifier.

The last component common to all of three schematics is the 0.02 differential mode line filter capacitor connected across the AC line. This functions the same as a modern X2 "safety capacitor" to remove differential mode line noise. The safety aspect of this X2 capacitor is that it was tested at a very high voltage to ensure that it could survive being cross the AC line voltage. See Reference 3.

### Sources of Hum

If one compares the position of the series string of vacuum tube heaters, you will notice that each tube heater is in the same position with respect to the other four tubes used in the AA5 circuit. This holds true for all three of the S-38 power supply schematics. It also holds true for perhaps all AA5 radios.

The reason for this is the susceptibility of some of the tubes to amplify the 60 cycle line frequency that is coupled by electro-magnetic radiation to any high impedance vacuum tube elements. The higher this coupled voltage is and the higher the stage gain, the higher this 60 cycle hum that will eventually reach the loud speaker.

A similar induced hum is caused by the location of the ON/OFF power switch which is physically connected to the 2 megohms volume control. Changing the power switch from switching the low side of the AC line to switching the high side will help induce hum directly into the audio amplifier.

With the original non-polarized line cord, if hum was noticed, one could always reverse the plug in the socket to ensure that the neutral side of the AC line is directly connected to the chassis through the ON/OFF power switch. If a polarized line cord is installed, less noise will be induced into the audio amplifier if the neutral lead remains connected to the power switch.

### Is the AA5 safety concern due to voltage or current?

Just about all of the videos and articles concerning the dangers of the AA5 mention that dangerous voltages are commonly found on the outside of the AA5. They state that these voltages will expose the user to electric shock or even death. The truth is that current is what makes one's muscles twitch and if it is high enough, it can kill. Voltage is just the potential difference that drives a current to flow from one point in a circuit to an-

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## A Deep Dive Into the All-American Five (What About That Tingle?)

(Continued)

other. If voltage was indeed lethal then perhaps we should all have passed on to our just rewards from static electricity, especially when the humidity is low and you shuffle across a carpet or pet your cat. (See Reference 4.)

### Electric Shock Calculations:

**S-38 power supply circuit** was evidently designed and manufactured before the UL requirements of 1945 were in effect. See Reference 5. As built, the S-38 exceeds the now in effect shock hazard, chassis to case, of 5 ma when the non-polarized AC line plug is installed in the receptacle in a way that produces the highest amount of audio hum. That is when the chassis is at approximately 126 vrms.

In the following calculations, capacitive reactance =  $X_c = 12 \times 3.14 \times 60 \times C$

Chassis to case leakage current when  $C_{36} = 0.25\mu\text{F}$ :

$X_c$  for  $C_{36} = 10.6\text{k} @ 60\text{Hz}$ ,  $i_{ac}$  for  $C_{36} = 126\text{vrms} / 10.6\text{k} = 11.9\text{mA}$

Chassis to Antenna Ground leakage current when  $C_1 = 0.01\mu\text{F}$ :

$X_c$  for  $C_1 = 265\text{k} @ 60\text{Hz}$ ,  $i_{ac}$  for  $C_1 = 126\text{vrms} / 265\text{k} = 0.48\text{mA}$

**S-38A, S-38B power supply circuit** reduced the S-38 shock hazard:

Chassis to case leakage current when  $C_{36} = 0.1\mu\text{F}$ :

$X_c$  for  $C_{36} = 26.5\text{k} @ 60\text{Hz}$ ,  $i_{ac}$  for  $C_{36} = 126\text{vrms} / 26.5\text{k} = 4.8\text{mA}$

Chassis to Antenna Ground leakage current is the same as in the S-38 above = 0.48ma

**S-38C power supply circuit** B- return separated from chassis:

Chassis to case leakage current when  $C_{24} = 0.05\mu\text{F}$ :

$X_c$  for  $C_{24} = 53\text{k} @ 60\text{Hz}$ ,  $i_{ac}$  for  $C_{24} = 126\text{vrms} / 53\text{k} = 2.4\text{mA}$

Chassis to Antenna Ground leakage current same as above = 2.4ma

**S-38D, S-38E power supply circuit** B- return separated from chassis:

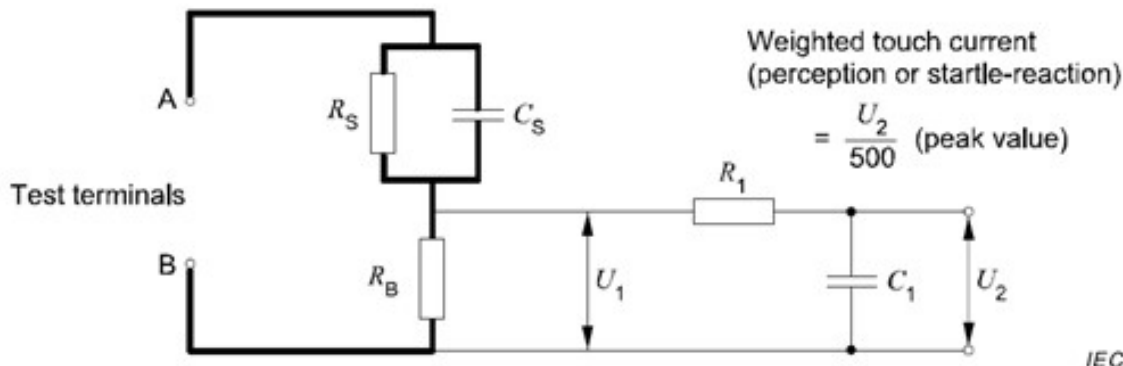
Chassis to case and chassis to Antenna Ground current are the same as in the S-38C.

### S-38 Method of measuring leakage current.

*Evidently, UL does not provide a pdf copy of ANSI C101, Leakage Current Measurement Specification, free of charge. Unwilling to spend hundreds of dollars to buy the UL documents, I searched for the European equivalent of the leakage current specification.*

The circuit below seems to meet the basic criterion of Reference 5 which basically follows the original 1945 UL measurement method. It uses a 1500 ohms resistor to simulate the average human body resistance and a 500 ohm resistor to simulate the ammeter resistance. Added to the 1945 circuit is the simulated body capacitance in parallel with the body resistance. There is also an RC network which is used to filter and average the measured voltage readings. The leakage current is then calculated by the measured voltage (U2) divided by 500 ohms. The typical DVM has an input impedance of 10 meg no matter the voltage range. This will have no measurable affect on the voltage dropped across the 500 ohm resistor.

**A Deep Dive Into the All-American Five (What About That Tingle?)**  
(Continued)



$R_S$	1 500 $\Omega$	$R_1$	10 000 $\Omega$
$R_B$	500 $\Omega$	$C_1$	0,022 $\mu F$
$C_S$	0,22 $\mu F$		

**Measured leakage current**

The calculated reactance of the capacitor that connects the S-38 chassis to the case controls the maximum AC leakage current that is available to shock the user. The smaller the external resistance to the power line neutral, the lower the external AC voltage drop. The higher the external resistance to power line neutral, the higher the external AC voltage drop.

In all cases, the maximum AC voltage available is the highest line voltage which is 126vac, that is 120vac times 105%. If a DVM is used to measure the voltage seen on the receiver metal case or the antenna ground terminal, to ground, the measured voltage is whatever the line voltage happens to be but the current is quite small, approximately 12.6  $\mu a$ , since the DVM input resistance is 10 megohms.

As the external resistance is lowered, the measured voltage will be lower than 126vac. When the external resistance is equal to  $X_c$ , then the measured voltage will be half of the line voltage and the available current is now 6 ma. As the external resistance continues to fall towards zero ohms, the voltage also gets closer to zero. As this happens, the available current increases to the maximum determined by  $X_c$ . In the calculations above, the maximum current available from the S-38 is 12 ma. For the S-38D and E models, the maximum current is limited to 2.4 ma.

Using the above Leakage Current Measuring circuit and my recapped S-38, I measured the leakage current per the European Specification. With the chassis connected to the AC line neutral the highest available current was 11.8  $\mu a$  which is well below one's ability to feel. See Reference 6.

With the chassis connected to the AC hot lead, the chassis was at 120vac. The  $U_2$  voltage measured at the chassis was 31vac and the calculated current was 31vac / 500ohms = 62ma which is over 10 times the present

## A Deep Dive Into the All-American Five (What About That Tingle?)

(Continued)

current limit and is dangerous. At the case. the U2 voltage measured was 4.8vac so the calculated current was  $4.8\text{vac} / 500 \text{ ohms} = 9.6\text{ma}$  which is still double the present current limit and is also dangerous. At the antenna ground lead, the U2 voltage was measured as 0.52vac and the calculated current was  $0.52\text{vac} / 500 \text{ ohms} = 1\text{ma}$  which is perceivable as a tingle.

To make the S-38 less of a shock hazard the line cord was replaced by a polarized line cord. The neutral line was connected to the ON/OFF switch and the hot line was connected to pin 2 of the rectifier. In other words, it directly replaced the old line cord. This left the AA5 in the same configuration as designed that reduced the chances of line cord induced hum. As in the S-38C and later variations, the chassis to case bypass capacitor was reduced from 0.25 uF to 0.05 uF and the leakage current measurements were again calculated.

Again with the chassis at 120 volts, the U2 voltage measured at the chassis was 31 volts so the calculated current was unchanged at  $31 \text{ vac} / 500 \text{ ohms} = 62 \text{ ma}$  which is still dangerous so a back cover and case isolation are important. On the case. the U2 voltage measured was 1.08 vac so the calculated current was  $1.08 \text{ vac} / 500 \text{ ohms} = 1 \text{ ma}$  which is below half of the maximum leakage current now allowed. At the antenna ground lead, the U2 voltage was unchanged at 0.52 vac and the calculated current was  $0.52 \text{ vac} / 500 \text{ ohms} = 1 \text{ ma}$  which is still perceivable as a tingle.

To get an idea of what these leakage currents mean to the average individual, see the log-log graph, Reference 6. This graph shows the relationship between current and time, the very definition of the Coulomb. What determines the lethality of any current conducted through the human body is both the amount of the current and the amount of the time that the current flows. It's complicated. "There's always something... if it's not one thing, it's another" - Roseanne Roseannadanna aka Gilda Radner.

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Log-Log graph from: [https://en.wikipedia.org/wiki/Electrical\\_injury](https://en.wikipedia.org/wiki/Electrical_injury) (By Cmglee - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=35414234>)

Log-log graph of the effect of alternating current I of duration T passing from left hand to feet as defined in IEC 60479

- AC-1: imperceptible
- AC-2: perceptible but no muscle reaction
- AC-3: muscle contraction with reversible effects
- AC-4.1: up to 5% probability of ventricular fibrillation
- AC-4.2: 5–50% probability of fibrillation
- AC-4.3: over 50% probability of fibrillation

