

Blueglow Electronics

TV-7 Tube Tester Calibration & Service, a Practical Guide v1e

Feb 2018

- There are high voltage present when working on a TV-7 with the unit outside of it's case, they can be lethal
- If you aren't trained and comfortable working around such high voltages, please seek professional help in calibrating and/or servicing your unit



Warning

- I don't claim to be a TV-7 expert, just someone who has been around them for many years and worked on many tube testers including these. I don't do this for a living, it's just a hobby.
- I'm sure people will debate some of what is in this document and YouTube video as there are multiple ways to go about these calibrations, I don't claim to have invented any of these practices. I'm just claiming to lay them out in an way easily understood by the average DIYer
- Much of what I'm sharing in this video / document is found on the web, just maybe not organized the same way
- These steps are not all inclusive, they assumes your unit is in decent condition with no major issues (bad transformer, broken meter, worn out pots, burnt switch connections, broken or incorrect wiring, etc.)
- There are experts out there:
 - Daniel Nielson (djn@ieee.org) – the renowned expert, good source for parts as well
 - Bill Waters (TS6550@yahoo.com) – “Hickokdoc”
 - Roger Kenney (alltubetesters.com) – replacement meters, other services
 - EB5AGV – TV7 Tube Tester Page – lots of tube data sets available on-line
 - And others

Disclaimer

- First Military Manuals for the TV-7/U appeared June 1960
- Made by several manufacturers to military specs: Hickok, Forway, Stark, Supreme (all seem similar quality)
- Extremely Rugged Devices, cases can get beat to death and the tube tester inside can be in great shape
- Five Variants – TV-7/U, TV-7A/U, TV-7B/U, TV-7C/U, TV-7D/U
- TV-7/U
 - had skirted dials for Bias & Shunt functions, makes it easy to identify this model
 - used phenolic wafers, more prone to warping (be careful soaking with deoxit or similar cleaners)
 - used fixed resistors, not potentiometers (much more difficult to calibrate)
- TV-7D/U
 - Added an additional high transconductance "Range F" for high- μ tubes.
 - Not Often Used
 - Has full set of adjustable potentiometers for calibration
- Later models C, D adding ferrite beads to the Tube Socket connections to prevent oscillations with high- μ low-cap tubes



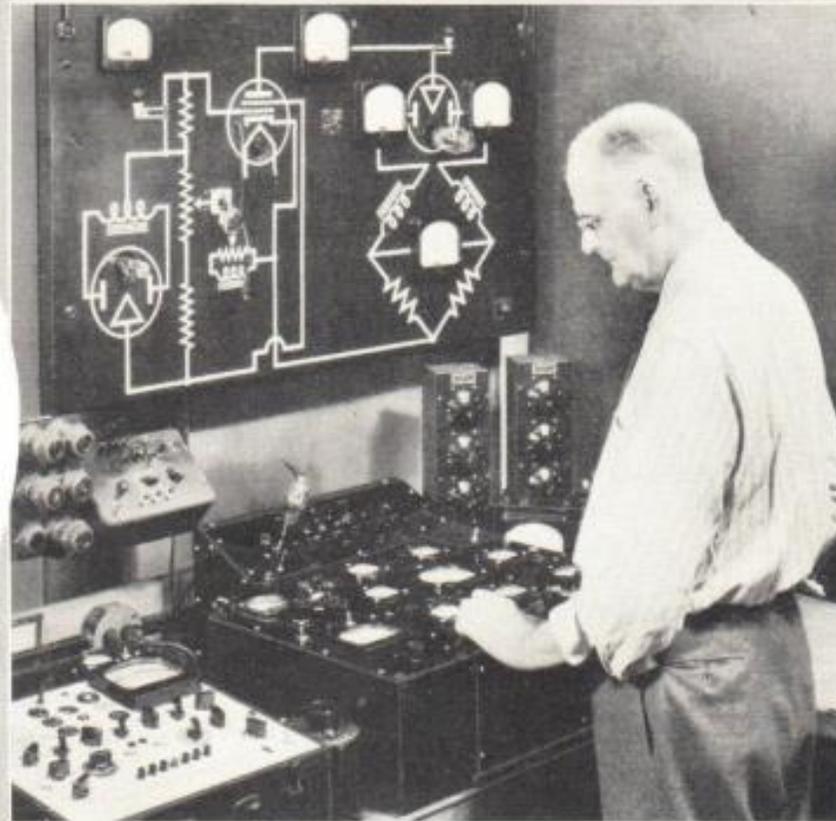
- Gm readings shown on a 1-120 scale
 - can compare to a spreadsheet for Gm values
 - can replace meter with modern version with Gm scale built in
- Uses 5v signal test voltage on scales B & C, 1V on D, and .5V on E
- Shunt pot used only for testing rectifier tubes
- Pros of TV-7
 - Many out there, thus parts are available
 - Quick and easy to use (one of my favorite go-to testers)
 - Easy to find someone to calibrate / service
 - Tube value recognition (good or bad...)
 - People have updated newer tube types in spreadsheets
- Cons of TV-7
 - Not a laboratory tube tester (yes, I'm saying these aren't the best)
 - Calibration Creep
 - 1-120 scale



CHOICE OF THE EXPERTS FOR SPEED, ACCURACY and DEPENDABILITY

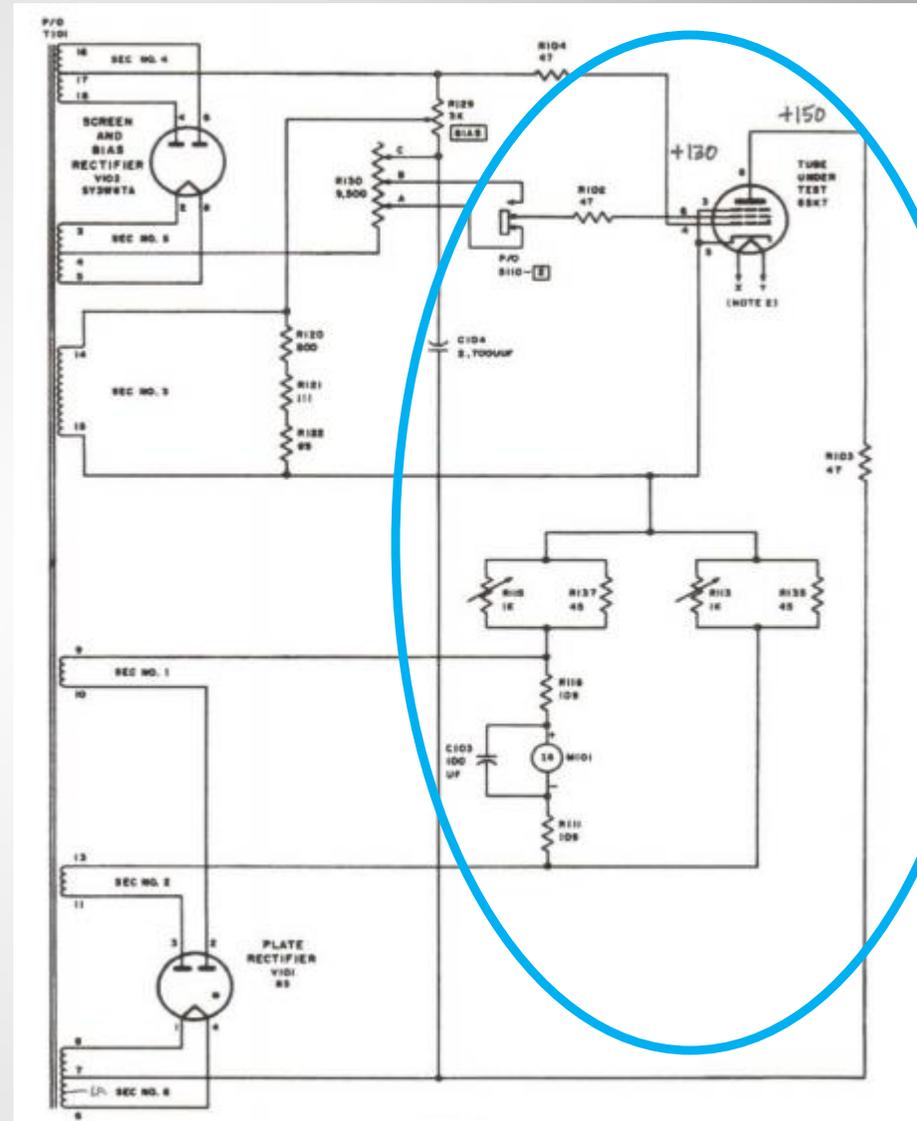
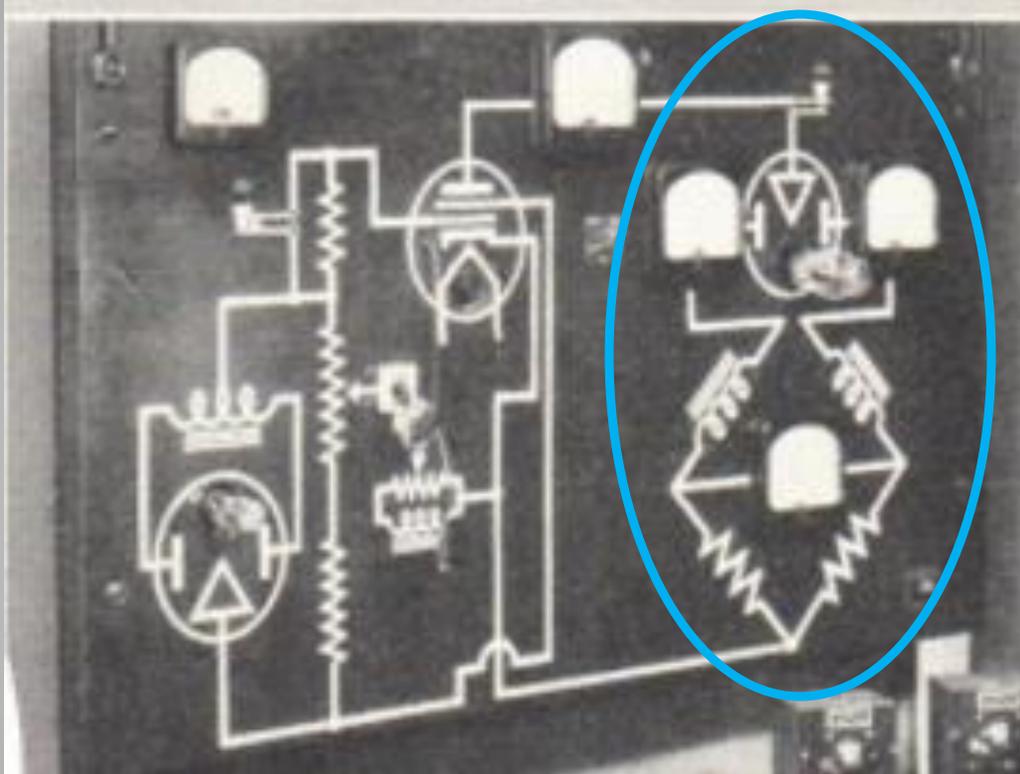
UNIVERSALLY ACCEPTED

Western Electric	Major Air Lines
Western Union	Major Tube
R. C. A.	Manufacturers
U.S. Signal Corps	Leading Radio &
U.S. Navy	TV Manufacturers
U.S. Air Corps	Technical Schools,
C. A. A.	Colleges, Universities
	Police Departments



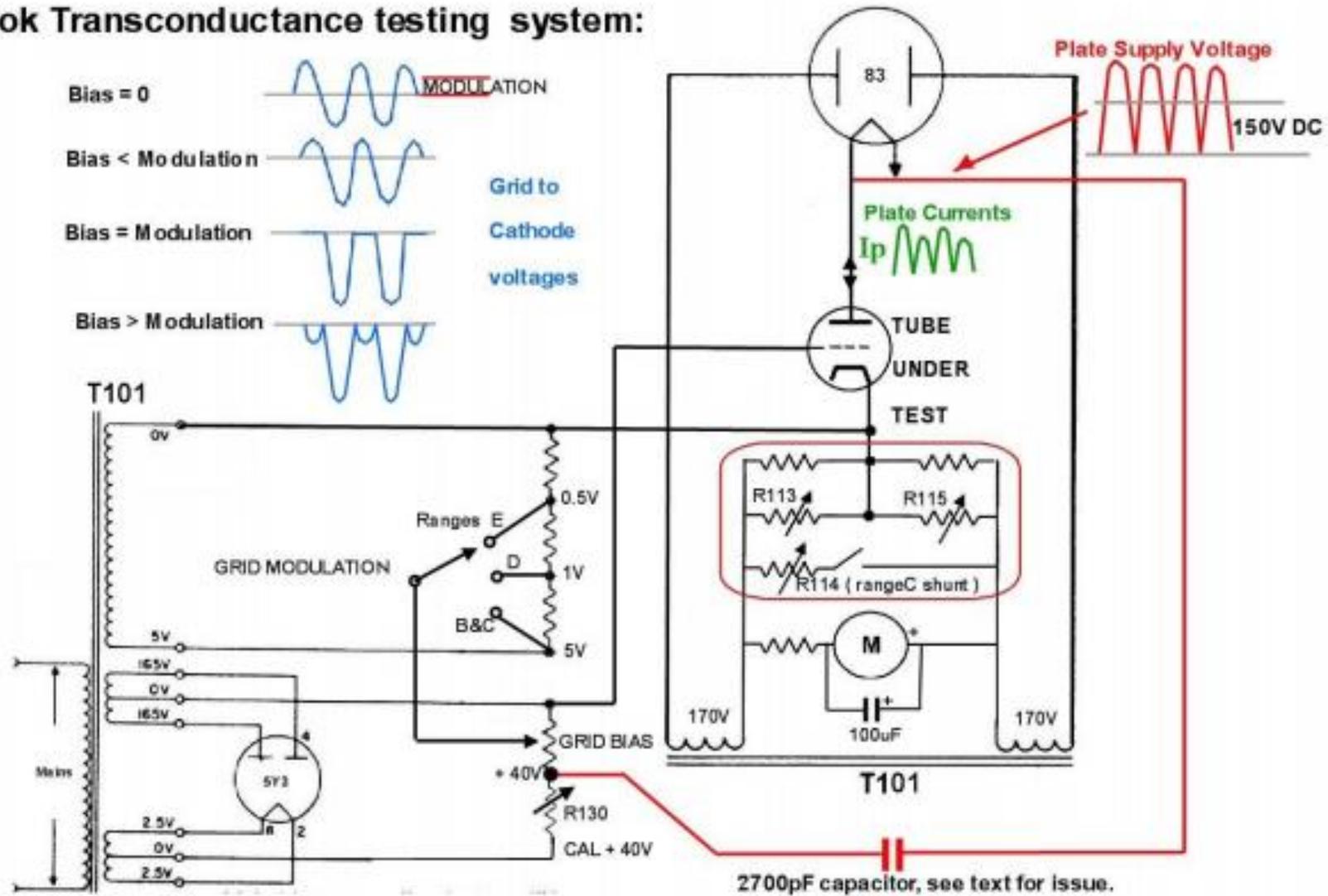
Classic Hickok Circuit Design

How a TV-7 works



How a TV-7 works

Hickok Transconductance testing system:



How a TV-7 works

- Things You Will Need To Calibrate a TV-7

- 330K Resistor – used for plate load (1/2 watt or more is fine)
 - Manual calls for 375K, 330K works fine
- Digital Multi-Meter (good one)
- Set of Reference Tubes
- 10K Potentiometer
- Can Deoxit D5 Electronics Cleaner
- Octal Tube Test Socket (not required but makes job easier)
- Basic electronics knowledge & patience



Things you will need

- By the Military Manual
 - Requires some special military test equipment (obsolete stuff)
 - Long and very in-depth
 - Although a good manual to have for reference

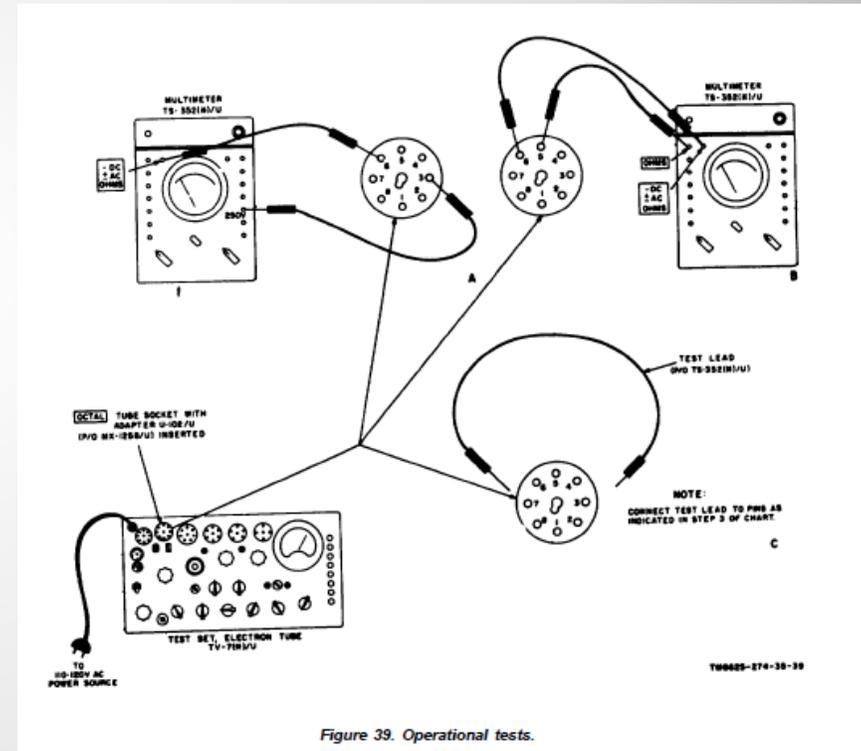
TM 11-6625-274-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT MAINTENANCE
MANUAL

TEST SETS, ELECTRON TUBE TV-7/U,
TV-7A/U, TV-7B/U, AND TV-7D/U

This reprint includes all changes in
effect at the time of publication:
Changes 4 and 5.

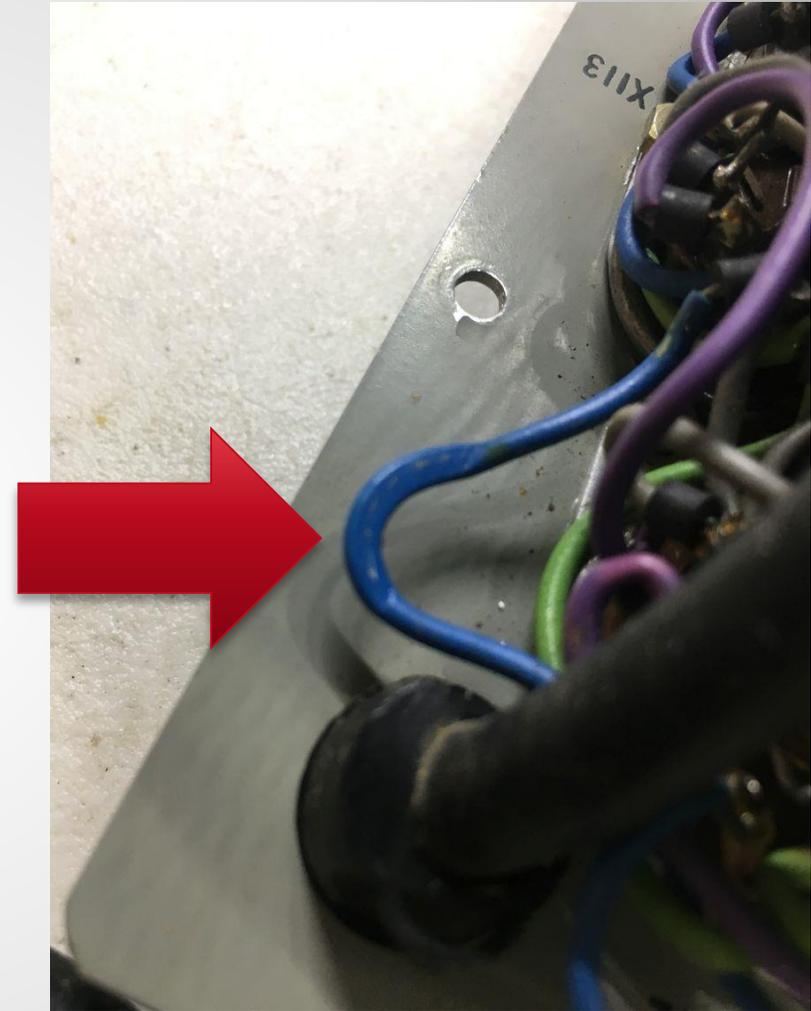


How we are not going to do it

- Unit Inspection
- Cleaning
- Replace CR101 Copper Oxide Diode Pair
- Test Meter
- Replace Capacitors (C103 meter "bath cap", maybe others)
- Voltage Calibrations
- Gm Calibrations

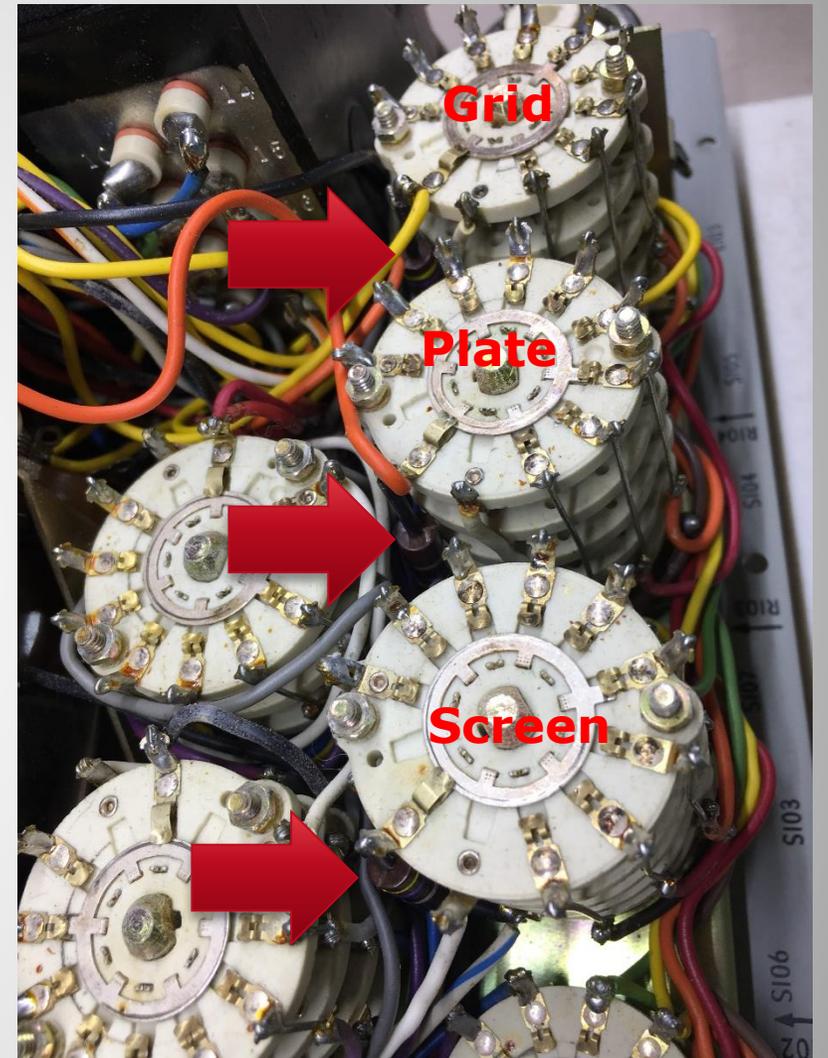
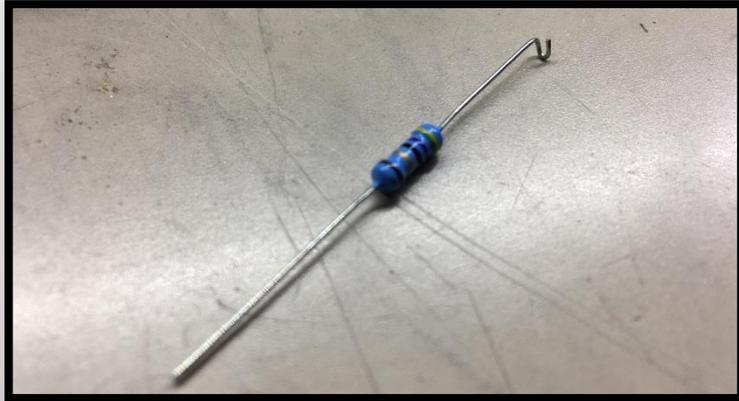
High Level Abbreviated Approach

- Remove all screws from top all the way around, lift up using filament knob and fingers under other side
- Inspect Power Cord, replace if needed
- Look for Squished Wires around edges (see example)
- Inspect wires in general, look for damaged, loose, or frayed wires



Unit Inspection

- Turn Potentiometers, feel for rough spots or broken areas
 - Especially Bias Pot (should be 3k end to end)
- Check condition of switches, look for burnt contacts
- Check 47R Resistors on Screen, Plate, and Grid ganged switches (**poke them**)
 - #One of the top TV-7 issues
 - Replace if needed 47ohm ½ watt are fine (tedious job, take your time).
 - Make a hook like shown and solder bottom connection first, then top



47R Resistor Locations

Unit Inspection

- Unit Inspection

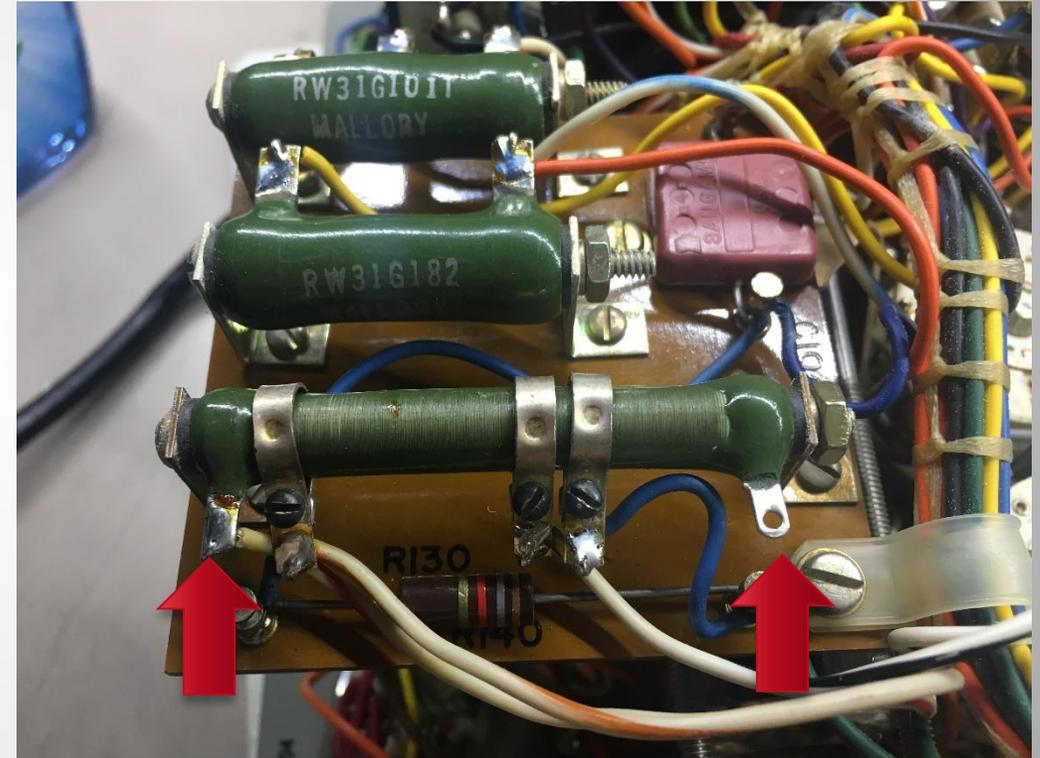
- Visually inspect Tube Sockets, Insert Tubes to see if they are "loose"
- Test "fuse" bulb with DMM on Continuity
- Test 83 & 5Y3 on another tester if you have one
 - Many 83's look worn out getter wise but function fine



Unit Inspection

- Unit Inspection

- Ensure R130 tapped power resistor is good
 - Test end to end – should be around 9.5K ohms
- Ensure Meter pivots are good
 - Meters that don't go back to zero and require tapping to get there need to be replaced



Here to here 9.5K

Unit Inspection

- Line Test
 - Plug in tube tester, power on, Pilot Light should come on
 - Press button 1 (Line Adj.) and rotate Line Adjust Knob until meter rest over the line test mark on the meter, release button 1
- Short Test
 - Set tester tube settings to AP0-0022
 - Rotate the Function Switch through the five short positions. The neon Shorts Lamp should glow on position 2 & 3 indicating the short test circuit is functioning properly



**Notice unit is set to:
AP0-0022 starting with Filament A,
Filament P, Grid 0, Plate 0, Screen 0,
Cathode 2, Suppressor 2**

Line Adj. →

← **Button 1**

Shorts 1-5 positions

Unit Inspection – Initial Tests

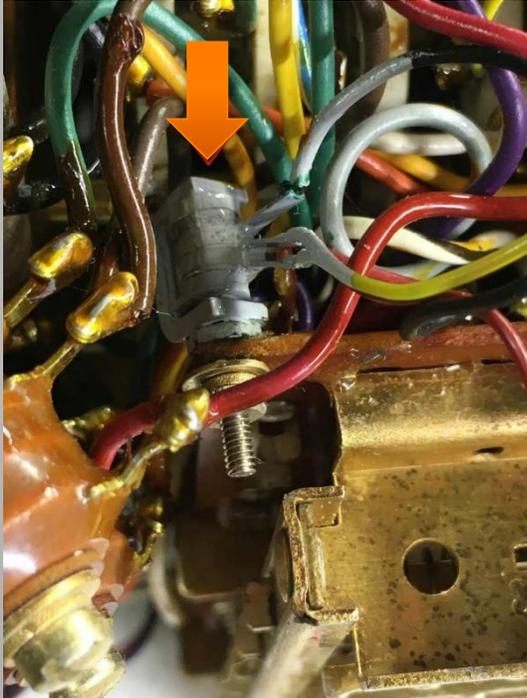
- Cleaning

- Clean face, meter cover, cover, etc. with Windex, 409, or similar
- Deoxit D5 on all rotary switches & pots, work them well
 - Be careful on TV-7/U, don't soak the phenolic wafers
- Clean tube sockets w/ Dexoit D5 – use small brush if you have one
- Clean push button switches w/ Deoxit D5, work them well

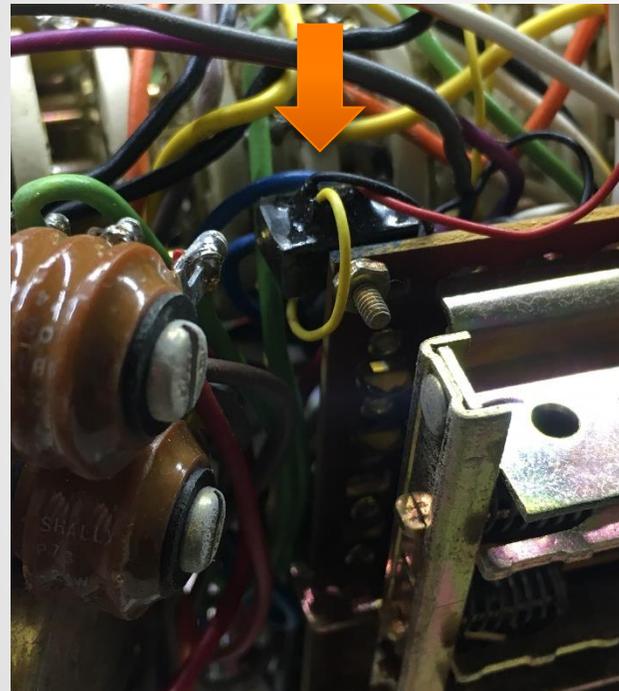


Cleaning

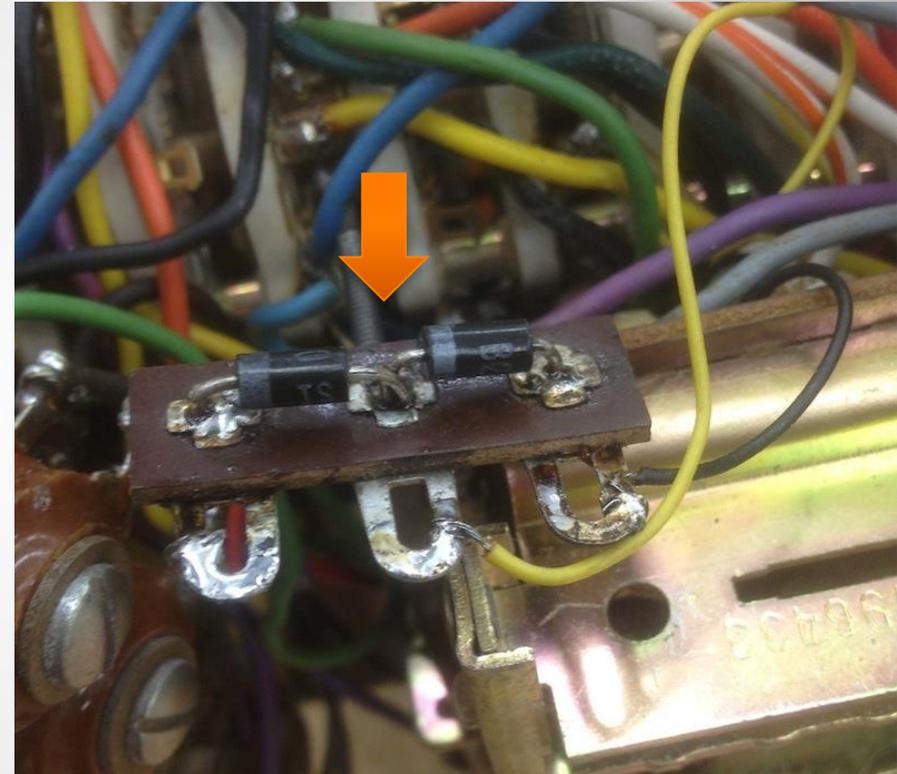
- Replace CR101 Copper Oxide Diode Pair
 - I made an entire video on this topic, find it on YouTube



Some are Grey



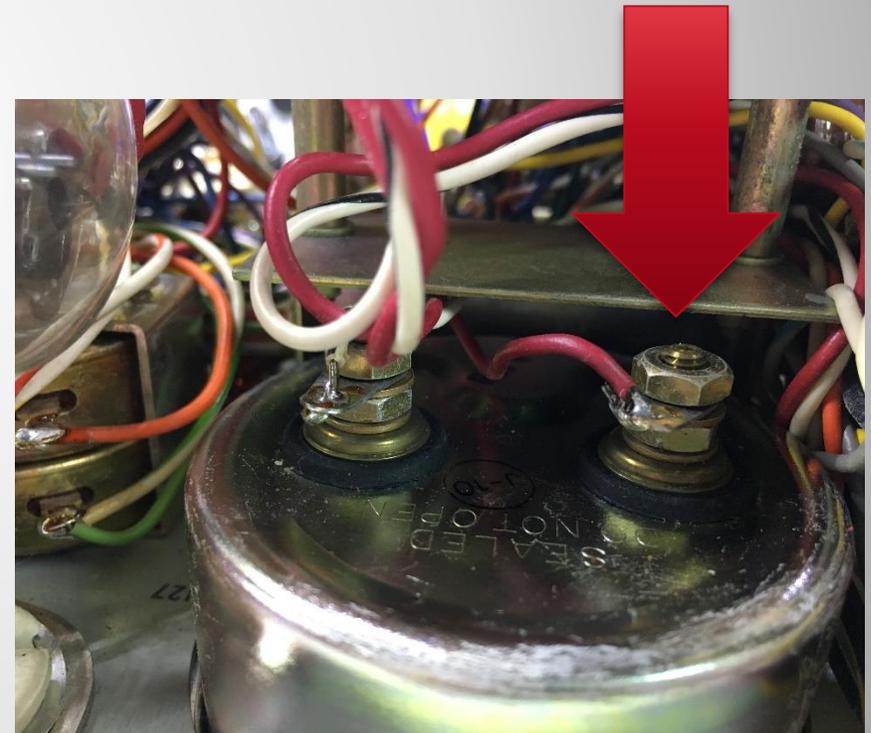
Some are Black



Regardless, replace like this. All use Red, Yellow, Black Connections. Use any 3 terminal strip. 1N4004 or 1N4007 work fine

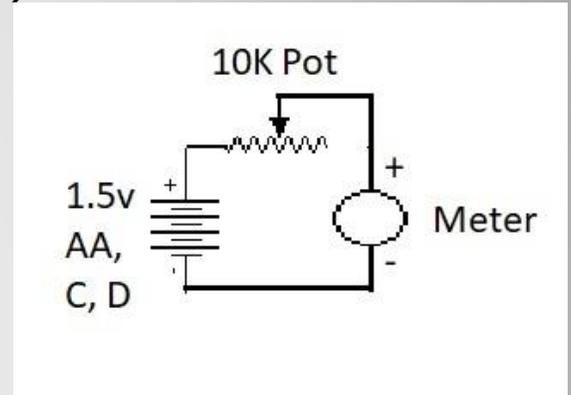
Replace CR101 Diodes

- Short and dirty quick test
 - Remove the red wire from back of meter
 - Use a DMM set to measure resistance (ohms)
 - Read across the two terminals on the back of the meter
 - A perfect meter will test between 2,370 and 2,390 ohms
 - If it is outside that reading, proceed to method #2



Test Meter Method #1

- Remove two nuts from back of meter and remove wires with tabs from studs (leave these disconnected for next step too)
- Connect a 10K pot in series with a 1.5v battery (or power supply set to 1.5v)
 - AA, C, D Battery will work
 - Connect wire from battery (+) to one side of the potentiometer
 - Connect wiper of pot (center terminal) to wire going to + side of meter
 - Leave other side of pot disconnected
 - Connect meter (-) to battery (-)
- Adjust pot until meter shows full scale at 120
- Use a DMM and read the voltage drop across the potentiometer from one side to the other. Note this as V.
- Now disconnect pot and measure the resistance across the terminal you had connected to the battery and the wiper. Note this reading as R.
- Using Ohms law determine full scale meter current by dividing V/R
 - This is your full scale current rating
 - It should be 200 microamps +/- 10 microamps (5%), anything outside of this means you should consider replacing the meter



Test Meter Method #2

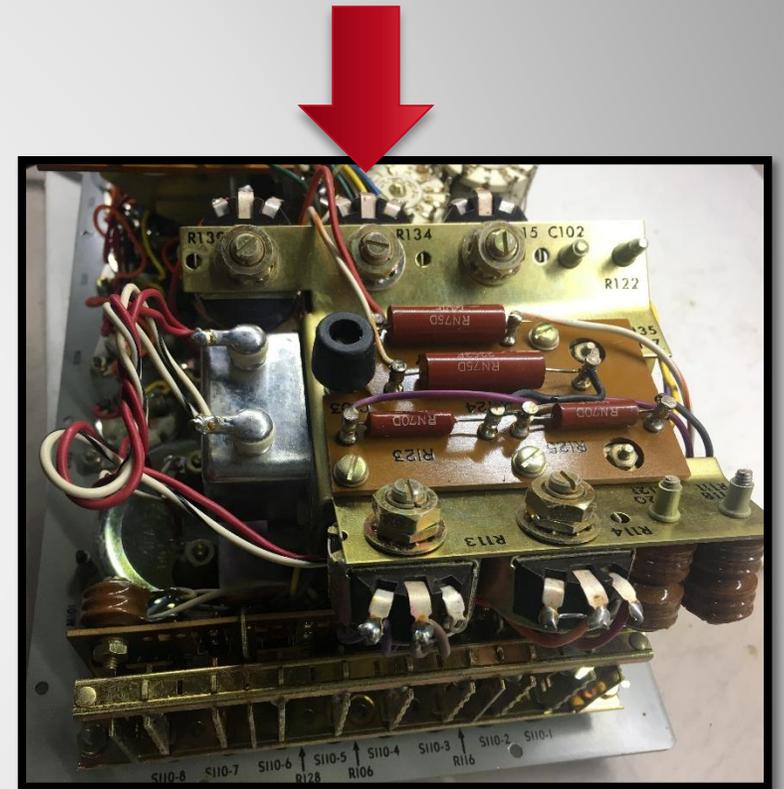
- While you have the meter wires disconnected is the time to do this step.
- Causes slow meter movement - remove "bath tub" meter capacitor and replace with **100uF @ 15v** or higher modern electrolytic (axial), notice polarity + & -
 - Can solder to tabs on meter and eliminate wires to capacitor



- C102, C104 are rarely bad, replace them if you wish (non-polarized)

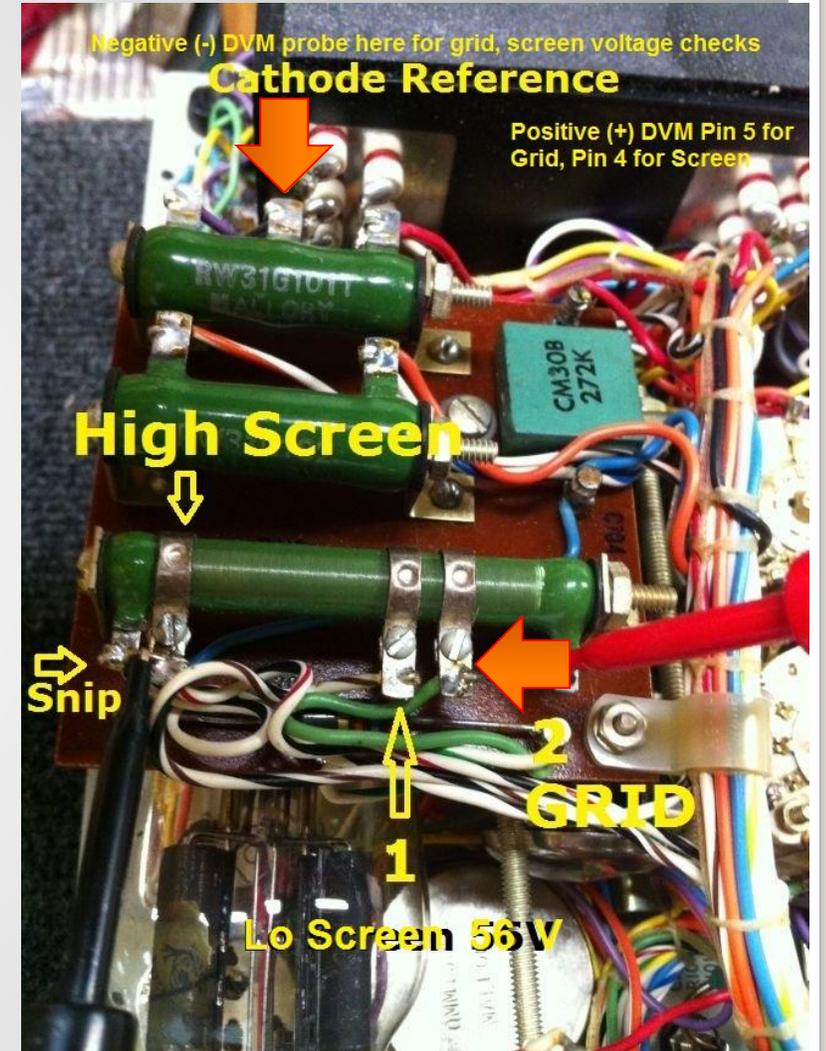
Replace Capacitor(s)

- Turn on tester, let warm up a good 15 minutes (walk away and come back)
- Set tube tester settings to **HS5-3481** (like setting for a 6L6 tube) but don't install a tube into the octal socket (insert tube socket test adapter if you have one)
- Set Filament to **10v** (be careful not to leave on this setting)
- Put DMM on AC Volts
- Read voltage at Pins **2** and **7** of octal socket
- Adjust Line Adjust knob on front until your DMM reads 10.3v – 10.12v RMS. Then adjust R134 (loosen lock nut) until your meter reads 60 or dead center. Some older models used fixed resistors for R134, substitute with pot where feasible.
- Some people also test **.6v** (set for .652v) and **117v** (set for 117v) and average for best setting across all three filament settings



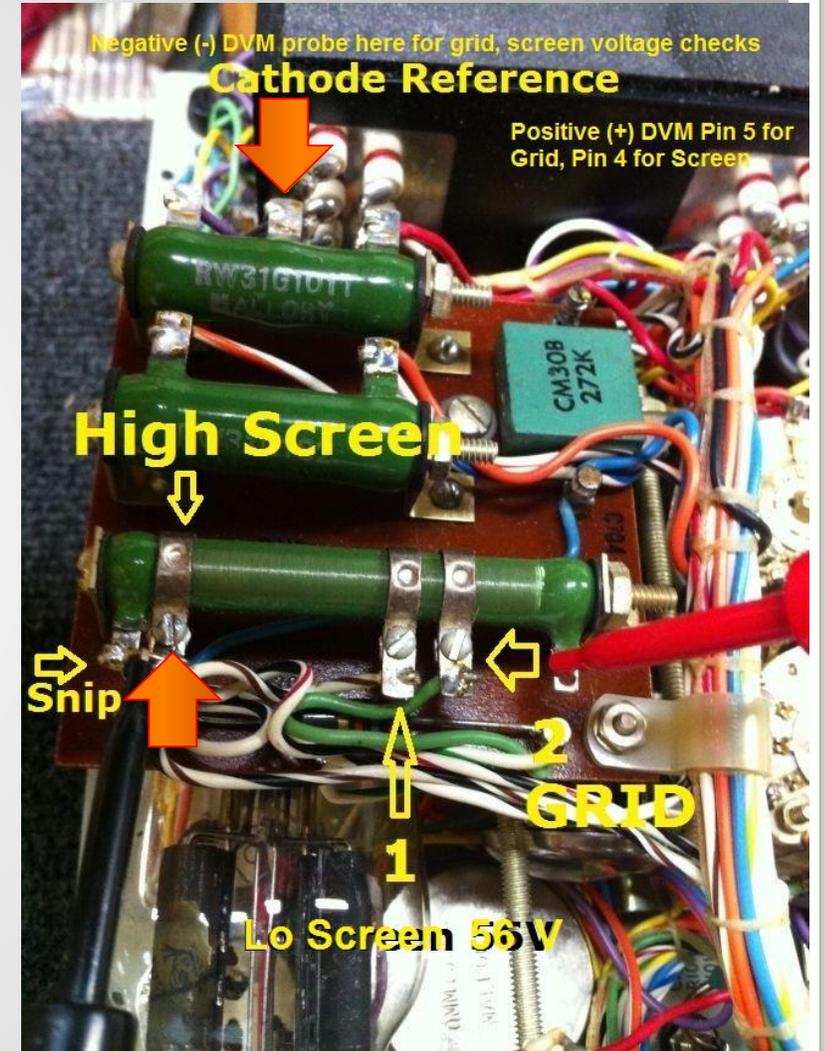
Voltages – Line Set Calibration

- Ensure Bias pot when knob is turned all the way to the left is exactly on 0
- Connect Negative (-) DMM lead to center tap of R110 or pin 8 of the Octal Socket
- Connect Positive (+) DMM lead to Pin 5 of Octal Socket (grid)
- Put meter on DC Volts
- Adjust #2 slider tap R130 until you get 2.3 – 3.2v DC on DMM when bias is at 22. Should be at 40v at 100.



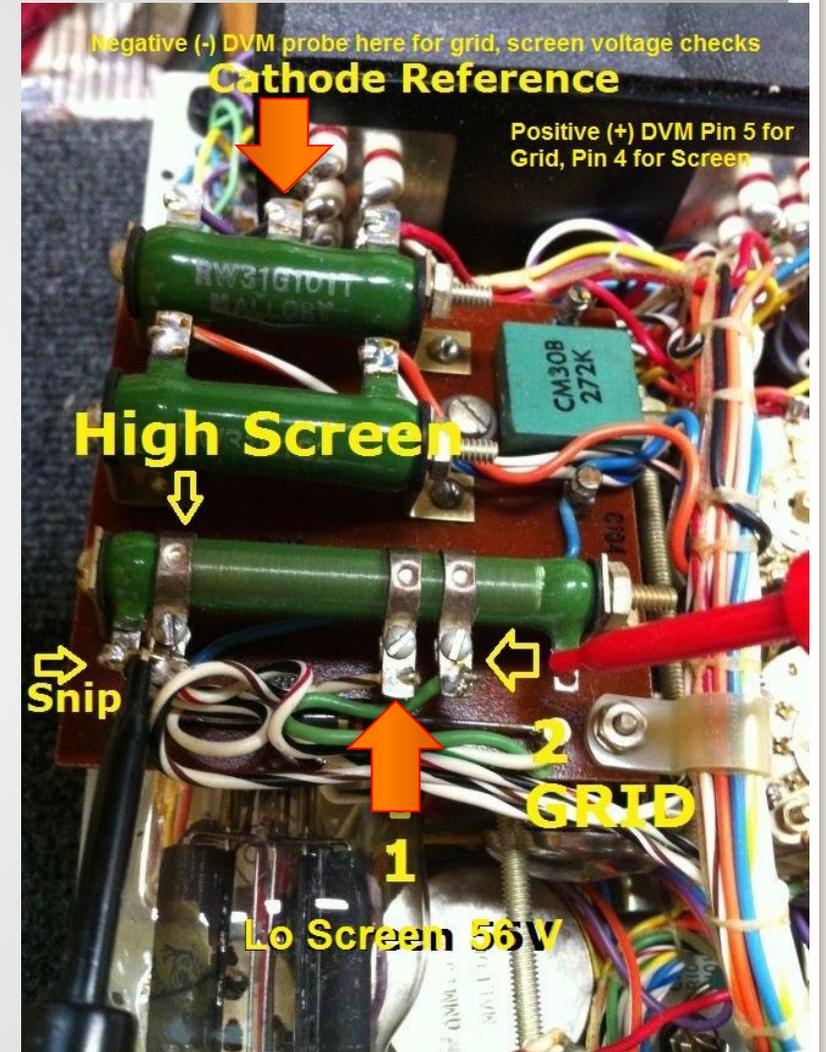
Voltages – Grid Setting

- With power disconnected, if left end post of R130 has a wire soldered to the first tap (High Screen), snip this wire out
- Connect 330K resistor pins 4 & 8 of Octal Socket
- Power On
- Turn Bias to 0
- Connect Negative (-) DMM lead to center tap of R110 or pin 8 of the octal tube socket
- Connect Positive (+) DMM lead to Pin 4 of Octal Socket (screen)
- Adjust High Screen slider tap R130 until you get 130v on DMM (must push button #3 Mut Cond. to activate)



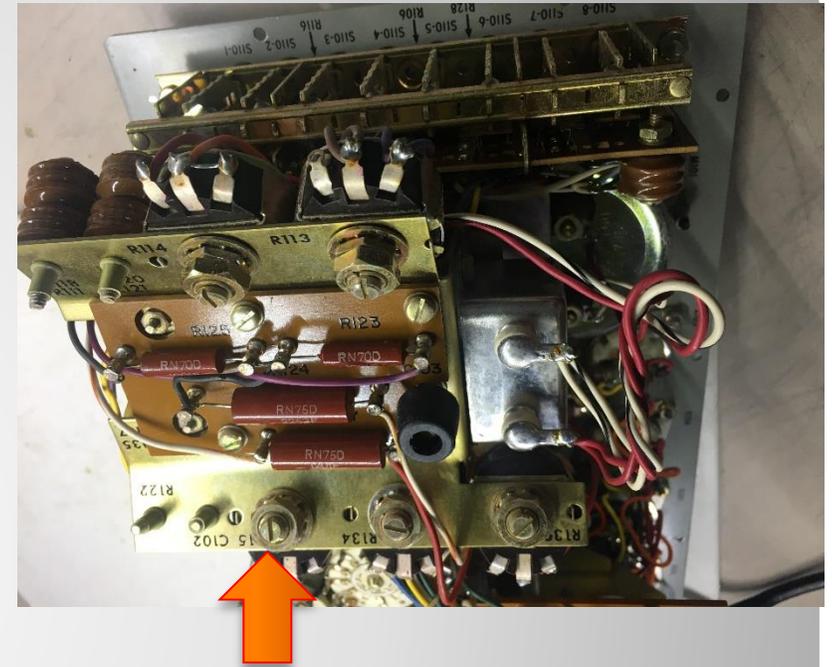
Voltages – High Screen Setting

- Connect Negative (-) DMM lead to center tap of R110 or pin 8 of the octal tube socket
- Connect Positive (+) DMM lead to Pin 4 of Octal Socket (screen)
- Leave all other settings and resistor intact
- Depress Buttons #2 (diode) & 3 (mut. cond.) at the same time
- Adjust Low Screen slider tap R130 until you get 56v on DMM



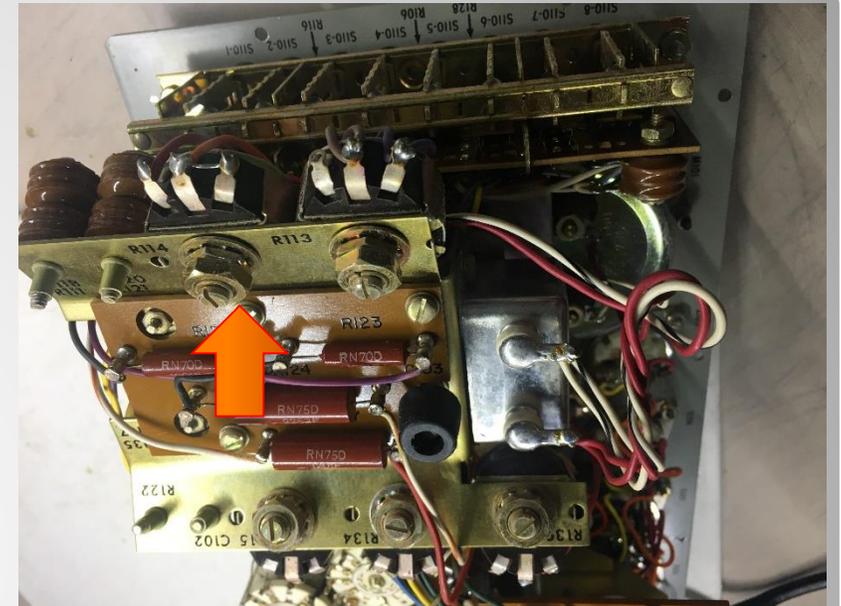
Voltages – Low Screen Setting

- Set tester to test a 6L6 (Filament 6.3v, HS5-3481, Bias 23, Range D)
- Insert calibration 6L6 tube, let unit warm up a good 5-10 minutes
- Perform line set adjustment (button 1 & line adjust knob)
- Press 3 (Mut. Cond.) and adjust R115 until meter reading matches calibration tube
- Repeat 6AU6 & 6L6 calibrations one more time, re-adjust as needed



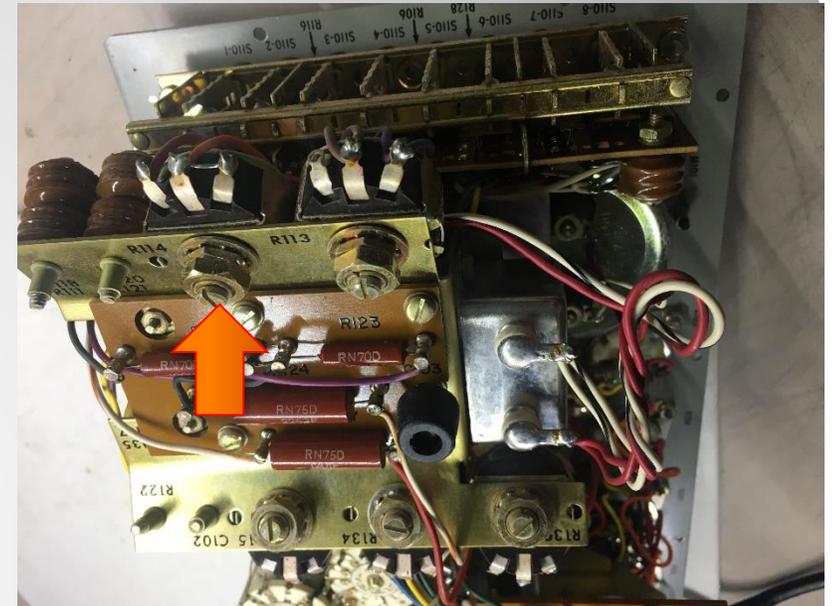
Gm Settings – Range D - 6L6 Tube

- Leave everything intact and the tube inserted from previous 6L6 test except
- Set range on "Range B" and adjust the bias so that the reading on the meter is 120 (full scale) exactly
- Change the range to "Range C", adjust R114 until the meter reads exactly 60 (mid point)
- Flip back and forth between Range B and C, recheck this several times, adjust as needed



Gm Settings – Range C - 6L6 Tube

- Set tester to test a 12AT7 (Filament 12.6v, EV7-6080, Bias 10, Range C)
- Insert calibration 12AT7 tube, let unit warm up a good 5-10 minutes
- Perform line set adjustment (button 1 & line adjust knob)
- Press 3 (Mut. Cond.) and tweak R114 until meter reading matches calibration tube



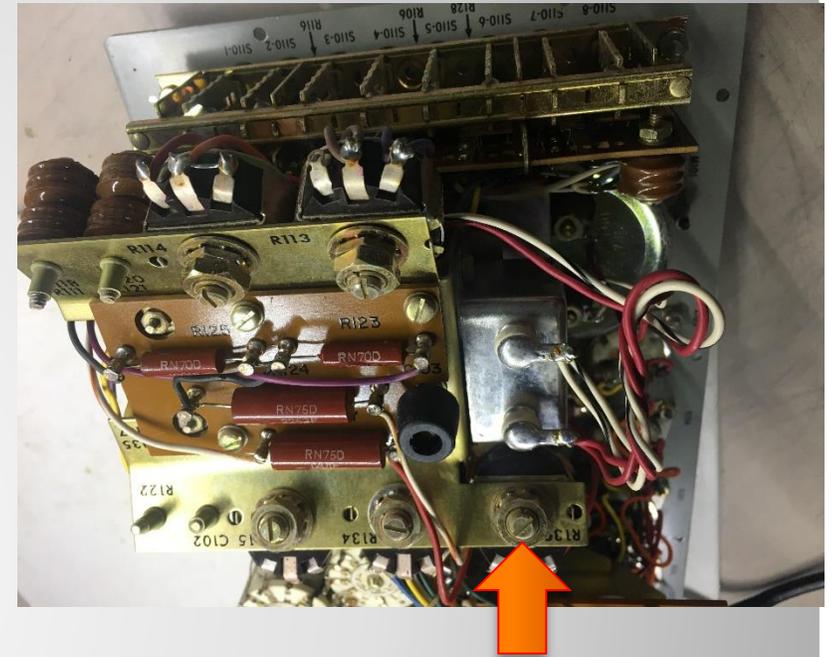
Gm Settings – Range C – 12AT7 Tube

- Set tester to test a 6L6 (Filament 6.3v, HS5-3481, Bias 23, Range D)
- Insert calibration 6L6 tube, let unit warm up a good 5-10 minutes
- Perform line set adjustment (button 1 & line adjust knob)
- Press 3 (Mut. Cond.) and adjust Bias until meter reads 40
- Change Range to E, reading should be between 20 and 22.



Gm Settings – Range E - 6L6 Tube

- Remove 6L6 tube from socket
- Set tester to test a 6L6 (Filament 6.3v, HS5-3481, Bias 23, **Range F**) Make sure to put on Range F
- Perform line set adjustment (button 1 & line adjust knob)
- Set bias meter to 75
- Adjust R139 for 2.7v DC across **Pins 8 & 5** on the octal socket



Gm Settings – Range F - No Tube

- Tighten all lock nuts on potentiometers, retest each associated tube setting following if needed
- Make sure all screws to sockets & others on faceplate are tight
- Ensure tube socket savers are all on tight
- When dropping unit back into cover, make sure not to pinch wires
- Indicate the calibration Date on the unit somewhere
- Enjoy your newly serviced and calibrated TV-7 tube tester
- Make a new set of calibration tubes and pass them along to a friend who has a TV-7

Wrap Up

- EB5AGV's TV-7 Tube Tester Page
 - <http://www.jvgavila.com/tv7.htm>
- Extensive TV-7 Tube Data Spreadsheet
 - http://www.antiqueairwaves.com/nlee/files/tv-7_097.xls
- Good source of TV-7 operators & service manuals
 - https://frank.pocnet.net/instruments/Military_us/TV7/TV7.html

Reference Material