TO-4 VOLTAGE & INSULATION RESISTANCE CALIBRATION

Before starting make sure the TO-4 is electrically safe and operating properly. These procedures are not intended to fix a TO-4 but calibrate a properly operating TO-4. The TO-4 uses a 5mA (25Ω) full scale meter. The VOLTAGE Control on the TO-4 sets the test voltage. With the Voltage Switch at 600V, the total resistance of R7-12k, R8-83k and R9-25k, which are in series with the meter, is 120k ohms. With 600 volts across 120k, the current draw is 5mA, full scale (600 Volts on meter). With the voltage switch at 60V only 12K resistor R7 is in series with the meter; 60 volts across 12k also results in 5mA of current flow. If C6-.0047µf is an original bumblebee I suggest you replace it or at least have a spare on hand. Sluggish meter movement while calibrating the INSULATION RESISTANCE function is a good indication of a leaky C6. Eric E. 2021.

Tools needed:

- SAFETY FIRST, there is 120 VAC and over 600 VDC exposed with the TO-4 out of the case and at times there is 600 VDC at the test terminals. If you do not have the proper training, PPE and tools to work around these voltages, please STOP here.
- Accurate High Impedance Voltmeter and Ohmmeter; VTVM or DMM recommended.
- At least one 1,000,000,000Ω precision resistor (2 or more is better). An alternate is a resistor out of a HV probe.
- Insulated shaft straight blade screwdriver, 5/32" tip x 6" shaft for adjusting R16.
- Accurate DC milliamp meter, 10mA and 100mA full scale. Simpson 260 or similar is perfect.
- 1.5k 2W resistor, 10% or even 20% is fine.

There is not any type of adjustment provided for the voltage calibration. The meter resistors must be very close tolerance.

ELECTROLYTIC LEAKAGE TEST (voltage) - CALIBRATION

- Observing correct polarity, connect a high impedance DC voltmeter capable of reading at least 650 volts to the test terminals.
- Set the TO-4 VOLTAGE switch to 600.
- Select ELECTROLYTIC LEAKAGE, Button B.
- While pressing Button A use the Voltage Control to increase the voltage until the TO-4 meter reads 600V, the reading on the external meter should also read 600V.
- Release Button A.
- Return the Voltage Control to OFF, fully CCW.
- Set the TO-4 VOLTAGE switch to 60.
- While pressing Button A use the Voltage Control to increase the voltage until the TO-4 meter reads 600V, the reading on the external meter should read 60V.

If the TO-4 is reading low, one or more of the metering resistors may have increased in value. If accurate at 60 volts but not at 600, R7 is probably within tolerance and only R8 and/or R9 need attention. Check all the metering resistors and replace or shunt the resistors as needed. Begin with R7 if it is out of tolerance since it will impact both ranges. If a resistor is within maybe +10% of the correct value, then shunting with a large value resistor(s) is an option.

NOTE: The TO-4 meter must be accurately calibrated for voltage before you can perform calibration of the TO-4 Insulation Resistance Test function.

INSULATION RESISTANCE TEST - CALIBRATION

- Make sure nothing is connected at the test terminals.
- Select INSULATION RESISTANCE, Button C.
- Rotate the VOLTAGE control until the meter reads SET.
- Connect a 1,000,000,000 resistor to the test terminals, the meter should read 1k Megohms.
- If not, adjust the front panel VOLTAGE control to get a 1k Megohm reading on the meter.

- Remove the resistor and use R16 to return the meter to SET.
- Connect the resistor again and note your reading.
- There is interaction between the controls you may need to do this a few times.
- After calibration, with two resistors, you can check the 500, 1k and 2k megohms points on the meter.

ELECTROLYTIC LEAKAGE CURRENT - CHECK The electrolytic leakage current circuit has three wirewound resistors R1, R2 and R10 which normally provide reliable service. You will need an accurate DC milliamp meter capable of accurately reading 3mA & 30mA plus a 1.5k 2W resistor.

NOTE: Make the tests quickly and return the Voltage Control to OFF as quickly as possible.

- Make sure the Voltage control is OFF, fully CCW.
- Set the ELECTROLYTIC LEAKAGE RANGE switch to 60 M.A.
- Set the VOLTAGE switch to 600 Volts.
- Observing correct polarity, connect the milliamp meter in series with the 1.5k 2W resistor, to the TO-4.
- Select ELECTROLYTIC LEAKAGE, Button B.
- Using the Voltage Control, increase the voltage until the TO-4 meter reads 300, the milliamp meter should read 30mA.
- Return the Voltage Control to OFF, fully CCW.
- Release the ELECTROLYTIC LEAKAGE button.
- Set the VOLTAGE switch to 60.
- Set the ELECTROLYTIC LEAKAGE RANGE switch to 6 M.A.
- Select ELECTROLYTIC LEAKAGE, Button B.
- Using the Voltage Control, increase the voltage until the TO-4 meter reads 300, the milliamp meter should read 3mA.
- Return the Voltage Control to OFF, fully CCW.
- Release the ELECTROLYTIC LEAKAGE button.