# Technical Service Bulletin 030524
# Adjustment of IOT Filaments

The correct IOT filament setting varies from unit to unit and is typically specified by the IOT manufacturer on the data sheet provided with the tube. Certain IOT manufacturers specify a certain operating voltage, while others specify a certain operating current.

As with any electron tube, it is a customary practice to slightly reduce IOT filament voltage/current to prolong tube life. Additionally, it is often necessary to reduce the filament voltage/current of a recently installed IOT during its first few months of operation to prevent negative grid current.

An IOT with excessive filament voltage/current will draw an excessive negative grid current. This is a sign that the filaments are too hot and emissive material is boiling off the cathode and landing on the grid, thereby causing it to emit electrons also. An IOT drawing more than –20mA negative grid current should have its filament voltage/current lowered as soon as conveniently possible.

An IOT with insufficient filament voltage/current will experience excessive peak signal compression. For a digital RF signal, this translates to an increase in adjacent channel sideband levels that are difficult to eliminate by nonlinear (LUT) precorrection (…because they are due to a lowered amplifier saturation power level).

Filament management, therefore, consists of always keeping filament voltage/current low enough to prevent excessive negative grid current and lowering the filament voltage/current, as desired, to prolong tube life until a point is reached where uncorrectable adjacent channel sideband levels are unacceptable.

The reader is invited to contact their tube manufacturer to obtain an official filament management procedure.

| Procedure 030524: Adjustment of IOT Filaments | |
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| Applicability | All IOX and DCX transmitters. |
| Prerequisites | None. |
| Equipment Required | Digital voltmeter. Precision current metering shunt or clamp on DC ammeter (25A). |
| Comments | Incorrect filament voltage will cause negative grid current (too high) or poor peak signal linearity performance (too low). |

**For tube types specifying IOT filament voltage. (E2V, L3)**

1. Press **HPA START MODE** button on HPA control panel to extinguish high voltage.

2. Allow high voltage to fall completely to zero.

3. Gain access to high voltage compartment via key interlock system.

4. Discharge all high voltage circuits with grounding hook.

5. Remove cover to gain access to IOT filament terminal connections in IOT junction box.

6. Measure IOT filament voltage with digital voltmeter across filament heater and cathode terminals in IOT junction box or across filament sense wires, where applicable.

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**NOTE:** There is a considerable voltage drop in the filament leads due to the high level of filament current flowing and non-zero filament lead resistance.  Accordingly, the filament voltage measurement should be made as close to the IOT filament terminals as possible.  Those tubes equipped with filament voltage sense wires are an exception (e.g. the E2V 3130).  When filament voltage sense wires are present, the measurement may be made where the sense wires return to the FBI supply.

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**WARNING:** There is 3kV present on ion pump lead (when installed).  Be careful to not inadvertently touch the ion pump lead while performing this measurement.
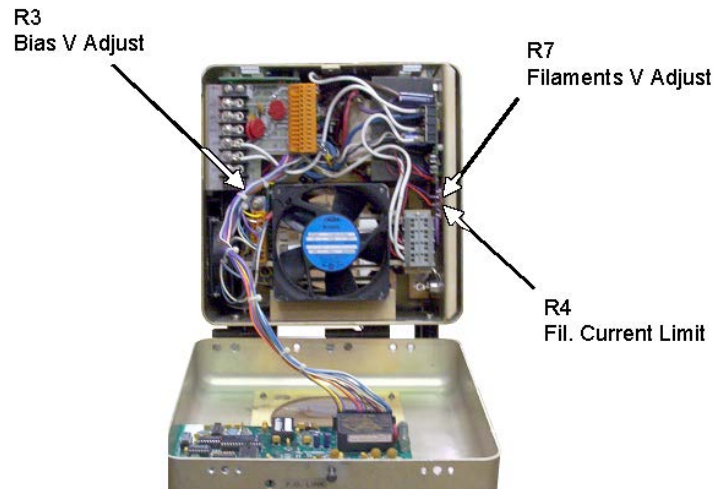
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7. Calibrate filament voltage meter, as necessary, by issuing following commands via HPA control panel:  **Information Access > System Operations > HPA Maintenance > Password = 55555 > Meter Calibrations > Filament, Bias, Ion > Filament > Voltage.**

8. Use **Up** and **Down** menu options to adjust displayed meter readings until correct value is obtained.  Press **Save** to save calibration and return to previous menu.

9. Select **Previous Menu** option five times to return to top-level **Information Access** menu.

10. For transmitters with type 46745360 Filament / Bias / Ion Supply (millennium style), adjust filament voltage to value specified by the IOT manufacturer by issuing following commands via HPA control panel:  **Information Access > Adjustments > Filament, Bias, Ion > Filament > Filament Voltage.**

11. Use **Up** and **Down** menu options to adjust filament voltage until satisfactory reading is obtained on HPA filament voltage meter.  Press **Save** to save filament voltage setting and return to previous menu.

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**NOTE:** The type 46745360 FBI supply will regulate to either the programmed current or voltage setting -- whichever is lower.  Accordingly, the filament current setting should be set to maximum (A) for those tubes designed to operate at a specified voltage.  Conversely, the voltage setting should be set to maximum (9V) for those tubes designed to operate at a specific filament current.

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12. For transmitters with type 405343-03 Filament / Bias / Ion Supply, adjust filament voltage to value specified by IOT manufacturer by rotating potentiometer R7 on filament regular PCB in filament / bias / ion supply.



13. For transmitters with type 405343-03 Filament / Bias / Ion Supply, adjust filament current limit to correct value by performing following steps:

    a. Consult tube data sheet for MAX filament current rating.

    b. Set R4 approximately to midrange position.

    c. With filaments completely cold, place HPA in START mode and observe filament current meter. As filaments start to warm up, current will increase. Adjust R4 to allow current to peak a few amperes below manufacturer MAX rating during warm up cycle. As tube continues to warm up, current should drop to normal operating point.

    d. Check that filament voltage is correct and readjust R7 slightly if necessary.

    e. Place HPA in STOP mode and allow ample time for filaments to cool down.

    f. Place HPA in START mode and observe filament voltage and current meters. Voltage and current should increase gradually, with current peaking at current limit set point (a few amperes below MAX limit). If filaments do not reach their normal operating point before a warm up timeout, it may be necessary to adjust R4 slightly clockwise to increase current limit set point and repeat procedure.

14. Restore equipment to original condition.

15. Procedure complete.

**For tube types specifying IOT filament current. (Thomson TED, CPI)**

1. Press **STOP MODE** on HPA control panel to extinguish high voltage and filament supply.

2. Allow high voltage to fall completely to zero.

3. Gain access to high voltage compartment via key interlock system.

4. Discharge all high voltage circuits with grounding hook.

5. Disconnect filament heater lead from output of filament / bias / ion supply.

6. Insert precision current metering shunt in series with filament heater lead.  A short, heavy-gauge jumper cable will be required to connect the precision current metering shunt to the output terminal on the filament / bias / ion supply. (See photo)
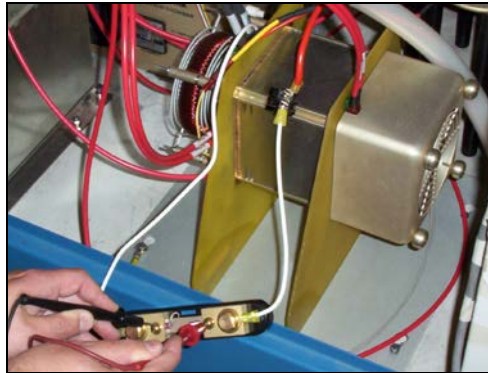


7. Press **HPA START MODE** button on HPA control panel to activate the filament supply.

8. Allow filaments to warm up for at least three minutes.

9. Measure voltage drop across precision current metering shunt with digital voltmeter. Apply appropriate multiplication factor, according to Ohms law, to convert voltage drop reading to throughput current reading ($I = V/R$).  Exact resistance value of shunt or V-A conversion factor should ideally be printed somewhere on shunt body.  (The typical shunt will read 50A/50mV, so a voltage reading of 10mV corresponds to 10A).

10. Calibrate filament current meter, as necessary, by issuing following commands via HPA control panel:  **Information Access > System Operations > HPA Maintenance > Password = 55555 > Meter Calibrations > Filament, Bias, Ion > Filament > Current.**

11. Use **Up** and **Down** menu options to adjust displayed meter readings until correct value is obtained.  Press **Save** to save calibration and return to previous menu.

12. Select **Previous Menu** option five times to return to top-level **Information Access** menu.

> **NOTE:** It may also be possible to calibrate the filament current reading with a trustworthy clamp-on DC ammeter. However, Comark strongly recommends that the accuracy of the clamp-on ammeter be checked at least once against the procedure given here.
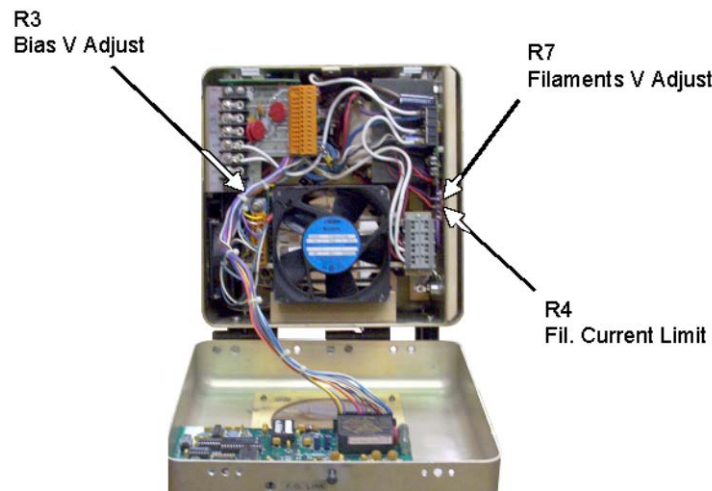
13. For transmitters with type 46745360 Filament / Bias / Ion Supply (millennium style), adjust filament current to value specified by the IOT manufacturer by issuing following commands via HPA control panel: **Information Access > Adjustments > Filament, Bias, Ion > Filament > Filament Current.**

14. Use **Up** and **Down** menu options to adjust filament current until satisfactory reading is obtained on HPA filament current meter. Press **Save** to save filament current setting and return to previous menu.

> **NOTE:** The type 46745360 FBI supply will regulate to either the programmed current or voltage setting -- whichever is lower. Accordingly, the filament current setting should be set to maximum (30A) for those tubes designed to operate at a specified voltage. Conversely, the voltage setting should be set to maximum (9V) for those tubes designed to operate at a specific filament current.

15. For transmitters with type 405343-03 Filament / Bias / Ion Supply, adjust filament current to value specified by IOT manufacturer by rotating <u>voltage set potentiometer R7</u> on filament regulator PCB in filament / bias / ion supply.



16. For transmitters with type 405343-03 Filament / Bias / Ion Supply, adjust filament current limit to correct value by performing following steps:

    a. Consult tube data sheet for MAX filament current rating.

    b. Set R4 approximately to midrange position.

    c. With filaments completely cold, place HPA in START mode and observe filament current meter. As filaments start to warm up, current will increase. Adjust R4 to allow current to peak a few amperes below manufacturer MAX rating during warm up cycle. As tube continues to warm up, current should drop to normal operating point.

    d. Check that filament voltage is correct and readjust R7 slightly if necessary.

    e. Place HPA in STOP mode and allow ample time for filaments to cool down.

    f. Place HPA in START mode and observe filament voltage and current meters. Voltage and current should increase gradually, with current peaking at current limit set point (a few amperes below MAX limit). If filaments do not reach their normal operating point before a warm up timeout, it may be necessary to adjust R4 slightly clockwise to increase current limit set point and repeat procedure.

16. Restore equipment to original condition.

17. Procedure complete.

Here at Comark Communications, we are constantly striving to improve the satisfaction of both our new and existing customers. Please do not hesitate to contact Comark Customer Service with any questions you may have concerning the contents of this service bulletin.

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