Technical Service Bulletin 031211

Calibration of IOT Filament, Bias, and Ion Sensors: DCX Paragon

This bulletin discusses the calibration of the various metering readings associated with the filament / bias / ion (FBI) supply. Maintaining a proper calibration of the meters discussed in this bulletin is essential to obtaining good performance and long life from the IOT.

The **filament current and voltage** meters measure the filament power being supplied to the cathode heater inside the IOT. The IOT cathode must operate at the proper temperature (heating power) to emit electrons properly (to form the beam). If the cathode is too cold, the IOT may not have enough emission to support the highest levels of beam current, resulting in excessive peak signal compression and the inability to meet the adjacent channel sideband mask. If the cathode is too hot, it may boil off its emissive material. This material can settle on the nearby grid, thereby causing grid emission.

The **grid current** meter measures the current intercepted or emitted by the IOT grid electrode. Positive grid current typically indicates that the IOT grid is intercepting beam current because it is being overdriven (grid is swinging positive) or has suffered an internal mechanical deformation (end of life IOT). Negative grid current typically indicates that the IOT is emitting electrons because it has become contaminated with emissive material boiled off of the cathode. This is a sign of excessive filament voltage.

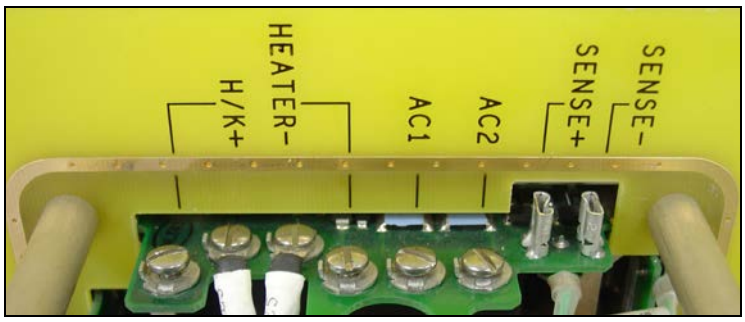
The correct calibration of the **grid voltage** meter is essential for monitoring the bias operating point of the IOT (idle current level).

The IOT ion pump uses an electrode charged to +3.5kV by an external power supply to trap charged gas molecules and maintain the IOT vacuum. A non-zero **ion current** indication reveals that gas molecules are being intercepted by the ion pump (i.e. there is gas inside the IOT). When sufficient gas is present, an ionization path will form and the IOT will arc internally.

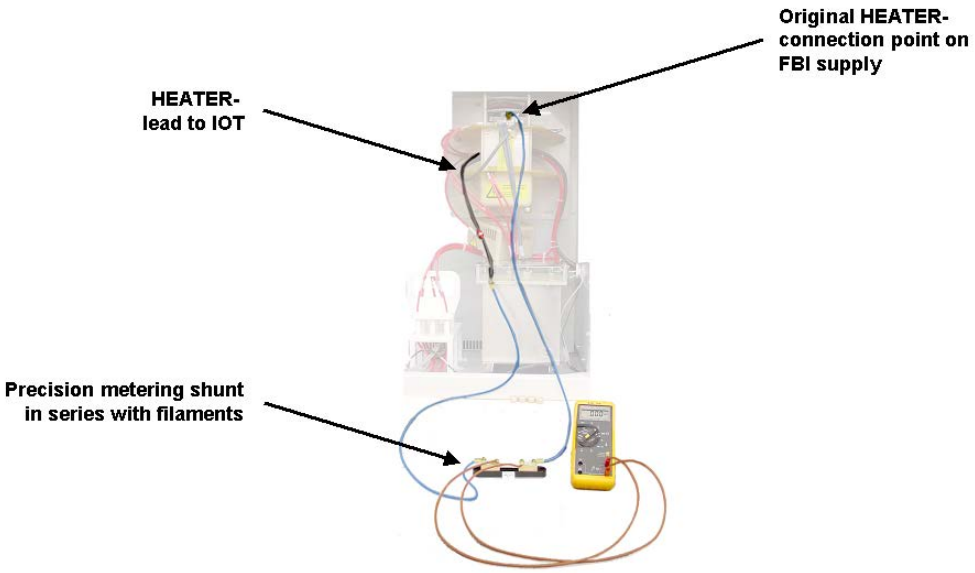
Procedure 031211: Calibration of IOT Filament, Bias, and Ion Sensors	
Applicability	DCX Paragon transmitters.
Prerequisites	Correct meter calibrations (031209).
Equipment Required	Precision current metering shunt (50A), Multimeter, High voltage probe, 1000Ω (5W minimum) resistor or load.
Comments	Type 46745361 Filament / Bias / Ion Supply.

Filament Current Sensor Calibration

1. Place amplifier cabinet in **STOP** mode, let high voltage drop off, and place ground switch in ground position using key interlock system.
2. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.
3. Open high voltage compartment using HV ENCLOSURE ACCESS key.
4. Ground all areas inside high voltage compartment with grounding hook. Leave grounding hook in contact with Filament / Bias / Ion (FBI) supply case while working on it.
5. Remove cover to FBI supply and locate "HEATER -" lead.



6. Insert precision current metering shunt in series with filament "HEATER -" lead. Heavy-gauge jumper cables will be required to connect precision current metering shunt to output terminal on FBI supply.



NOTE: Ready-made metering shunt & harness assembly shown here is available from Comark. Request part number 412828-01.

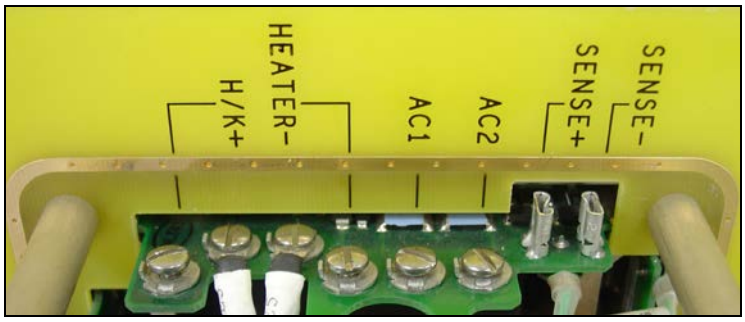
7. Return Filament / Bias / Ion breaker (CB8) to ON position.
8. Select **Filament** option on front panel current meter to obtain reading of filament current.
9. Navigate to filament metering calibration menus via following sequence of buttons on LCD screen: Information Access > **System Operations > HPA Maintenance > Sensor Calibration > Filament, Bias, Ion > Filament > Current > Offset.** Default technician password is 4444.
10. Use **Up** and **Down** menu options to adjust reading to exactly zero. Press **Ok** to save setting and return to previous menu.

NOTE: Do not go "past" zero. Continuing to press the down button will not physically drive the reading below zero, but the zero calibration factor will continue to decrease, thereby creating the potential for metering inaccuracy.

11. Place amplifier cabinet in **STANDBY** mode to activate filament supply.
12. Allow filaments to warm-up for approximately three minutes (filament timer should appear on LCD screen).
13. 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. (Typical shunt will read 50A/50mV, so a voltage reading of 10mV corresponds to 10A).
14. Press **Scale** menu option. Meter will move to a value. Use keypad to match reading on cabinet meter to current computed from voltmeter reading of shunt. Once proper meter reading is obtained, press **Ok** to save setting and return to previous menu.
15. Place amplifier cabinet in **STOP** mode to deactivate filament supply.
16. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.
17. Restore equipment to original condition.
18. Procedure complete.

Filament Voltage Sensor Calibration

1. Place amplifier cabinet in **STOP** mode, let high voltage drop off, and place ground switch in ground position using key interlock system.
2. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.
3. Open high voltage compartment using HV ENCLOSURE ACCESS key.
4. Ground all areas inside high voltage compartment with grounding hook. Leave grounding hook in contact with Filament / Bias / Ion (FBI) supply case while working on it.
5. Remove cover to FBI supply and locate "SENSE +" and "SENSE -" (filament voltage sense) terminals.



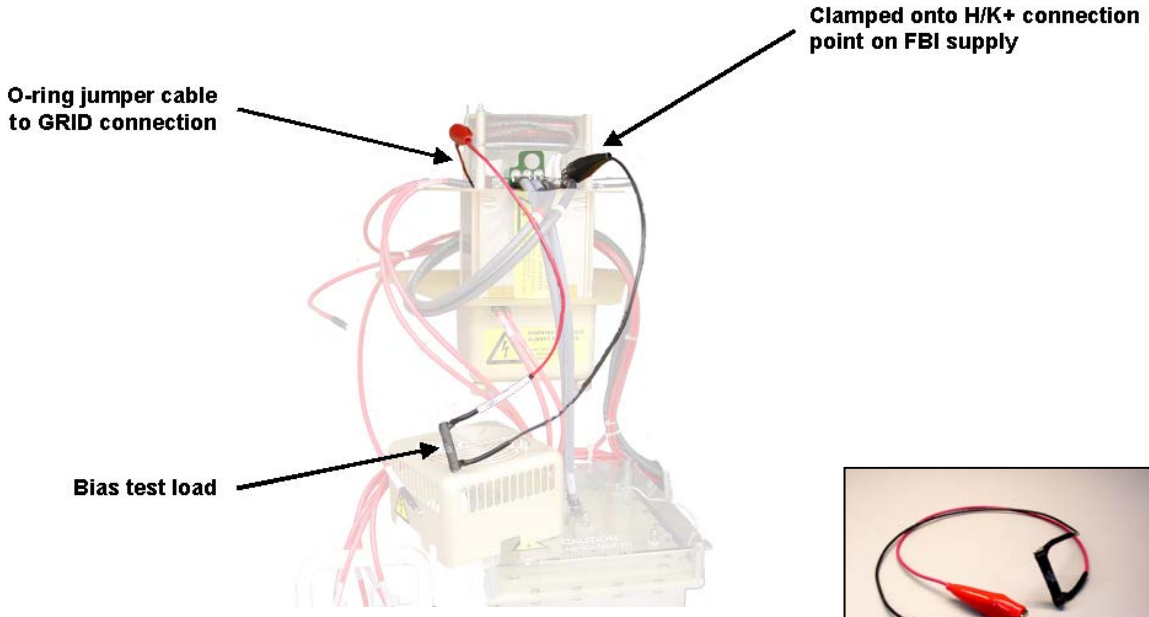
6. Return Filament / Bias / Ion breaker (CB8) to ON position.
7. Select **Filament** option on front panel voltage meter to obtain reading of filament voltage.
8. Navigate to filament metering calibration menus via following sequence of buttons on LCD screen: **Information Access > System Operations > HPA Maintenance > Sensor Calibration > Filament, Bias, Ion > Filament > Voltage > Offset.** Default technician password is 4444.
9. Use **Up** and **Down** menu options to adjust reading to (exactly) zero. Press **Ok** to save setting and return to previous menu.
10. Place amplifier cabinet in **STANDBY** mode to activate filament supply.
11. Allow filaments to warm-up for approximately three minutes (filament timer should be on LCD screen).
12. Measure voltage across SENSE + and SENSE - terminals on FBI supply with voltmeter.
13. Press **Scale** menu option. Meter will move to a value. Use keypad to match reading on cabinet meter to voltage on voltmeter. Once proper voltage is obtained, press **Ok** to save setting and return to previous menu.
14. Place amplifier cabinet in **STOP** mode to deactivate filament supply.
15. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.

16. Restore equipment to original condition.
17. Procedure complete.

Grid Bias Sensors Calibration

1. Place amplifier cabinet in **STOP** mode, let high voltage drop off, and place ground switch in ground position using key interlock system.
2. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.
3. Open high voltage compartment using HV ENCLOSURE ACCESS key.
4. Ground all areas inside high voltage compartment with grounding hook. Leave grounding hook in contact with Filament/Bias/Ion (FBI) supply case while working on it.
5. Remove cover to FBI supply and locate "GRID" terminal connection.
6. Disconnect lead from GRID terminal connection.
7. Attach 1000Ω (10W minimum) resistor load from "H/K+" to "GRID" terminals on FBI supply. Do not leave H/K+ lead to IOT disconnected. It may be necessary to fabricate a spade-lug Y adapter to allow the 1000Ω load and H/K+ leads to be simultaneously connected to the H/K+ terminal on the FBI supply.

CAUTION: The filament portion of the FBI supply must be properly loaded at all times. Do not operate the FBI supply with the H/K+ and HEATER- leads removed, as this will break the filament circuit and possibly damage the filament supply.



NOTE: Ready-made grid dummy load assembly shown here is available from Comark. Request part number 453256-01. A short O-lug jumper cable is included for connection to recessed GRID connection. O-lugs are smaller than grid output lug-sleeve, so as to not stretch sleeve and cause intermittent connection when regular bias lead is reconnected. Some mechanical deformation of jumper O-lug (pre-bending or twisting) may be required to permit a reasonably tight connection to older (stretched open) output lug-sleeves.

8. Return Filament / Bias / Ion breaker to ON position.
9. Select **Bias** option on front panel voltage meter to obtain reading of bias voltage.
10. Navigate to bias metering calibration menus via following sequence of buttons on LCD screen: **Information Access > System Operations > HPA Maintenance > Sensor Calibration > Filament, Bias, Ion > Bias > Voltage > Offset.** Default technician password is 4444.
11. Use **Up** and **Down** menu options to adjust reading to exactly zero. Press **Ok** to save setting and return to previous menu.

NOTE: Do not go "past" zero. Continuing to press the down button will not physically drive the reading below zero, but the zero calibration factor will continue to decrease, thereby creating the potential for metering inaccuracy.

12. Place amplifier cabinet in **STANDBY** mode to activate bias supply.
13. Measure voltage across 1000Ω resistor load with voltmeter (or GRID and H/K+ terminals).
14. Press **Scale** menu option. Meter will move to a value. Use keypad to match reading on cabinet meter to voltage measured on voltmeter. Once proper voltage reading is obtained, press **Ok** to save setting and return to previous menu.
15. Continue with bias current sensor calibration menu by returning to **STOP** mode and selecting **Current > Offset** on LCD screen.
16. Use **Up** and **Down** menu options to adjust reading to (exactly) zero. Press **Ok** to save setting and return to previous menu.
17. Return amplifier to **STANDBY** mode to activate bias supply.
18. Press **Scale** menu option. Meter will move to a value that is approximately the bias voltage (from previous steps) divided by 1000. (e.g. 88V bias voltage should draw 88mA bias current, 120V bias voltage should draw 120mA bias current, etc.)
19. Use keypad to match reading on cabinet meter to calculated [bias voltage/1000] value. Once proper current reading is obtained, press **Ok** to save setting and return to previous menu.
20. Place amplifier cabinet in **STOP** mode to extinguish bias supply.

21. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.
22. Restore equipment to original condition.

WARNING: Bias test load may be HOT. Use caution while removing test load.

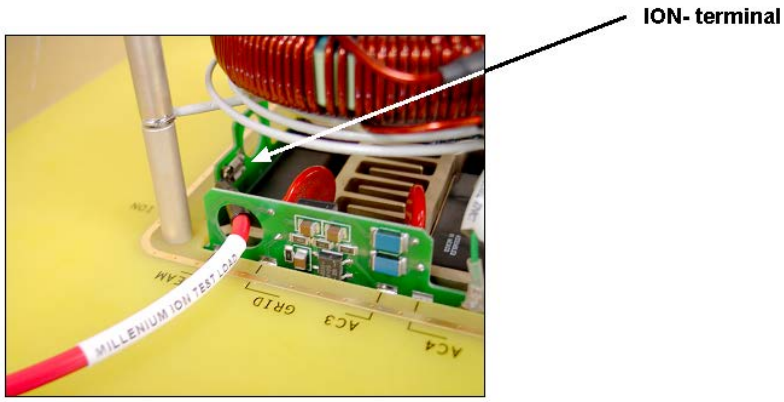
23. Procedure complete.

Ion Sensors Calibration

WARNING: This procedure involves potentially dangerous high voltages. It is critical that proper high voltage safety procedures be employed at all times. Do not attempt this procedure without a second person present. Do not attempt this procedure while tired or otherwise not fully alert. Always use the transmitter grounding hook to properly ground all high voltage circuits before attempting to touch them. Consult Service Bulletin 940911 for information on proper high voltage safety procedures.

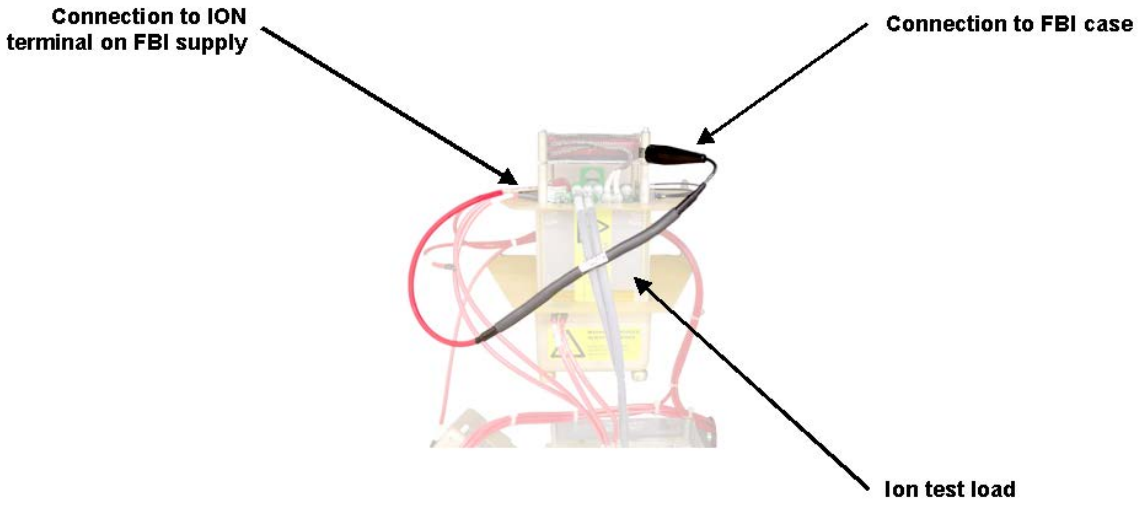
WARNING: A suitable high voltage probe and multimeter combo must be used to measure the ion pump supply voltage. This voltage is nominally 3.5kV and is measured directly with the probe by the operator. Care must be taken to ensure the safety of the operator and any assistants.

1. Place amplifier cabinet in **STOP** mode, let high voltage drop off, and place ground switch in ground position using key interlock system.
2. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.
3. Open high voltage compartment using HV ENCLOSURE ACCESS key.
4. Ground all areas inside high voltage compartment with grounding hook. Leave grounding hook in contact with Filament / Bias / Ion (FBI) supply case while working on it.
5. Remove cover to FBI supply and locate "ION -" terminal connection.



6. Install 70 Mohm ion test load fixture from "ION -" terminal to case of FBI supply (see photo). Ion test load fixture is a series string of 7 x 10 Mohm resistors with spade lug on one end and alligator clip on opposite end.

NOTE: Ready-made 70 Mohm ion dummy load assembly shown in photo is available from Comark. Request part number 453254-01.



7. Return Filament / Bias / Ion breaker to ON position.
8. Select **Ion** option on front panel voltage meter to obtain reading of ion pump voltage.
9. Navigate to ion metering calibration menus via following sequence of buttons on LCD screen: **System Operations > HPA Maintenance > Sensor Calibration > Filament, Bias, Ion > Ion > Voltage > Offset.** Default technician password is 4444.

10. Use **Up** and **Down** menu options to adjust reading to exactly zero. Press **Ok** to save setting and return to previous menu.

NOTE: Do not go "past" zero. Continuing to press the down button will not physically drive the reading below zero, but the zero calibration factor will continue to decrease, thereby creating the potential for metering inaccuracy.

11. Connect HV probe ground lead to case of FBI supply.
12. Place amplifier cabinet in **STANDBY** mode to activate ion supply.
13. Carefully touch high voltage probe tip to ION - terminal on FBI supply. Read ion pump voltage on voltmeter, applying appropriate probe conversion factor as necessary. Note reading, and set high voltage probe aside.

WARNING: 3500 volts present on ION- terminal. Exercise caution.

14. Press **Scale** menu option. Meter will move to a value. Use **Up** and **Down** menu options to change ion voltage meter reading to level measured with high voltage probe.
15. Press **Ok** button to save ion voltage calibration setting and return to previous menu.
16. Place amplifier cabinet in **STOP** mode to deactivate ion supply.
17. Select **Ion** option on front panel current meter to obtain reading of ion pump current.
18. Continue with ion current sensor calibration menu by selecting **Current > Offset** on LCD screen.
19. Use **Up** and **Down** menu options to adjust reading to (exactly) zero. Press **Ok** to save setting and return to previous menu.
20. Place amplifier cabinet in **STANDBY** mode to reactivate FBI supply.

WARNING: 3500 volts present on ION- terminal. Exercise caution.

21. Press **Scale** menu option on LCD screen. Meter will move to a value close to 50uA for a 3500V ion voltage.
22. Calculate anticipated ion current level according to 70 Mohm load resistance value and Ohm's law (e.g. 3500V / 7 Mohm = 50uA).
24. Use **Up** and **Down** menu options until ion current meter reading agrees with anticipated ion current level. Once proper current reading is obtained, press **Ok** to save setting and return to previous menu.
25. Place amplifier cabinet in **STOP** mode to deactivate ion pump supply.
23. Place Filament / Bias / Ion circuit breaker (CB8) on transmitter front panel in OFF position.
26. Restore equipment to original condition.

27. Procedure complete.

At Comark, 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.

Comark Communications
104 Feeding Hills Road
Southwick, MA 01077 U.S.A.
(800) 345-9295
http://www.comarktv.com