TROUBLESHOOTING GUIDE: E34 – IPM OVERLOAD ERROR

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PRELIMINARY INFORMATION:

Process:

- Follow the step-by-step instructions until the faulty component is found.

Tools Required (No further assistance will be provided if these tools are not available):

- A **known good** set of HV cables
- True RMS Multimeter with the following capabilities (recommend Fluke 83, 87, 89, 175, 177, 179, 187, 189, 287 or 289):
  - Auto-Ranging
  - Min/Max Mode
  - Ohm
  - VDC
  - VAC
  - AmpDC
  - AmpAC
  - Frequency (Hz)
- Jumper wires [Alligator clips, and Mini-grabbers (ex. Pomona 5523)]
- An ESD wrist strap
- Stopwatch (or equivalent APP on phone)
- A tablet with picture and email capability [or a laptop (for emails) and phone (for pictures)]

Tools Optional (May be required if testing below does not find issue):

- Digital Storage Oscilloscope
- mAs meter

Minimum FSE (Field Service Engineer) knowledge base:

- Must have already read the manual and is familiar with all the safety precautions.
- Multimeter operation with the following:
  - Range
  - Ohms, KOhms, MOhms (and know the multi-meter message for Open Circuit and Short Circuit)
  - Amps, mAmps
  - Volts, mVolts

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TROUBLESHOOTING INSTRUCTIONS:

1. **Check basic connections (with generator OFF)**
   a. K904 Connections: See Service Manual sections 2.5.3 and 2.10.2
   b. Incoming Line voltage: See Service Manual section 2.10.3
   c. Accessory Transformer: See Service Manual section 2.10.4
   d. Main GND: See Service Manual section 2.10.5

2. **Check DIP SWITCHES on System Controller Board (with generator OFF and FSE grounded with ESD strap)**
   a. **DIP1**:
      i. **-1**, **-2**, **-3**, **-5**, **-6**, **-7**, **-8** must be OPEN/OFF/LEFT
      ii. **-4** must be CLOSED/ON/RIGHT
   b. **DIP3**:
      i. **300mA** Generator: **-1** & **-2** must be OPEN/OFF/LEFT
      ii. **500mA** Generator: **-1** & **-2** must be CLOSED/ON/RIGHT
      iii. **-3** & **-4** must be OPEN/OFF/LEFT

3. **Check for loose components/connections (with generator OFF and FSE grounded with ESD strap)**
   a. System Controller Board (01003, 01700 or 08020):
      i. Push in U24, U33, U13, U17 chips if IC sockets employed.
      ii. Remove and reseat all connectors. Tighten wires at connectors, if needed.
      iii. Be sure to apply pressure on the back of all ribbon cable connectors.
   b. Filament Driver Board (02850):
      i. Remove and reseat all connectors. Tighten wires at connectors, if needed.
      ii. Be sure to apply pressure on the back of the ribbon cable connector.
   c. IPM Driver Boards (2x 01780):
      i. Remove and reseat all connectors. Tighten wires at connectors, if needed.
      ii. Be sure to apply pressure on the back of the ribbon cable connector.

4. **Check kV/mA feedback circuit (with generator OFF and FSE grounded with ESD strap)**
   a. Check the Feedback Cable (00510-000) and HV Tank (K904-*):
      i. Disconnect **H9** from the System Controller Board.
      ii. At **H9** cable end, verify resistance from pin **1** to pin **3** to be **9.0-12.0 KOhms**.
      iii. At **H9** cable end, verify resistance from pin **2** to pin **3** to be **9.0-12.0 KOhms**.
      iv. At **H9** cable end, verify resistance from pin **5** to pin **4** to be **66.8-69.5 Ohms.**
      v. At **H9** cable end, verify resistance from pin **6** to pin **4** to be **66.8-69.5 Ohms.**
      vi. If any of the values are incorrect, the Feedback Cable or the HV Tank is defective.
      vii. Verify the continuity of the **Feedback Cable** (00510-000) & replace if defective.
      viii. If the Feedback Cable is in good condition, replace the **HV Tank** (K904-*).
   b. Check the System Controller Board (01003, 01700 or 08020):
      i. Keep **H9** cable disconnected from the System Controller Board.
      Note: If your meter can't read these resistances, you may need a better meter.
      ii. At **H9** header of System Controller Board:
      Verify resistance from pin **1** to pin **3** to be **254-284 KOhms**.
      iii. At **H9** header of System Controller Board:
      Verify resistance from pin **2** to pin **3** to be **209-231 KOhms**.

iv. At **H9** header of System Controller Board:
Verify resistance from pin **5** to pin **4** to be **102-114 KOhms**.
v. At **H9** header of System Controller Board:
Verify resistance from pin **6** to pin **4** to be **181-203 KOhms**.
vi. If any of the values are incorrect, replace **System Controller Board** with **Kit 06357-***.
vii. Reconnect **H9** cable to System Controller Board.

5. **Check Capacitor C7 and IPM Block for Shorts (with generator OFF)**
WARNING: Make sure generator has been **OFF** for at least **20** minutes.
a. Capacitor C7 (L297-00 or HAT26)
i. Verify resistance across capacitor **C7** (located right below the K660 Relay Board) to be **> 10 Ohms**.
ii. If the resistance is out of range, **C7** is shorted and needs to be replaced.
- For 208-277VAC Generators: Replacement part is L297-00
- For 416-480VAC Generators: Replacement part is HAT26
b. IPM Blocks (06056)
i. On top of the Left IPM, verify resistance from each of the DC Bus Bars to the 3rd terminal (C2E1) of the IPM to be **> 100 Ohms**.
ii. If the resistance is out of range, the **Left IPM** (06056) needs to be replaced.
iii. On top of the Right IPM, verify resistance from each of the DC Bus Bars to the 3rd terminal (C2E1) of the IPM to be **> 100 Ohms**.
iv. If the resistance is out of range, the **Right IPM** (06056) needs to be replaced.

6. **Check voltages in idle (with generator ON, be careful not to cause any short circuit)**
a. System Controller Board (01003, 01700 or 08020)
i. Connect VDC meter Black (-) to TP2 (GND), RED (+) to TP3 (+12V).
Verify voltage to be: **11.4VDC to 12.8VDC**
If out of range, check Power Supply Board **K650-00**, fuse **F4** and cables.
ii. Connect VDC meter Black (-) to TP2 (GND), RED (+) to TP6 (-12V).
Verify voltage to be: **-11.4VDC to -12.8VDC**
If out of range, check Power Supply Board **K650-00**, fuse **F5** and cables.
iii. Connect VDC meter Black (-) to TP2 (GND), RED (+) to TP1 (+5V).
Verify voltage to be: **4.9VDC to 5.1VDC**
If out of range, check Power Supply Board **K650-00**, fuse **F4** and the +5VDC Power Supply Board **04260** (if present).
b. Filament Driver Board (02850)
i. Connect VDC meter Black (-) to TP3 (PCOM), RED (+) to TP2 (PVOLT).
Verify voltage to be: **14.2VDC to 15.8VDC**
ii. Connect VDC meter Black (-) to TP5 (NCOM), RED (+) to TP4 (NVOLT).
Verify voltage to be: **14.2VDC to 15.8VDC**
iii. Connect VDC meter Black (-) to TP1 (GND), RED (+) to TP11 (+12VDC).
Verify voltage to be: **11.4VDC to 12.8VDC**
iv. Connect VDC meter Black (-) to TP1 (GND), RED (+) to TP12 (-12VDC).
Verify voltage to be: **-11.4VDC to -12.8VDC**
v. If any value is out of range, replace **Filament Driver Board** with **Kit 03035-***.
c. IPM Driver Board (01780), Left Side
i. Connect VDC meter Black (-) to TP12 (PCOM), RED (+) to TP14 (PVOLT).
Verify voltage to be: **14.2VDC to 15.8VDC**
ii. Connect VDC meter Black (-) to TP8 (NCOM), RED (+) to TP9 (NVOLT).
Verify voltage to be: **14.2VDC to 15.8VDC**

iii. Connect VDC meter Black (-) to TP6 (GND), RED (+) to TP2 (+5VDC). Verify voltage to be: **4.7VDC to 5.1VDC**
iv. If out of range, the Left **01780** Board needs to be replaced.

d. IPM Driver Board (01780), Right Side
i. Connect VDC meter Black (-) to TP12 (PCOM), RED (+) to TP14 (PVOLT). Verify voltage to be: **14.2VDC to 15.8VDC**
ii. Connect VDC meter Black (-) to TP8 (NCOM), RED (+) to TP9 (NVOLT). Verify voltage to be: **14.2VDC to 15.8VDC**
iii. Connect VDC meter Black (-) to TP6 (GND), RED (+) to TP2 (+5VDC). Verify voltage to be: **4.7VDC to 5.1VDC**
iv. If out of range, the Right **01780** Board needs to be replaced.

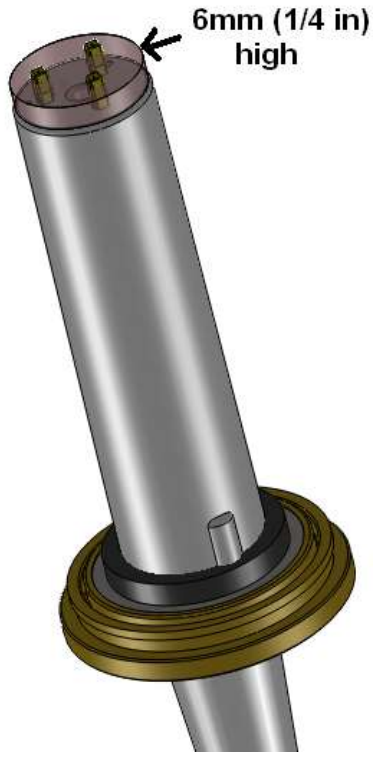
7. Check for HV breakdown in HV Tank or HV Cables

a. Setup generator for **High Pot Mode**:
i. Shut off generator.
ii. Set DIP1-3 to CLOSED/ON/RIGHT.
iii. Set DIP1-4 to CLOSED/ON/RIGHT.
iv. Set DIP1-5 to CLOSED/ON/RIGHT.
v. Turn on generator. Select LG focus and 200mAs.

b. Is there a HV breakdown in the system?
i. Leave all HV cables connected.
ii. Take exposures at 50kV, 60kV, 70kV, 80kV, 90kV, 100kV, 110k, 125kV. If an error occurs at any kV, **go to step 7.c** to find where the HV breakdown is.
iii. If NO error, **go to step 8**.

c. Check if HV breakdown is in the HV Tank.
WARNING: This test is considered dangerous to FSE and generator. Any damage to the generator due to negligence will not be covered under warranty.
i. Shut off generator.
ii. Remove **both** HV cables from the HV Tank.
iii. Fill up the receptacles in the HV Tank (3-6 mm,1/8-1/4 inch **from top of lid**) with HV oil. The oil can be borrowed from HV Tank vent using a syringe or turkey baster.
iv. Turn on generator. Select LG focus and 200mAs.
v. Take exposures at 50kV, 60kV, 70kV, 80kV, 90kV, 100kV, 110k, 125kV. If an error occurs at any kV, the **HV Tank** (K904-*) needs to be replaced.
vi. Remove oil from receptacles and place back to where it was borrowed from.
vii. If error occurred, **go to step 7.e** and **STOP**.
viii. If NO error, the HV breakdown may be in the HV cables or X-ray tube. **Go to step 7.d** to narrow down where the breakdown is.

d. Check if the HV breakdown is in the HV cables.
i. Shut off generator.
ii. Install a known good set of HV cables into system.
1. High Voltage Tank
a. Make sure there is at least 6 mm (1/4 inch) of oil in each of the HV Tank's receptacles.
b. Make sure the receptacles are all the way in. High current passes through the pins and they must be seated properly to prevent arcing.
2. X-ray Tube
a. Clean out the receptacles with alcohol, then apply grease as indicated below:



b. Make sure the HV cable plugs are all the way in. High current passes through the pins and they must be seated properly to prevent arcing.
c. Use the setscrew located on top of the brass ring to assist in forcing the plugs in all the way. This is done by tightening and loosening the screw, then hand turn the ring. Repeat process until plugs are fully seated.

iii. Leave both the Anode and Cathode HV cables connected to the HV Tank and X-ray Tube.
iv. Turn on generator. Select LG focus and 200mAs.
v. Take exposures at 50kV, 60kV, 70kV, 80kV, 90kV, 100kV, 110k, 125kV.
vi. If NO error, the **HV cables** need to be replaced.
vii. If error occurred, the **X-ray tube** may need to be replaced.
At this point, contact Summit Technical Support Team for additional guidance before condemning the tube.

e. Set generator for normal operation:
i. Shut off generator.
ii. Reconnect HV cables.
iii. Set DIP1-3 to OPEN/OFF/LEFT.
iv. Set DIP1-4 to CLOSED/ON/RIGHT.
v. Set DIP1-5 to OPEN/OFF/LEFT.

8. Low power check (using 50mA)

a. Setup generator:
i. Shut off generator.
ii. Set DIP1-3 to OPEN/OFF/LEFT.
iii. Set DIP1-4 to CLOSED/ON/RIGHT.

iv. Set DIP1-5 to CLOSED/ON/RIGHT.

b. Check mA on System Controller Board (01003, 01700 or 08020):
   i. Connect VDC meter Black (-) to TP2 (GND), RED (+) to TP9 (mA).
   ii. Set meter range to 0.000 Volts DC.
   iii. Set meter to Max mode.
   iv. Turn on generator and select 50kV, 15mAs, 50mA SM. Take an exposure.
   v. If error occurred, remove meter and **go to step 9**.
   vi. If NO error, then verify meter displays:
   - For 300mA generators: 0.50VDC ±20% (0.40 to 0.60VDC)
   - For 500mA generators: 0.33VDC ±20% (0.26 to 0.40VDC)
   - If mA is out of range, replace **System Controller Board** with **Kit 06357-***.
   - If mA is within range, remove meter and **go to step 10**.

9. Check Main Inverter (IPM) circuit

a. Setup generator for troubleshooting:
   i. Set DIP1-4 to OPEN/OFF/LEFT.
   ii. Set DIP1-5 to CLOSED/ON/RIGHT.

b. Set generator to 50kV, 15mAs, 50mA.
   NOTE: If the generator produces error E71 (for 2PT) or "mA FEEDBACK DISABLED" (for AP) at the end of an exposure, simply press any button (for 2PT) or RESET button (for AP) to clear the error and continue with these tests.

c. Disconnect H4 on System Controller Board. Take an exposure, then reconnect H4.
   i. If error occurred, **go to step 9.d**.
   ii. If NO error, **go to step 9.e**.

d. Disconnect H3 on System Controller Board. Take an exposure, then reconnect H3.
   i. If error occurred, **go to step 10**.
   ii. If NO error, **go to step 9.e**.

e. There might be a problem with the IPM circuit, continue to narrow down the culprit.

f. Check for Shorted IPM Circuit.
   i. Find side with trouble:
      1. Disconnect H4 ribbon cable from System Controller Board (controls left IPM circuit). Take an exposure.
      2. If E34 goes away, that indicates something is **BAD on the Left side**.
      3. If E34 persists, that indicates something is **BAD on the Right side**.
      4. Note the side of the failure (Left or Right).
      5. Place pieces of tape on components of the failing side (to keep track for next steps): The IPM block, IPM Driver Board's transformer, IPM driver cable (at the IPM Driver Board).
   ii. Check if it is a bad IPM cable:
      1. Exchange the left and right IPM cables at the IPM Driver Boards.
      2. **Repeat step 9.f.i** and note the side of the failure (Left or Right).
      3. If the failing side changed (ex. Left changed to Right), then the **cable with the tape** needs to be replaced (Left cable is L235, Right cable is L233).
      4. If the failing side stayed the same, then it is the IPM Driver Board or the IPM block.
      5. Put cables back to their original position.
   iii. Check if it is a bad IPM Driver Board (01780) or the IPM block (06056):
      1. Discharge DC BUS.

a. **WARNING**: Dangerous voltages on Bus Bars (280-700VDC). You must discharge DC Bus before proceeding.
b. Disconnect the ribbon cable (H3 or H4) that will allow for x-ray (make the error go away).
c. Set DIP1-2 to CLOSED/ON/RIGHT (to discharge DC Bus).
d. Set technique to 66kV,100mAs.
e. Take 4 exposures. Make sure DC bus is < 5VDC. If DC bus is not < 5VDC, then shut off generator and wait 20 minutes for the bus to naturally discharge.
f. Set DIP1-2 to OPEN/OFF/LEFT (for normal operation).

2. Shut off generator.
3. Shut off the circuit breaker powering the generator. Voltage at main fuses **F1** and **F2** must be **0VAC**! Again, verify DC bus is < 5VDC.
4. Exchange the Left and Right IPM Driver Boards.
5. **Repeat step 9.f.i** and note the side of the failure (Left or Right)
6. If the failing side changed (ex. Left changed to Right), then the **IPM Driver Board (10780) with the tape** needs to be replaced.
7. If the failing side stayed the same, then the **IPM Driver Board (01780) without the tape** needs to be replaced.
8. Put the IPM Driver Boards back to their original position.

g. Set for normal operation:
   i. Set DIP1-4 to CLOSED/ON/RIGHT.
   ii. Set DIP1-5 to OPEN/OFF/LEFT.

10. Attempt to manually season tube (using 50mA)

a. Setup generator for manual tube seasoning:
   i. Set DIP1-3 to OPEN/OFF/LEFT.
   ii. Set DIP1-4 to CLOSED/ON/RIGHT
   iii. Set DIP1-5 to CLOSED/ON/RIGHT.
b. Go to 2PT RAD mode and take exposures below.
   If at any point there is a failure, go back one kV station and try a second time. If failure occurs a second time, then stop and contact Summit Technical Support Team.
   i. Set to 50kV, 1mAs, **50mA**, take exposure
   ii. Set to 50kV, 5mAs, **50mA**, take exposure
   iii. Set to 50kV, 10mAs, **50mA**, take exposure
   iv. Wait 30 seconds, set to 50kV, 20mAs, **50mA**, take exposure
   v. Wait 30 seconds, set to 60kV, 20mAs, **50mA**, take exposure
   vi. Wait 30 seconds, set to 70kV, 20mAs, **50mA**, take exposure
   vii. Wait 30 seconds, set to 80kV, 20mAs, **50mA**, take exposure
   viii. Wait 30 seconds, set to 90kV, 20mAs, **50mA**, take exposure
   ix. Wait 30 seconds, set to 100kV, 20mAs, **50mA**, take exposure
   x. Wait 30 seconds, set to 100kV, 20mAs, **50mA**, take exposure
   xi. Wait 30 seconds, set to 125kV, 20mAs, **50mA**, take exposure
c. Set generator for normal operation:
   i. Shut off generator.
   ii. Set DIP1-3 to OPEN/OFF/LEFT.
   iii. Set DIP1-4 to CLOSED/ON/RIGHT.
   iv. Set DIP1-5 to OPEN/OFF/LEFT.
   v. If you were able to get passed all the kV's above, continue to the next step.

11. Calibration

a. Auto CAL (for generators built **after** 06/2012)
    i. 2PT Generator: See Service Manual section 5.11
    ii. AP Generator: See Service Manual section 4.13
b. Manual CAL (for generators built **before** 06/2012)
    i. 2PT Generator: See Service Manual section 5.12
    ii. AP Generator: See Service Manual section 4.14

12. Check 500mA Generator on 208VAC Line (skip for power lines ≥ 220VAC or 300mA Gen.)

a. Setup generator for troubleshooting:
    i. Shut off generator.
    ii. Set DIP1-4 to CLOSED/ON/RIGHT.
    iii. Set DIP1-5 to CLOSED/ON/RIGHT.
b. Check for line compatibility:
    i. Turn on generator.
    ii. Set technique to 60kV, 140mAs, 450mA and take an exposure.
    iii. If error occurred, your generator needs to have a Bus Capacitor add on kit (08243) installed.
    iv. Set technique to 60kV, 14mAs, 500mA and take an exposure.
    v. If error occurred, your generator needs to have a Bus Capacitor add on kit (08243) installed.
c. Set for normal operation:
    i. Set DIP1-5 to OPEN/OFF/LEFT if Auto CAL was used in step **11**.
    ii. Set DIP1-5 to CLOSED/ON/RIGHT if Manual CAL was used in step **11.**

13. Additional replacement parts to be considered

a. The **System Controller Board** (06357-*) may need to be replaced as a last resource.