

TROUBLESHOOTING GUIDE: E24 – FAIL KV FB ERROR

=====

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

=====

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 reseal all connectors. Tighten wires at connectors, if needed.
 - iii. Be sure to apply pressure on the back of all ribbon cable connectors.
- b. IPM Driver Boards (2x 01780):
 - i. Remove and reseal all connectors. Tighten wires at connectors, if needed.
 - ii. Be sure to apply pressure on the back of the ribbon cable connector.
 - iii. Remove and reseal each IPM Driver Board 5 times. This helps break away any oxidation on the pins that may be causing bad contacts.

4. Check kV 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. If any of the values are incorrect, the Feedback Cable or the HV Tank is defective.
 - v. Verify the continuity of the **Feedback Cable** (00510-000) & replace if defective.
 - vi. 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 **254-384 KOhms**.
 - iii. At **H9** header of System Controller Board:
Verify resistance from pin **2** to pin **3** to be **209-231 KOhms**.
 - iv. If any of the values are incorrect, replace **System Controller Board** with Kit **06357-***.
 - v. Reconnect **H9** cable to System Controller Board.

5. 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).

6. Check for kV Imbalance in HV Tank or System Controller Board

- 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. Setup System Controller Board (**through hole version**):
 - i. Short R38D (place jumper across both sides of resistor).
 - ii. Short R38B (place jumper across both sides of resistor).
- c. Setup System Controller Board (**SMT version**):
 - i. Remove shunt on header JMP1 and short JMP1 pin 2 to pin 3.
- d. Evaluate Positive and Negative kV:
 - i. Turn on generator and select 50kV, 15mAs, 50mA SM.
 - ii. Get PKV:
 1. Connect VDC meter **RED (+)** to connector **H9 pin 2**, Black (-) to connector **H9 pin 3**. Set Multimeter to Max mode.
 2. Take exposure & verify meter displays 0.81 to 0.99 VDC.
Note value of **PKV**: _____
 - iii. Get NKV:
 1. Connect VDC meter **RED (+)** to connector **H9 pin 1**, Black (-) to connector **H9 pin 3**. Set Multimeter to Min mode.
 2. Take exposure & verify meter displays -0.81 to -0.99 VDC.
Note the ABSOLUTE value of **NKV**: _____
 - iv. Calculate % Error:
 1. $\% = 100 \times |PKV - NKV| / PKV$
(Ex. PKV = 0.91, NKV = 0.80 \rightarrow $\% = 100 \times |0.91 - 0.80| / 0.91 = 12.1\%$)
Note % Error: _____
 2. If % Error > 30%, the **HV Tank** (K904-*) needs to be replaced.
- e. Set generator for normal operation:
 - i. Remove jumper from R38B (**through hole version**).
 - ii. Remove jumper from R38D (**through hole version**).
 - iii. Remove shunt on header JMP1 and short JMP1 pin 2 to pin 1 (**SMT version**).
 - iv. Set DIP1-5 to OPEN/OFF/LEFT.

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. 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, then re-run Auto CAL.

9. Additional replacement parts to be considered

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