TROUBLESHOOTING GUIDE: E44 – KVP TOO LOW 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. 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 connectors.
      iii. Remove and reseat 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 **254-284 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 for open fuses (with generator OFF and FSE grounded with ESD strap)**
    a. Shut OFF generator.
    b. IPM Driver Board (01780), Left Side
        i. Verify resistance across **F1** of Left IPM Driver Board to be **≤ 22.0 Ohms**.
        ii. If the resistance is out of range, first replace **F1** (50mA, 250V, Slo-Blo, 5x20mm). If **F1** opens again, replace the **Left IPM Driver Board** (01780).
    c. IPM Driver Board (01780), Right Side
        i. Verify resistance across **F1** of Right IPM Driver Board to be **≤ 22.0 Ohms**.
        ii. If the resistance is out of range, first replace **F1** (50mA, 250V, Slo-Blo, 5x20mm). If **F1** opens again, replace the **Right IPM Driver Board** (01780).

6. **Check HV Tank's primary coil (with generator OFF)**
    a. Shut OFF generator. Verify wires **P1**, **P2** & **GND** are connected properly to HV Tank.
    b. Verify resistance across wires **P1** & **P2** at the HV Tank to be **< 1 Ohm**.
    c. If the resistance is out of range, the **HV Tank** (K904-*) needs to be replaced.

7. **Check HV cables connection (with generator OFF)**
    a. Verify both HV cables are properly greased at the Tube, use the black set screw to make sure the HV cables are properly tightened.
    b. Verify both HV cables are properly oiled at the HV Tank, use the black set screw to make sure the HV cables are properly tightened.

8. **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. 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.
    c. 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.

9. **Check Capacitor C7**

WARNING: Make sure generator has been **OFF** for at least **20** minutes.

a. Check Capacitor **C7** for deformation (**with generator OFF**)
   i. Inspect capacitor **C7**, located right below the K660 Relay Board, for any form of deformation. A normal capacitor must have a flat top and parallel posts. If the capacitor is suspect, then it should be replaced immediately to prevent damage to other components within the generator (**go to step 9.c** for replacement part).

b. Check Capacitor **C7** for open
   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. Short 2 posts of capacitor **C7** with a jumper (pay close attention as this capacitor may still hold some charge).
   vi. Turn on generator and select 50kV, 20mAs, 300mA LG.
   vii. Take an exposure and verify if there is any error.
   viii. Shut off the generator and **remove the jumper from C7**.
   ix. If error occurred, **go to step 10**.
   x. If NO error, capacitor **C7** is defective and needs to be replaced. **Go to step 9.c** for replacement part.

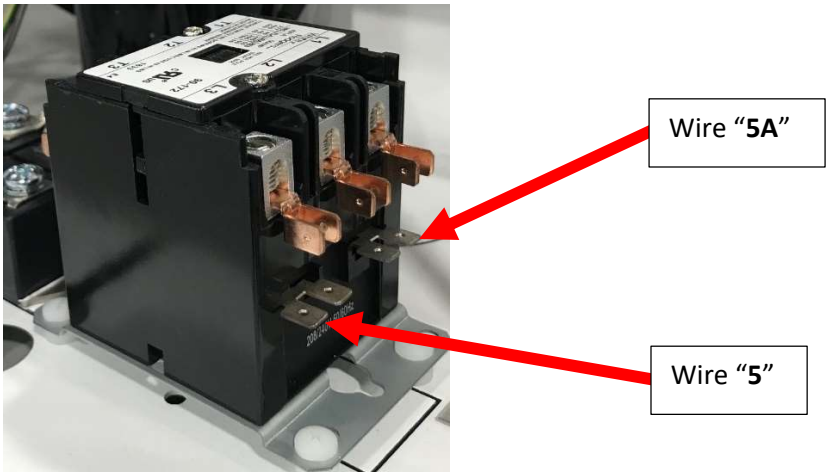
c. Replacement part for Capacitor **C7** (if needed)
   i. For 208-277VAC Generators: Replacement part is L297-00
   ii. For 416-480VAC Generators: Replacement part is HAT26

10. **Check Contactor K1**

a. Setup generator:
   i. Shut off generator and main breaker box.
   ii. Set DIP1-3 to OPEN/OFF/LEFT.
   iii. Set DIP1-4 to CLOSED/ON/RIGHT.
   iv. Set DIP1-5 to CLOSED/ON/RIGHT.

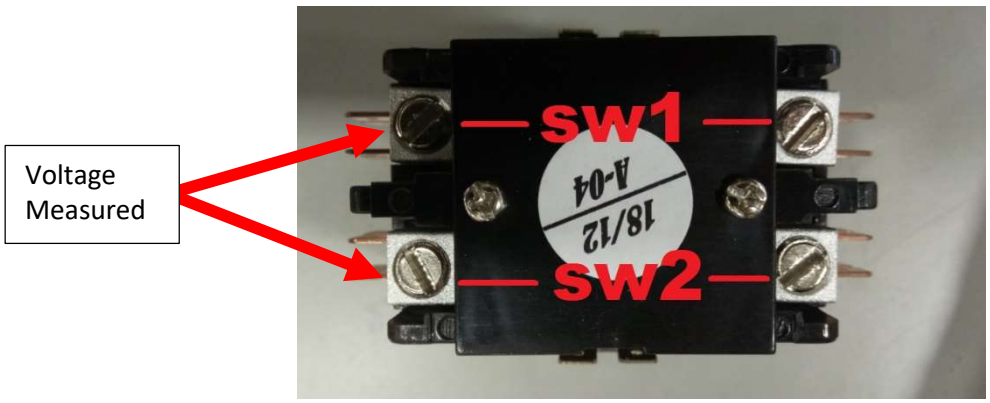
b. Check VAC across **K1** contactor's coil:
   i. Reference image of 1 PH contactor **K1**.

ii. Reference image of 3 PH contactor **K1**.



iii. Place VAC meter across terminals connected to wires "**5**" and "**5A**" as shown above. Make sure to use alligator clips or some other probes that will leave your hands free.
iv. Turn on main breaker box.
v. Turn on generator and select 50kV, 15mAs, 50mA SM.
vi. Press and hold **PREP** button/switch only.
vii. Verify voltage to be: **228VAC to 252VAC**
viii. If out of range, replace **Relay Board** with **Kit 01985-000**.
ix. Release the PREP button/switch.
x. Shut off generator and main breaker box. Then, remove VAC meter.

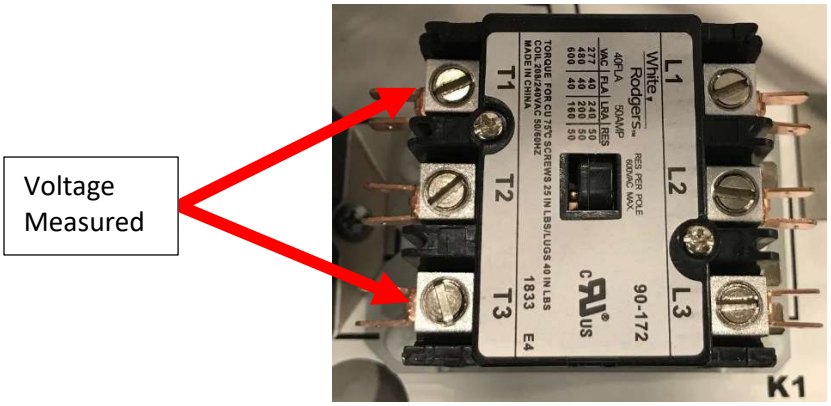
c. Measure VAC across **sw1 & sw2** of contactor **K1** (1 PH):
i. Reference image of 1 PH contactor **K1**.



ii. Turn on main breaker box.
iii. Measure & record AC voltage between line fuses **F1** and **F2** (**1PH VAC**).
iv. Shut off main breaker box.
v. Place VAC meter across **LEFT side of sw1 & sw2** as shown above. Make sure to use alligator clips or some other probes that will leave your hands free.
vi. Turn on main breaker box.
vii. Turn on generator and select 50kV, 15mAs, 50mA SM.

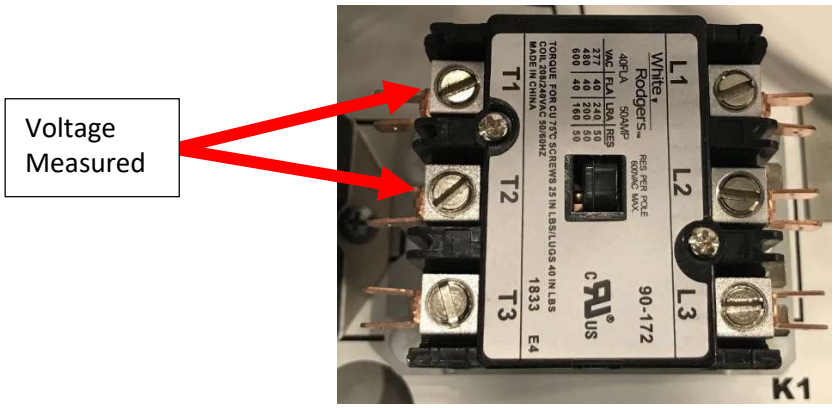
viii. Press and hold **PREP** button/switch only.
ix. Verify voltage to be: **1PH VAC ±2VAC** (where **1PH VAC** is from **step 10.c.iii**).
x. If out of range, **Contactor K1** (K414-00 for 1 PH) needs to be replaced.
xi. Release the PREP button/switch.
xii. Shut off generator and main breaker box. Then, remove VAC meter.

d. Measure VAC across **sw1 & sw3** of contactor **K1** (3 PH only):
i. Reference image of 3 PH contactor **K1**.



ii. Turn on main breaker box.
iii. Measure & record AC voltage between line fuses **F1** and **F2** (**3PH-1 VAC**).
iv. Shut off main breaker box.
v. Place VAC meter across **LEFT side of sw1 & sw3** as shown above. Make sure to use alligator clips or some other probes that will leave your hands free.
vi. Turn on main breaker box.
vii. Turn on generator and select 50kV, 15mAs, 50mA SM.
viii. Press and hold **PREP** button/switch only.
ix. Verify voltage to be: **3PH-1 VAC ±2VAC** (where **3PH-1 VAC** is from **step 10.d.iii**).
x. If out of range, **Contactor K1** (03962 for 3 PH) needs to be replaced.
xi. Release the PREP button/switch.
xii. Shut off generator and main breaker box. Then, remove VAC meter.

e. Measure VAC across **sw1 & sw2** of contactor **K1** (3 PH only):
i. Reference image of 3 PH contactor **K1**.



ii. Turn on main breaker box.

iii. Measure & record AC voltage between line fuses **F1** and **F3** (**3PH-2 VAC**).
iv. Shut off main breaker box.
v. Place VAC meter across **LEFT side of sw1 & sw3** as shown above. Make sure to use alligator clips or some other probes that will leave your hands free.
vi. Turn on main breaker box.
vii. Turn on generator and select 50kV, 15mAs, 50mA SM.
viii. Press and hold **PREP** button/switch only.
ix. Verify voltage to be: **3PH-2 VAC ±2VAC** (where **3PH-2 VAC** is from **step 10.e.iii**).
x. If out of range, **Contactor K1** (03962 for 3 PH) needs to be replaced.
xi. Release the PREP button/switch.
xii. Shut off generator and main breaker box. Then, remove VAC meter.

11. Main Inverter (IPM) circuit

a. Discharge DC BUS.
   i. **WARNING**: Dangerous voltages on Bus Bars (280-700VDC).
   ii. Shut off generator and wait at least 20 minutes for DC Bus to naturally discharge. Make sure DC Bus is < 5VDC before proceeding.
b. The following two choices are left:
   i. High cost replacement:
      - Purchase and replace entire IPM Assembly (07520), includes cables, both IPM's, and both IPM Driver Boards on a bracket.
   ii. Low cost replacement with trial and error:
      - Purchase and replace both IPM ribbon cables (Left cable is L235, Right cable is L233).
      - Order 1 IPM Driver Board (01780) and try replacing the left and the right side until the issue goes away.
      - If the above does not work then, order 1 IPM (06056) and try replacing the left and the right side until the issue goes away.

12. Additional replacement parts to be considered

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