

## "Original" INNOVET® TROUBLESHOOTING GUIDE

**Verify basic voltages:** Line tap is correctly set for supply, 120 VAC F1 to F2, on F377 board, H6-5 to H6-6 is 14 VAC, TP9 is +5 VDC, TP11 is -5 VDC, TP10 common

**Verify basic connections:** P1 white, P2 black, Ground green. XL white, XS green, XC black, M1 red. Rotor 07 black, 08 red, 09 white; typically 30 ohms 07 to 09 and 60 ohms 08 to 09. Insure tight crimps, receptor studs and screw terminals.

### "--E--" in mAs window

This occurs because the F377 does not know the kV, mA or time selected. It can happen from improper kV selection (above 125 or below 40 kVp), bad tap switch, timer switch, mA switch, poor cable connections from these devices, P1/P2 voltage in idle (a loose stud on transformer top), or a failure of the F377 board.

1. With the **kVp window blank and "--E--" in the mAs window**, failure to get a kVp voltage to the F377 is one cause. Adjust kVp tap switches so that 200 VAC is seen between their common poles. Insure 200 VAC can be seen on the F377 board at pins H7-1 and H7-4.
2. With the **kVp window blank and "--E--" in the mAs window**, failure to have an mA select signal on H3 of the F377 is the other cause. Insure on F377 that H3-1 is +5 VDC for small, H3-2 is +5 VDC for large spot, or remove the H3 plug and force in the correct signal by jumping pins H3-3 to H3-2 for large spot or H3-3 to H3-1 for small spot. Insure +5V on H3-3.
3. When the **kVp window is a valid kVp but the mAs window is "--E--"**, the time code is not correct, not getting to, or not processed correctly by the F377 board. Select time stations and monitor H1 pins 3, 4, 2, 5 and 6 (time station code) and insure binary increment count of +5 VDC as time is changed. The pins on H1 as shown above are in Most Significant Bit to Least Significant Bit sequence.
4. If the **kVp display reads "333"**, "666" or some other scrambled, invalid kVp, the EPROM U18 on F377 board (part number W341 for 60 Hz, U18 and U21 part number F364, two required) has probably been damaged from electrical noise. Cycling power may clear the problem, and replacing the W341 chip will likely clear the problem, but it is very important to look for sources of noise, such as each high voltage cable, cable end, h.v. transformer, x-ray tube, rotor circuitry, solid grounding, and so on. Putting a 0.1mfd capacitor from pin 5 to pin 7 of U6, and another from pin 21 to pin 20 of U18 may help. It is important to note that this "333" display is a symptom of electrical noise, not the real problem. Confirm that in IDLE, D11 to ground is +5VDC. If less, remove U18 and confirm that D11 returns to +5V. If it does, replace U18 (part #W341-- even though removing this chip may not clear the "333" during this test). If +5V does not return, replace the F377 board.

**No exposure, no "beep" from timer**

1. Does LED 1 on the motor start board light? If no, check rotor circuitry, rotor cap, and rotor connections.
2. Is there 120 VAC between J1-1 and J1-2 on the C118 timer board at EXPOSE? If no, check pin 11 of motor start board, connections, and exposure switch.
3. D11 on F377 board must go from +5 VDC to ground at PREP. (It is this signal which enables the F377 board to turn the time select signal into an anticipated pulse count and to send this count to the C118 timer. Without this signal, the timer is told to count to zero pulses.) Confirm that R30 on the F377 board is not open--some wire wound resistors can open over time--and replace it with a 12K ohm, 3 watt ceramic or carbon film resistor, if open. If no +5V to ground signal on D11 at PREP, check R30 and OC1 for open, C25 for short, H6-3/H6-4 for 120 V at Prep.
4. If there is a +5V to ground transition at PREP, verify H2 output code of F377, which is the source of the J3 input of C118 anticipated pulse count. Without an anticipated pulse count the timer is satisfied with counting zero pulses. Pin one of J3 is the +5V supply, pins 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 are Most Significant to Least Significant bits of the binary code for anticipated pulse count. Verify proper input code, +5/+12 VDC on timer, replace C118 timer.

**No exposure, but timer "beeps"**

1. Verify line tap is correctly set; the SCR drive voltage is an unregulated supply. If the unit is tapped for 240V but connected to 208V, this may be a cause.
2. Verify filament voltage and mA. Typically 24 VAC in idle, 54 VAC (XL to XC) for 80 kVp at 300 mA boost. If low, look for open in control or other source of reduction for filament voltage (TS transformer, mA selector, C2 capacitor, RE-1, RX, or poor control connections). If high, look for open in secondary (filament or HV cable, tube, HV tank).
3. Verify primary voltage and kVp. Look for RE-2 to close, insure good connections from J2 to primary SCR pack, confirm both primary and backup SCRs will conduct. Replace C118 timer.

**kVp or mAs segments do not light**

Insure good connections between the wires and the plugs at either end of the connecting cables. Remove the spring clip cover at the plug to inspect. Switch cables at control end, then tubestand end, to determine source of the open. All segments out is a poor +5V connection on this cable.

**Unit exposes but no mA can be measured**

Verify filament voltages (see description above), lit filaments, and that the spark gap is not shorting to top of can.

## INNOVET® CALIBRATION TIPS

### kVp adjustment

The actual kVp output of the InnoVet® can be predicted by the AC voltage measured between the common poles of the major and minor kVp tap switches for each mA station. As a result, it is possible to "pre-calibrate" the kVp display to read what the expected output should be, assuming the mA level is correct and the line voltage drop under load is within acceptable limits.

For the 100 mA station (these adjustments are interactive):

With 107 VAC between the tap switches, adjust P3 to display 50 kVp.

With 230 VAC between the tap switches, adjust P1 to display 120 kVp.

Typically 160 VAC between the tap switches will result in 80 kVp.

for 100mA  
P3=offset &  
P1=slope  
<O>  
for 300mA  
P4=offset &  
P2=slope

For the 300 mA station (these adjustments are interactive):

With 155 VAC between the tap switches, adjust P4 to display 50 kVp.

With 280 VAC between the tap switches, adjust P2 to display 120 kVp.

Typically 207 VAC between the tap switches will result in 80 kVp.

### mA adjustment

The actual mA output of the InnoVet® will depend upon the filament characteristics of the x-ray tube, but the following voltages and adjustment band positions are typical.

The RB band on resistor RX which controls filament voltage in idle will be at or very near the top end of the resistor, with about 24 VAC on it as measured from XC. Moving this band down will reduce idle filament voltage and I generally recommend it.

For the 100 mA station:

The 100 mA station resistor band on the filament resistor RX will be about 1/4 of the way up from the bottom of the resistor. Measured from XC to XS, the filament voltage will be about 21 VAC in idle and about 41 VAC in boost when 80 kVp is selected.

For the 300 mA station:

The 300 mA resistor band on the filament resistor RX will be about 3/8 of the way up from the bottom of the resistor. Measured from XC to XL, the filament voltage will be about 21 VAC in idle and 54 VAC in boost when 80 kVp is selected.

### Space charge adjustment

On the space charge resistor RSCC, the 100 mA band will be about 3/8 of the way up from the bottom, and will measure about 18 VAC from XC with 80 kVp selected. The 300 mA band will be about 5/8 of the way up from the bottom and will measure about 22 VAC from XC with 80 kVp selected. For each mA station, selecting 120 kVp will cause the XC to XS (or XL) voltage to decrease about 1.5 VAC when compared to 80 kVp, and decreasing to 50 kVp will increase the XC to XS (or XL) voltage about 1.5 VAC when compared to 80kVp.

As the band is moved up on the resistor, the space charge compensation effect will increase (causing mA to decrease at higher kVp).