

Optimizing patient care— with a digital multimeter?

Application Note

How a medical electronics specialist uses a DMM at an Ohio hospital

For Brian Morey, BMET Imaging Specialist at Summa Western Reserve Hospital (SWRH) in Cuyahoga Falls, Ohio, timely maintenance and quick resolution of trouble calls do more than just boost productivity; they are critical to optimizing patient care. His department is charged with keeping a wide range of patient care equipment—from IV pumps and monitors, to blood and fluid warmers, to x-ray equipment—ready to serve patients of the 257-bed, acute care hospital where he has worked for the last 29 years.

When Morey started at the hospital he worked mostly on telephone systems and nurse call systems. Today he focuses primarily on equipment in the radiology department. That includes: six C-arm fluoroscope x-ray units that move in and out of surgery suites; two portable x-rays that go anywhere in the hospital they are needed; and a variety of patient monitoring equipment.

Preparing for trouble calls

Although Morey divides his time about 50/50 between preventive maintenance and repairs, trouble calls take first priority. As one of two technicians in the hospital's BMET department, Morey frequently takes trouble calls beyond the radiology department. Those calls may take him to repair a malfunctioning IV pump in the ICU, or to check the calibration and temperature of incubators and infant warmers in the Emergency Department.



Brian Morey, B.S., CBET, Summa Western Reserve Hospital Biomedical Equipment Technician/Imaging Specialist, checks the power control PCB for a C-arm interlock "good" signal. That enables the ARCNET nodes that control the C-arm.

Regardless of the problem, Morey has found over the years that one of the most useful problem solving tools is a good pair of ears. "You have to listen really hard to the staff that use the equipment and ask careful questions," Morey says. "Sometimes you get all kinds of details including the error codes. Other times all you get is a little tag

hanging off of the item that says 'broken'."

In either case, he relies on a Fluke 87V Digital Multimeter (DMM) to either help him find the problem or, in preventive maintenance, to help avoid problems. "Almost every time I walk out the door of my shop I have my DMM in one pocket and my collection of tools in another," Morey recalls.



Troubleshooting infusion pumps

Trouble calls are typically the first order of the day. They could involve anything from an IV pump that doesn't pump to an x-ray machine that doesn't produce good enough images.

In the case of a malfunctioning IV pump Morey first verifies that the batteries are fully charged and the fuses are good. He then checks for opens and shorts: in the power supply if it is a power issue; and the occlusion sensor if it is an alarm problem. Most of the time Morey uses the Fluke TL40 retractable tip leads with the 87V because they allow good access in very crowded or confined areas. "The tips are very fine and long so I can probe the back of connectors without causing damage," Morey notes. When he locates the faulty component he replaces it and rechecks it with the DMM to confirm that the problem is resolved.

Keeping x-rays on the beam

To find problems with a portable x-ray unit Morey typically starts by testing the rechargeable battery pack—checking each cell individually and in comparison to the other cells in the pack. "You're looking for readings of 11.9 to 12.1 V dc; the cells should be within 0.2 V dc of each other. If you have one battery that's soft, you may have failure problems all over the place," Morey explains. By testing the batteries regularly and keeping them properly charged he has been able to get as much as five years out of portable x-ray batteries.

After replacing a battery, circuit board, or tube on an x-ray unit he calibrates the unit to ensure that the dose is correct and that all parameters of the machine are properly readjusted. He sets the x-ray unit in calibration mode and uses hook clips to securely connect the leads to test points on the x-ray charger board to measure voltage. If the voltage is out of range, Morey adjusts the voltmeter on the x-ray machine up or down until it matches the value on the DMM.

He uses a similar technique to set up the filament current on the x-ray monitor. He attaches hook clip leads from the DMM mA function to mA test points on the mA/kV control board to take a current measurement. Then he adjusts the mA value on the x-ray display until it agrees with the value that appears on the meter.

In addition to measuring amps and volts, Morey uses the built-in thermometer in the Fluke 87 with thermocouple probes to test temperature and temperature alarm and safety points on warming devices, such as blood and fluid warmer, incubators, infant warmers, and refrigerated centrifuges.

Ensuring cable continuity

Another big challenge in troubleshooting medical electronics is isolating shorts in cables and patient leads. When Morey gets a complaint about signal interference on an EEG or ECG monitor, quite often the problem is found in the patient leads. "If I can't figure out which lead it is just by looking at the signal on the monitor, I use the Ohms function

on the DMM to check the leads from end to end to locate continuity problems," Morey says.

Another particularly sticky problem occurred when the collimator control on the x-ray machine began to work intermittently. This control automatically adjusts the sizing of the x-ray exposure based on the distance of the machine over the table. Morey started by testing for certain V dc values that should appear on some pins of the collimator connector. He didn't find any. Then he tested the collimator itself and found that all the voltages were present. So the problem had to be in the cable. "Using the Ohms function and the continuity beeper on the Fluke 87V it didn't take long to find two or three broken wires," Morey says. "We installed a new cable and later discovered that 16 of 37 wires in the old cable were broken right at the connector." They were able to repair the old cable and keep it as a spare. "I don't think I could do this job without a meter," Morey concludes.

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Fluke Corporation

PO Box 9090, Everett, WA 98206 U.S.A.

Fluke Europe B.V.

PO Box 1186, 5602 BD Eindhoven, The Netherlands

For more information call:

In the U.S.A. (800) 443-5853 or Fax (425) 446-5116
 In Europe/M-East/Africa +31 (0) 40 2675 200 or Fax +31 (0) 40 2675 222
 In Canada (800)-36-FLUKE or Fax (905) 890-6866
 From other countries +1 (425) 446-5500 or Fax +1 (425) 446-5116
 Web access: <http://www.fluke.com>

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