New multimeters tackle challenges across the manufacturing floor

Application Note

When engineers and technicians talk about diagnostic tools used in a "manufacturing environment," they really ought to define which of the distinct manufacturing environments they're considering. Is it functional test? Quality assurance? Service? Each environment has specific testing challenges requiring a different set of diagnostic tools. Still, one thing is for sure: across the manufacturing floor, the production of electronic gear of all kinds requires a full-featured, high-resolution, high-accuracy digital multimeter at critical points in the production flow.

What features and functionality would recommend a particular multimeter for use in a wide range of manufacturing applications? And how does a multimeter cope with the testing requirements of today's more complex, highly integrated PCBs? Let's look deeper.

Basic concerns: Measurement consistency, measurement repeatability, and accurate interpretation

Consider that testing procedures in this environment are characterized by repetitive measurements at multiple production test station points, often by lower-skilled operators, and by the need for accurate recording and interpretation of results. As a result, manufacturing floor managers need to provide their operators tools that will encourage:

- **Measurement consistency.** The operator must make multiple, similar measurements in a row, with 100 % consistency.
- **Measurement repeatability.** The operator must make the same measurement (for example, "measure the impedance on the secondary coil") on each unit repeatably.

- **Accurate interpretation.** The operator must interpret measurements correctly. If he makes the measurement with the multimeter on the wrong range setting, for example, he could identify failing parts as good, or vice versa.

Consider this example. In the assembly and testing of a power adapter for a laptop computer, the operator must mount the transformer in a plastic housing, attach the main input lead to the primary side of the transformer, and connect rectifier diodes to the output side of the transformer.

As the power adapter is assembled, the operator must make, minimally, four critical tests:

- Measuring the impedance of the primary side windings of the transformer.
- Measuring the impedance of the secondary windings.
- Applying power to the transformer and measuring the output voltage and current with no load.
- Measuring the output voltage and current with the load attached to the transformer.

To top it off, the operator must repeat this process for every power adapter being assembled during his shift. Doing so requires almost robotic consistency. A Japanese lean-manufacturing principle known as Poke Yoke stresses minimizing waste and eliminating failures at each stage of production. That principle applies in any testing environment where a fault can replicate itself unless it is detected and eliminated at its source.

The Fluke 8808A—built for manufacturing

With the arrival of the new 8808A benchtop multimeter, Fluke has tackled the requirements of diverse manufacturing environments head-on.

The meter offers a dual-display, 5½-digit benchtop multimeter optimized for the manufacturing environment. The full-featured instrument handles all the standard measurements—volts, ohms, and amps—and it offers 0.01 % V dc accuracy. And while many meters offer dual volts/frequency readings, the 8808A displays volts and current side by side, a much harder engineering accomplishment.

While serving in a variety of ways in design and service, as well as manufacturing, the Fluke 8808A multimeter is distinguished by a range of functions that optimize it for the complexities of a diverse manufacturing environment:

- Simplified setup for multi-step test routines via front-panel "radio like" preset buttons.
- A Limit Compare mode with pass/fail indicators to eliminate misinterpretations from borderline readings.
- An integral dc leakage current test for measuring low "standby" or leakage currents.
- A "2x4-wire" function eases testing of complex surface-mount PCBs.

Setup keys for repetitive operations ensure consistency and repeatability

Setup keys on the Fluke 8808A take the familiar paradigm of preset-station buttons on a car radio and advance it by several levels of sophistication. Imagine that a single test on the production line entails several settings on the multimeter, including range setting and pressing of multiple buttons. Leaving these setup steps in the hands of a production line operator could be risky, especially if it involves repeating those steps for every unit coming down the production line. (The operator typically has a work instruction sheet for this purpose, but that approach simply specifies a step-by-step procedure for the operator to follow; it doesn't eliminate those steps.)

However, with the introduction of setups, a test engineer defines each procedure, programs it into the multimeter, and associates it with a setup button on the front panel of the multimeter. On the production line, the operator simply pushes one button to recall the setup.

Setup keys help to ensure consistency and repeatability of measurements throughout the manufacturing process, eliminating the major causes of error in fast-moving manufacturing operations.

Limit Compare mode eliminates errors in interpretation

What about the challenge of interpreting measurement results? Should that be left to a production line operator who is trained to follow processes but lacks understanding of the fundamentals behind them?

Take the example of measuring a 9 V power supply rail with a high-precision multimeter, in which a reading may show fluctuations in the last one or two digits due to variations in component characteristics or environmental conditions. The operator's work instruction sheet may state that the battery voltage must fall between 9.001 V and 8.999. However, if the last digit is fluctuating—right on the "edge" of the specification—does the production line operator have the skill to specify whether the power supply has passed or failed?

Using the Limit Compare mode, the 8808A defines a reading as a "pass" or a "fail," saving the operator from having to make a judgment call when faced with a borderline reading.

This otherwise complex setup, requiring a four-wire connection, is simple with the aid of the 8808A's patented split-terminal test leads. Each lead contains two conductors.

With the 8808A's integral Limit Compare mode, the test engineer defines the upper and lower limits of a passing reading and programs them into the multimeter. Then, when the operator makes the measurement, the multimeter returns either a pass or a fail indication based on the limits programmed into it for that operation. The operator, rather than interpreting a borderline reading, simply notes the Pass or Fail reading in his documentation. The Limit Compare mode eliminates guesswork—and errors.

Advanced functions show this bench meter's "manufacturing pedigree"

While incorporating the functionality required for a wide range of testing challenges, the 8808A also provides a range of features geared toward specific challenges encountered in manufacturing.

Measuring dc leakage current

DC leakage current occurs in a range of applications—often by design, in which case it is often called "standby current"—and in some of those applications it may be critical to measure that current. In the design of an automotive electrical system, for example, electronic devices impose a current drain on the battery when the vehicle is turned off, and the current required to power those devices is the leakage, or standby, current.

Leakage current measurements are a source of potential error in many multimeters. Why? Multimeters typically measure current by applying a known resistance in series with the circuit under test and allowing a current to flow through the circuit. With the current flowing, the multimeter measures the voltage drop across the resistor. The multimeter uses Ohm's Law to calculate the current.

But this current-shunt resistor method introduces a voltage drop or a "burden voltage" to the circuit, and that burden voltage becomes a source of error because it erroneously subtracts from the applied voltage in the circuit.

Add to this the fact that measuring current becomes tricky in the low-nanoampere range. Noise becomes a problem, and the internal impedances of the measurement instrument or circuit can introduce errors in an otherwise accurate measurement.

However, the 8808A uses an alternate method to measure resistance. In its two low-current measurement ranges—the 2000 µA and 200 µA ranges—the multimeter uses an op amp, rather than a shunt resistor, in series with the circuit. In these ranges, the op amp introduces a high impedance to the circuit, and the high impedance eliminates the burdened voltage, reducing errors in low-current measurements.

Making four-wire measurements

Like the Fluke 884X multimeter, the Fluke 8808A offers a patented 2x4-wire function, split-terminal jacks that allow operators to perform four-wire measurements using only two leads instead of four.

The miniature surface-mount components on many electronic designs today make it difficult to establish connections. The same is true of discrete components in tight spaces on a board or module. Compounding the problem is the need to use a four-wire setup to make accurate low-ohms measurements such as to measure the low impedances in coils or secondary transformer windings in manufacturing.

The 8808A DMM's test lead accessory combines the four required wires into two pairs of test leads, vastly reducing the complexity of establishing connections and making critical measurements. It may be plugs with ribbon cables connecting one PCB to another, or measuring resistances across relay and switch contacts—which are typically the weak points on a PCB.

With this innovation, the 8808A proves its adaptability to the more demanding requirements of today's circuits.

Manufacturing your way

Is there a typical manufacturing application? A typical manufacturing flow? Or are your manufacturing operations just as unique as your manufacturing personnel? Fluke's studies indicate that, if any commonalities exist across all manufacturing applications and environments, they are the need for measurement consistency and measurement reliability from one end of the production line to the other, and the ability to interpret results accurately. It's also a good bet that operators do not understand the readings they obtain from their diagnostic tools. Now you can let their tools bridge that gap.

Just as important: provide tools that address the complications of today's manufacturing environments, surface-mount components, four-wire measurement applications, and leakage currents are a few of those. It may turn out that the most useful diagnostic tool in your arsenal is the tool that wraps a manufacturing "savviness" around a full-featured benchtop multimeter.

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