

# Voltage measurements made easy

## Application Note

Transient spikes can create some serious problems when they occur in sensitive electronic equipment. Not only can voltage spikes cause electronic components to fail, but also circuitry can be falsely triggered and produce unexpected results. And if that's not bad enough, the transient's unpredictable nature presents a considerable challenge to the technician trying to detect the elusive signal and locate its source.

In the past, transient problems required a trained eye and a complicated oscilloscope for detection — not always a convenient or practical solution. But today, technicians can employ a high-performance digital multimeter (DMM) with the latest recording features to track down even the most difficult transient problems.

### Not your daddy's DMM

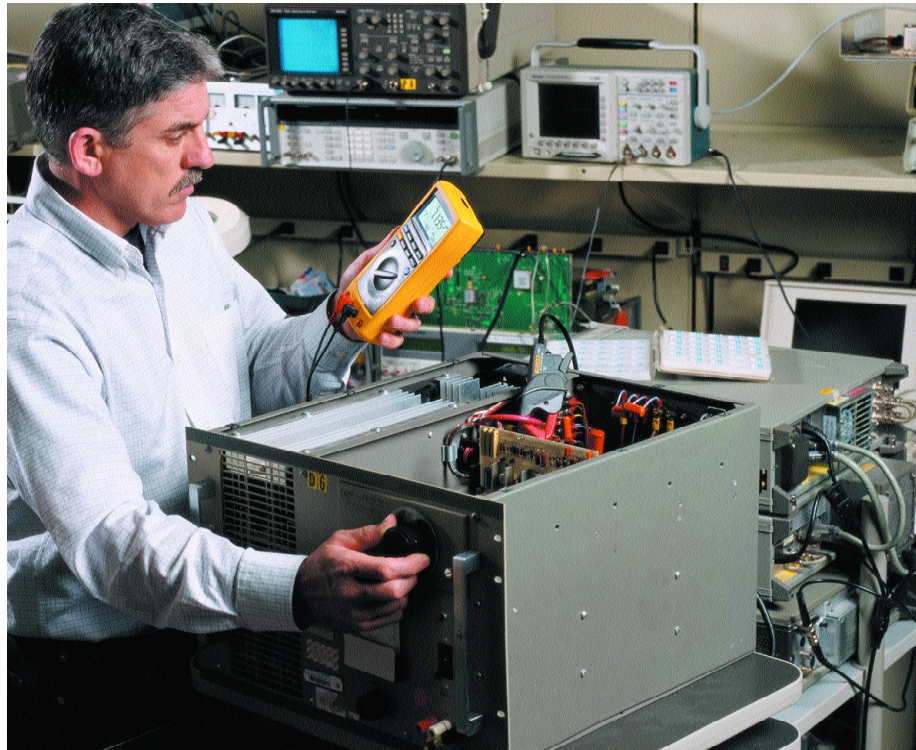
Both the Fluke 87 and Fluke 189 offer a MIN MAX function, a recording feature that allows the DMM to record the highest and lowest values. When the function is enabled, the DMM stores the first reading it takes into two registers. One register for high values (MAX) and one for low (MIN). From this point on, each measurement of the DMM is compared to the values in these two registers. Whenever a measured value is higher than the value in the MAX register or lower than the value in the MIN register, the DMM beeps and the new value is stored.

In order to track down transients, the DMM has to be able to "capture" a very short change in measured value and still produce a reading that represents the magnitude or peak value of that change. For example, if the DMM is measuring a steady dc value, and a transient voltage spike is placed on the dc value, the DMM needs to display the maximum voltage deviation caused by the transient. Also keep in mind, the transient could either increase or decrease the steady dc voltage.

### Only a matter of time

Transients can be pretty short in duration. How short a signal the DMM can detect and measure depends on the DMM's response time, which is the length of time an input must stay at a new value to be recorded. Obviously, a shorter response time captures shorter events.

Both the Fluke 87 and 189 DMMs have selectable MIN MAX response times. For tracking down transient problems, a DMM needs to have very fast response



times. When using a Fluke 87, the fastest MIN MAX response time is captured when the **"PEAK MIN MAX"** mode is enabled. The same feature is labeled **"FAST MN MX"** on the Fluke 189. In both these meters, these selections set the DMM's response time to 250 microseconds.

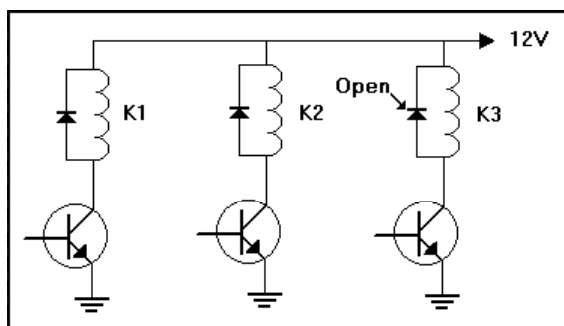


Figure 1.

## Step by step

To demonstrate the use of the MIN MAX function in detecting and measuring transients, consider the example shown in Figure one. The circuit is part of a control circuit that, among other things, controls some dc relays. The diode across the coils of the relays is used to short out any electrical energy created by the collapsing magnetic field in the relay coil when the voltage is removed. Assume for this example that one of the diodes has opened. Without the diode to short out the energy released by the collapsing field around the coil, the energy must be dissipated by the remaining circuitry of our control circuit. With the coil now acting like a source, the voltage it creates will be added to the supply voltage, possibly causing a spike on the dc supply line. As this transient propagates through the circuitry, it may cause erratic and intermittent behavior in our control circuit.

To capture and measure this transient, set up the DMM as follows:

1. Select the dc voltage mode.
2. Plug the red test lead into the **V** jack and the black test lead in the **COM** jack.
3. Connect the black test lead to the dc common of our control circuit and the red test lead on the 12-volt power line going to the relays.
4. Press the **RANGE** until the desired range is selected. This should be done to get the best accuracy before entering the MIN MAX mode.
5. Activate the MIN MAX mode.

### For the Fluke 87:

Press the **MIN MAX**.

Press the to enter the PEAK MIN MAX mode until 1 mS is displayed.

### For the Fluke 189:

Activate FAST MN MX by pressing then press **MIN MAX**.

The maximum stored value is presented in the primary display while the secondary display indicates the present measured value.

At this point, the MIN MAX recording mode has been activated and the DMM is comparing each new measurement against the MIN MAX registers and storing any new values it detects. When the relay with the open diode de-energizes, a transient may be detected by the DMM.

To see the recorded values, perform the following.

### For the Fluke 87:

Press the **MIN MAX** to see the maximum value measured. Press it again to see the minimum value measured.

### For the Fluke 189:

With the maximum value already displayed in the primary display, each press of **MIN MAX** steps through the minimum (MIN), average (AVG) and back to the maximum (MAX) reading.

Again, the present measured value is always displayed in the secondary display while cycling through the MIN MAX values.

It may also be helpful to know that the amount of time that has elapsed since the MIN MAX mode was activated to the last recorded MAX or MIN value is also displayed.

The MIN MAX function is a very handy addition to a DMM. You will find it very helpful for identifying intermittent problems, such as transients. The Peak or Fast MIN MAX functions greatly enhance DMMs, making your work easier and more productive.

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