

Detecting intermittents with a DMM

Application Note

The elusive electrical intermittent is one of the most difficult problems for anyone to troubleshoot. The difficulty lies primarily in the timing. Being able to look at the symptoms while the problem is present simplifies the troubleshooting process considerably. However, the old adage "A watched pot never boils" seems to be applicable to electrical intermittents as well. Being present, as well as being able to take an electrical measurement while the problem exists, are the two biggest challenges in tracking down an intermittent.

There are a number of test tools that can help make the intermittent troubleshooting process a little easier. These tools range from complex signal analyzers and storage oscilloscopes to handheld digital multimeters (DMM). Of course, you may not have these tools available or the location of the problem makes it difficult to bring a large analyzer to the problem site. A DMM may be able to tell you a lot about an intermittent without having to go back to the shop and haul that storage scope to the job site. This article will describe how to use a DMM as an intermittent troubleshooting tool.

DMM features for hunting intermittents

Couple the basic measurement features of a DMM (ac volts, dc volts and resistance) with some form of measurement recording ability, and you have a tool for detecting the symptoms of intermittents. Not too long ago, you could buy a voltage or current measuring tool that was built around a mechanical strip chart recorder. Just place the input on

a voltage, or clamp a current transformer around a conductor and the recorder would make progressive marks on a strip of paper fed under the marking pen. The maximum length of the recording was determined by the amount of paper that could be placed on a roll of paper. This same strip chart recorder technique has been incorporated into some of today's DMMs.

Fluke's 170 and 180 Series DMMs have a feature called *MIN MAX AVG Recording Mode*. Just like the strip chart recorder, the DMM takes a reading of the input at regular intervals. But instead

of saving each reading, it compares the reading to two previously stored values to determine if it is higher than previous highest reading or lower than the previous lowest reading. If it is, the new reading replaces the old value stored in high or low reading register. After allowing the recording process to continue for a period of time, you can recall these registers to the display and see the highest and lowest reading taken during the recording time. As an added bonus, these DMMs will also compute and store the average value of all readings taken during a given time period.



To use the MIN MAX AVG Recording mode:

1. **Select the appropriate function** for the desired measurement. (ac volts, dc volts, resistance, ac current, dc current, and frequency)
2. **Connect the test leads** of the DMM to the circuit to be measured. Fluke's SureGrip test leads and probes offer a multitude of circuit attachment methods. Make sure you do this before activating the MIN MAX AVG function, otherwise, the minimum reading will be whatever the ambient value is on the unconnected test leads. This could throw off your analysis of the recorded data after the recording time period expired.
3. **Switch to manual range** by pressing the RANGE button. If necessary, repeat pressing the RANGE button until the correct range is indicated in the DMM's display. This step is necessary because the DMM will automatically switch to manual range mode whenever the DMM is placed in the MIN MAX AVG recording mode. Once MIN MAX AVG is activated, you cannot change the range setting.
4. **Press the MIN MAX** to activate the MIN MAX AVG recording mode. In the Fluke 170 Series, the display indicates the maximum reading and beeps each time a new low or high value is detected. In the Fluke 180 Series, the primary display indicates the maximum reading while the secondary display indicates the present measured value.

After insuring the DMM won't be disturbed and won't present a safety hazard to anyone, you can leave the DMM unattended while you focus on other tasks. At anytime during the recording period, you can review the stored readings using the procedure in the next step, or pause the recording mode without deleting the stored readings by pressing the HOLD button. To continue recording, press the HOLD button again.

5. View the stored readings by pressing **MIN MAX**. Each press of this button causes each of the stored values (lowest, highest and average readings) to be sequentially recalled to the DMM's display.

Elapse time stamp

The ability to determine when the lowest and highest reading was detected could also be useful information in determining the cause of an intermittent measurement. The Fluke 180 Series DMMs have the additional ability of storing the amount of time that has elapsed between the start of recording and when a new minimum or maximum or average value was stored during MIN MAX AVG recording. As a result, each stored minimum, maximum and average reading has a "time stamp" associated with it.

By separately documenting the time of day you activated the MIN MAX AVG recording mode, you can easily calculate the actual time of day a reading was detected by the DMM. For example, assume you activated the record mode at 3:07:00 p.m. and the highest reading displayed has an elapsed time of 47:05. You simply add the elapsed time to the start time to determine what time of day the highest reading was recorded. In this example that would be 3:54:05 p.m. the same day.

Using the MIN MAX AVG recording mode found in both the 170 and 180 Series DMMs, can be useful for some intermittent problems. But it assumes the circuit point you are connected to will indicate the highest or lowest reading when the problem appears. If the intermittent causes the measured value to be between the highest and lowest value, then the MIN MAX AVG function will not be of much help in determining the source of the intermittent.

Tip:

Do not remove the test leads from the circuit being measured until you have either pressed the HOLD button to stop the recording, or looked at and documented all the stored values. Removing the leads while recording will result in the DMM processing the values present on the disconnected leads and affect the AVERAGE value and possibly the lowest or highest stored values taken during the time the leads were connected to the circuit.

Advanced MIN MAX Recording functions

The Fluke 189 True-rms Multimeter not only has the stand-alone MIN MAX AVG Recording feature described above, but also incorporates this feature with another called AutoHOLD and additional storage memory to create the Event Logging function.

AutoHOLD has the ability to sense when a measured signal becomes unstable and when it re-stabilizes. Using the AutoHOLD feature to trigger the starting and stopping of the MIN MAX record function, you are not limited to using the DMM for problems that only result in signals moving to a minimum or maximum value.

To use the Event Logging feature, you will need a Fluke 189 True-rms Multimeter, FlukeView® Forms Documenting Software and a personal computer on which to download and view the recorded data. The DMM is taken to the site where the recording needs to be done and set up to record for a period of time, hopefully during which the intermittent will occur. Only after the recording is complete do you need the software and PC.

As in the MIN MAX AVG Recording steps above, setup the meter by selecting the desired measurement function and set the range of the meter manually. Connect the meter's input to the point to be measured and then activate Event Logging.

As in the MIN MAX AVG Recording mode, the DMM will start storing the highest and lowest values in memory. As long as the measured signal stays within a specified percent of the selected range, the meter will keep updating the same set of MIN MAX values. However, should the input signal value change by more than a specific percent of range, the DMM will store the minimum and maximum values it has accumulated so far, along with their respective time stamps and start accumulating another set of MIN MAX values until the measured signal stabilizes. Once stabilized, the meter stores the minimum and maximum readings for that period and starts collecting a new set of MIN MAX values for the stable period. This process continues for as long as the logging session is in progress or the DMM runs out of memory. Depending on how the meter is setup, the meter has enough memory to store up to three days of MIN MAX pairs.

When the logging session is terminated, the DMM can be taken back to the shop and its stored data transferred to a PC through FlukeView Forms Documenting Software. Once in the PC, each stable and unstable event can be analyzed in detail. Not only do you get to see the minimum and maximum values

of each stable and unstable period, but you also see the time of day each period began and ended. In addition, the average value of each period is also recorded.

The recorded data can be displayed on the PC either in table form as in table 1, or in graphical form as in figure 1. Looking at row three of table 1, you can see the third event started at 9:53:30 a.m. on July 4, 2000. The duration of the event was 1 minute and 20.6 seconds. The highest value during the period was 8.1 amps, the average of all the values taken during the event was 7.7 amps and the lowest value was 7.5 amps. This was a stable event and ended at 9:54:51 a.m. the same day. As you can see from this example, a lot of data can be captured during an intermittent period using Event Logging.

Yes, locating intermittent problems can be difficult, however, a DMM with the right features can help considerably in tracking down these elusive problems. Fluke's wide range of DMMs incorporate features that are not only valuable for finding intermittents, but a whole host of other problems as well. Check with your local Fluke distributor or check Fluke's web site at www.fluke.com to find the test tool that best fits your needs.

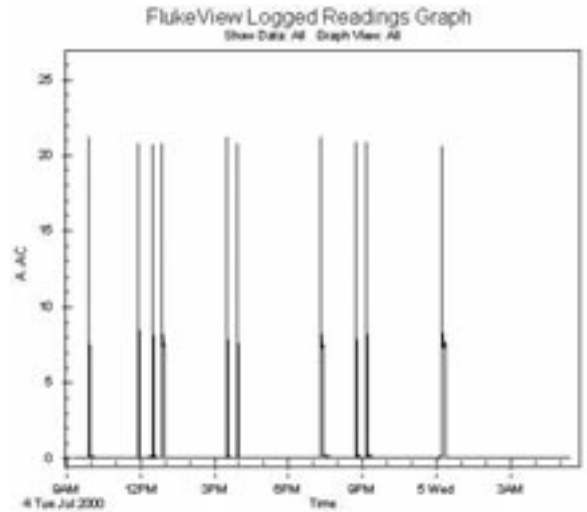


Figure 1.

E	Start Time	Duration	High	Average	Low	Description	Stop Time
1	9:21:15 AM	32:14.7	0.0 A ac	0.0 A ac	0.0 A ac	Stable	9:53:30 AM
2	9:53:30 AM	00:00.4	21.2 A ac	12.1 A ac	0.5 A ac	Unstable	9:53:30 AM
3	9:53:30 AM	01:20.6	8.1 A ac	7.7 A ac	7.5 A ac	Stable	9:54:51 AM
4	9:54:51 AM	02:06.5	7.5 A ac	7.4 A ac	7.3 A ac	Stable	9:56:57 AM
5	9:56:57 AM	00:01.1	7.0 A ac	1.0 A ac	0.2 A ac	Unstable	9:56:58 AM
6	9:56:58 AM	58:34.6	0.1 A ac	0.0 A ac	0.0 A ac	Stable	11:55:33 AM
7	11:55:33 AM	00:00.3	20.8 A ac	11.7 A ac	0.3 A ac	Unstable	11:55:33 AM
8	11:55:33 AM	01:23.3	8.4 A ac	8.0 A ac	7.8 A ac	Stable	11:56:56 AM
9	11:56:56 AM	01:59.3	7.8 A ac	7.7 A ac	7.4 A ac	Stable	11:58:56 AM
10	11:58:56 AM	00:00.7	6.6 A ac	1.3 A ac	0.2 A ac	Unstable	11:58:56 AM
11	11:58:56 AM	00:04.5	0.2 A ac	0.1 A ac	0.0 A ac	Stable	11:59:01 AM

Table 1.

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