

# Event logging with a Fluke 189

## Application Note

One of the major features of the Fluke 189 digital multimeter (DMM) is its ability to “do logging.” This application note explains what kind of logging the Fluke 189 meter can perform, how to use the event logging feature, and the information that can be provided to you. This note also discusses briefly how FlukeView® Forms PC software is used to increase the power of the logging feature.

### Differences between the Fluke 189 and a data logger

First and foremost, the Fluke 189 was not built to do data logging in the traditional sense of a dedicated data logger. Typically, the goal of a data logger is to sample an input signal at a rate sufficient enough to be able to track something of interest that you expect to be contained within the signal. This often means that it is desirable to sample the signal as fast as possible so you don't miss anything. The problem with this approach is you need a large storage place for the fast data sampling that is taking place. You can also end up wading through a lot of redundant data that is considered “normal” to find the exceptional data (or lack of) that you are interested in.

The Fluke 189 meter was not designed with a large memory for data storage, yet it does an effective job of monitoring and logging data from an input signal enabling you to detect if and when a system is operating abnormally. This is accomplished by a feature we call *event logging*.

### Introduction to event logging

Event logging can be thought of as an extension of the “Touch Hold” feature of the original Fluke 87. (Touch Hold is now called “Auto Hold” on the 187/189.) When the Touch Hold feature is activated, the meter waits until a period of stability has been reached, then it beeps and freezes (holds) a stable reading on the display for the user to see. If the input changes to the point that it is no longer stable then becomes stable again, the meter will beep a second time and hold a new reading on the display.

Event logging encompasses a similar scheme. When the Fluke 189 is logging it is looking for periods of stability. Obviously, while waiting for a stable signal, there are periods of instability as well. What happens during the logging process is that as each period of stability or instability ends the meter will log information about that period to its internal memory. The information that is logged for each stable or unstable period is a start time, stop time and between that period of time the maximum reading, minimum reading and average reading. The event logging feature is designed to store only enough information to describe any *changes*; i.e., events, to the input signal.

### Event logging data

The Fluke 189 excels at logging transition events, but does not have the kind of large graphical display needed to view the event data. This is where FlukeView



Forms software comes into the picture, allowing you to view the data in table or graph form on a PC. An example is shown in Figure 1:

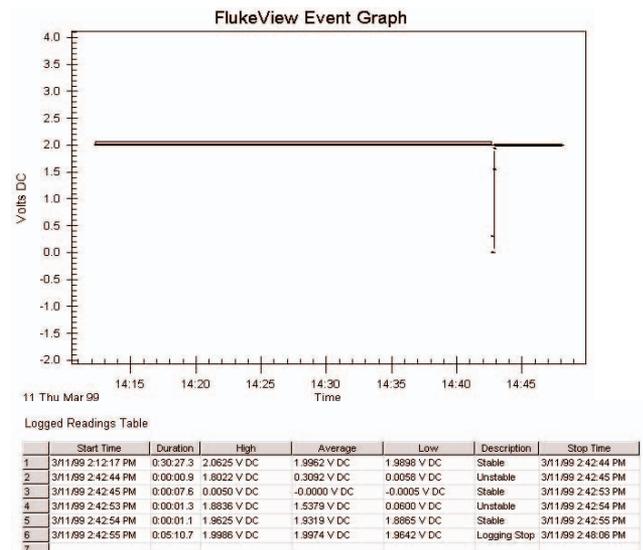


Figure 1.

Looking at this data, you can see that the logging session started at 2:12:17 PM and ended at 2:48:06 PM with an elapsed time around 36 minutes. You can also see that the signal being measured was stable at 2 V for most of the logging session. However, there were two occurrences of instability detected by the meter during a 11-second period just before 2:43 PM. The graph gives a visual indication of what happened around that time. What is interesting about this example is that the table of data shows only six “events” needed to be stored in the meter memory over the entire 36 minutes of logging to capture the essence of what happened.

What this illustration shows is that with event logging, only a very small amount of memory is needed to store the information. To capture the same data using traditional data logging would require a one-second sample rate over the entire 36 minutes which would have produced 2160 records of data, yet that level of detail was not required to detect the problem.

### Definition of a stable and an unstable signal

So what determines if a signal is stable or unstable? The original Touch Hold feature of the Fluke 87 that was mentioned earlier uses the criteria: “if the input signal changed more than 4 percent of the current measurement range” then a period of instability would be started. Once the input signal settles to within that 4 percent window for at least one second, then a period of stability begins again.

For event logging, a similar approach is taken, but percent of reading is used instead of percent of range. This event stability window defaults to 4 percent. While this value can be modified with the FlukeView Forms software (Version 1.5 or later), we will continue to refer to the default value in this document.

A stable period will continue to be stable if the input signal does not vary more than  $\pm 4$  percent from the input signal amplitude at the beginning of a stable period. If during this time the input signal jumps or drifts outside the  $\pm 4$  percent window and is detected by the meter as being outside the window, the meter will end that stable period and log (record) the input signal’s high, low and average values for that stable period of time. The meter will then attempt to start another stable period. If the meter finds the input signal can not stay within the  $\pm 4$  percent window after trying to start a new stable period, it then defines a period of time as unstable.

### Minimum event duration time

If the input signal jumps outside of the  $\pm 4$  percent window and then quickly returns back into the window, the duration of the event may be too short for the Fluke 189 to detect. There is a minimum amount of time an event must exist outside of the 4 percent window before the meter will detect and record the event. Table 1 below shows some typical minimum event duration times for the various input functions.

### Logging interval

If you have already experimented with the Fluke 189 logging feature, you are probably aware that the meter also has a *Logging Interval* setting. This is a time value that can be set in the meter setup function. The meter will allow you to set the value anywhere from 0:00 to 99:59 (hours:minutes). The factory default value is 15 minutes. The logging interval value is very similar to a sample rate that you might set for a traditional data logging session. Contrary to traditional data logging where one reading is saved at the sample interval, event logging stores the minimum, maximum and average values seen during a set interval of time. So if you use a logging interval, you will see a mixture of data within the logging session – some generated from the event logging, and some generated from using the interval (see section on how events and intervals blend together).

Keep in mind that using the logging interval is optional. Setting it to 00:00 will mean that no logging interval will be used and the meter will do pure event logging only. This may be a useful feature if you use FlukeView Forms software to view logging data. But keep in mind that only the interval average is viewable from the front panel of the meter.

Input Function	Minimum Detectable Event
V ac, mV ac, V dc, mV dc, Ohms, Continuity, Diode, A ac, mA ac, $\mu$ A ac, A dc, mA dc, $\mu$ A dc	50 ms
Exceptions: 50 mV dc, 500 Ohms, 5 A dc, 50 mA dc, 500 $\mu$ A dc	100 ms
ac + dc V, ac + dc mV, ac + dc A, ac + dc mA, ac + dc $\mu$ A	1.5 sec
Exception: ac + dc 5 V	3 sec
Conductance	250 ms
Capacitance (1 $\mu$ F is 6.7 samples per second)	300 ms
Temperature	500 ms
Frequency while in: V ac, mV ac, V dc, mV dc, Ohms, Continuity, Diode, A ac, mA ac, $\mu$ A ac, A dc, mA dc, and $\mu$ A dc	50 ms
Frequency while in: 50 mV dc, 500 Ohms, 5 A dc, 50 mA dc, 500 $\mu$ A dc	100 ms

Table 1.

Setting the logging interval to 00:00 will mean that you can not view any logging data on the front panel of the meter.

Most of the time you will probably want to set a logging interval. If you select a logging interval of 15 minutes, the meter will record a minimum, maximum and average value based on all the readings encountered during each 15-minute period of time. The meter will always reserve 288 of its 995 memory locations for data resulting from these intervals. That leaves 707 memory locations to store event logging data. Keep in mind, if more than 288 memory locations are needed for interval data, the meter will start using up any of the unused 707 event logging data memory locations. Once the 995 memory locations become full, logging is automatically turned off.

### Calculating what logging interval to use

While the logging interval acts similar to a data logging sample rate, you need to think about it differently. Rather than keeping the interval small, its best to make it large. For example, say you want to monitor for three days or 72 hours. You want to be certain you have some logging data over the entire 72 hours regardless of how stable or unstable your signal is. Calculate the necessary interval as follows:

$$\frac{\text{Length of test}}{288} = \frac{\text{minimum logging interval}}{\text{interval}}$$

For three days or 72 hours or 4320 minutes this works out as:

$$\frac{4320 \text{ minutes}}{288 \text{ memory locations}} = 15 \text{ minutes}$$

This result shows that a 15 minute or greater interval is needed to guarantee that there will be enough interval data storage for the full 72 hours. If you believe your signal is going to be mostly stable and therefore generating only a few logging events, you could make the logging interval smaller. You can do this because some of the 707

event logging memory locations will not be used up for recording events and will therefore be available for recording interval data instead. This trick of lowering the logging interval only works if you know those events will not fill up the other 707 event logging memory locations first. But keep in mind, even with the longer logging intervals, the Fluke 189 will catch events each time the input signal jumps outside the  $\pm 4$  percent stability window.

You should also be aware of the following: each automatic range change will eat up two logging interval memory locations. A few range changes are okay, but any more will require you to place the meter into manual range, selecting the input range needed to measure the highest expected signal.

### Cases where a smaller logging interval is valuable

For most uses, the factory default value of 15 minutes for the logging interval is sufficient to provide some logging data regardless of what happens with the event logging portion of the logging process. There are some times however, when it may be desirable to use a smaller interval:

- You need to have definite minimum, maximum and average values "on paper" for set intervals that are less than 15 minutes in length.
- You have a slow changing signal and want more detail about what is happening within the 4 percent stability window.
- Your logging session will not be very long in duration and you know that the meter will be able to hold all the interval data you plan to log.
- If you don't have FlukeView Forms software. If this is the case, you will not be able to view the event data. The only logging data you can see on the meter is the average value and stop time of each interval. So if your logging application allows, it might be advantageous to use a smaller interval so more data that is viewable can be collected.

### Cases where a larger logging interval is valuable

In some instances, you may want the logging interval to be longer than the 15 minute factory default:

- You need to have definite minimum, maximum and average values "on paper" at set intervals that are more than 15 minutes in length.
- You want minimal interference between the interval data and any event data, but aren't willing to turn off the logging interval by setting it to 00:00. That is, you want some readings at intervals once in a great while for feedback over the course of the logging session, but you are mainly focused on capturing transition data from the event logging process.

### Starting and stopping a logging session from the meter

Starting a logging session on the meter is pretty simple. Once you select the desired meter input function, you start the logging function by pressing the LOGGING key (the yellow shift button followed by the REL button). If there is already some logging data in the meter memory, the meter will prompt with a message of "CLR?" in order to ask if it is OK to clear this out. Press the YES button (up arrow) if this is ok, or the NO button (down arrow or let timeout) to cancel the logging session. Once memory is cleared, logging will begin. The display will show the LOG annunciator at the top, the elapsed time of the logging session will appear in the lower right corner, and the index number of the interval in progress appears in the lower left corner. There will also be a small flashing MEM symbol just above the index number to show that logging data is going into the meter memory. The index number begins at 001 and increments at the start of each new interval (or range change). Note that the index number will **not** increment when events are detected.

To stop logging, press CANCEL (the yellow shift button followed by the Hz button) or press LOGGING (yellow shift button followed by the REL button). Turning the rotary switch will halt the logging session as well, but this is not recommended since it is possible for stray readings to be logged while the rotary switch is being moved.

The logging session will also stop if the battery becomes low or if the memory becomes full. If the memory does fill up, the word "End" will appear in place of the index number in the lower left corner of the display.

### Viewing logged data using the meter

After a logging session is complete, you have two choices to view the logging data. You can transfer the data to the FlukeView Forms software, or you can choose to view a limited portion of the data directly on the meter display. Keep in mind that the meter is not able to show any of the event data that was collected or the minimum and maximum value for interval data. What you can view is the average reading for each logging interval. To do this, turn the rotary switch to the VIEW MEM position, then press Logging (press the yellow button followed by the REL button).

The meter will begin by showing the average reading during the first interval. The index number in the lower left corner will read 001 to indicate this fact. The time that the interval concluded is shown in the lower right corner. This is a time of day value with a format of hour and minute. Since seconds are not shown, you would see the same time for more than one interval if the logging interval was set to less than one minute.

To see the average of the next interval, press the up-arrow button. The index number will change to 002. If you want to move backwards through the data, press the down-arrow button. When you reach the end of the data, the up button will wrap the data around to show the beginning again. Likewise, when you are at the beginning of the data, the down button will show you the last interval.

If one or more overloads happen during an interval, an OL will be displayed in the secondary reading area of the display. Overload readings are ignored in calculation of the average for the interval with the overload.

If a range change happens during an interval, the meter will record the data for the portion of the interval spent in each range. In such a case, the meter will display the average reading for each portion – the time of day reading will reflect the partial interval. This is a side effect of using Auto Range during a logging session. When a range change is logged it will occupy one of the 288 reserved interval locations. If this is a concern you can set the meter in manual range before beginning a logging session.

### Viewing logged data using FlukeView Forms PC Software

If you want additional viewing capabilities for your logging data, you can use the FlukeView Forms software to transfer the data from the meter memory into a PC. FlukeView Forms has various ways to view the data in graphical and tabular form (see event logging data). An important feature is the ability to "zoom in" on graphs containing event data to get more visual detail of what took place. The data can also be saved in a database on the PC or printed for later review.

### How events and intervals blend together

As we've discussed, the Fluke 189 will log event data in addition to interval data at regular time intervals. Since two types of data are being logged, it can be confusing to think about how both of these mix together to make up the logging session as a whole. FlukeView Forms enables you to see all this data obtained during a logging session. Figure 2 illustrates how the meter ends up storing this mixture of data and how it will appear graphically in the FlukeView Forms software.

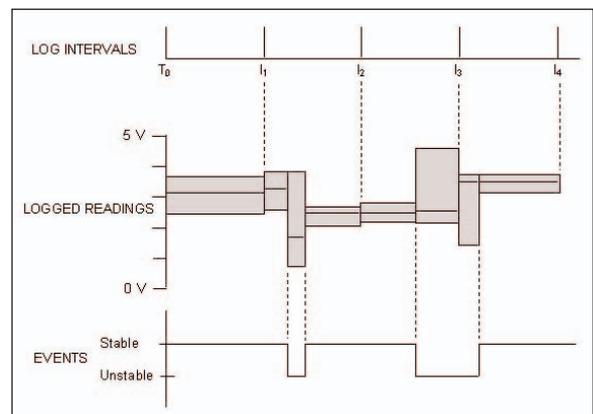


Figure 2.

At the top of the Figure 2 is a time line indicating when the end of one logging interval takes place and the start of another logging interval begins. The logging session starts at time  $T_0$ . Intervals are shown ending at times  $I_1$ ,  $I_2$ ,  $I_3$ , and  $I_4$ . At the bottom of Figure 2 is a time line showing when the meter is logging stable or unstable signals. The logging session starts with a stable signal, then shows two periods of an unstable signal occurring.

In the center of Figure 2, an event graph is depicted which looks like an event graph in the FlukeView Forms software. The dashed lines indicate when the Fluke 189 will log for the preceding time period the high, low, and average measurement and the ending time stamp. The FlukeView Forms software constructs a box, whose vertical height represents the high and low measurements for a given logging period and whose horizontal length represents the period duration. The average for that period is shown as a straight line through the box. Table 2 contains an explanation for each box.

Looking at Figure 2 shows that the logging intervals get added to the logging results at regular periods of time. The events also get added to the logging results whenever a transition to or from a stable state occurs. Note that when an interval expires, it will split up any period of stability (or instability) and cause a new logging period (box) to be started. FlukeView Forms logged readings table and logged readings graph have the capability to show just the interval data or just the event data if this is preferred. You can do this by placing the mouse pointer over the logged readings table, clicking the right mouse key and selecting "show data." While you are doing this, you may also want to try right clicking while the mouse pointer is over one of the event graphs and selecting view.

Box #	Explanation
1	The first box is generated because a logging interval (I1) came to an end
2	A stable signal went unstable; the box will represent the stable period that has come to a close
3	The signal became stable again; data is logged about the unstable period
4	The second logging interval (I2) has expired (this interval has been split into three pieces because of some events)
5	A stable signal went unstable
6	The third logging interval (I3) expired
7	The unstable period ended
8	A fourth logging interval (I4) has ended

Table 2.

### Real time event logging using the FlukeView Forms PC Software

FlukeView Forms software 1.5 and higher support event logging on the PC even when the meter does not offer internal logging (previous versions of FlukeView Forms software supported online logging only with the Fluke 189).

When used with the Fluke 189, you have an option to let the meter determine the events, or let the PC determine the events.

- If you choose to have the meter determine the events, you maintain the best time resolution (minimum detection time) for detecting and recording events. The meter has a temporary buffer of ten memory locations that FlukeView Forms reads, so that short events are not lost.
- If you choose to have the PC determine the events, you have a slower detection time, but gain the ability to log both the primary and secondary display's data as well as choosing either a fixed threshold (stable window) size, or a relative threshold and set both the threshold percent and a minimum threshold size.

FlukeView Forms also allows you to specify different levels of compression above or below some values when real-time logging. For instance, you might specify that you only want interval data for reading between 100 and 130 V ac, but want interval and input data above the 130 V limit, and minimum data (combine interval and input data) below the 100 V limit.

FlukeView Forms (1.5 and above) allows you to change the meter's stored "event stability window size" parameter. This allows you to specify the amount of change you consider significant for your application.

For events involving multiple locations, FlukeView Forms can link data from up to eight different meters on the same graph.

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