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Measuring short interrupts on the mains with a Fluke ScopeMeter® 190 Series II

Application Note

Electrical energy is the driving force of today's world. It is available almost everywhere you go, and is capable of driving all sorts of equipment from heating and cooking equipment, through motors and ventilators to the PC that this application note is written on. And it's available all the time. Or is it?

Power interruptions

Unfortunately the unconditional availability of electrical power can never be taken for granted. In fact, quite frequently interruptions occur of various durations. Many of these pass unnoticed, but some may prevent your equipment from working properly. The longest interrupts are obviously the ones that make all lights go down and all equipment stop. But sometimes, we see only a single piece of equipment blink as if the power has been interrupted, after which operation continues immediately with nothing else apparently indicating that anything has happened. This then raises question of whether the 'hiccough' was due to a power malfunction, or to the fact that the affected piece of equipment itself is faulty.

An oscilloscope from the ScopeMeter 190 Series II can be a valuable tool in finding answers here, as it allows you to detect these short-duration interrupts of the electrical power system.

Pulse width triggering

ScopeMeter 190 Series II oscilloscopes are equipped with a pulsewidth-trigger mode. This trigger mode is able to detect, for instance, the pulse width in a repetitive signal. But it is also capable of detecting the absence of a signal for a certain amount of time, for instance of the mains voltage.

When the oscilloscope is used to monitor the mains signal, an interruption will trigger the oscilloscope and the waveform information will be "frozen" in the oscilloscope's memory. If more such events should occur, the scope screen will automatically be updated for each such event, and the successive events will be stored in the REPLAY-memory. The whole sequence of events can then be re-played and analyzed from the scope screen which also displays a date- and timestamp. The replay screens can be copied to a PC for documenting and archiving.

Here's a set-up that allows you to detect the moments that the mains voltage is interrupted.

Instrument set-up

The mains voltage is a sinusoidal ac voltage. This means that it is half the time positive and half the time negative. A full cycle takes 20 ms if the line frequency is 50 Hz, or 16.6 ms for 60 Hz systems.

Given this ac voltage, we can set-up the ScopeMeter to detect if the mains voltage is interrupted. To do so, we set up the ScopeMeter to recognize the absence of any voltage for longer than ¾ of a cycle, this is 15 ms (or 12.5 ms for a 60 Hz system), as this can only happen during an interrupt of the normal cycle.

Connect the ScopeMeter probe to input A, and connect the probe ground clip (alligator) to the mains neutral. Connect the probe tip to the 'live' mains line. Be careful in making these connections as the mains system carries hazardous voltage! Use only the safety-designed accessories described with the Fluke ScopeMeter.

Alternatively, if a low-voltage transformer is part of the system under test, measure on the low-voltage side of that transformer as this provides the necessary safety barrier.

Select the ScopeMeter to work in 'Scope' mode, and make sure the instrument is in 'Auto' mode (see upper right corner of the screen). If it is not in 'Auto' mode,

press the green AUTO/MANUAL button to set the indicator in the upper-right corner to read 'Auto'. A continuous sinewave will now be visible. Change the time-base setting to give about 2 or 3 cycles per horizontal division, so select 20 or 40 ms/div (see figure 1).

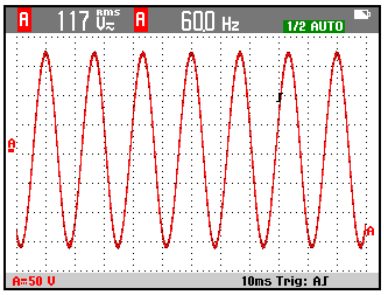

Figure 1: *60 Hz mains voltage using AUTO-mode.*

Change the horizontal trigger position to a position to the right of the screen, e.g. at a position three divisions from the right side of the screen. Look at the ƒ-symbol in Figure 1. A continuous sinewave will remain visible and is repeatedly refreshed on screen. The vertical position of the ƒ-symbol marks the voltage level that the trigger system is responding to.

Figure 2: *Menu layer for pulse-width trigger settings.*

Now select the 'Trigger' menu, and press F4 (Trigger options) and select "Pulse Width on A" from the menu. Press Enter. You will notice that a new menu layer appears. Select the negative oriented pulses ('U'-shaped pulses) and the condition 'Pulsewidth >t ', select 'Update on trigger' in order to catch successive interrupts rather than only one.

Press Enter until all selections are made, and the menu text is switched off again. The up and down controls (s and t) can now be used to change the time duration of the interrupts that the scope will respond to. Set this to 15 ms (or 12.5 ms when working on a 60 Hz system). The oscilloscope is now ready to respond to any short-term interrupt of the mains voltage.

Figures 3 and 4 provide some examples of power interrupts that were captured.

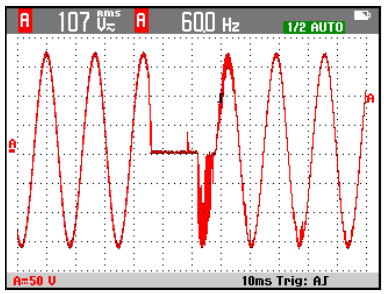

Figure 3*: Power disruption due to a loose contact in the wiring.*

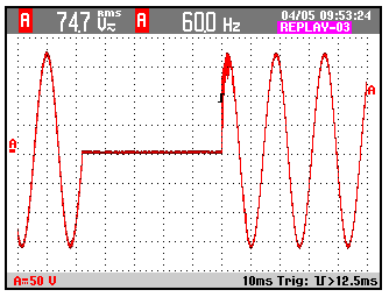

Figure 4: *Interrupt as stored in the replay-memory. Note the date- and time-markers that were automatically attached to the recording.*

Conclusion

Malfunctioning of electronic equipment is sometimes related to short-duration interrupts of the mains supply. This calls for a tool to find such interrupts, complete with date and time of occurrence. Fluke ScopeMeter 190 Series II oscilloscopes are capable of conveniently detecting and storing such power interrupts. Even if many such events occur over a longer period of time, up to 100 individual events can be stored, complete with date- and time-indicator, making longer-term power monitoring easier than ever.

Fluke. *Keeping your world up and running.*

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