

## Capturing Impulses with the Fluke 123

These application notes are designed to explore the use of your Fluke 123 Scopemeter™.

Our experiment will test the instrument on its ability to record short duration impulses that occur at a random rate. For any digital recording instrument there is a point at which a non-repetitive impulse will not register on the unit in a reliable manner. This point depends upon the sweep speed setting (horizontal axis) and the length of the impulse (duration).

It is important that you are familiar with the scopemeter and its functions.

The next step is to make sure the unit has ALL the settings in a known state. Sometimes settings made for past measurements will remain in the instrument, adding confusion for future measurements.

Yes you could reset the unit as outlined in the manual. This exercise will help familiarize you with all of the settings of the unit.



After turning on the unit, push the **Channel AV-Hz-A-ohms-Cap** button.  
 Select the one option noted below:

- VAC
- VDC
- VAC+DC
- dB
- OHM
- CONTINUITY
- DIODE
- CAP
- Hz
- AMPERE PROBE 0.1 mV/A
- AMPERE PROBE 1 mV/A
- AMPERE PROBE 10 mV/A
- AMPERE PROBE 100 mV/A
- AMPERE PROBE 1 V/A
- AMPERE PROBE 10 mV/mA
- PROBE TYPE AMP AC
- PROBE TYPE AMP DC
- PROBE TYPE AMP AC+DC
- TEMPERATURE 1 mV/deg C
- TEMPERATURE 1 mV/deg F
- PEAK MAXIMUM
- PEAK TO PEAK **select**
- PEAK MINIMUM
- DUTY CYCLE POSITIVE
- DUTY CYCLE NEGATIVE
- PULSE WIDTH POSITIVE
- PULSE WIDTH NEGATIVE
- CREST
- PHASE



Push F1 for METER OPTIONS  
 Select the options noted below:

- COUPLING AC+DC **select**
- COUPLING AC ONLY
- SMOOTHING FAST **select**
- SMOOTHING NORMAL
- SMOOTHING SMOOTH
- ZERO REF OFF **select**
- ZERO REF ON

Push F2 for TREND PLOT options  
 Select the options noted below:

- TREND OFF (F1) **select**
- TREND RESTART(F2) **n/a**
- MIN/MAX AVERAGE (F3) **n/a**
- CONTRAST (F4) **n/a**



Push the **SCOPE MENU** button  
 Select the options noted below:

- INPUT A - DC **select**
- INPUT A - AC
- INPUT A NORMAL **select**
- INPUT A INVERT
- INPUT B - DC **select**
- INPUT B - AC
- INPUT B NORMAL
- INPUT B INVERT
- INPUT B OFF **select**

Push F1 for Scope Options:

- SCOPE MODE NORMAL **select**
- SCOPE MODE SINGLE SHOT
- SCOPE MODE ROLL
- WAVEFORM MODE NORMAL **select**
- WAVEFORM MODE SMOOTH
- WAVEFORM MODE ENVELOPE

Push F2 for PROBES

Push ENTER to set up probes on A:

PROBE ON A 1:1 LEADS	<b>select</b>
PROBE ON A 10:1 V	
PROBE ON A 20:1 V	
PROBE ON A 100:1 V	
PROBE ON A 200:1 V	
PROBE ON A 1,000:1 LEADS	
PROBE ON A 0.1 mV/A	
PROBE ON A 1 mV/A	
PROBE ON A 10 mV/A	
PROBE ON A 100 mV/A	
PROBE ON A 1 V/A	
PROBE ON A 10 mV/mA	
PROBE ON A 1mV/deg C	
PROBE ON A 1mV/deg F	

Repeat for PROBES on Ch B if B is used:

PROBE ON B 1:1 LEADS	<b>n/a</b>
PROBE ON B 10:1 V	<b>n/a</b>
PROBE ON B 20:1 V	<b>n/a</b>
PROBE ON B 100:1 V	<b>n/a</b>
PROBE ON B 200:1 V	<b>n/a</b>
PROBE ON B 1,000:1 LEADS	<b>n/a</b>
PROBE ON B 0.1 mV/A	<b>n/a</b>
PROBE ON B 1 mV/A	<b>n/a</b>
PROBE ON B 10 mV/A	<b>n/a</b>
PROBE ON B 100 mV/A	<b>n/a</b>
PROBE ON B 1 V/A	<b>n/a</b>
PROBE ON B 10 mV/mA	<b>n/a</b>
PROBE ON B 1mV/deg C	<b>n/a</b>
PROBE ON B 1mV/deg F	<b>n/a</b>

Push the **SCOPE MENU** button

Push F2 for PROBES

Select PROBE AC ADJUST.....

PROBE AC ADJUST=NO ADJUST	<b>select</b>
PROBE AC ADJUST=ADJ 10:1	
PROBE	

Push the **SCOPE MENU** button

Push F3 for TRIGGER

INPUT A	<b>select</b>
INPUT B	
EXT	
VIDEO ON A	
SCREEN UPDATE=FREE RUN	<b>select</b>
SCREEN UPDATE=ON TRIG	
AUTO RANGE=>15 Hz	<b>select</b>
AUTO RANGE=>1 Hz	



Push the **USER OPTIONS**

Select GRID TYPE ...

GRID TYPE=LINES	<b>select</b>
GRID TYPE=DOT	
GRID TYPE=NO GRID	

Push the **USER OPTIONS**

Select DATE ADJUST ...

SET the DATE	<b>set</b>
SET the FORMAT	<b>set</b>

Push the **USER OPTIONS**

Select DATE ADJUST ...

SET the TIME	<b>set</b>
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Push the **USER OPTIONS**

Select AUTOSET ADJUST ...

SIGNAL>15 Hz	<b>select</b>
SIGNAL>1 Hz	
COUPLING	
SET TO DC	<b>select</b>
UNCHANGED	

Push the **USER OPTIONS**  
 Select **POWER DOWN ...**  
**POWERDOWN**

AFTER 5 MINUTES	
AFTER 30 MINUTES	
NEVER	<b>select</b>



Push the **USER OPTIONS**  
 Push **F3** for **VERSION & CAL...**

	<b>123</b>
SOFTWARE VERSION	<b>V01.04</b>
CAL NUMBER	<b>#1</b>
CAL DATE	<b>3/17/99</b>
BATTERY REFRESH DATE	<b>3/17/99</b>

varies Push **F1** **A MOVE**  
 Use vertical cursors to place horiz. axis 2 divisions up from the bottom of the grid.  
 varies Push **F3** **TRIGGER/SLOPE**  
 varies Use horizontal cursors to select positive rising trigger  
 varies Use vertical cursors to set trigger 3 divisions up  
 varies Scope screen should look the same as the view below:

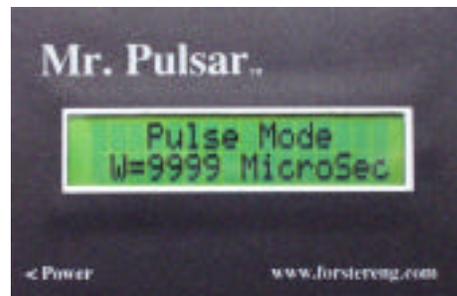
Push the **SAVE/PRINT**  
 Make any setting you wish or none



Next we need to set the trigger level and polarity  
 Go back to the main menu, turn off the scope if necessary

Push **mV/V** to obtain **2 V/d** on the Channel A gain setting

Set **Mr. Pulsar™** as shown below:



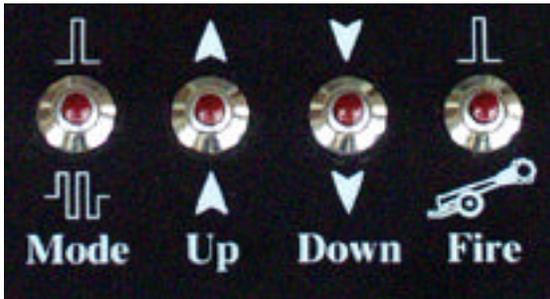
Use the **MODE** and **UP/DOWN** pushbuttons to get the above setting:

Push **TIME** to obtain **2 s/d** on the Channel A sweep setting

Connect the two instruments with a coaxial cable so the output of Mr. Pulsar is connected to the Channel A input of the scopemeter.

You may need the special coaxial cable BNC adapter that came with your scopemeter to convert the input to a BNC adapter. If you do not have coaxial cable, your nearby Radio Shack store will have the cable and or adapters to complete the connections. If all else fails, use the BNC to Binding post adapter provided with Mr. Pulsar to connect the test leads of the scopemeter. Remember, the red post goes to the probe on the scopemeter.

Now, every one or two seconds hit the FIRE button on Mr. Pulsar. You should see the impulse waveform appear for a brief time on the scopemeter.



Next perform the same test using various combinations of sweep speeds and pulse lengths.

Scopemeter sweep speed (SwSpd) can be set for nanoseconds per division, microseconds per division, milliseconds per division and seconds per division.

Some hints on timing:

- 1 second = 1,000 milliseconds
- 1 millisecond = 1,000 microseconds
- 1 microsecond = 1,000 nanoseconds
- 60 Hertz cycle = 16.666 milliseconds
- 60 Hertz cycle = 16,666 microseconds
- 60 Hertz cycle = 0.0167 seconds
- Third Harmonic of 60Hz) cycle = 5.555 milliseconds
- AM radio station (1000 on the dial) cycle = 1 microsecond

Mr. Pulsar's pulse output (PulDur) can be set for 2 microseconds to 9,999 microseconds (~10milliseconds).

Try the following checks, noting if the pulse was visible on the scopemeter. I will use the following abbreviations:

- ms = milliseconds
- µsec = microseconds
- ns = nanoseconds

The following tests will require you to use the triggering features of the scopemeter to capture single events. Your meter must be set to the correct settings noted below.

Push the SCOPE MENU button  
Push F3 for TRIGGER

INPUT A	select
INPUT B	
EXT	
VIDEO ON A	
SCREEN UPDATE=FREE RUN	
SCREEN UPDATE=ON TRIG	select
AUTO RANGE=>15 Hz	select
AUTO RANGE=>1 Hz	

The scope should show "NOTRIG" at the top of the screen

Push the FIRE button one time.

The horizontal sweep should start and "NOTRIG" should switch to "MANUAL". About every two seconds hit the FIRE button, you should see the impulses on the scope. When the sweep finishes, "NOTRIG" should appear.

Push the FIRE button one time.

The horizontal sweep should start and "NOTRIG" should switch to "MANUAL". About every two seconds hit the FIRE button, you should see the impulses on the scope. When the sweep finishes, "NOTRIG" should appear. Repeat this until you feel comfortable with the triggering.

Adjust the TIME selector pushbutton to have a sweep speed of 200 ms/d.

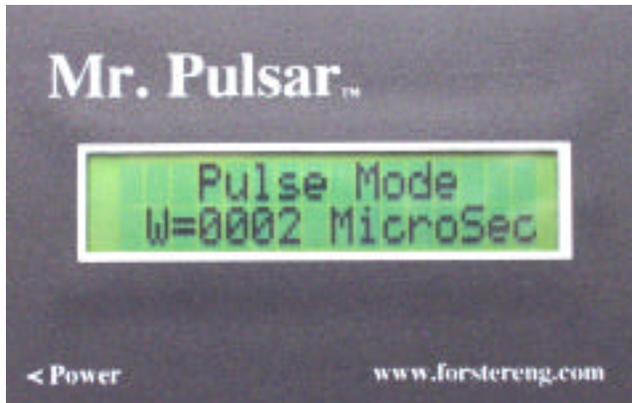
Push the FIRE button three (3) times as fast as you can. The horizontal sweep should start and "NOTRIG" should switch to "MANUAL". When the sweep finishes, "NOTRIG" should appear. Repeat this until you feel comfortable with the triggering. You may have to adjust the trigger level and trigger slope.

By the way, the vertical height of the impulse should be 2.5 divisions.

Adjust the TIME selector pushbutton to have a sweep speed of 20 ms/d. Push the FIRE button three (3) times as fast as you can. Not fast enough are you? The sweep is being completed in 20 msec times 10 divisions or 0.2 seconds. When the sweep finishes, "NOTRIG" should appear. Note that the width of the pulse is about 1/2 division or 10 milliseconds duration. Repeat this until you feel comfortable with the triggering.

Adjust the TIME selector pushbutton to have a sweep speed of 10 ms/d. Push the FIRE button one time. When the sweep finishes, "NOTRIG" should appear. Note that the width of the pulse is about 1 division or 10 milliseconds duration. Repeat this until you feel comfortable with the triggering.

Lets shorten the duration of the pulse and see what happens. Push the DOWN arrow on Mr. Pulsar to get to 2 microseconds.



Adjust the TIME selector pushbutton to have a sweep speed of 10 ms/d.

Push the FIRE button one time. The horizontal sweep should start and "NOTRIG" should switch to "MANUAL" If the scope triggers, you should see the impulse on the scope. When the sweep finishes, "NOTRIG" should appear. If the unit does not trigger, the last impulse will still be there.

Push MODE and go to a square wave to disturb the scope trace.

Push MODE again and go back the the 2 microsecond impulse. Now if the scope triggers, you will see the impulse.

At this point you should find that triggering is not reliable. Some impulses of this short duration would not be recorded.

Adjust the TIME selector pushbutton to have a sweep speed of 20  $\mu$ s/d. Alternate between the UP and FIRE button or the DOWN and FIRE button. This will make it easier to observe each new trigger as the duration changes. Triggering should be reliable.

Do the same for a sweep speed of 2  $\mu$ s/d. Triggering should be reliable.

Exactly where the scope fails to trigger properly will depend on many things:

The voltage level of the trigger setting (vertical adjustment of the trigger symbol above the zero volt X axis.

The shape of the input impulse.

The duration of the impulse. The shorter the impulse duration, the harder to trigger.

The polarity of the trigger setting. You set the trigger for a positive going impulse which is what Mr. Pulsar provides. Use the adapter provided with Mr. Pulsar and invert the impulse by connecting the probe to the Black terminal and the ground to the Red terminal.

If you try reversing the polarity of the impulse, go back to the startup MENU and F3 for TRIGGER settings. Use the horizontal cursors to set the trigger slope to negative. Triggering should resume for negative going impulses.

But you say the scope triggers for a positive going impulse, are you sure? It may be triggering for the end of the impulse from the Mr. Pulsar which is a negative going waveform.

Fortunately, in the real world of electrical noise, the impulses you will measure are usually a burst of impulses that will trigger the scope allowing you to detect the impulse of interest.

## How to get more information on Mr. Pulsar

Contact Chuck Forster at 608-835-9605 or [cforster@phasorlabs.com](mailto:cforster@phasorlabs.com). Check our website at [www.phasorlabs.com](http://www.phasorlabs.com).