Use of the Fluke 105B Scopemeter on the Farm

Safety

The following are safety items that should be considered when using the Scopemeter. These are in addition to the safety procedures detailed in the WPS Safety Manual.

Voltage Rating of the Scopemeter and Accessories

Scopemeter inputs are rated for 300 volts, therefore care must be used to ensure this voltage is not exceeded. This limitation is true for both the scope mode and meter modes. The Scopemeter probes, however, are rated for 600 v. Scopemeter CT's are typically rated for 600 v.

BNC to Banana Plug Adapters

The BNC to banana plug adapters do not have a voltage divider in them as the probes do (ie. 10:1 probes supplied with the Scopemeter. Therefore they must not be connected to equipment where the 300 v scopementer rating may be exceeded. Also, the outer shield of the BNC connector is metallic. Therefore, it may be energized if connected improperly or connected phase to phase. If the shield becomes energized there could be energized parts near the hands of the user.

Current Transformers

Current transformers are available that connect directly to the Scopemeter. Only these current transformers should be used with the scopementer. These current transformers convert the current to a voltage. The scopementer cannot measure currents directly. Therefore, the current transformers commonly used with the Fluke multimeters, CANNOT be used with the Scopemeter.

On Farm Measurements

The Fluke 105B Scopemeter (scope) can be used on the farm to check a variety of equipment including:

- Transients (Events which occur periodically but not every cycle)
  - Motor Starts
  - Fencers/Trainers
  - Faults
- Voltages
  - Cow Contact Area
  - Low Voltage Farm Voltages (120 v/ 277 v) see safety notes
  - Control Voltages (24 v to solenoid valves, relays)
  - Voltage Harmonic Distortion
- Currents (through the use of a current transformer) see safety notes
  - Motor Starts
  - Current Distortion

In addition to the above measurements the Scopemeter can measure or display numerous signals including:

- Radio Signals
- TV Signals
- Signals Induced in the measurement leads

It is important that the proper measurement techniques be used to ensure that images displayed on the Scopemeter are representative of the signals being investigated. Proper measurement techniques include but are not limited to: using the proper cabling to the Scopemeter, using a resistor to represent the impedance of the animal when appropriate, setting up the triggering, range and time properly.

Cabling

The Scopemeter is capable of displaying extremely fast changing short duration voltage events. However, it is important that when these types of signals are being monitored, that the proper cabling is used. The use of coaxial or twisted cable may be required. The use of cable which is not coaxial or twisted may cause the signal displayed on the scope to not be representative of what is being measured. The signal amplitude may be affected. The shape of the signal may be affected. The cabling may pick up signals other than that being measured.

The use of twisted pair or coaxial cabling is not typically necessary when measuring things such as motor starts, voltage distortion, and current distortion. They should also not be necessary for measuring the affects of fencers/trainers in the cow contact area provided that the lead lengths are not excessive.

Animal Impedance

A resistor should be used to represent the impedance of the animal to measure the currents that would be going through the animal.

Scope Settings

Scopes have four main groups of settings: time, range (voltage), input and triggering. It is important that the settings match the type of signal being measured. Failure to set scope up properly usually results in missed information but can cause the signal displayed to not be representative of that being measured. This document will detail these settings for detecting fencers/trainers in the cow contact area.

Scopemeter Settings

Before adjusting the Scopemeter settings, it is helpful to think about the signal being measured. Answer the following questions:

What is the range of the voltage being measured?
How fast does the event take place?
Does the event repeat?
Is the voltage AC, DC or both?
Is the shape of the event important?

The answer to these questions will help to set up the oscilloscope. Consider the above questions when reading the descriptions of the settings.

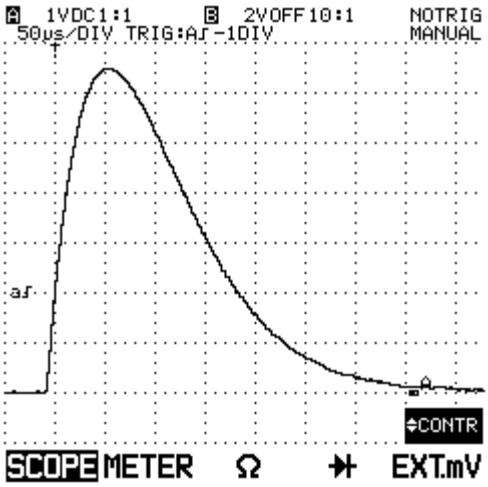
Voltage Range

The voltage range is the most straightforward setting. This setting should be selected such that the waveform is displayed as large as possible on the screen. It is especially important if measurements are going to be made. If the signal is too small on the screen the measurements may be inaccurate. This is even true of the automatic measurements taken through the measure menu. Graph 1 below shows the proper setting for the voltage range. The range is set to 1 volt/division. The peak signal magnitude is:

(1 volts / div x 6.5 div) = 6.5 volts.

Time

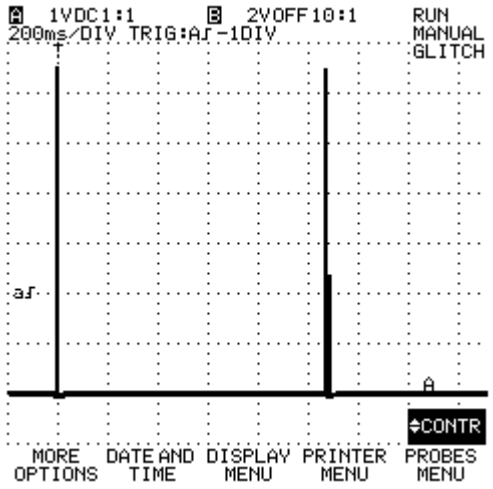
When determining the time setting two things should be taking into consideration: how long does the event last and how often does the event repeat? Consider a trainer (Blitzer Model 8200 by American Farmworks). The event (pulse) lasts approximately 0.3 milliseconds and repeats approximately every second. The graph below shows a pulse from the trainer.



Graph 1

To see the shape of the pulse the time setting was set to 50 microseconds/division. This setting allows the full pulse to be viewed on the display.

The graph below shows the time between the pulses from the trainer.



Graph 2

To see the time between pulses the time setting was set to 200 milliseconds/division. The two vertical lines represent two pulses. The time between the pulses is (200ms/div x 5.2 div) or 1040 ms (1.04 seconds).

Input A (or Input B)

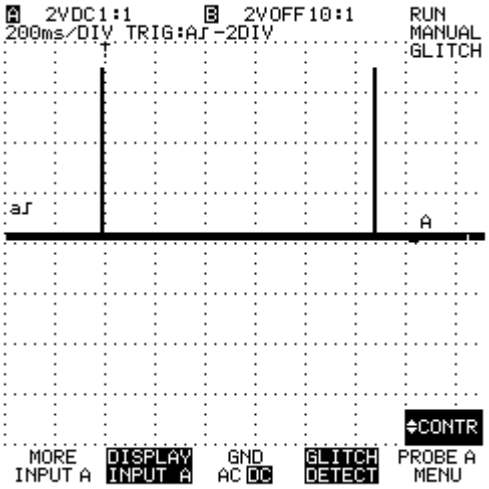
The input A settings define the parameters for measuring the signal on probe A. Pressing INPUT A provides the following options:

More Input A
Display Input A
GND, AC, DC
Glitch Detect
Probe A Menu

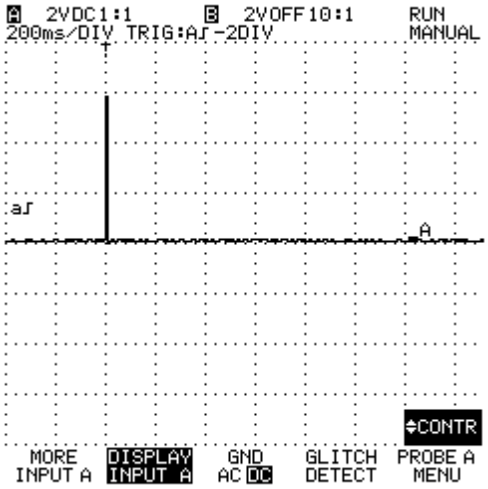
Display Input A: *Determines whether the A channel is active (on-active, off-inactive) assuming that channel A is being used, this should be on when measuring for the fencer/trainer.*

GND, AC, DC: Used to change the 'coupling' for channel A. When GND is selected a horizontal line is displayed where zero volts is indicated. DC coupling will show the AC attributes and DC attributes of the signal. AC Coupling will 'filter' or block the DC attributes. For example if the scope was connected to a 12 volt battery (DC supply) under DC coupling the display would show 12 volts dc. On the other hand, under AC coupling the display would show zero voltage. *When measuring for the fencer/trainer either AC or DC coupling could be used. However, AC coupling will filter out any DC voltage that may be present such as galvanic voltages.* Galvanic voltages are DC voltages that occur when dissimilar metals are in contact with each other.

Glitch Detect: Glitch Detect displays spikes that occur in the waveform. The scope is sampling at a very high rate (2.5 billion samples per second). The scope does not store and display all these values. The scope periodically combines a set of samples and stores that value. The scope then displays that combined sample. Without glitch detect, the scope combines and stores voltage samples in groups that are a function of the TIME setting. If voltage spikes occur between samples, those spikes will not appear on the display. When glitch detect is on, the scope stores and displays the highest and lowest voltages that sampled. The two graphs below demonstrate how this applies to measuring for the fencer/trainer .



Graph 3: Glitch Detect ON



Graph 4: Glitch Detect OFF

The left display is with glitch detect on where as the right display is with glitch detect off. No other settings were changed. With glitch detect off (right display) the scope missed some of the pulses because the pulses occurred between the times the scope was sampling the waveform. Also the peak voltage during the pulse was not displayed because the pulse was not at the peak when the scope sampled the waveform. In fact, when glitch detect was off the scope missed most of the pulses.

When measuring for fencers/trainers the glitch detect should be on. The exception to this is when the shape of the pulse is being viewed and the time scale is very short (see Graph 1).

Probe on Input A:(Found under the Probe A Menu):
This setting allows the user to connect probes that have different scaling factors to the scope. The probes that are provided with the scope are 10:1. This means that the voltage into the scope is 1/10 of that being measured. *In order to be scaled properly this should be set to 10:1 when using the Fluke supplied probes. However, when using the BNC to banana plug adapter the setting should be 1:1.*

Calibrate Probe on A: (Found under the Probe A Menu):
This function is used to calibrate the probe. Refer to the manual when performing the calibration. The calibration is for the probe not the scope.

Trigger Source: (Found under More Input A):
Digital scopes such as the Fluke 105B do not continuously display the waveform being monitored. Instead, the scope waits for a trigger to tell it when to display what is being monitored. The trigger source can be the signal being measured (Input A), the signal on

Input B or other sources. *When measuring for the fencer/trainer the trigger source should be Input A.*

Combine A & B: (Found under More Input A):
This feature allows channels A and B to be added or subtracted from each other. *When measuring for the fencer/trainer this should be OFF.*

Trigger

The trigger menu is used to configure when the scope will display the input signals. The scope waits for the trigger to occur then displays the waveform when the trigger occurs. If not for the trigger, the display would change so quickly that the waveforms would not be viewable. The trigger is determined by a voltage level and slope (i.e. whether the voltage is rising (+) or falling (-) through that level).

Pressing the Trigger button produces the following options:

More Trigger
Normal/TV
+ Slope/-Slope
Time Delay
Adjust Level

Normal/TV: *This should be set to Normal.* The TV mode is a mode used for testing television signals.

Adjust Level: This determines the voltage level that will cause the trigger to activate. The trigger will occur either when the voltage rises above this level or drops below this lever (see + Slope/- Slope) This can be set to Automatic or Manual. *Best results for measuring for the fencer/trainer are usually obtained by setting the level to Manual then adjusting the level to just above the noise. However, sometimes it is useful place it on automatic first.*

+ Slope/-Slope: In addition to the voltage level, the trigger is dependent on whether the voltage is rising through the level or dropping below the level. + Slope causes the trigger to occur when the voltage rises through the level. – Slope causes the trigger to occur when the voltage drops below the level. *It generally does not matter what this is set at for viewing the fencer/trainer.* However, if the wave shape of the fencer/trainer pulse is being viewed, this can affect where on the screen the pulse is displayed.

Time Delay: The time delay setting allows the user to capture and display portions of the waveform that occur before the trigger. The units for the display are divisions. *Similar to +/- Slope it generally does not matter what this is set at for viewing the fencer/trainer.* However, if the wave shape of the fencer/trainer pulse is being viewed, this can affect where on the screen the pulse is displayed.

Trace Repeat: (Found under More Trigger):
Trace repeat has two options: Single and Recurrent. When set on single, the scope will trigger and display the waveform and then wait for the user to press HOLD/RUN before triggering again. When set on recurrent, the scope will NOT WAIT for the user to press HOLD/RUN before triggering again. *For detecting the fencer/trainer this can be set on either single or recurrent.*

Trace Start: (Found under More Trigger):

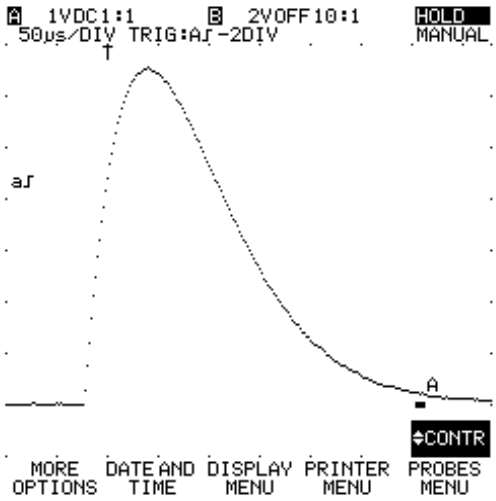
Trace start has two options: Free Run and Wait for Trigger. When set on free run the scope will not wait for the trigger to occur. It will start displaying the waveform after Hold/Run is pressed. When set on Wait for Trigger it will wait for the trigger before displaying the waveform. *For detecting the fencer/trainer this can be set on either Free Run or Wait for Trigger. Set the display to Wait for Trigger to capture a signal such as that in Graph 1. Free Run is usually used with extremely slow time scales such as in Graph 3 (200 ms/div)*

Other Scope Settings

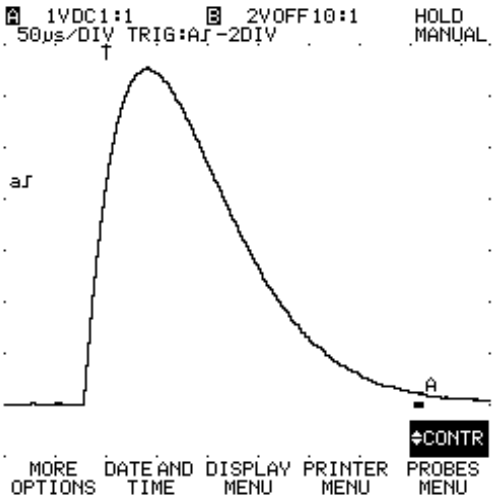
There are many other settings available on the Scopemeter. However, the following settings can impact the display of the waveform.

Dot Join: (Found under Display Menu)

The dot join function draws lines between the samples. The two graphs below demonstrate this function.



Graph 5: Dot Join OFF



Graph 6: Dot Join ON

It is difficult to see quickly changing signals without the dot join on. *Therefore, it is usually best to have the dot join on when looking for the fencer/trainer signal.*

Auto Set:

This function may be helpful for monitoring things other than fencers. However, most often it will prevent you from seeing the fencer/trainer signals. This is because it usually turns off the glitch detect and quite often changes the settings such that it does not trigger on the fencer signal. *Therefore it is recommended that this function not be used when looking for the fencer/trainer signal.*