



Scopes for Stray Voltage

Why use an oscilloscope?

Those guys from the PSCW
said just measure steady
state.....

Well the world is changing

Steady state is not all that's out there
and....

Leine's not just for breakfast
anymore



In the old days a chart recorder
was good enough



It still is
pretty good!

Today we have to measure...

- >Steady state
- >Motor starting transients
- >Impulses

Most of the units
we use do just
that, but they
record and display
things like:

Average rms

True rms

Averaged true rms

Maximum rms

Peak

Peak-to-peak

This complicates your explanation to the farm owner!

If you say 1.0 volts rms steady state is the level of concern (your level of action may be 0.5 Volts)....

How do you explain the higher magnitude values you recorded??

What's the
difference....

Average rms

True rms

Averaged true rms

Maximum rms

Peak

Peak-to-peak



Here's what your meters offer...

	Average rms	TRUE rms	Averaged true rms	Maximum rms
Chessel	yes	close	no	no
WaveRider	calculated	no	no	no
Metrosonics	no	yes	yes	yes
Fluke 189	no	yes	yes	yes
PMI(new)	no	yes	yes	yes
Scopes	"maybe"	yes	no	"sort of"

What is “Steady State” per the PSCW?

The average of the true rms cycle values averaged over 10 seconds.

What's acceptable to the PSCW....

	Average rms	TRUE rms	Averaged true rms	Maximum rms
Chessel	yes	close	no	no
WaveRider	calculated	no	no	no
Metrosonics	no	yes	yes	yes
Fluke 189	no	yes	yes	yes
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Scopes	"maybe"	yes	no	"sort of"

We still have those higher values
we recorded...

Maximum rms

Peak

Peak-to-peak

Maximum rms

This should be the maximum
true rms recorded.....

Maybe it is, but who said it had
to be a 60 Hertz cycle????

Peak and Peak-to-Peak

The Waverider
measures Peak. It
clearly shows the
magnitude
recorded..

Scopes measure Peak-
to-Peak (also Peak)
They clearly show the
waveform recorded..

Life in the fast lane...

Would be a lot simpler if we could observe the waveform of the voltage that caused the reading we recorded.

The problem is that these voltages are not always present for our measurement.

This creates two problems...

1. We need to use a scope.
2. We need to know how to set the scope up to capture the peak or impulse type event.

Capturing a waveform is kind of like musky fishing...

We need to set the line at the right depth and reel in at the right speed.

The “**right depth**” is the vertical scale of the scope in volts/div.

The “**rewind speed**” is the horizontal sweep speed of the scope.

The first cast....

Set the vertical range to about three times the rms value recorded.

Set the sweep speed at 5 milliseconds per division.

Set the unit to “trigger” and wait for a capture.

Trigger? Trigger? Trigger?

I thought these were cows not Roy Roger's
horse...

Well go to www.phasorlabs.com
and look up the application notes for
“Mr. Pulsar”. (better yet buy one)

Setting up the scope to trigger

There are several decisions to make when setting trigger levels:

Channel A, B or external

Rising or falling slope

Exact trigger level

Exact trigger time

After you capture the first ~~musky~~ waveform

Increase the vertical voltage scale two steps up
on your scope. (more volts/div)

Increase the sweep speed two steps faster on
your scope. (less time/div)

If the voltage recorded goes off the top of the display, increase the
voltage scale one step and try again.

Don't forget to save each
~~musky~~ waveform

You will want to print them out
to show your friends and
engineer.

Let's take a look at the fishy looking waveforms

Before we do we need to know about “duration” and “magnitude”.

Then we need to know how duration and magnitude can predict if a cow might have perceived the event.

Comments on “Duration”

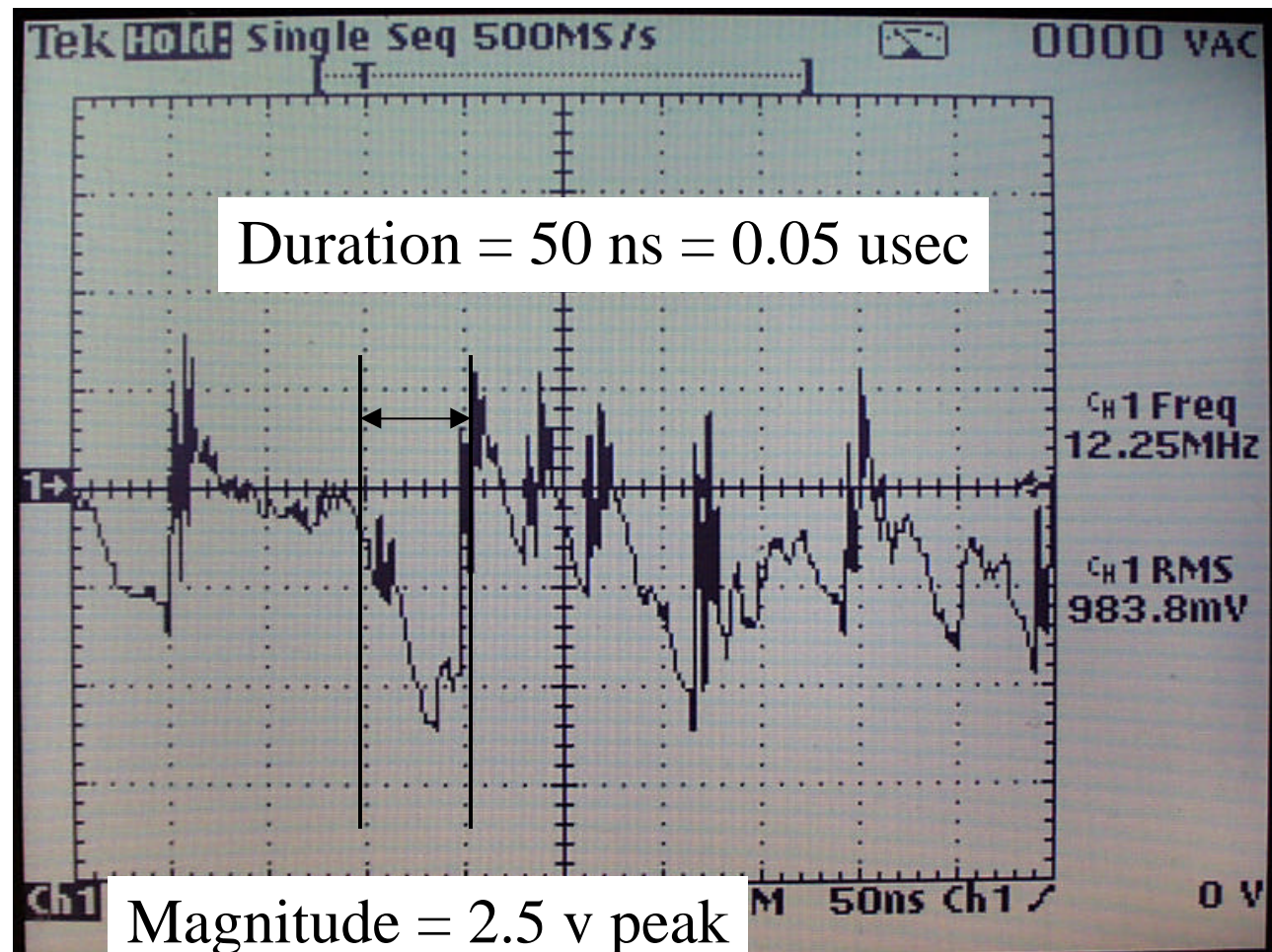
Duration may have two (2) meanings:

In stray voltage research work it is considered the time between zero crossings of an impulse.

In industry it may be considered the time difference between the point an impulse reaches 90% of the peak value and when it decays to 50% of the peak value.

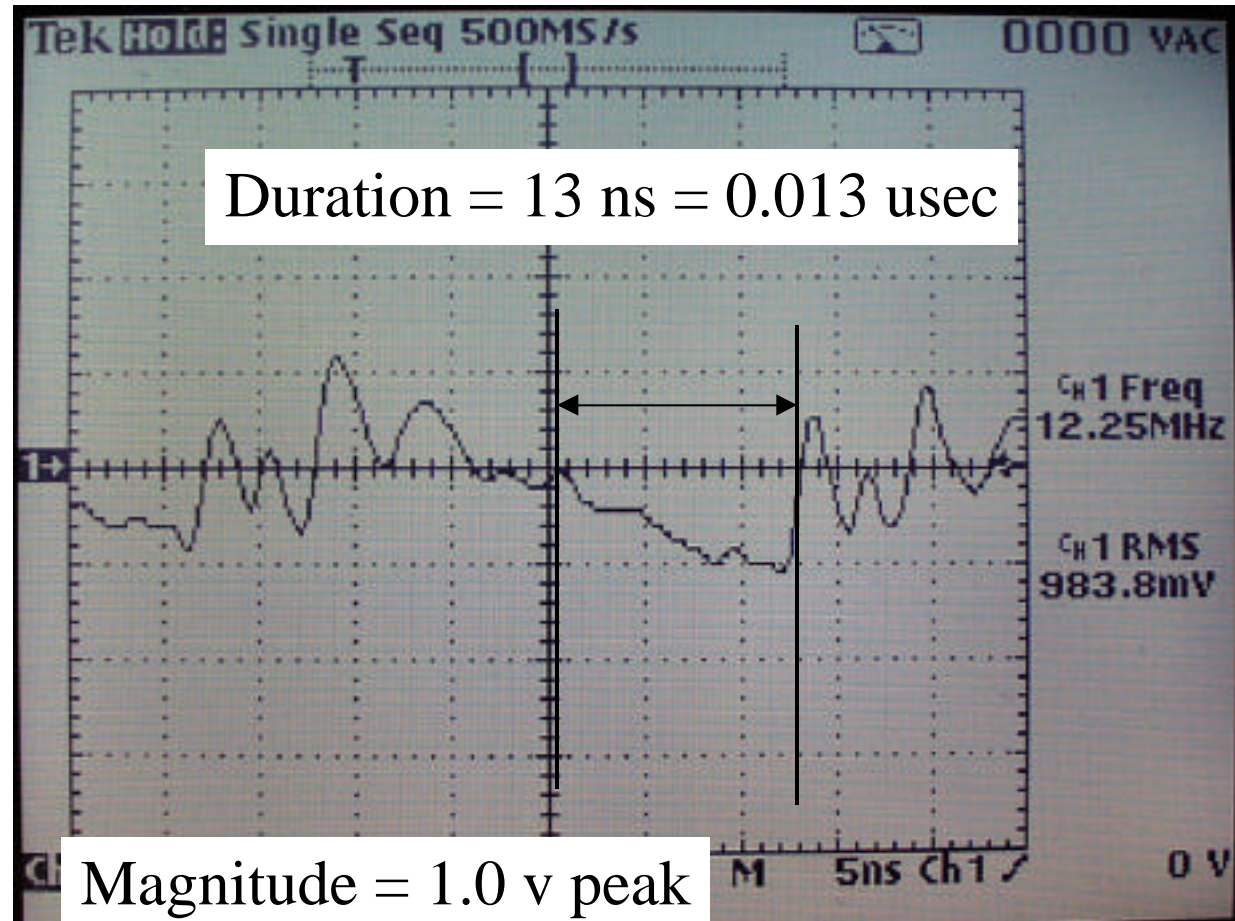
Is this “Duration”?

Here is an impulse burst similar to that caused by secondary load switching



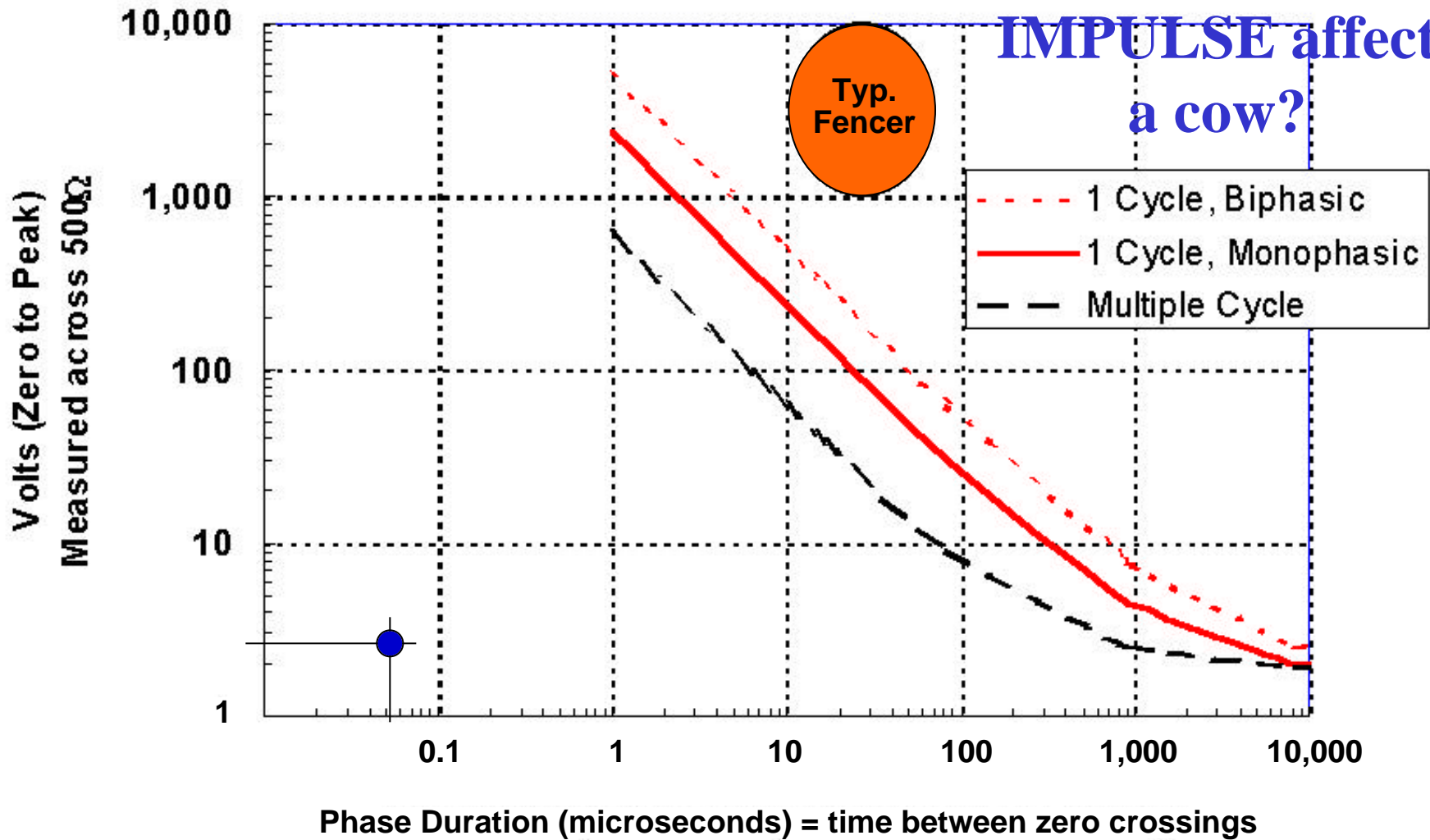
Or is this “Duration”?

Here is
part of the
SAME
impulse
burst
expanded
10 times



Behavioral response for 5% most sensitive cows, sine waves
muzzle to hooves exposure

How does an
IMPULSE affect
a cow?



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Nope,
didn't feel
a thing!

Some conversion factors:

1 second =

1,000 milliseconds =

1,000,000 microseconds =

1,000,000,000 nanoseconds =

1,000,000,000,000 picoseconds

Some conversion factors:

0.001 second =

1 milliseconds =

1,000 microseconds =

1,000,000 nanoseconds =

1,000,000,000 picoseconds

Some conversion factors:

0.000001 second =

0.001 milliseconds =

1 microseconds =

1,000 nanoseconds =

1,000,000 picoseconds

Periods for sine waves:

1 Hertz = 1,000 milliseconds

60 Hertz = 16.7 milliseconds

1 kHz = 1 millisecond

1,000 kHz = 1,000 microseconds

1 MHz = 1 microsecond

Periods for sine waves:

1 MHz = 1 microsecond

10 MHz = 0.1 microsecond

10 MHz = 100 nanoseconds

100 MHz = 10 nanoseconds

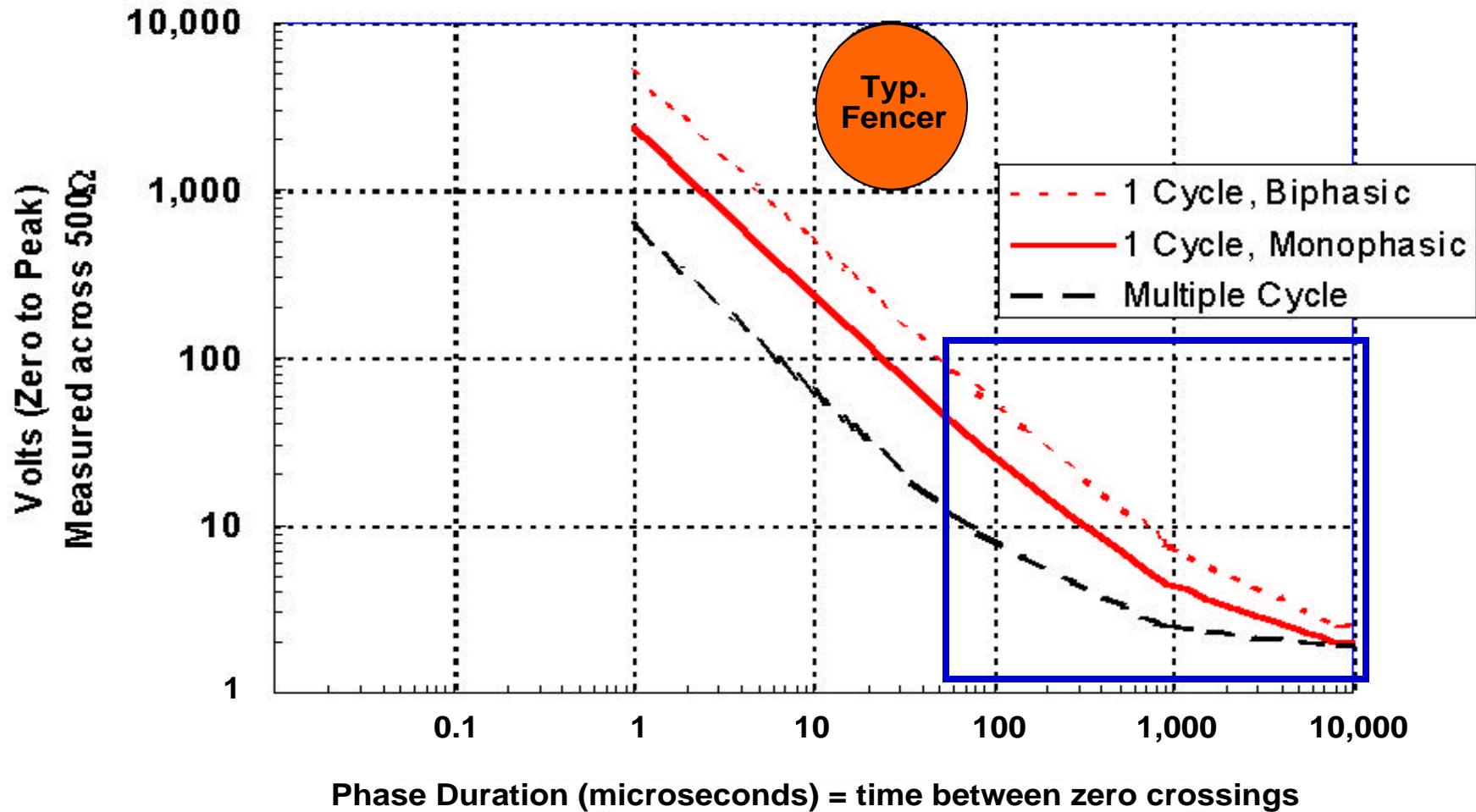
200 MHz = 5 nanoseconds

Some Proposed Revisions

The following chart was prepared at the
University of Wisconsin.

Due to present research on the typical
voltages and frequencies to expect from on
and off farm sources, expect refinement of
the chart in the range of 0 to 20 kHz or 50
microseconds and above.

Behavioral response for 5% most sensitive cows, sine waves muzzle to hooves exposure



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<http://bse.wisc.edu/FacultyPublications/Reinemann/StrayVoltage/Stray%20Voltage%20Field%20Guide.htm>

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Thanks!

If you have any questions
contact me:

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