PRIMARY CABLE FAULT LOCATING

Technologies - Methods - Hardware

HIGH VOLTAGE, INC.

www.hvinc.com

VLF Hipots – Tan Delta – Fault Locators – AC & DC Hipots - Oil & Aerial Lift Testers

HVI *ISO 9001 2015* *The World's Source for High Voltage Test Equipment* ***MADE IN THE USA***

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

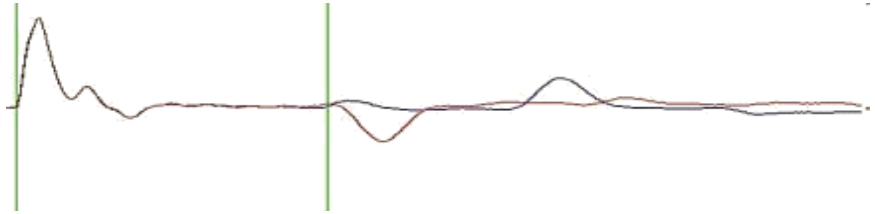
SUBJECTS COVERED

Capacitor Discharge Systems – Thumpers

Time Domain Reflectometry – TDR/Radar

Acoustical & Magnetic Listening Devices

Other Accessories



HVI ISO 9001 2015 *The World's Source for High Voltage Test Equipment* ***MADE IN THE USA***

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

MOST COMMON METHOD OF FAULT LOCATING USES:

CAPACITOR DISCHARGE SYSTEMS (Thumpers)
with TDR/Radar Fault Prelocation

&

FAULT PINPOINTING DEVICES
with Acoustical and Electro-Magnetic Fault Detection

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

COMMONLY USED TERMS

Capacitive Discharge Fault Locator	**an impulse designed type of thumper**
Thumper	**a device that develops a HV pulse output to arc a cable fault**
Joules	**the energy in a stored capacitor = ½ CV^2**
Burn	**a technique to deliver high current to a fault**
TDR	**Time Domain Reflectometry**
HV Coupler	**Interface between HV thumper and TDR/Radar instrument**
Arc Reflection	**Reflecting a TDR pulse off the thumper arc to measure the distance**
Current Surge	**A technique that reflects a TDR pulse off the fault arc to measure distance**
URD	**Underground Residential Distribution**

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

COMMONLY USED PRODUCT NAMES

For Capacitor Discharge Systems

Thumpers - mostly in the US

Surge or Impulse Generators – outside the US

Bangers – The Brits of course

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

WHAT IS A THUMPER?

A box containing the following, and more:

1. DC high voltage power supply or cap charger
2. A high capacitance, or µF, rated capacitor
3. A TDR/Radar instrument
4. Controls, meters, cables, etc.
5. Various accessories to help locate/pinpoint the fault

All of the above used to apply a high voltage, high energy pulse to a faulted cable to cause an arc at the fault. Often used with a TDR to pre-locate the fault, and an electronic listening or impulse detection device to hear the sound or sense the magnetic impulse coming from the arc.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

How the Fault-Finding Process Works

Internal capacitors are charged to a selected voltage level

Charged capacitor is connected to cable

Stored energy of capacitor is dumped at the fault

Loud noise and electro-magnetic pulse occurs

Hear the noise and measure the electromagnetism

Use Arc Reflection w/TDR to pre-locate fault

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

CAPACITOR DISCHARGE SYSTEM

Modes of Operation

Variable Hipot

Multiple Voltage Outputs

Capacitor Discharge

Cable Burning

TDR – Time Domain Reflectometry

Arc Reflection filter

HVI ISO 9001 2015 *The World's Source for High Voltage Test Equipment* **MADE IN THE USA**

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

VARIABLE HIPOT OUTPUT

A Very Useful & Often Necessary Feature, to:

- ❑ Apply voltage to ID the bad cable and verify the fault
- ❑ Increase voltage to learn the breakdown voltage to select optimum output voltage tap to use
- ❑ Arc cable to decrease breakover voltage to permit less damaging lower voltage thumping
- ❑ Apply voltage/hipot the cable after repair to verify no fault

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

CABLE BURNING – FAULT CONDITIONING

Turn a 15 kV fault into 5 kV fault

Elevate voltage until fault arcs. Maintain current flow to reduce fault impedance and breakdown voltage

Thumper must have variable hipot output with high mA rating to be effective, best if > 100 mAdc

Once “burned”, can now use lower voltage to thump, causing less insulation damage.

Find the fault without making more.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

DISCHARGE OUTPUT VOLTAGE
CONTROLLED/CONSTANT ENERGY THUMPER

Best to have several output voltage taps *with all at the full joule rating*.

Permits thumping at lower voltages but with full energy.

Find the fault without making more.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

MULTIPLE OUTPUT RATINGS OF COMMON MODELS

Noise & energy pulse created at 5 kV = 15 kV if both at the same joules/energy rating. Find the fault without making more.

0 - 7.5/15 kV @ 1000 Joules
0 - 12.5/25 kV @ 1653 Joules
0 - 5/10/20 kV @ 1000 Joules
0 - 8/16/32 kV @ 3000 Joules
0 - 9/18/36 kV @ 3200 Joules

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

DISCHARGE ENERGY

Measured in **Joules** = watts x seconds

Sufficient energy must be delivered to the fault to create a loud discharge for ease in fault finding.

The higher the joules, the louder the bang and more intense the magnetic pulse

Today's thumpers range from 350J to 7500J

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

DISCHARGE ENERGY

Joules = ½CV²

C = µF rating of caps

V = voltage across caps

Full joule output is achieved at full voltage output. At half voltage output, only ¼ of the joules are delivered to the fault.

A 20 kV thumper set to 10 kV will deliver only 25% of full energy, making fault locating difficult. Need thumper with multiple output voltages at full energy

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

TDR CAPABILITY

TDR's or Time Domain Reflectometers allow users to see changes in impedance in cables.

Examples of impedance are splices, terminations damage etc.

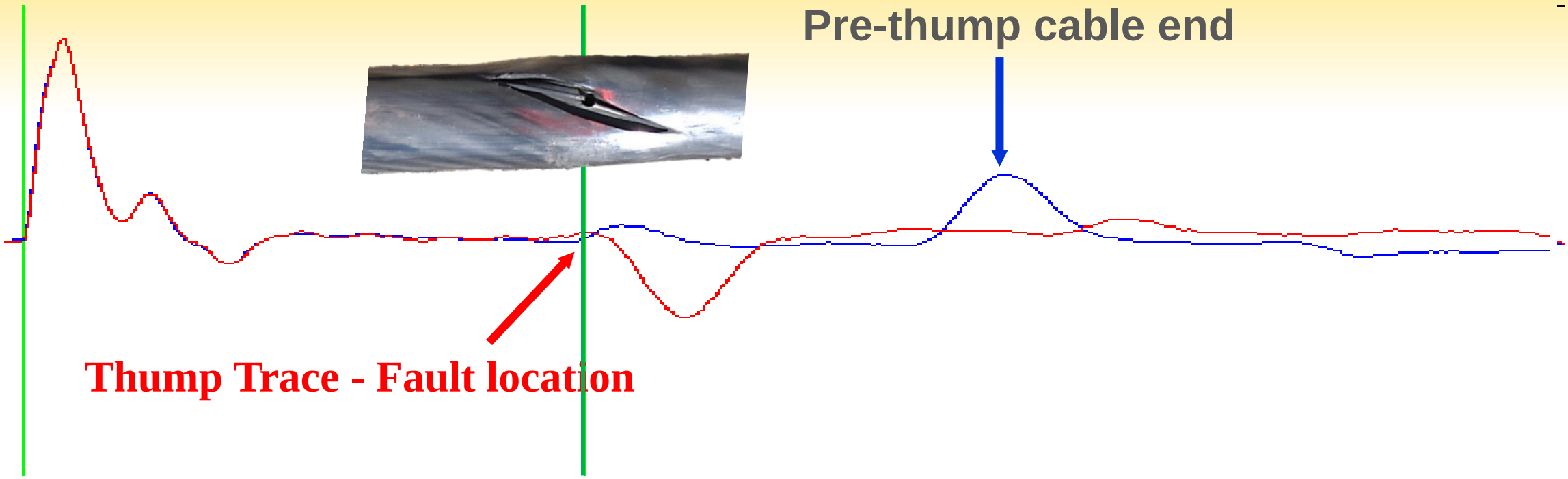
Modern thumpers have internal "arc reflection filters" which allow a TDR to be used in conjunction with a thumper

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

TDR SPLICE TRACE

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

PRE & POST THUMP TRACES



High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

REVIEW: IDEAL THUMPER DESIGN

Can thump at low voltage yet deliver high joules

Multiple full joule output voltage taps

Fully variable hipot output

Ample burn current

TDR/Radar ready

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

SELECTING A THUMPER

Hipot Output Voltage
Thump Output Voltage
Burn Current
Energy/Joule Rating
Input Power – Battery
TDR
Portability

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

SELECTING THE HIPOT OUTPUT VOLTAGE

Consider the voltage rating of your cable system.

Hipot voltage should be at least equal to or greater than the line-to-ground voltage.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

THUMP OUTPUT VOLTAGE?

What is highest cable voltage rating?

If thumper has no cable burning method, then a thump voltage 20% - 25% higher than the line-to-ground system voltage is needed

<u>Multiple voltage outputs desirable</u>

15kV systems need >10kV thump

25kV systems need > 18kV thump

35kV systems need > 25kV thump

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

CABLE FAULT BURNING

Full featured thumpers have a variable hipot output with a high current rating, used to reduce the fault arc over voltage to permit lower voltage thumping.

Look for thumpers with at least 100ma output to rapidly reduce fault impedance.

Allows thumping at the lowest possible voltage yet delivering the highest possible energy. Find your fault without making more.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

HOW MANY JOULES ARE NEEDED?

What kind of cable insulation?

What kind of distribution system?

How long are the cables?

Using only arc reflection or pinpointing?

What listening device will be used?

Power versus size and weight?

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

JOULES NEEDED?

Arc reflection needs < 300J, like Sectionalizers

Pinpointing using good listening device > 500J

15 - 25kV URD needs ≥ 1000J w/o good list. dev.

“Network” systems thumpers need > 2000J

Long PILC cables need 2000 – 3000J

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

JOULE RATING EXAMPLES

CDS-2010UF has 1000 Joules

CDS-3632UF has 1600 or 3200 Joules

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

PORTABILITY

Energy/Joule ratings (watts/sec): $J = \frac{1}{2}CV^2$

Size, weight, and portability is in direct proportion to Joule output.

The higher the energy/joules rating, the higher (larger & heavier) the capacitance needed inside thumper.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

REVIEW: THUMPER SELECTION

System Voltage?

Insulation type?

Cable length?

TDR Needed?

Hipot/Burn Needed?

Input Power?

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

IDEAL THUMPER DESIGN
ALL THE FEATURES NEEDED

Can thump at low voltage yet deliver high joules

Multiple full joule output voltage taps

Fully variable hipot output

Ample burn current

TDR/Radar ready

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

High Voltage, Inc. CDS-2010U

- 0 - 5/10/20 kVdc outputs
- 1000 Joules at each voltage
- 400 ma Burn current
- Internal Arc Reflection filter
- 6 – 9 second thump rate
- 50’ output cables
- 260 lbs. (118 kg)

HVI ISO 9001 2015 *The World’s Source for High Voltage Test Equipment* **MADE IN THE USA**

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

High Voltage, Inc. CDS-3616U

- 0 - 9/18/36 kVdc outputs
- 1600 Joules at each voltage
- 280 ma Burn current
- Internal Arc Reflection filter
- 6 – 10 second thump rate
- 100’ output cables
- 375 lbs (170 kg)

HVI ISO 9001 2015 *The World’s Source for High Voltage Test Equipment* **MADE IN THE USA**

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

High Voltage, Inc. CDS-3632U

- 0 - 9/18/36 kVdc outputs
- 3200 Joules at each voltage
- 280 ma Burn current
- Internal Arc Reflection filter
- 6 – 10 second thump rate
- 100’ output cables
- 450 lbs (204 kg)

HVI ISO 9001 2015 *The World’s Source for High Voltage Test Equipment* **MADE IN THE USA**

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

High Voltage, Inc. VT33

VLF & Thumper Combination

- 0 - 33 kV peak VLF, 0-13.5 kV impulse
- 760 Joules at max impulse voltage
- VLF Burner, Arcs cable every few seconds
- Internal Arc Reflection filter
- 8 second thump rate
- 50’ output cables
- 245 lbs. (111 kg)

HVI ISO 9001 2015

The World’s Source for High Voltage Test Equipment

MADE IN THE USA

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

Questions About Selecting

The Right Thumper?

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

TIME DOMAIN REFLECTOMETRY - TDR

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

WHY USE TDR

Pre-locate fault in minutes with just one or two thumps

Walk to location and continuously thump 20 – 30 times while listening. Pinpoint fault to dig hole or pull cable

Alternative is to thump continuously and walk for hours listening for fault. Wastes time and harms cable with hundreds of thumps

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

TIME DOMAIN REFLECTOMETRY

The TDR outputs a low voltage pulse that travels down the cable "looking" at the insulation between the conductor and shield. Any change in resistance reflects some of the signal back to TDR.

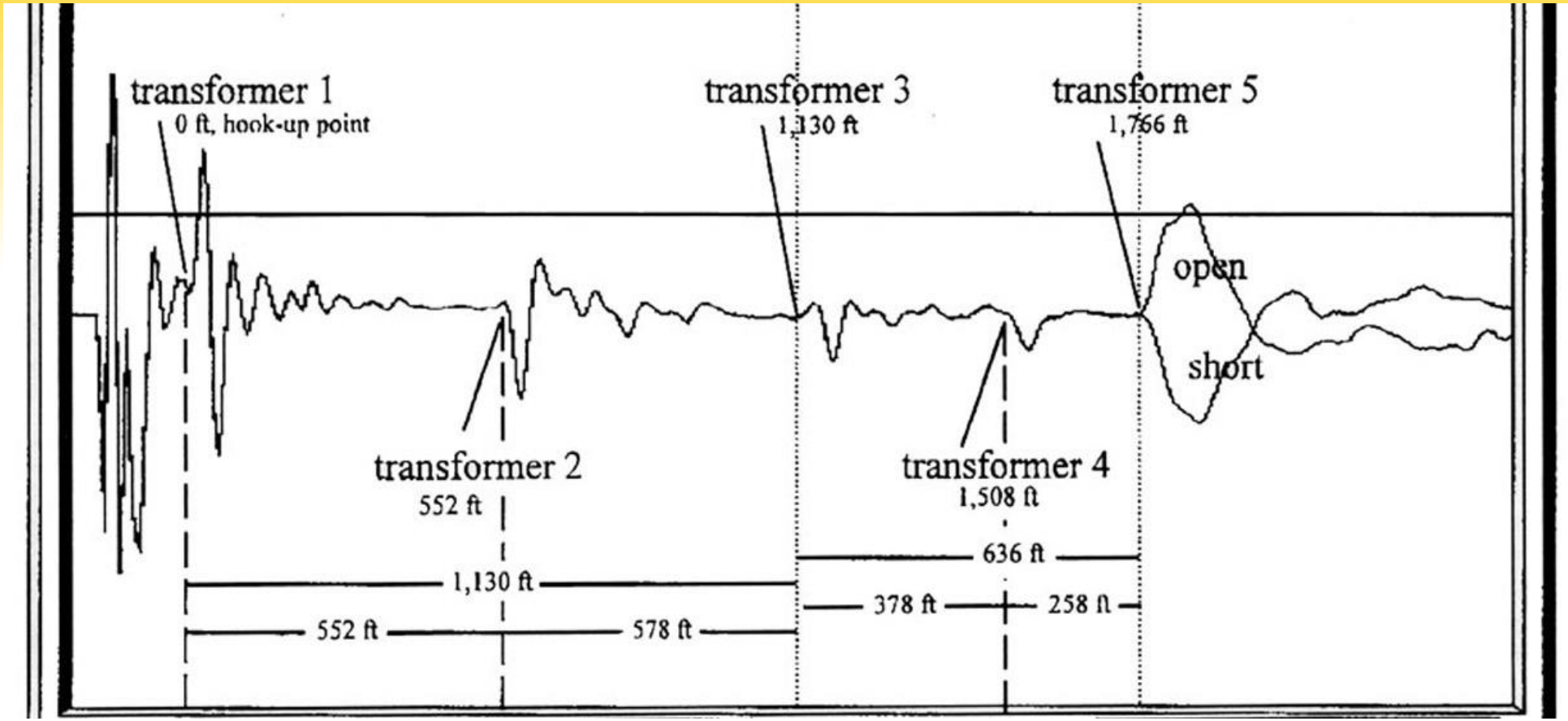
TDR produces a "picture" of the cable. It measures distances, find opens or shorts, find transformers, splices, and shows other accessories.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

TDR SPLICE TRACE

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

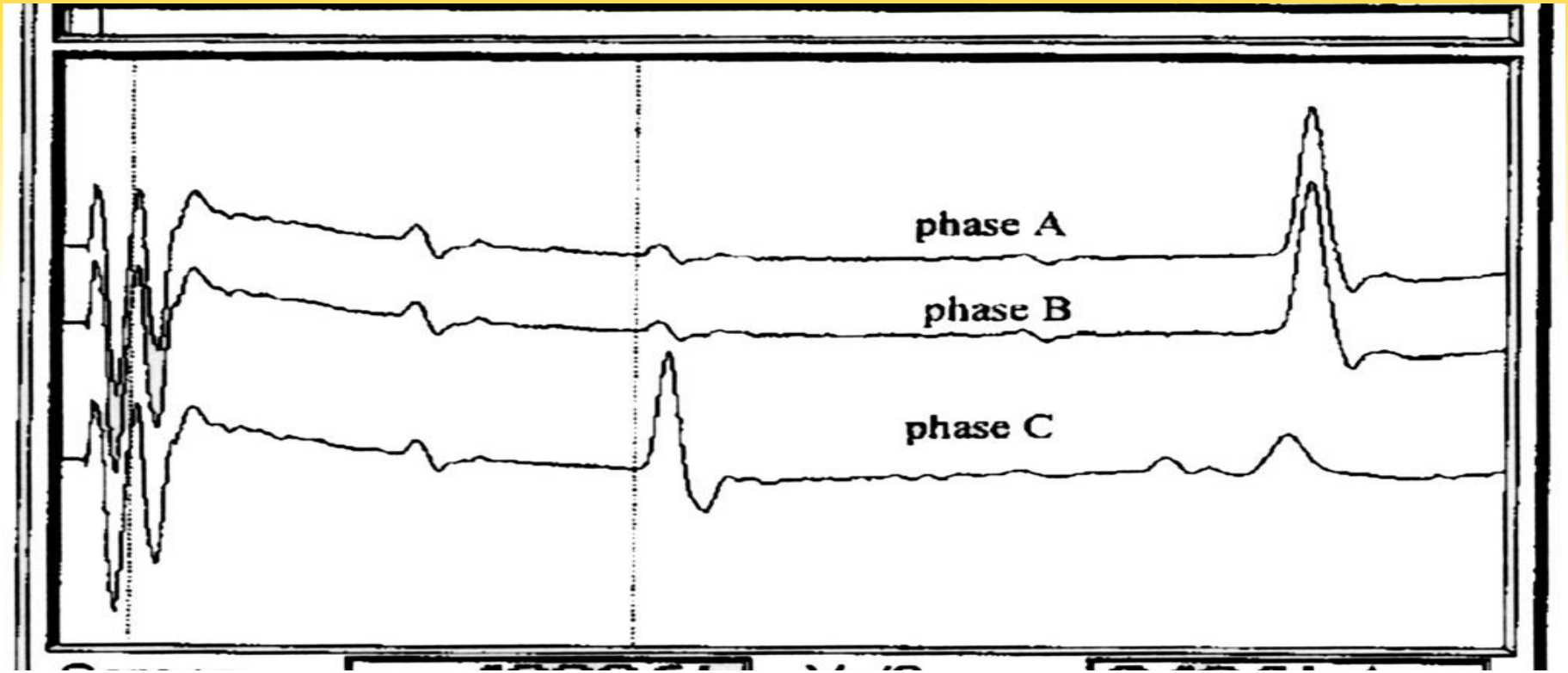
TDR TRACE



Four transformers shown & cable end open and shorted

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

TDR TRACE OF THREE PHASES



Second splice of phase C is faulty, shows high resistance, perhaps corroded conductor or neutrala

ARC REFLECTION

TDR signal alone see open circuits, short circuits and changes in impedance.

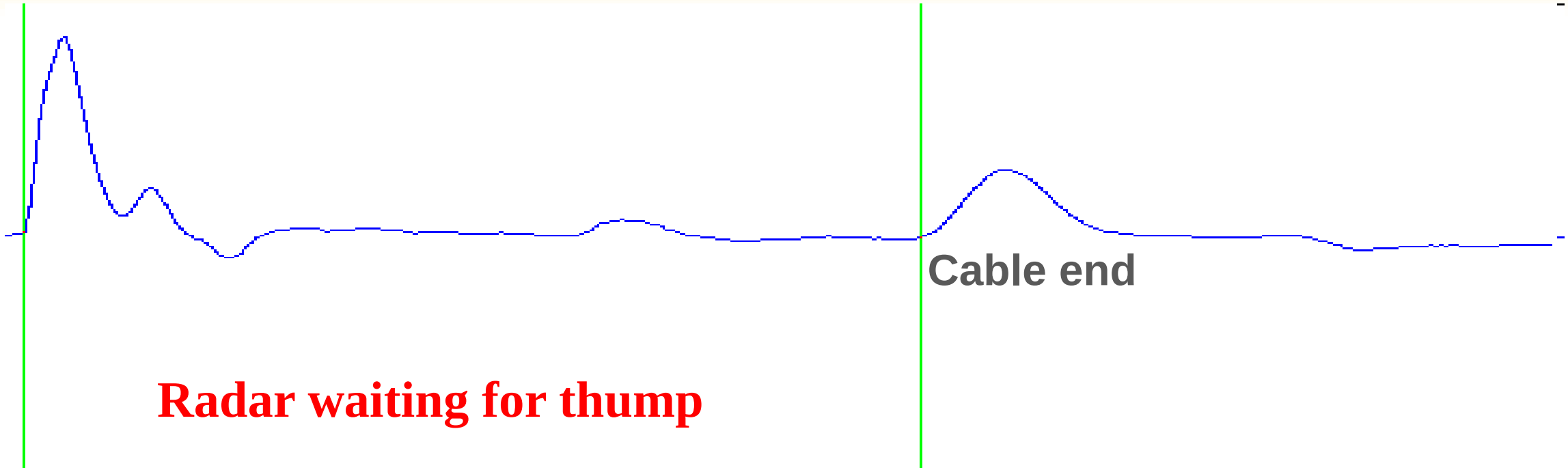
TDR used with thumper in capacitor discharge mode (thump) to reflect signal off of an arc (fault point) to pre-locate the fault

The arc is a momentary short circuit, off of which a TDR reflects.

Thumper is pulsed once, creating arc at fault, TDR signal bounces off fault back to TDR and indicates the distance

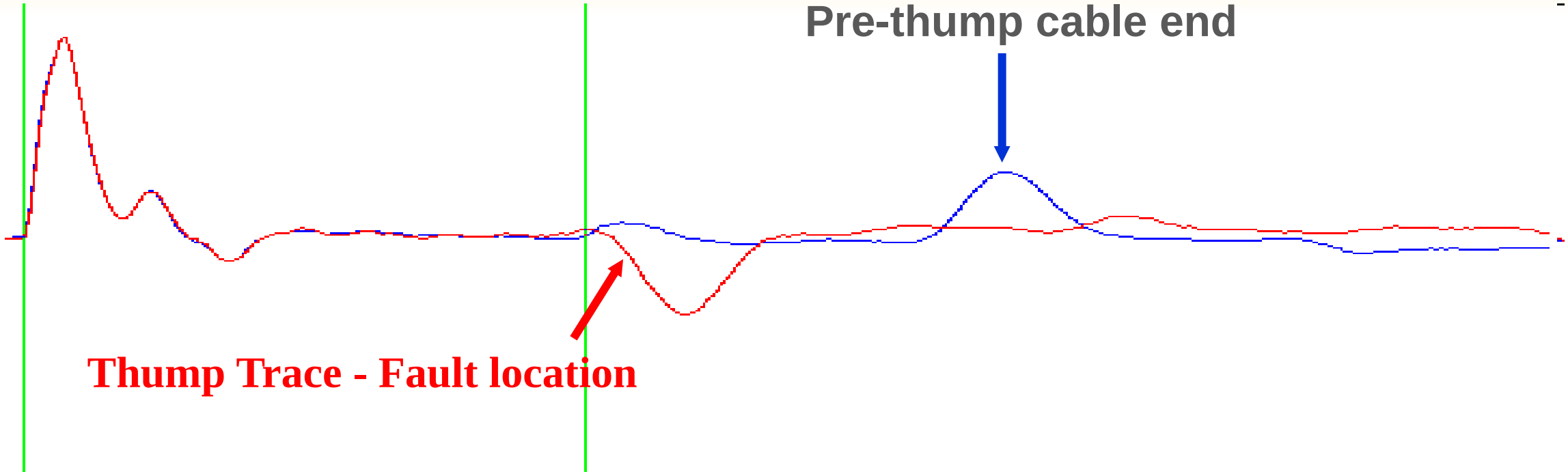
High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

PRE-THUMP TRACE



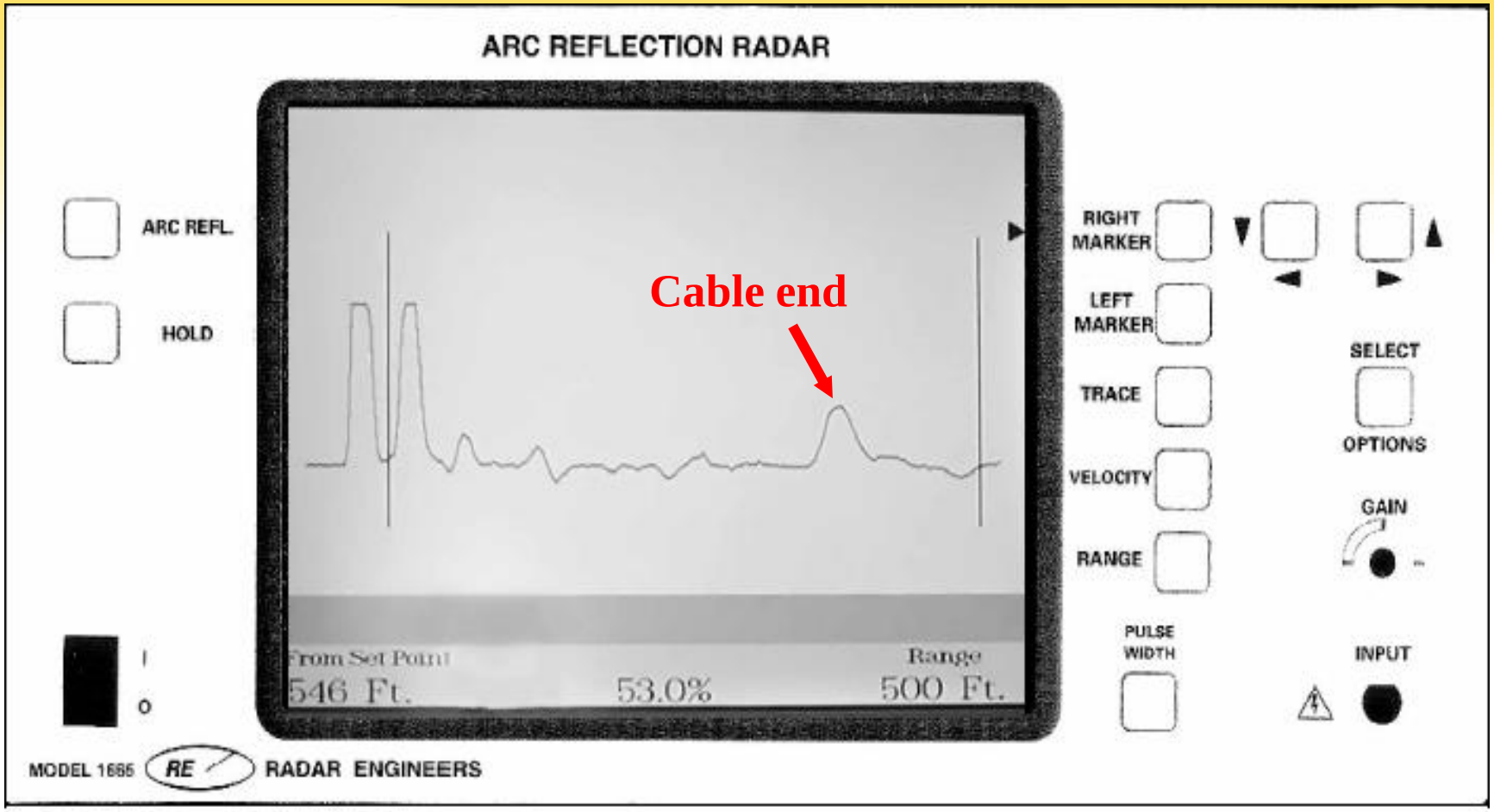
High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

PRE & POST THUMP TRACES

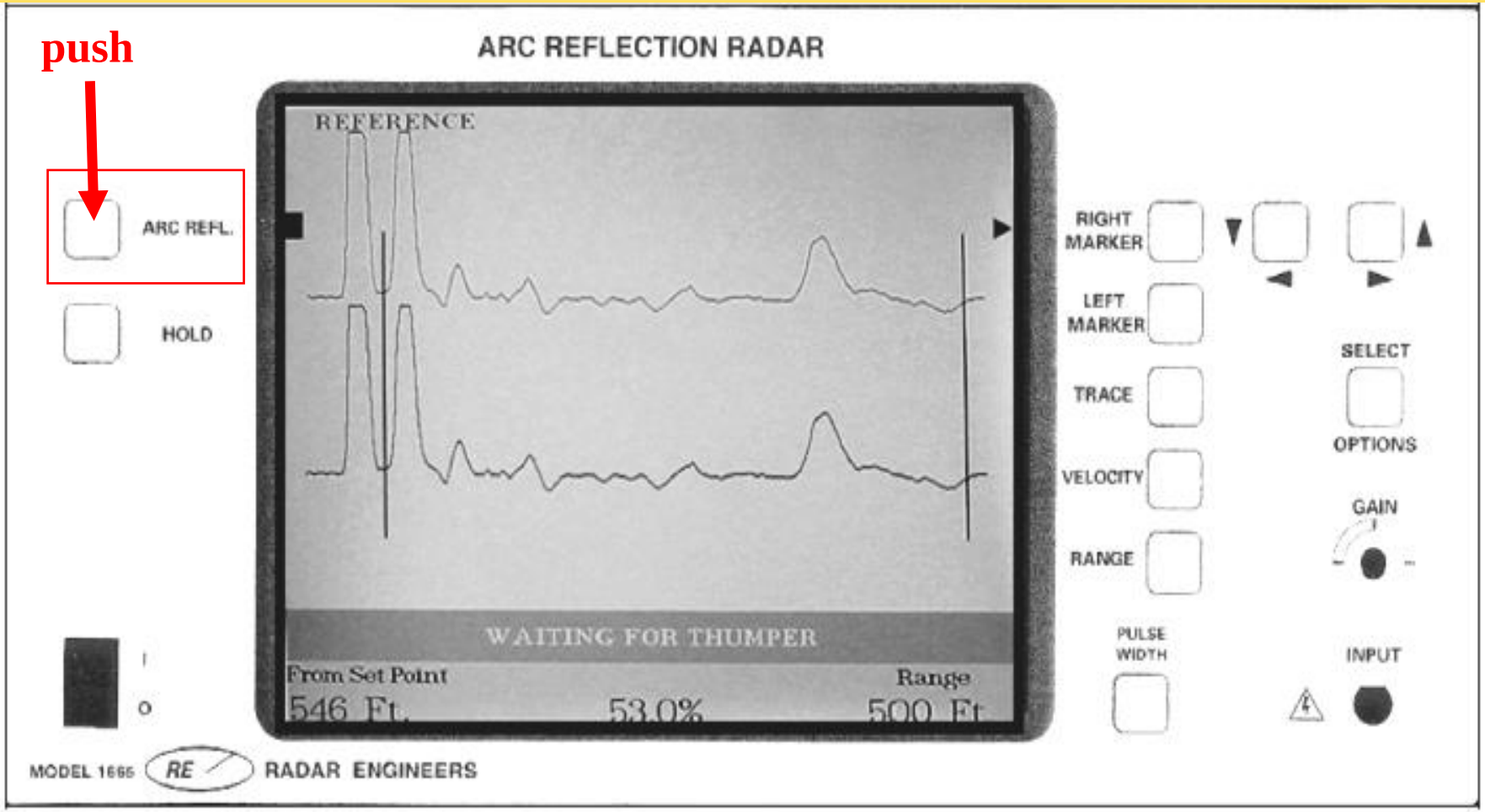


High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

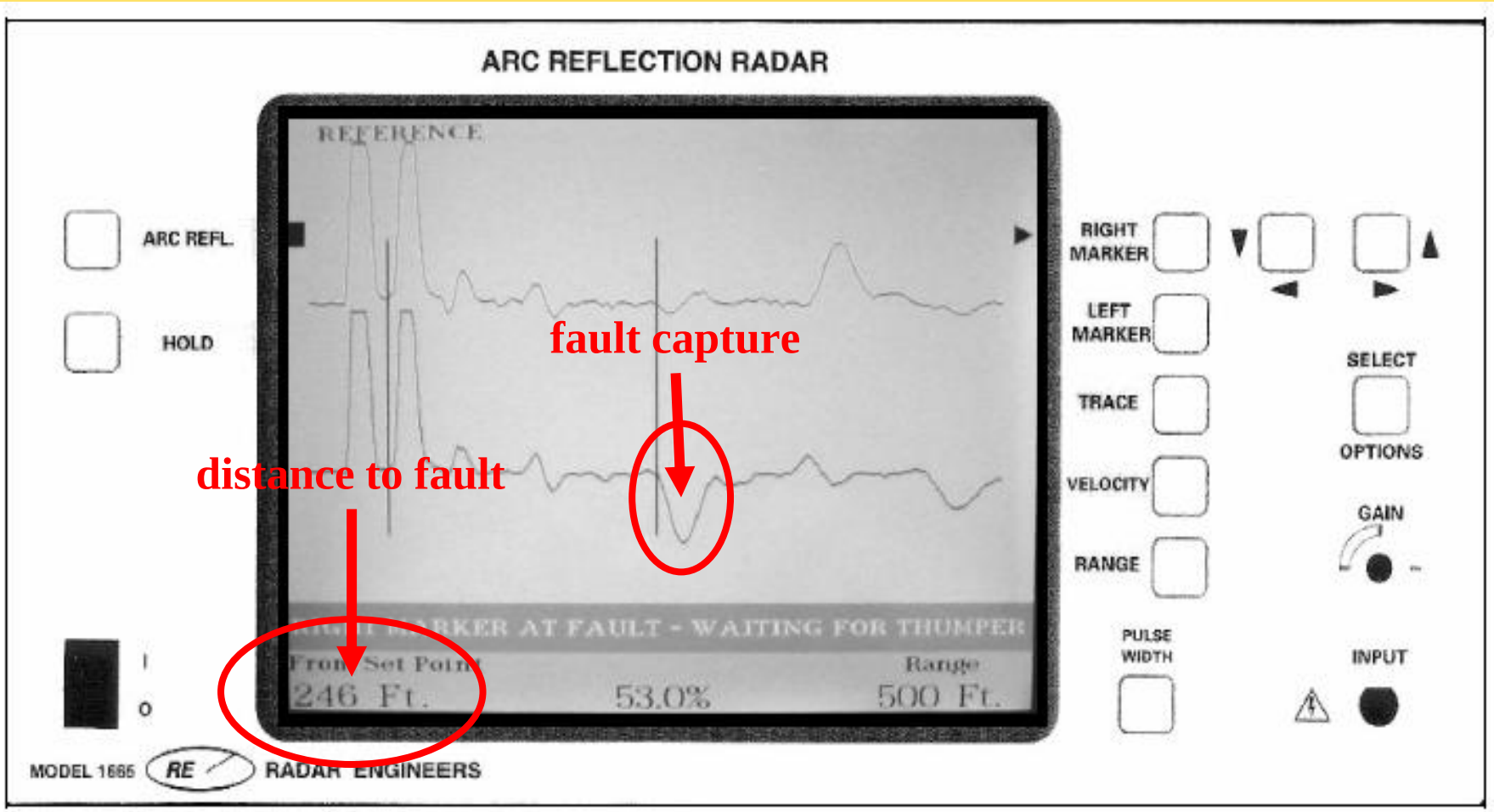
TDR TRACE OF CABLE



WAITING FOR THUMP

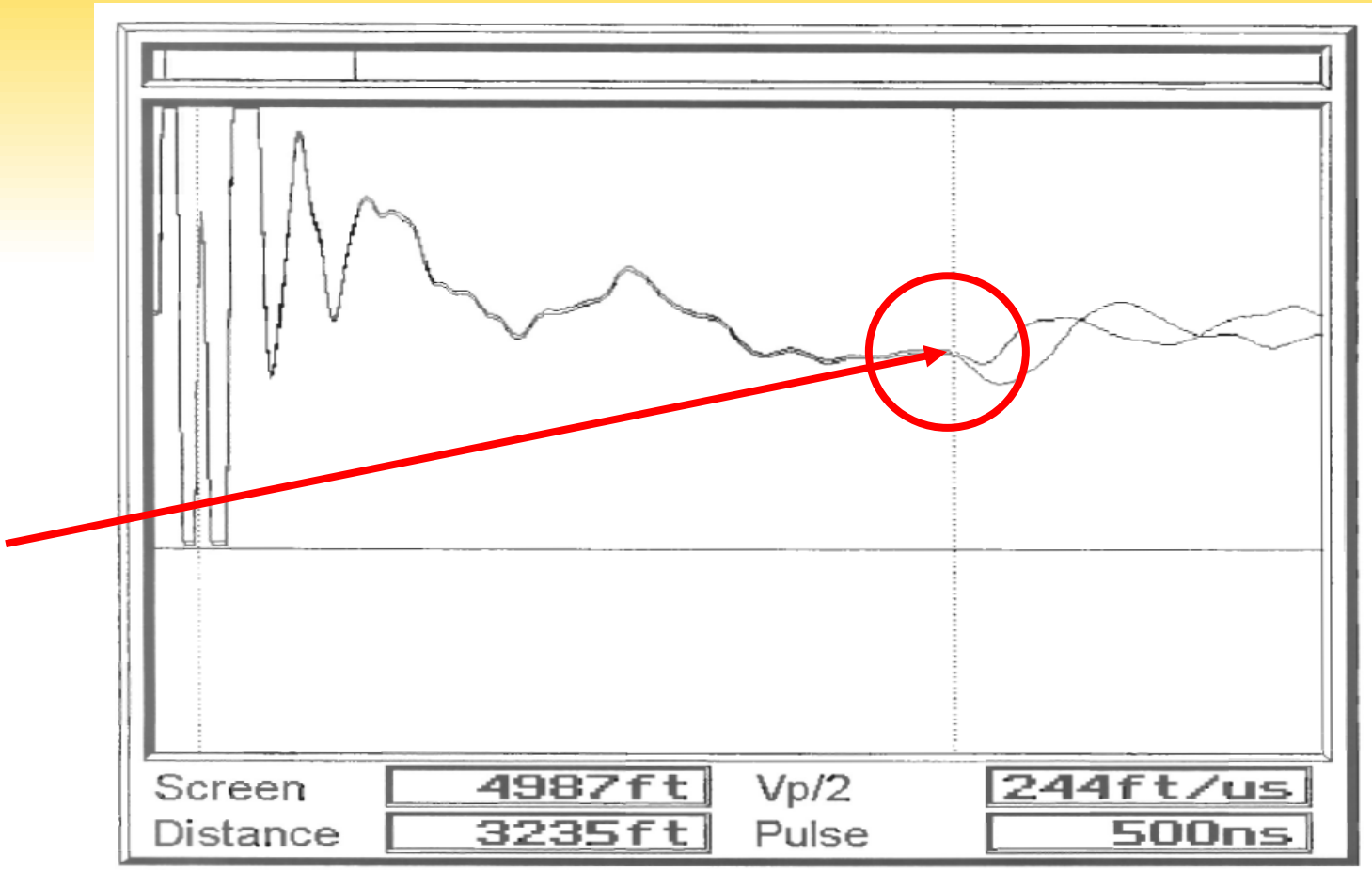


POST THUMP TRACE



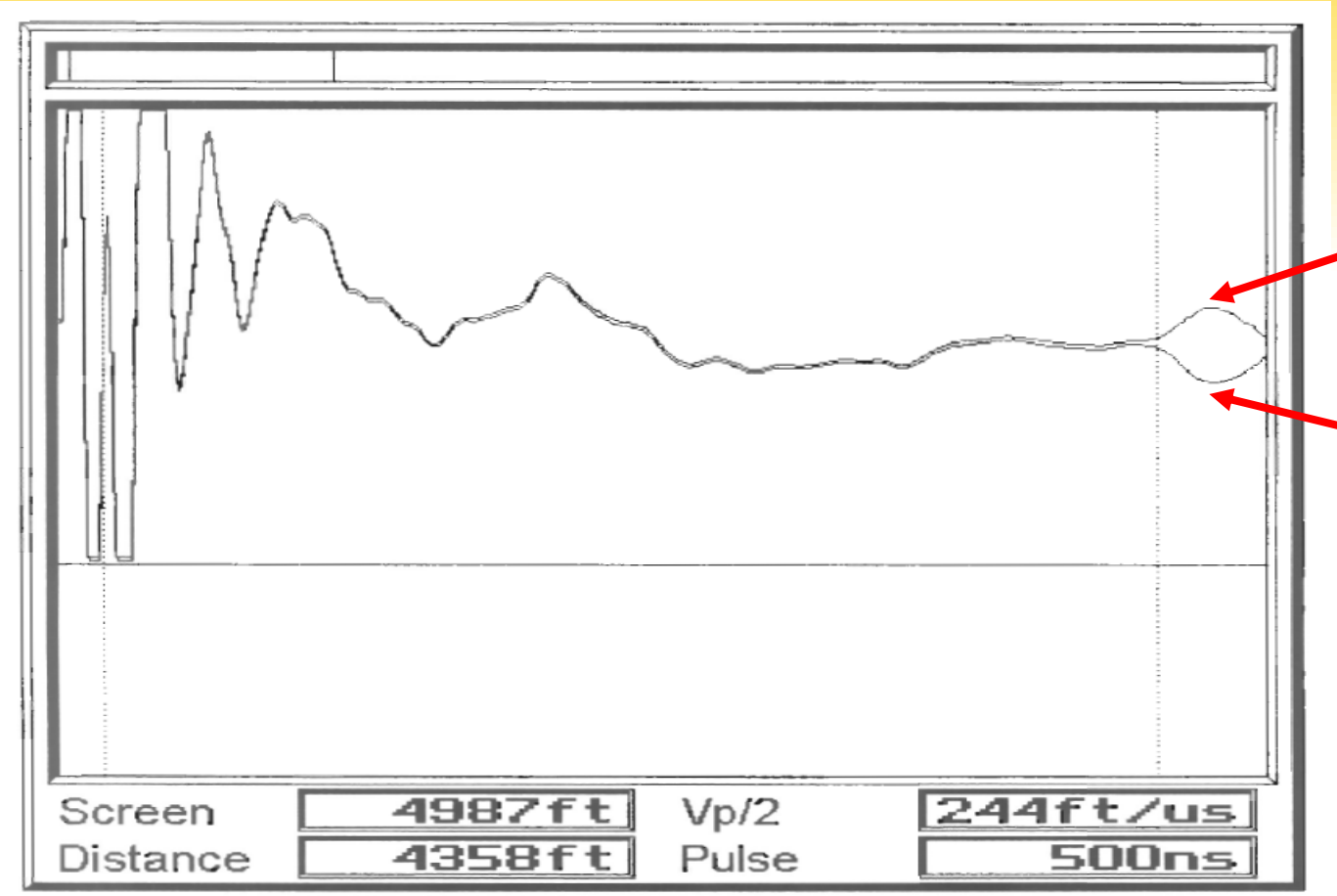
POST THUMP TRACE

Fault location is where curves separate pre & post thump, indicating a change at that location.



High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

POST THUMP TRACE



Cable end open

Cable shorted to neutral

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

TDR USE MADE EASY

Modern TDRs are very easy to use

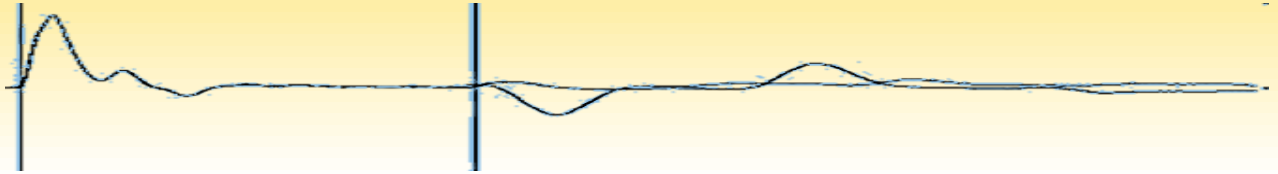
Once programmed for your cable, turn it on, press *Arc Reflect, or Waiting For Thump,* button, pulse thumper and see fault location.

Full feature mode available for those familiar with TDR use

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

PROPAGATION RATE or VELOCITY RATE

How Fast Does The TDR Signal Travel?



- VR is the speed of the TDR signal in specific cable types
- Entered as m/µs or percentage of the speed of light.
- If we know how fast the TDR signal travels and how long it took to bounce off the fault, we know how far the fault is.
- Shown as V/2. Want to measure the speed of signal from fault only, not the round trip.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

SEPARATE TDR or BUILT INTO THUMPER?

TDR Best If Not Integral To Thumper

- Can be used alone without fault locator
- Can be more easily upgraded
- Can change TDR **vendors** easily
- If TDR or thumper fails, don't lose both for service

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

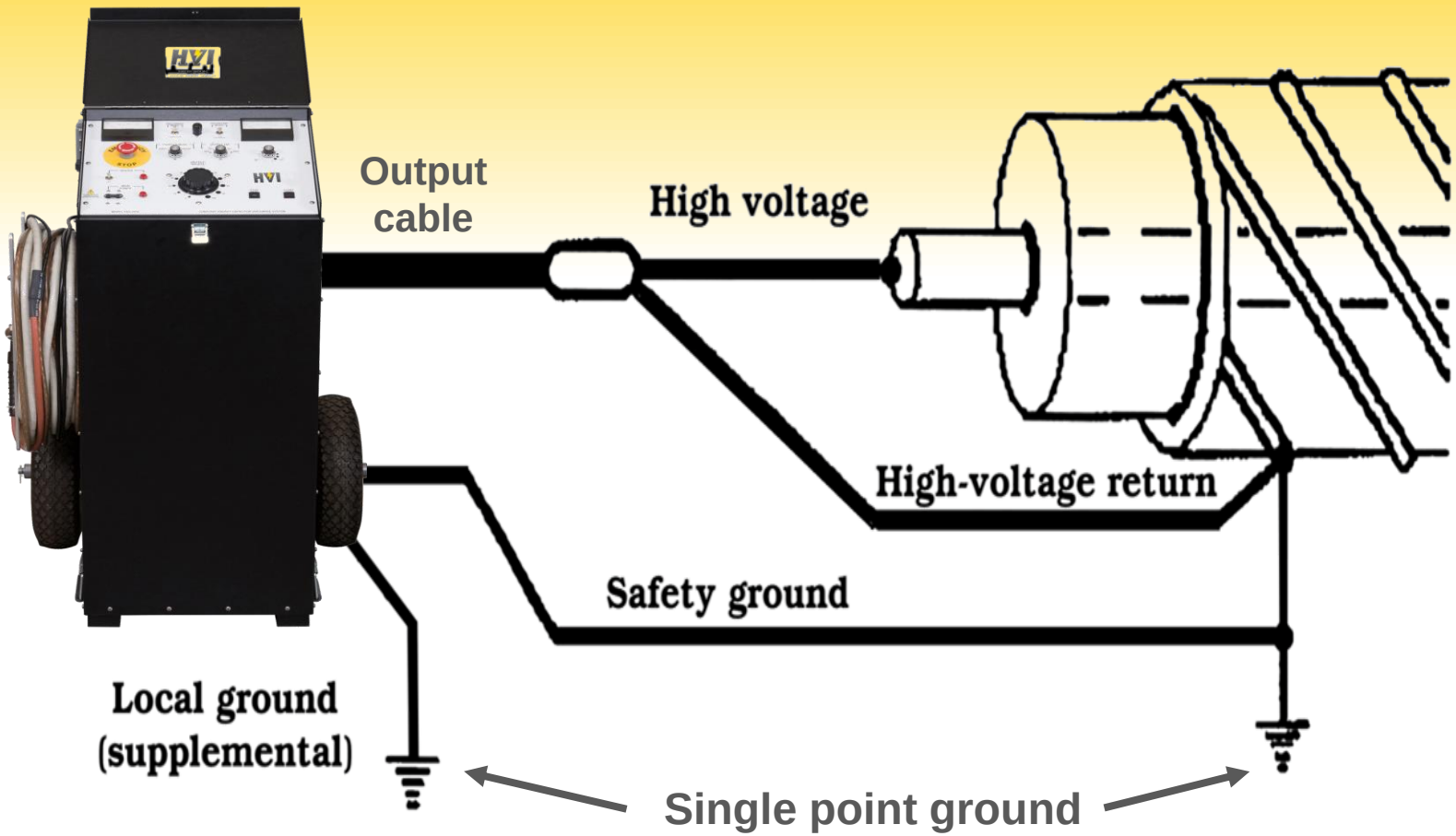
FAULT LOCATING METHODS

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

FAULT LOCATING PROCEDURE

- ❑ Examine cable map or trace cable and mark cable path
- ❑ Connect and ground all equipment
- ❑ Apply voltage to confirm faulted phase and fault voltage
- ❑ Select appropriate output voltage tap
- ❑ Calibrate TDR start cursor and Velocity Rate for cable type
- ❑ Collect LV Pulse (Signature) of cable with TDR
- ❑ Collect HV Pulse (Arc Reflection) of cable
- ❑ Analyze and determine failure location
- ❑ Go to approximate failure location
- ❑ Thump Continuously and use Pinpointing Method to find fault

THUMPER HOOK-UP



HIPOTING A CABLE

Main Power On

Hipot/Burn Mode

Select Output Tap

Press Start

Raise Voltage

If burning turn up voltage to increase current and observe breakdown voltage

ISO 9001 2015

The World's Source for High Voltage Test Equipment

MADE IN THE USA

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

ARC REFLECTION TO SEE FAULT

Main Power On

Cap Discharge Mode

Select Output Tap

Coupler in Radar mode

Press Start

Raise to desired Voltage

When caps charged hit Single Pulse.

Look at TDR

HVI ISO 9001 2015 *The World's Source for High Voltage Test Equipment* ***MADE IN THE USA***

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

CONTINUOUS THUMP TO FIND FAULT

Main Power On

Cap Discharge Mode

Select Output Tap

Coupler – Direct mode

Press Start

Raise Voltage

Let caps charge

Discharge Mode - Continuous

Listen for fault

HVI **ISO 9001 2015** *The World's Source for High Voltage Test Equipment* ***MADE IN THE USA***

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

FAULT FINDING MORE THAN JUST A THUMPER

Efficient locating requires a coordinated approach, using all the tools available

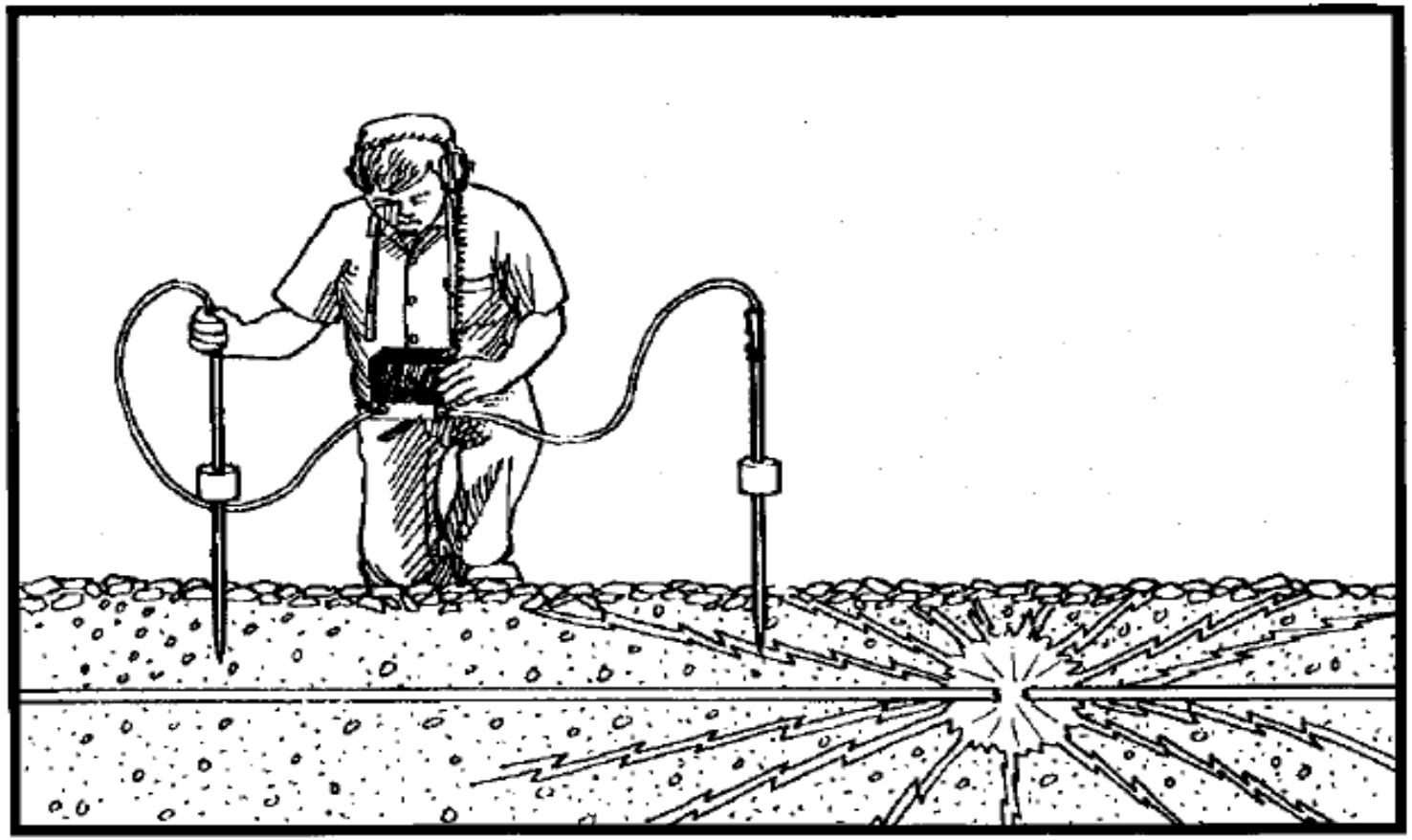
History of cable/splice locations/transitions, etc
Cable route from maps or from tracing
Full Featured Thumper
Use of TDR where appropriate
Acoustical & electromagnetic detection devicea

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

Fault Locating Questions?

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING, OR PINPOINTING, DEVICES



Drawing courtesy of Aquatronics

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING, OR PINPOINTING, DEVICES

The proper pinpointing device saves time, money, and wear on the cable

Common basic methods

ACOUSTIC
ELECTRO-MAGNETIC
COMBINATION OF BOTH

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING, OR PINPOINTING, DEVICES COMBO – GOOD

SDAD from Aquatronics

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING, OR PINPOINTING, DEVICES
Acoustics/Combo

- Most devices use a combination of noise and magnetics to detect the “THUMP”
- After pre-locating the fault with TDR, go to the approximate fault location
- With the two probe detectors, follow the indicators to the fault
- Single probe units look for the time delay between Magnetics and Noise.
- Limitations: Conduits, Concrete, Frozen soil

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING & PINPOINTING, DEVICES
Summary

- Modern listening devices use both magnetics and sound to pinpoint faults.
- As with all aspects of fault locating, environment and installation play a critical part in determining the best locator to choose.
- Each style has it benefits and limitations.
- Spending a little can save you a lot.

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING & PINPOINTING, DEVICES
Electromagnetic Field Analyzer - Good

X35 from Technology Enhancement Corp

HVI ISO 9001 2015 *The World's Source for High Voltage Test Equipment* **MADE IN THE USA**

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

Electromagnetic Field Analyzer

- Used on Network Systems with many “T”s where TDR is ineffective
- Electromagnetic type pickup
- Works with Thumpers/Impulse Generators and Thyratron type fault locators
- Easy to read LCD
- Used for sectionalizing between manholes without opening them
- Limitations: Must have the return path be the neutral or grounded lead sheath

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING & PINPOINTING DEVICES

Cable fault locating programs should include acoustic and electro-magnetic detection devices.

The proper listening device or field analyzer saves time, money, and wear on the cable.

The investment in a cable fault locator and TDR should be complemented by a quality listening and/or electro-magnetic pickup device to make it all work optimally

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

LISTENING, OR PINPOINTING, DEVICES

QUESTIONS?

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA

THANK YOU

ISO 9001 2015

The World's Source for High Voltage Test Equipment

MADE IN THE USA

High Voltage, Inc. • hvinc.com • p. 518.329.3275 • f. 518.329.3271 • 31 County Route 7A • Copake, NY 12516 USA