RADIODETECTION®

Model 1270A

Twisted Pair/Coaxial Metallic Time Domain Reflectometer

Operation Manual

250-0026-04

SPX®

TABLE OF CONTENTS

SECTION 1: GENERAL INFORMATION

1.1 Safety Information

Symbols:

	Caution: Refers to accompanying documents
Warning	Any *Warning* sign identifies a procedure or process, which if not correctly followed, may result in personal injury.
Caution	Any *Caution* sign identifies a procedure or process, which if not correctly followed, may result in equipment damage or loss of data.

Warnings

Before using, review all safety precautions. Note and observe all warning and caution statements on the equipment and in the documentation.

Do not operate this instrument near flammable gases or fumes.

Do not modify any part or accessory of this instrument. If the unit is damaged, do not use. Make sure the product is secured from use by others.

To avoid electric shock, do not remove covers or any parts of the enclosure.

If the instrument or any associated accessory is used in any manner not detailed by the accompanying documentation, the safety of the operator may be compromised.

Caution: As with most electronic equipment, care should be taken not to expose the equipment to extreme temperatures. To insure that your Model 1270A will be ready to use, store the instrument indoors during extreme hot or cold temperatures. If the instrument is stored overnight in a service vehicle, be certain the instrument is brought to specified operating temperatures before using.

1.2 Introduction

The Model 1270A is a multipurpose metallic time domain reflectometer, cable fault locator. Model 1270A is designed to quickly and easily locate cable faults in both twisted pair and coaxial cable. Model 1270A combines the latest in technology and user-friendly operation, creating the most versatile and accurate test set available.

Using time domain reflectometry, or cable radar, the Model 1270A transmits a signal down the cable. Impedance discontinuities along the length of the cable reflect some or all of the signal energy back to the instrument. These reflections are measured and displayed as both a waveform and a numeric distance to the fault.

The Model 1270A will test all types of metallic paired cables for opens, shorts, crosstalk, taps, amplifiers, impedance discontinuities, faulty connectors, water problems, bridged taps, load coils, rodent damage, intentional and accidental tampering, bad splices and system components.

1.3 General Features

Locates cable and connector faults in all types of telephone and coaxial cables.

Rugged packaging for testing in all types of weather conditions.

Pre-set ranges for quick testing.

Exclusive SUPER-STORE waveform storage.

RS-232 Port.

Unique dual independent cursors.

Automatic and manual cursor placement functions.

Compact, lightweight, portable.

Two live waveforms can be displayed simultaneously.

SECTION 2: OPERATING PROCEDURES

2.1 Theory of Operation

A Time Domain Reflectometer (TDR) works on the same basic principle as radar. Pulses of energy are transmitted down the cable under test. If the cable has a constant impedance and is properly terminated, all of the energy will be absorbed.

If the pulse reaches an impedance discontinuity, part or all of the pulse energy is reflected back to the instrument. If the cable is an open circuit, the reflected pulse will be in-phase (upward reflection) with the output pulse. If the cable is a short circuit, the reflected pulse will be out-of-phase (downward reflection) with the output pulse.

In either case, a substantial amount of energy will be reflected. If it were possible to have a cable with no loss, all of the signal energy would be reflected. The incident and the reflected signals would look identical.

Reflections from an impedance higher than the characteristic impedance of the cable are in-phase, or upward. Reflections from an impedance lower than the characteristic impedance of the cable are out-of-phase, or downward.

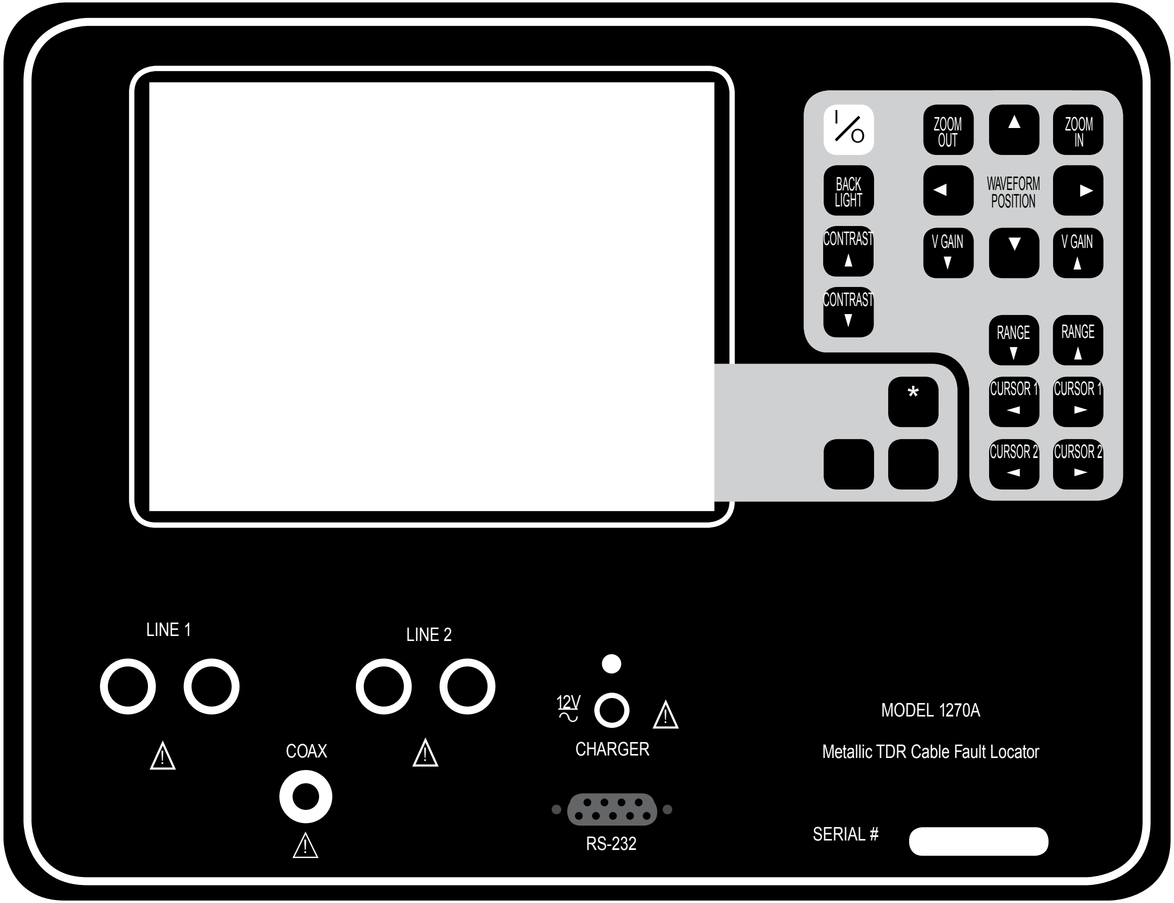
Inductive faults cause the TDR to display an impedance higher than the characteristic impedance of the cable being tested.

Capacitive faults cause the TDR to display an impedance lower than the characteristic impedance of the cable.

The Model 1270A displays the cable under test as a digitized waveform with a numeric distance readout on the Liquid Crystal Display.

The digitized waveform enables the operator to view the signature of the cable in great detail. An impedance mismatch (opens, shorts or faults of less severity) can be identified and distances to the faults determined.

2.2 Front Panel Description



Keypad

I/O Use the I/O key to turn the instrument on and off.

Backlight Use the backlight key to turn the CFL backlight on or off.

Contrast Use the two arrow keys to change the contrast of the LCD.

Zoom In, Zoom Out Use the two zoom keys to zoom in or out on an area of interest on the waveform display.

Waveform Position Use the four arrow keys to move the position of the waveform(s) left, right, up, and down.

V Gain Use the two arrow keys to decrease and increase the vertical waveform amplitude or gain.

Range Use the two range keys to increase and decrease the cable distance displayed on screen. Pulse width and vertical gain are automatically adjusted for each range.

Cursors The 1st and 2nd cursor keys move the cursors along the waveform. Use the 2nd cursor arrows to move the second cursor to the point of interest on the waveform. Cursors should be set on the leading edges of the reflection.

* A menu will pop-up when the asterisk key is pressed. The unlabeled icon keys control a selection cursor for choosing the desired instrument control. Once the control is selected, pressing the asterisk key will close the pop-up menu and activate the control.

When a control is activated, the icon keys will control the function and on-screen icons will graphically represent how the keys affect the control. The icon will change depending on the type of action in the particular control.

Display

The display is a 320 x 240 dot-matrix, high contrast, SUPERTWIST Liquid Crystal Display (LCD) with cold cathode fluorescent lamp (CFL) back lighting. The top two thirds of the display contains the waveform and cursors. Instrument setting and measurements are located on the bottom of the display.

Information areas on the Liquid Crystal Display (LCD) are:

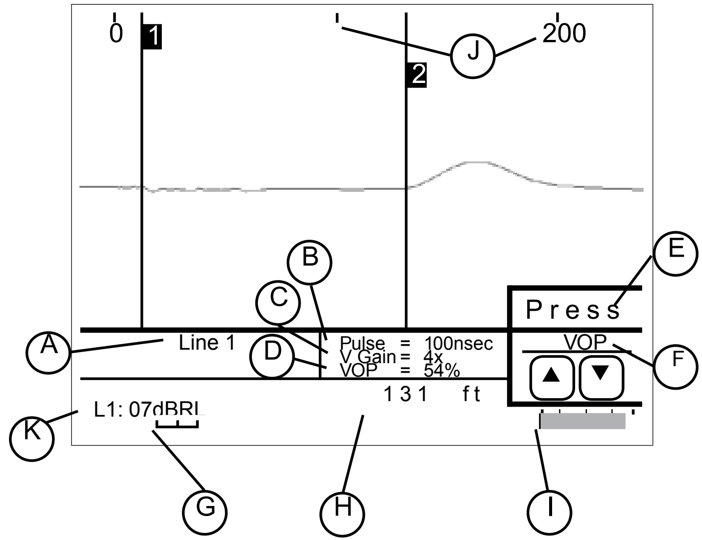
A. MESSAGE CENTER. The message center displays various information about the status of the instrument. Additional messages are displayed when utilizing the standard and optional waveform storage functions.

B. PULSE WIDTH. Model 1270A has selectable pulse widths for testing various lengths of cable.

C. VERTICAL GAIN. Displays the level of vertical amplitude or gain applied to the waveform.

D. VOP or V/2. The programmed velocity of propagation is displayed as a percentage of the speed of light from 30% to 99%.

E. MENU. Pop-up menu for selecting instrument controls.



F. SELECTED MENU ITEM. Displays the currently active menu selection, which is controlled by the icon keys. The on-screen icons graphically represent how the keys affect the control.

G. BALANCE displays the current position of the CABLE BALANCE control on a "slider" type indicator for Line 1 and Line 2.

H. DISTANCE BETWEEN CURSORS. The Model 1270A automatically calculates and displays the distance between the 1st and 2nd cursors. Each time the cursor placement is changed or the VOP is adjusted, the DISTANCE BETWEEN CURSORS reading will automatically update.

I. BATTERY LEVEL INDICATOR. A horizontal bar graph indicates the battery level. When the battery level reaches the one-quarter full scale mark, the low battery message is activated.

J. DISTANCE MARKERS. These tick marks are displayed along the top of the screen and can be in feet or meters format. These marks enable the operator to view the distance along the cable being tested.

K. FAULT SEVERITY. The Model 1270A automatically calculates the signal return loss (dBRL). The return loss and crosstalk are calculated from a comparison of the pulse amplitude at the 1st and 2nd cursors. Crosstalk is only displayed in the twisted pair mode.

Pop-up menu

Store Use the icon keys to select an available storage location and press the * key to store.

Recall Use the icon keys to select a storage location and press the * to recall to display.

Pulse Use the two icon keys for decreasing and increasing the pulse width.

Cable Use the two icon keys to select the cable type under test. VOP will automatically be set for that cable type.

VOP or **V/2** (depending on the velocity format setting chosen in the setup menu) Use the two icon keys for decreasing and increasing the velocity of propagation.

Balance Use the two icon keys to adjust the output balance circuit.

Filter Use the two icon keys for cycling through the available software filters.

Setup Use the * key to display the setup options menu.

Print Use the * key to print the on-screen waveform to a serial printer for documentation.

Mode Use the two icon keys for cycling through the available display modes for single, dual, or difference waveform display modes.

Test Port Use the two icon keys to select the active test port.

Overlay Use the two icon keys to adjust the trace separation in dual waveform display modes. This control is only available when two waveforms are displayed.

Tagging Use the * and icon keys to edit the alpha numeric label associated with a stored waveform.

Search Use the * key to preform an auto-search of the cable to find major faults or the end of the cable.

Press * to select.	
Store	Setup
Recall	Print
Pulse	Mode
Cable	Test Port
VOP	Overlay
Balance	Tagging
Filter	Search

2.3 Instrument Operation

Proper operation and precise distance readings will be insured if you remember the following procedures and choose the mode of operation to best suit your cable testing conditions:

1. Establish a quality cable connection. It is best if the cable is adapted to connect directly to the instrument front panel. Use adapters and connectors with the same impedance as the cable under test.
2. Adjust the Balance Control to match the proper impedance of the cable. (See section 2.3.6)
3. Enter the correct VOP of the cable under test. (See section 3.5)
4. Start the test in the shortest range or pulse width.

2.3.1 Range Control

RANGE operation will step through and display a preset distance of cable. A range consists of a specific pulse width, gain setting, and distance of cable. The transmitted pulse is on the left side of the screen and the cable span is shown to the right. The exact length of cable on the screen for each range will be relative to the VOP being used. When using range, you still have complete manual control and can change the pulse width, zoom-level and other key functions as needed.

Line 1, Line 2:
With the distance format set in feet mode and a 65% VOP, the ranges are 50, 100, 200, 500, 1k, 2k, 5k, 10k, and 20k feet.

Coax:
With the distance format set in feet mode and a 83% VOP, the ranges are 10, 20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k feet.

Characteristics of RANGE operation:

1. To switch to the next range, press the RANGE up and down arrows. The distance graduations will change as the range is changed.

2. Cursor 2 can be moved while in the RANGE mode. As the ranges are changed, cursor 2 will remain at the same position as the previous range.

3. Cursor 1 can also be adjusted; however, it will be placed back at the "0" distance marker whenever a new range is selected.

2.3.2 Distance Between Cursors

When a test is initiated, the two independent cursors are used to measure the distance to a fault or to the end of the cable. The cursors are interchangeable; but, to reduce confusion, use the 1st CURSOR to mark the point you are measuring from and the 2nd CURSOR to mark the point you are measuring to. The cursors will retain their accuracy and resolution regardless of distance or horizontal zoom settings.

Model 1270A's unique dual independent cursors feature allows you to place cursors at, and measure to (or between) ANY TWO POINTS on the waveform. The distance displayed will automatically adjust with the movement of the cursors.

DISTANCE BETWEEN CURSORS is automatically calculated and displayed. Distance is determined from the cursor placement on the waveform. Therefore, the accuracy of the cursor placement is crucial to accurate readings. For greatest accuracy, place the 1st cursor to the "0" distance marker and the 2nd cursor at the leading edge of the reflected pulse.

To set the cursors, zoom in on the point of interest using HORIZONTAL ZOOM. Set the first cursor by using the 1st cursor left and right arrows to the “0” distance marker on the waveform. To set the second cursor, use the 2nd cursor left and right arrows to move the second cursor to any point of interest. For a more accurate distance reading, zoom in on the reflected pulse for better detail and adjust cursor placement manually.

The distance between the cursors is displayed on the LCD. Remember that the distance measurement is not from the transmitted pulse, but from the first cursor to the second cursor. Accuracy of the distance reading is dependent on the placement of the cursors and an accurate VOP.

2.3.3 Test Port

The Test Port control selects the active cable test port and displays the waveform on screen. The Model 1270A has four test port options:

Coax: Displays live cable waveform via BNC connector.
Line 1: Displays live cable waveform via Line 1 banana jack connector.
Line 2: Displays live cable waveform via Line 2 banana jack connector.
Line 1 & 2: Displays Line 1 & Line 2 simultaneously.

2.3.4 Display Modes

Live Display Mode Loops:
While the Line 1, Line 2 and Coax test ports are active the Display mode loop alternates between Live and IFD (Intermittent Fault Detection) mode.

Live (active test port)	Displays active test port. (Coax, Line 1, or Line 2)
IFD	Displays IFD waveform (Coax, Line 1, Line 2)

If the Line 1 & Line 2 ports are active the display mode control toggles between dual line display modes.

Line 1 & Line 2	Displays Line 1 and Line 2 live waveforms simultaneously.
Line 1 - Line 2	Displays difference between Line 1 and Line 2 waveforms.
Crosstalk 1-2	Displays Crosstalk waveform, Line 1 transmit Line 2 recieve and display.

Recalled Display Mode Loops:
When a waveform has been recalled from memory the Mode control will cycle through display modes involving the active test port and the recalled waveform. the loop discribed below applies to each test port.

Live (active test port) & Stored	Displays Live and Stored waveforms simultaneously.
Live-Stored	Displays difference between Live and Stored waveform.
Stored	Displays Stored waveform only
Live*	Displays Live (active test port) waveform

* To exit the recalled waveform loop enter the Live mode and wait five seconds or select a different test port. If the recalled waveform is already a difference (Line 1 - Line 2), Live-Stored will not be available in loop.

2.3.5 Intermittent Fault Detection (IFD) Mode

IFD detects and displays intermittent faults, whether they are opens or shorts. Some TDRs have a similar feature; however, if the waveform is repositioned, the intermittent fault function is interrupted and the process must be started over. The Model 1270A's IFD retains the waveform trace. The waveform can be adjusted, repositioned, zoomed in and out, and the cursors moved, without affecting the IFD function. The Model 1270A will monitor the cable, waiting for an intermittent fault to occur.

Upon entering the intermittent fault mode:

The LCD's waveform area displays and saves the maximum and minimum reflections of the waveform trace. The auto-off 10 minute timer is disabled so the instrument does not turn off in the middle of the test.

The IFD waveform area stores waveform changes. If an open or short occurs, the instrument will keep the fault trace displayed against the live waveform. This function allows the user to find intermittent problems.

The operator can adjust the waveform with the horizontal position controls, increase or decrease the vertical gain, zoom in or out, and move the cursors. When zooming during the IFD mode, the instrument may need to pause slightly to fill in additional waveform data.

During the IFD mode, do not change the pulse width or range. If the pulse width is changed, the IFD routine will reset and start collecting data at the new pulse width.

The intermittent fault waveforms are stored in memory. This is an important difference between the Model 1270A and other TDRs. While the waveform is in memory, there are three important things to note;

1. The waveform can be adjusted as if it were a live waveform.
2. Make sure the Model 1270A battery is fully charged. In the IFD mode, if the instrument battery level goes below a minimum safe level, the instrument will turn itself off to prevent possible battery damage.
3. Waveforms can be stored and taken back to the office for downloading to a computer via WAVE-VIEW software or to a serial printer for archiving.

To store an IFD waveform, select Store from the pop-up menu while in the IFD mode. The instrument will save the intermittent waveforms in a dedicated IFD memory location. If a waveform has been stored in the IFD memory, the next time you enter the IFD mode, a prompt will appear to confirm you wish to overwrite the old waveform. Stored IFD waveforms have approximately maximum 1/2 distance range compared to normal stored waveform of equivalent pulse width. See chart on page 15.

2.3.6 Zoom Control

The Horizontal Zoom control expands and contracts the waveform around center screen. This control can be used to closely examine a feature found using preset RANGE operation or can be used for complete control of the waveform display distance.

2.3.7 Balance Control (Line 1, Line 2 ONLY)

The Balance Control matches the instrument to the impedance of the cable under test and balances or minimizes the TDR output pulse and test lead mismatches out of the waveform display. After the instrument has been connected to the cable under test, adjust the balance control so the pulse out area is as flat as possible.

If a fault is contained in the pulse area, the balance control will not be able to balance the reflection out of the waveform so the fault will be visible.

2.3.8 Vertical Gain

The Vertical Gain control increases or decreases the vertical amplitude or gain of the waveform display. Increasing the vertical gain of the waveform display allows the user to see smaller reflections or minor faults on the cable signature.

2.3.9 Cable Type Menu

The Cable Type Menu is used to select the type of cable under test which sets the VOP control to the correct value. The VOP control can still be changed at any time by the operator if a different VOP value is required.

2.3.10 Setup Options Menu

Before using your Model 1270A, there are several setup options you can choose from. The options you choose will remain selected, even when the instrument is turned off.

Options available	
Distance for mat:	FEET, METERS, or TIME
dBRL Type	FAULT or TOTAL (Coax)
Backlight at start-up:	ON or OFF
Velocity format:	VOP % or V/2
VOP precision:	2 DIGIT or 3 DIGIT
Cancel test lead length:	YES or NO
Serial printer type:	CITIZEN PN60 or SEIKO DPU 411
Horizontal reference	ON or OFF

The distance format option allows the operator to select the distance between cursor and waveform distance markers to either feet, meters, or time.

The backlight at start-up option is used to select whether the LCD backlight is on or off at start-up.

The velocity format option selects whether the velocity of propagation control is displayed as a percentage of the speed of light (VOP) or as meters or feet per microsecond velocity divided by 2 (V/2). The precision of the velocity can also be set using the VOP precision option in either two or three digits.

The cancel test lead length option allows the user to automatically subtract the length associated with the test leads from the distance between cursor readout. The instrument will place the first cursor at the end of the test leads.

NOTE: If test leads are not used, make sure to disable the cancel test lead length disabled.

The serial printer option is used to select the type of serial printer for RS232 printing. The options available are Seiko DPU 411 thermal printer and the Citizen PN60 plain paper printer.

The horizontal reference option allows the user to display a horizontal reference line on the center of the display.

2.3.11 Waveform Storage and Recall

Model 1270A's SUPER-STORE waveform storage capability allows the operator to store a waveform for later comparison and analysis. SUPER-STORE stores the entire cable under test, not just the section of cable displayed on screen at the time of storage. This feature is helpful if: the incorrect section of cable was on screen at the time of storage; comparing two separate waveforms (cables); or for comparing the same waveform (cable) before and after repairing the cable.

The Model 1270A comes standard with 32 SUPER-STORE waveforms. The waveform(s) will remain in storage, even after the instrument is switched off.

To store a waveform, scroll through the menu items until STORE is highlighted. SUPER-STORE will prompt the operator to select a memory location.

NOTE: If a memory location is selected which already has a stored waveform, the user will be prompted to overwrite the existing waveform or cancel the store. Memory locations do not have to be “cleared” to use. A “clear waveform” function also exists to allow the user to clear all waveforms in memory.

Choose a previously stored waveform to be displayed by scrolling through the menu until RECALL is highlighted. A memory selection list will appear allowing the user to select the desired memory location.

If any waveforms are currently stored in memory, the operator may choose the stored waveform by scrolling to the desired number. When the desired location number is highlighted, press * to select the stored waveform to be displayed with the live waveform. All instrument functions will operate normally.

SUPER-STORE will optimize the distance and resolution of a stored waveform based on the pulse width of the test. The following table describes minimum distances versus pulse width of a stored waveform.

Pulse Width	Coax Distance (83% VOP)	Line 1, Line 2 distance (65% VOP)
Sub nsec	450ft (180m)	N/A
2 nsec	1,500ft (590m)	1,500ft (590m)
25 nsec	5,000ft (1,970m)	3,800ft (1,500m)
100 nsec	10,000ft (3,940m)	7,300ft (2,870m)
500 nsec	15,000ft (5,900m)	N/A
1 usec	N/A	20,000ft (7800m)
6 usec	N/A	29,000ft (11,400m)

2.3.12 Noise Filter / Powered Cable

Testing a cable that has power or a signal present is possible, although for safety reasons, it is not recommended.

> WARNING: For safety reasons, it is recommended that the Model 1270A not be connected to cable that has a signal or power present. The Model 1270A is input protected and features a POWERED CABLE WARNING indicating power is present on the cable under test. The POWERED CABLE WARNING will appear in the message center.

If you must test a cable with power present, the Model 1270A
features NOISE FILTERS which allow the testing of cables with some signal or power present. If the Model 1270A is connected to a cable with power present, the microprocessor automatically filters out the power signal and displays only the normal waveform of the cable under test. When the NOISE FILTER automatically engages, the message center will alternately display POWERED CABLE and AUTO FILTER.

If noise or power is present at levels not sufficient to automatically engage the noise filter, the filter can be switched on manually.

If any key is touched while the noise filter is in use, the filter is disengaged while that key function is performed. The filter reengages after five display cycles. This allows multiple keypad selections without waiting for the filter to engage or disengage.

> Note: It takes longer to generate a waveform with the noise filter engaged. Therefore, the waveform repetition rate is reduced.

> Note: The filter will not protect the instrument from damage caused by high voltage.

<u>Multifunction Waveform Filtering (Optional)</u>

This option provides a unique multilevel filtering system for filtering various types of interference. Each touch of the FILTER key engages a different type or level of filter. Try each of the filters to determine which filter works the best for each test.

TDRs are used in a variety of industries and applications. With the various types of test surroundings, also comes various types of signals which can affect the performance of a TDR.

Signals such as power (50 to 400 Hz), audio (100 Hz to 20,000 Hz), data (50 kHz to 10 MHz), and RF (500kHz to 1GHz) can all affect a TDR differently. Therefore, a TDR with only one type of filtering system may work well in one application but not in another.

Riser Bond Instruments has addressed this problem by engineering a unique multifunction/multilevel noise filtering system into the Model 1270A which can greatly improve test results under these types of conditions.

Pressing the NOISE FILTER key on the keypad allows you to manually step through various levels and types of noise filters. Each touch of the NOISE FILTER key starts a new type and level of filtering, each of which will be displayed in the message center. Each type and level of filtering should be used in order to determine the best result.

Once you have cycled through all filtering modes, the next touch of the key switches off the filtering. If the noise filter is manually switched off, but power is still present on the cable, the message center will alternately display POWERED CABLE and FILTER OFF.

After the filter has been turned off, depressing the NOISE FILTER key again starts the filter, allowing the operator to again cycle through each type and level of filtering.

The combination of automatic and manual noise filters effectively filters out unwanted signals and will display the normal waveform signature of the cable.

2.3.13 Crosstalk

Model 1270A Crosstalk mode is used to locate the point in a cable where one cable pair is coupling signal into an adjacent pair. Crosstalk is used only with twisted pair.

Unwanted signal coupling, which is responsible for generating crosstalk, will cause pulse energy from the transmit cable pair to crossover into the receive cable pair. Coupled pulse energy will be displayed on the waveform.
The Crosstalk mode is an excellent way to find split pairs.

Wiring errors, water in the cable, and insulation problems may be a cause of crosstalk. Crosstalk is caused by capacitive coupling from one pair to another and will result in a distorted waveform on the receive line.

Crosstalk is generally frequency sensitive. Each of the pulse widths of the Model 1270A has a different fundamental frequency. When testing cable for crosstalk, it is a good idea to use the different pulse widths to measure the level of crosstalk at different frequencies.

The approximate equivalent fundamental frequency from different pulse widths are as follows:

Pulse Width	Fundamental Frequency
2 nsec	250 Mhz
25 nsec	20 Mhz
100 nsec	5 Mhz
1 usec	500 Khz
6 usec	83 Khz

A unique feature of the crosstalk mode of Model 1270A is that it will sense the fundamental frequency of the transmitted pulse and measure and display the value of the crosstalk at that frequency. The crosstalk value and distance to the crosstalk coupling is displayed in the FAULT SEVERITY area of the LCD.

To measure crosstalk, connect two suspected crosstalk pairs to LINE 1 and LINE 2. Select the test ports of Line 1 and Line 2 and change the mode to crosstalk. Set the first cursor to the transmitted pulse. Increase the vertical gain and adjust the zoom level sufficiently so as to be able to see any crosstalk. Scroll the 2nd cursor along the cable length. By setting the 2nd cursor at the leading edge of a crosstalk signal, you can read the distance to the crosstalk point and the crosstalk value as shown in the FAULT SEVERITY section of the display at the frequency of the transmitted pulse. To measure near end crosstalk (NEXT), simply set both cursors to the beginning of the transmitted pulse.

Crosstalk is also an excellent way to find the location of two split pairs. Again, connect two suspected split pairs to LINE 1 and LINE 2. You will get an upward or downward reflection at the point where the two pairs are split.

2.3.13 Charging the Batteries

The Model 1270A is powered by a rechargeable battery pack contained within the instrument. The Model 1270A is shipped from the manufacturing plant with a full charge and will operate approximately 6 hours between charges.

When the battery supply has been depleted and the batteries need to be recharged, plug the external battery charger into the front panel charger socket and into any common AC outlet. The front panel green LED will light to indicate the batteries are being charged. The LED indicator will stay illuminated while the charger is plugged in.

The Model 1270A has a built-in, current-limiting circuit which limits battery charge current. As the batteries approach maximum charge, the charging rate is decreased. Do not leave the batteries charging for long periods of time; their useful life will be shortened. The Model 1270A can be charged with either an AC or DC power source with correct voltage and current specifications.

The Model 1270A will operate while being charged as long as the battery level indicator is above a quarter charge. Allow at least 16 hours charging time for the batteries to cycle from a completely discharged state to a fully charged state. The Model 1270A may be operated while the batteries are charging, but this will increase the charging time.

Note: The Model 1270A may also be charged using an optional 12 volt cigarette lighter adapter.

2.3.14 RS-232 Interface

Model 1270A includes an RS-232 Interface Connector for serial printing and the WAVE-VIEW software option. Two serial printer drivers are available in the setup options menu.

SECTION 3: TDR FUNDAMENTALS

3.1 First Time Start-up

Before using your Model 1270A, there are several set-up options you can choose from. Select the Setup menu control and select the desired default settings for the instrument. The options you choose will remain selected, even when the instrument is turned off. (See section 2.3.8 for setup options.)

3.2 Cable Connection

It is important to establish a quality connection to the cable under test. The TDR sends a high frequency signal that is not efficiently transmitted through poor connections or inadequate test leads.

3.3 Cable Check

Do a quick check of the cable. Get as close to the suspected fault as possible. Use common sense when examining the area near to the suspected fault. For example, if there is a new fence, that is probably where the problem is located.

When testing a section of cable where different types of cable are spliced, use the independent cursors and the correct VOP for each section of cable to yield the most accurate readings.

3.4 Cable Impedance

Any time two metallic conductors are placed close together, they form a transmission line which has a characteristic impedance. A TDR tests for a change in impedance which can be caused by cable damage, faulty splices, water ingress, change in cable type, improper installation, bridge taps and even manufacturing flaws.

The insulating material that keeps the conductors separated is called the cable dielectric. The impedance of the cable is determined by the conductor diameter, the spacing of the conductors from one another, and the type of dielectric or insulation used.
The line 1 and line 2 inputs of the Model 1270A uses an output pulse balance circuit that cancels the output pulse out of the waveform display and matches the instrument to the cable under test. The Model 1270A will still display fault reflections which occur in this region.

3.5 Velocity of Propagation (VOP)

<u>Determining the VOP</u>

Determine VOP: The VOP number of a cable is determined by the dielectric material that separates the two conductors. In a coaxial cable, the foam separating the center conductor and the outer sheath is the material determining the VOP. In twisted pair, the VOP number is determined by the spacing between conductors and the insulation that separates them.

The VOP of a cable can change with temperature, age and humidity. It can also vary from one manufacturing run to another. Even new cable can vary as much as +/- 3%.

There are several ways to determine the correct VOP. The first is to simply refer to the VOP card provided with the instrument. Second, consult the manufacturer for the correct VOP of that specific cable. A third way is to actually determine the VOP from a known cable length. Measure a known cable length - the longer the cable, the more accurate the VOP will be. Correctly place the cursors of the TDR on the output pulse and the reflected pulse (end) of the cable. Change the VOP setting until the “Distance Between Cursors” displays the known length. You have now determined the VOP of the cable.

Reducing VOP error: When trying to pinpoint a fault, the most common technique used to reduce VOP error is to test the faulty cable from both ends. The procedure is as follows:

Determine the path of the cable. With a measuring wheel or tape, measure the exact length of the cable being tested. Set the VOP according to the manufacturer’s specifications, test the cable from one end and record the fault distance reading. Next, using the same VOP setting, test from the opposite end of the cable and again record the fault distance reading. If the sum of the readings is the exact length of the cable that was measured, the VOP is correct and the fault has been located.

However, if the sum of the two readings is more than the measured distance, reduce the VOP setting and retest. If the sum of the two readings is less than the measured distance, increase the VOP setting and retest, but the operator must also consider the possibility of two faults. Keep changing the VOP settings until the distance readings total the known length.

The same result can be obtained mathematically. Take the actual cable length and divide by the sum of the two TDR readings obtained by the tests from each end. This produces an adjustment factor. Next, multiply each of the TDR readings by the adjustment factor. The result will be the corrected length readings.

> Example: TDR readings equal 700 feet and 500 feet from either end. Actual cable distance equals 1000 feet.

700 + 500 = 1200
1000/1200 = Adjustment Factor = 0.833
700 x 0.833 = 584 actual (corrected length)
500 x 0.833 = 416 actual (corrected length)

NOTE:
When measuring cable reels, cable coiled on the reel can cause an error in the length reading by as much as 2 to 5%.

3.6 Pulse Widths

Many TDRs have selectable pulse width settings. The pulse width allows the TDR signal to travel down a cable at different levels of energy and distances. The wider the pulse width, the more energy is transmitted, and therefore, the further the signal will travel down the cable.

NOTE: Always start the fault finding procedure in the shortest pulse width available, as the fault may be only a short distance away. Use the range or zoom and gain controls to locate fault. If the fault is not located, adjust to the next range or larger pulse width and retest. Keep adjusting to the next larger pulse until the fault is located.

Cable Loss

Cable has loss. A signal attenuates as it travels down a cable. Some cables have greater loss or signal attenuation than others. Because the pulse amplitude is reduced by the loss in the cable, major faults at long distances will appear to be of the same amplitude as minor faults close to the instrument.

Attenuation affects the maximum length of cable that can be tested. The greater the cable attenuation, the more energy must be sent down the cable to test longer lengths. To increase the amount of energy transmitted into the cable, increase the pulse width. Model 1270A has multiple pulse widths which the operator can select to best accommodate the cable length being tested. However, since the location of a fault is unknown, it is best to start the testing procedure in the shortest pulse and increase the pulse widths as the distance being tested is increased.

3.7 Return Loss / Fault Severity

A unique feature of Model 1270A is AUTOMATIC dBRL calculation. This eliminates the need to visually and/or manually calculate the RETURN LOSS at a particular point on the waveform.
The RETURN LOSS (dBRL) reading is calculated using the

signal amplitudes and waveform data samples taken just to the left and right of each cursor. It is best to position the cursors along the leading edge of both pulses.

Return Loss is a way of measuring impedance changes in a cable. The algorithm for determining return loss is:

$$dBRL=20\ Log_{10}V_O/V_R$$

Where V_O is the amplitude of the transmitted pulse and V_R is the amplitude of the reflected pulse.

A small value dBRL number means that most of the pulse energy is reflected by the cable fault. An open or short would reflect all the energy so its return loss is zero.

Remember, the larger the dBRL reading, the smaller the problem and vice versa.

The coax port of the Model 1270A can be set up to display dBRL in two possible modes, Total dBRL and Fault dBRL.

Total dBRL displays the dBRL of the fault, plus the attenuation of the cable or cable loss.

Fault dBRL displays the dBRL of the fault and factors out the attenuation of the cable or cable loss.

In the Fault dBRL mode, the attenuation (loss) of the cable has been subtracted out of the display reading. Therefore, a complete open or short will read 0 dBRL, regardless of the length of cable.

NOTE: The only way to get an accurate measurement in the Fault dBRL mode is to use the Setup menu to enter the type of cable under test.

To select Fault dBRL mode, press the Set UP key and select CABLE TYPE. Select Fault dBRL. After Fault dBRL is selected, you will be prompted to select the type of cable under test. This is necessary to accurately cancel out attenuation effects on the dBRL reading.

Selecting a cable type will also set the VOP of that particular cable into the VOP display settings.

SECTION 4: APPLICATION NOTES

4.1 TDR - Tap Plate Connector

It can be tiresome breaking down installed taps and installing an adapter in order to test the cable with a TDR. A solution is to modify a tap plate of the same type in your system to connect the TDR to each leg of the cable. The modified tap plate can be installed instead of the original tap plate to gain quick and easy access to the cable.
First, using a two port tap, remove the circuit board. Desolder and remove all the components, from the circuit board.

Next, make two wire jumpers which connect the input and output ports to housing connectors at the respective tap ports on the plate. Connect the input connector to one tap port and the output connector to the other tap port. This makes the two tap ports independent from each other and used to test in either direction from the tap.

To find a location for the wire jumper, look for a coil connection from the IN to the OUT port which passes any power signal on the cable through the tap. Solder one end of a wire jumper to one side of the removed coil location. To connect the jumper to the tap port, look for a hole in the circuit board which is connected to the tap port center conductor. Solder the other end of the jumper here. Do this for both tap ports.
Use an Ohmmeter to check for continuity when trying to locate which holes in the board to use, and to check to see if the plate is wired properly.

To use, remove an existing face plate of a tap either overhead or underground and replace it with a modified TAP plate. Connect the lead from the TDR to the input tap port and test the cable back to the next tap. Double check that there is no AC on the line. Alternatively, connect the lead to the output tap port and read the following tap. Removing face plates is a lot easier and quicker than working with connectors.

> *Warning:* Make sure you do not test cable with AC on the line.

4.2 Missing Signals, Corroded Splices, & Unidentified Cables

Missing Signals - In certain situations cables may go bad for no apparent reason. For example a signal may not be getting into a cable. Start by verifying the problem is not within the transmitting equipment. If it is not in the transmitting equipment then begin to check the cable with a TDR. Check the cable from both ends to find the fault.

After locating the fault on the waveform measure out to the distance of the fault then check for anything unusual. For example, a new sign driven into the ground or a new fence, something that may have caused the good cable to quit working. Then repair the faulty part of the cable.

Corroded Splices - Within many systems, there are a lot of cable splices. Many are old and their locations are unknown. With most splices, it is just a matter of time before they go bad. Use a TDR to locate corroded splices that need to be repaired.
Identifying Cables - If no markings were used during construction one can go back with the aid of a plant map and use the TDR to identify cables by their length. This is a very efficient way to accurately identify and mark cables.

4.3 Detecting Intermittent Faults

As sometimes happens, a cable may cause a problem only when the wind blows, the rain falls, or infrequently for no apparent reason. When this type problem occurs, the IFD function of the instrument can be a real time saver.

The IFD mode can be used to monitor a cable for “intermittent” type problems. The instrument will monitor the cable, waiting for the mysterious or elusive event to take place. If a change in the waveform does occur, the instrument will capture the change, and not let it disappear. With the event captured, the distance can be measured and the mystery solved.

When using the IFD mode, there should be no power present (RF or AC) that can affect the readings. The test can take only a few minutes or, the instrument can be left on indefinitely to help capture even the most stubborn intermittent fault. See section 4.8 for additional information.

4.4 Measuring and Documenting

Measuring - Cable inventory and management can be very expensive and time consuming. Many companies have a problem getting technicians to use up partial reels of cable, due to unknown lengths.

While learning to use the TDR, an installation crew experimented measuring reels of cable. They learned to measure and use the partial reels, which saved money and extra trips back to the warehouse.

The TDR can also be used to verify the lengths of incoming new reels by the length in new construction or if the cables are unmarked.

Documenting - Contractors can use SUPER-STORE and WAVE-VIEW to document their work or to use as proof-of completion and /or performance. SUPER-STORE can also be used to show the need for cable replacement or repair. Documenting a cable section when newly installed makes a convenient and easy comparison when problems arise at a later date. Cables can be periodically monitored for signs of deterioration. SUPER-STORE and WAVE-VIEW provide a variety of opportunities and applications not found with any other TDR.

SUPER-STORE Waveform Storage is a unique storage feature of Riser Bonds' waveform TDRs. SUPER-STORE waveform storage, stores all of the waveform information on screen and off screen. The user then has the ability to recall and display the waveform at any time. The waveform can still be fully adjusted. The only changes that cannot be made are in the pulse width, the impedance settings, balance or engaging the filters. This feature allows a more experienced person to interpret the waveform, or get a second opinion from coworkers. It also allows you to do a before and after, alond with recallin information to test form both ends.

WAVE-VIEW software allows the stored waveforms to be transferred to a personal computer where they can be archived, adjusted, compared, or analyzed. Using WAVE-VIEW software in combination with the appropriate equipment allows the user to e-mail stored waveforms.

NOTE: Updates to WAVE-VIEW software can be downloaded from the Radiodetection website at www.radiodetection/waveview

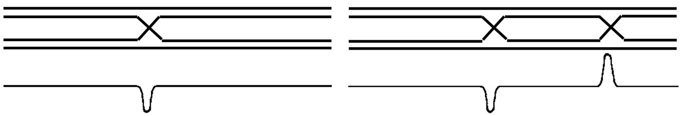
The combination of SUPER-STORE and WAVE-VIEW also make a good tool for TDR training. Students or new employees can use the computer as though it were a TDR, which keeps the TDR in the field. In addition, a variety of sample waveforms can be stored. Various cable spans and types, faults, system components and samples of known cables conditions can all be recalled and studied.

4.5 Locating Splits and Resplits

A split or split/resplit pair occurs when one conductor (each of two different pairs) are switched somewhere along the cable length. A TDR used in the traditional mode of simply looking for the impedance discontinuity can, many times, find this split. The problem with the traditional method is the discontinuity is relatively small and, therefore, the TDR's reflection will be small. If the split is close, it can be identified. If, on the other hand, the split is some distance away, the small reflection is attenuated by cable length and the split can be difficult to locate.

Using the Model 1270A in the Crosstalk mode greatly enhances the reflection and makes finding splits that are far away much easier.

Shown below is an example of a split, and split/resplit and their corresponding TDR waveforms using the crosstalk mode.



Connect one pair of the split pair to Line 1 and the other pair to Line 2. Set the Model 1270A to display Line 1 and adjust the 1st cursor to the “0” distance marker. Select Line 1 and Line 2 test port and cycle the Model 1270A display mode to the Crosstalk mode. The Crosstalk mode transmits the TDR pulse on Line 1 and receives on Line 2. If any energy is coupled from pair 1 to pair 2 (split or resplit), it will return to the instrument and be displayed on the waveform trace. Use the Range, horizontal zoom, waveform position, and vertical gain functions to find the discontinuity. Set the cursor to this point. Now you have found the locations of the split and resplit.

4.6 Locating Bridged Taps

A bridged tap is a component within a telephone system that can be one of the easiest to locate with a TDR, but it is also often mis-identified. Some people refer to a bridged tap as a lateral which extends off of a main cable. However, the true definition of a bridged tap is the point on the cable where a lateral connects to the main cable. A bridged tap is not a section of cable.

This manual will refer to the point of connection of the lateral to the main cable as the bridged tap. The cable extending from the bridged tap to the subscriber will be referred to as the lateral.

Figure 1 is a common waveform which results from testing a section of cable containing a bridged tap from which a lateral extends to the subscriber.

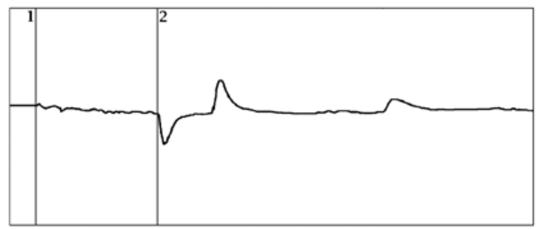


Figure 1

Referring to Figure 1, you might assume the following.

Point A: the TDR's point of connection to the cable
Point B: (downward reflection) the point of a bridged tap on the main cable
Point C: the open end of the lateral
Point D: the open end of the main cable circuit

The waveform shown in Figure 1 and the conclusions were correct. However, Figure 1 could also be the result of a somewhat different cable layout as explained below.

A common mistake when testing through bridged taps is to mis-identify the end of the lateral for the end of the main cable circuit. As shown below, Figures 1a and 1b show two different cable plant layouts. However, the resulting waveforms are identical.

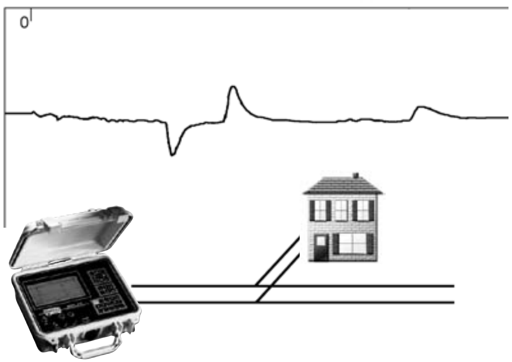


Figure 1a

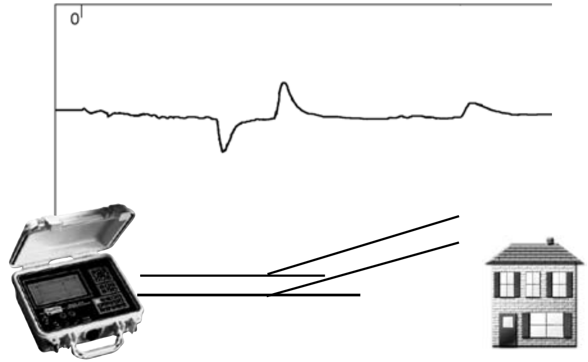


Figure 1 b

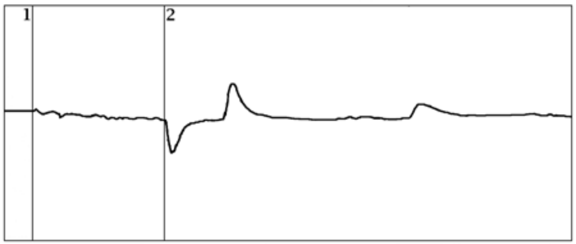
In Figure 1a, the length of the lateral is shorter than the end of the main cable circuit. In Figure 1b, the length of the lateral is longer than the main cable circuit.

> LESSON: Do not assume the first upward reflection after a bridged tap is always the end of the lateral; it may be the end of the cable, depending on the layout of the network.

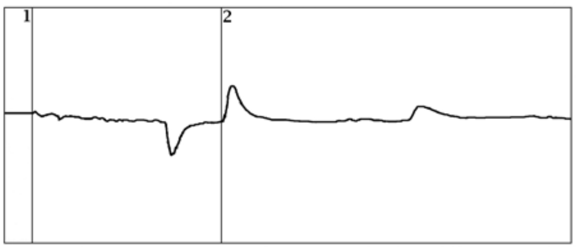
It is always a good idea to refer to plant maps whenever possible to help minimize confusion or errors, especially when testing through bridged taps.

Remember, a TDR will test through a bridged tap displaying a waveform of the cable under test, including any bridged taps and their corresponding laterals. A great deal of information is displayed in the waveform. Therefore, a thorough study of the waveform and correct cursor placement becomes very important.

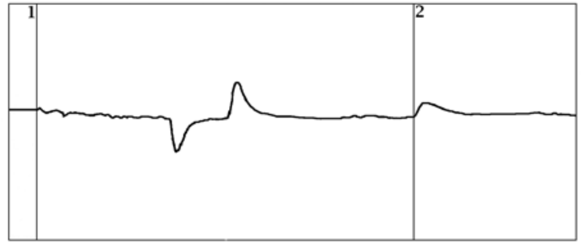
In the following examples, we will use the cable layout as shown in Figure 1a where the first downward reflection is the bridged tap, the next upward reflection is the end of the lateral, and the last upward reflection is the end of the main cable circuit.



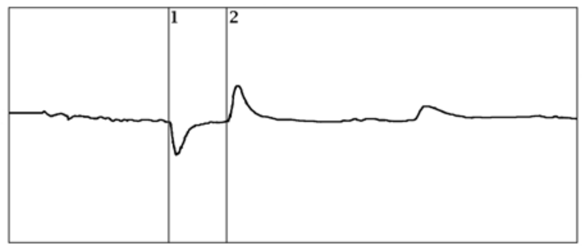
The distance between the two cursors is the distance from the TDR to the point of the bridged tap.



The distance between the two cursors is the distance from the TDR to the end of the lateral.



The distance between the two cursors is the distance from the TDR to the end of the main cable. There is no need to subtract the length of the lateral. This is an advantage of a TDR over an ***open locator.***



The distance between the two cursors is the length of the lateral.

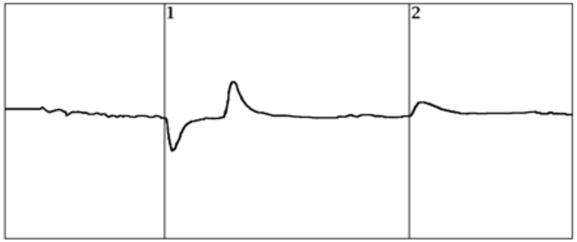


Figure 1

The distance between the two cursors is the distance from the bridged tap to the end of the main cable.

When testing through a bridged tap, it can be difficult to determine if the reflection caused by a fault is located in the lateral or in the main cable section beyond the bridged tap point, as illustrated in Figure 2. The fault could be in either the lateral or the main cable.

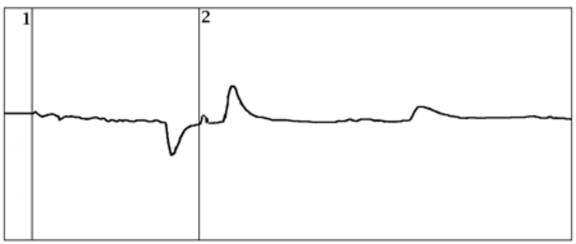


Figure 2

Figure 3 is a waveform from the cable plant layout in Figure 1a. The reflection caused by a fault is obviously located in the main cable beyond the point of the bridged tap and not the lateral. It is always a good idea to go to the bridged tap point and test both the lateral and the main cable beyond the point of bridged tap.

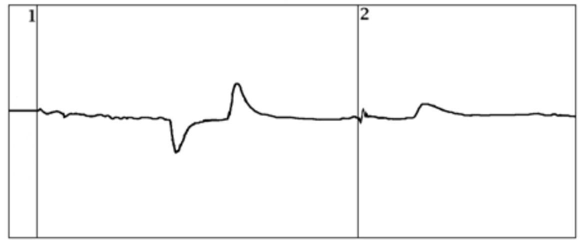


Figure 3

Another example of how bridged taps can be misinterpreted is shown below: In Figure 4, there appears to be a short on the waveform. However, the waveform shown in Figure 4 is actually the same waveform shown in Figure 5. The only difference is the operator has used the zoom function to show only a specific section of cable in Figure 4. The amount of cable shown on the display is not enough to see the end of the lateral or the end of the cable.

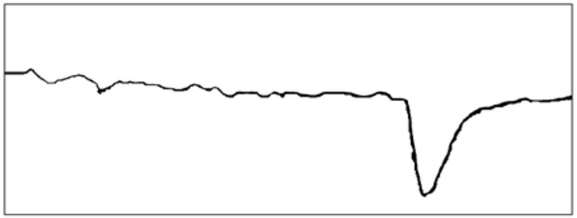


Figure 4

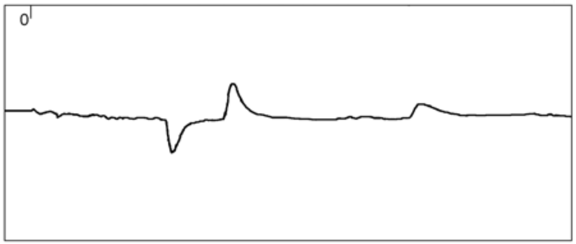


Figure 5

Remember, when testing with a TDR, always start the test in the shortest pulse width or range possible. Continue to increase the pulse width or range until the entire waveform has been viewed. This procedure will insure that no faults are accidentally missed and waveforms are not misinterpreted.

Ghost reflections can appear when testing through bridged taps. Referring to Figure 6a, it appears as though there is a partial open at Point E. This cannot be true as the cable physically ends at Point D. Referring to the cable plant layout in Figure 6b, the ghost is caused when the signal returning from Point D passes Point B. The signal splits, some energy returning straight to the TDR (Point D) and some energy traveling down the lateral, reflecting from the end and returning to the TDR (Point E) after the reflection of the end of the cable.

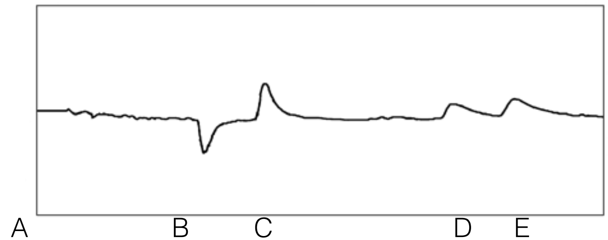


Figure 6a

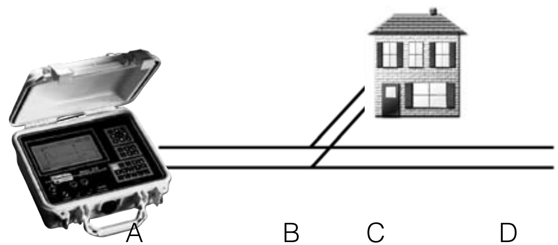


Figure 6b

A good clue that a reflection is actually a ghost from a bridged tap, is that the distance from the end of the cable to the ghost is the same length as the lateral itself (the distance from Points D to E in Figure 6a is the same as Points B to C in Figure 6a). A way to test whether or not Point E is a ghost is to have someone short the end of the cable. If Point D reflects downward along with Point E when the cable is shorted, then Point E is a ghost reflection of the bridged tap.

When testing through bridged taps, the signal strength is cut in half, because a lateral provides a second path for the signal. Point B in Figure 6b is where the signal splits, and because of this, the maximum distance readability is reduced from that point outward. If you can normally test 6,000 feet in a particular pulse width or range, you may only be able to see 3,000 feet beyond due to the bridged tap.

4.7 Moisture in twisted pair

A subscriber complained about a noisy telephone line. The noise was traced to the drop. The subscriber had a 2,800 foot two-pair drop to the home, along a country road ditch, through the yard, and into the house. The unused pair was found to be quieter so the customer was switched to the quieter pair. This seemed to solve the problem until a few months later, when the customer started complaining again.

Retesting the pairs found the original pair was now quieter. Noisy pairs going quiet and quiet pairs becoming noisy led the technicians to suspect water in the cable. Plant records showed the cable was not spliced so it was unknown how and where the water was getting into the cable.

The cable was tested with a TDR and an undocumented splice was found. Close examination of the splice showed it to be totally saturated with water. The cable was re-spliced and the lines were now quiet.

The greatest percentage of twisted pair problems fall in the moisture-in-the-cable category. How to locate the problem, why one pair may be affected but not another, and how much of the cable is affected are all problems which have to be addressed.

A TDR will find water in the cable. It shows up as a lowering of the cable impedance. Most times, though, it is difficult to accurately tell how much of the cable is affected. In filled cable, moisture cannot migrate inside the cable so it is typically a point problem in the cable or splice case. In air-core or pulp cable, moisture can migrate along the cable.

By testing the cable from both ends and recording the distance to fault in all pairs, it is possible to determine approximately how much cable is affected.

When testing through water, measurements up to the water are very accurate. After the water, distance readings may be erroneous due to a VOP change caused by the water. Although the moisture may be 20 or 30 feet wide, each pair usually becomes impregnated at different points. The range of these points will indicate the length of the problem.

Water can seep into the conductors through pin holes in the plastic insulator around the conductors. When testing each pair, the footage to the problem may read different for each pair. This is because the water has penetrated through the conductor insulation at different points and affects the conductors at different footages.

The location and how much cable is affected is now known. But it is still necessary to locate where the water actually entered the cable. A break in the sheath may not necessarily be within the span of where the water is and may not necessarily show up in testing. If the break in the sheath is not fixed, the problem will show up again in the future.

If the break in the sheath happens to be at a high point in the cable, the water will enter through the hole then migrate to a lower point. If the water entry point is not found, it may be necessary to visually inspect the cable. Check the integrity of the sheath.

4.8 Locating Intermittent Faults

A major problem in troubleshooting outside plant is locating intermittent faults. The first indication of an intermittent fault is when a telephone customer complains of noisy static or no dial tone. The problem is usually a high resistance series fault or intermittent connectors.

Many times, the customer calls with a noisy telephone line. However, by the time the trouble crew is deployed, there is no trouble found. When there is no loop current, the fault heals itself. As soon as you leave the trouble, and the customer uses the line again, they report the same type of trouble.

Solid cases of trouble are very easy to locate with the help of a TDR. If the trouble is intermittent, the technician will have a difficult time seeing the problem on a TDRs waveform with just the naked eye. When this type of trouble is located very close to the subscriber end of the line, this may be a high resistance open (series resistance fault).

Below is a quick and easy guide on how to locate "noisy static" troubles with the Model 1270A's IFD Mode:

1. **Disconnect** at the lightning protector on the subscriber end.

2. **Confirm the trouble**. Connect a butt set, turn the speaker on and listen to the line. Confirm that the trouble you hear (if any) is what the customer reported.

3. **Turn the butt set to mute, and dial a silent termination.** This is done to prevent any noise picked up by the microphone of the butt set to be put on the line, as it may affect the TDR waveform.

4. **Connect the Model 1270A.** Connect the test probe leads to the pair under test. Continue to keep the butt set connected to the pair with the silent termination.

5. **Switch on the TDR** by touching the I/O key.

6. **Initiate the IFD mode** by selecting a mode soft key.

7. **Wait for the fault to occur.** The Model 1270A will display a live waveform, while monitoring the line for any intermittent waveforms. If an intermittent fault occurs, the trace of the fault area will be superimposed on the live waveform. With the loop current on line, the trouble will normally appear within 5 to 10 minutes. Adjustment of the waveform on the screen both vertically and horizontally will not affect the test.

Note: Some intermittent faults are caused by the environment. For these situations it is not necessary to have access to a dial tone.

SECTION 5: WAVEFORM EXAMPLES

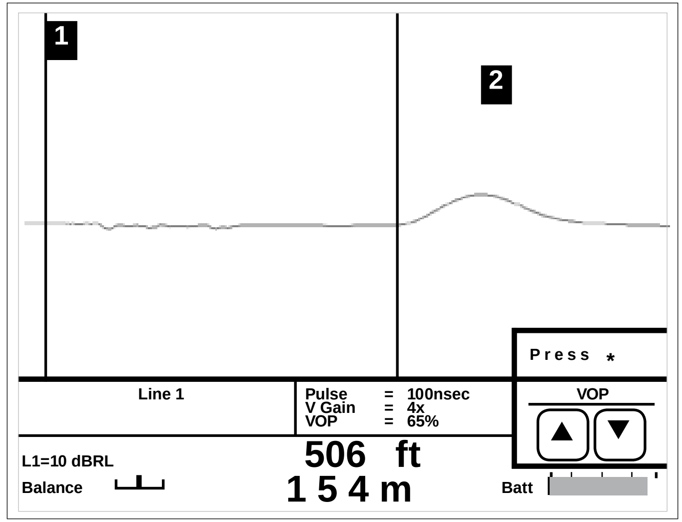
A great variety of waveforms may be encountered. This is due to the various applications and electrical and environmental characteristic differences found in the wide variety of cables that exist today.

Remember also: The reflection of a fault or component will look different on a short length of cable than it will on a long length of cable.

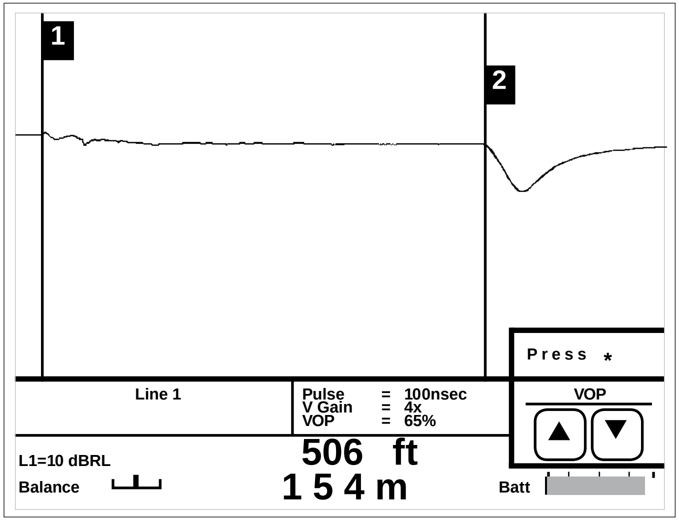
Various industries, cable types, and components produce many different waveforms. The TDR's pulse width, horizontal zoom, and vertical gain settings all affect how a waveform will appear.

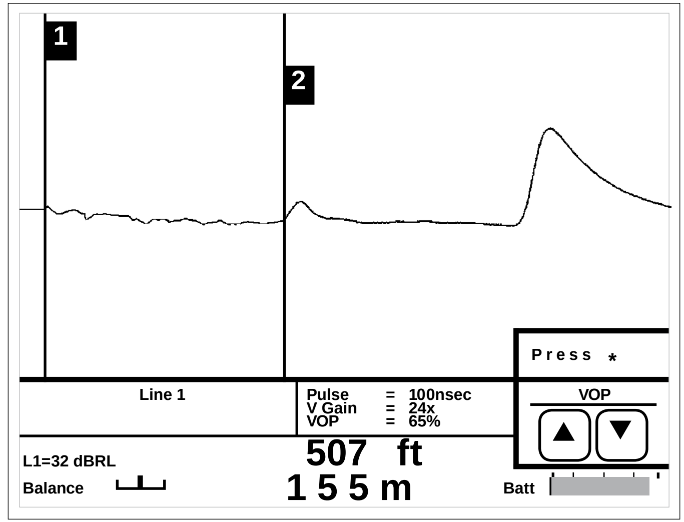
Practice testing various known cable segments, with and without components. Become familiar with how each segment looks prior to any problems.

The following pages contain samples of waveforms you may encounter when testing twisted pair cable:



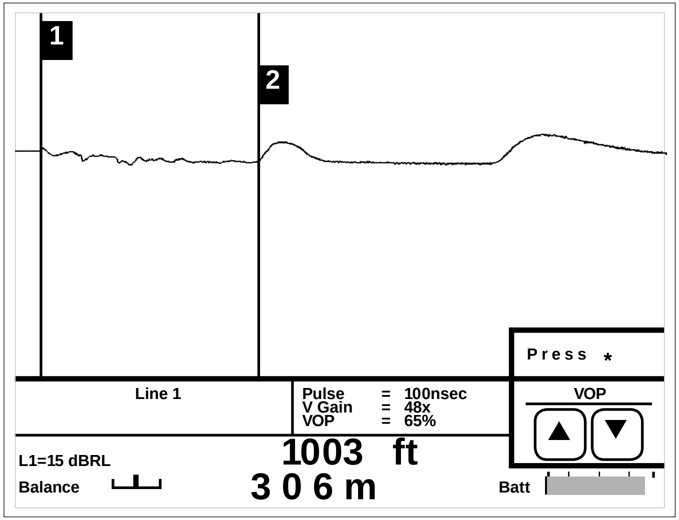
A reflection with upward polarity indicates a fault with OPEN (high impedance) tendencies. The reflection shown at the second cursor is a COMPLETE OPEN.



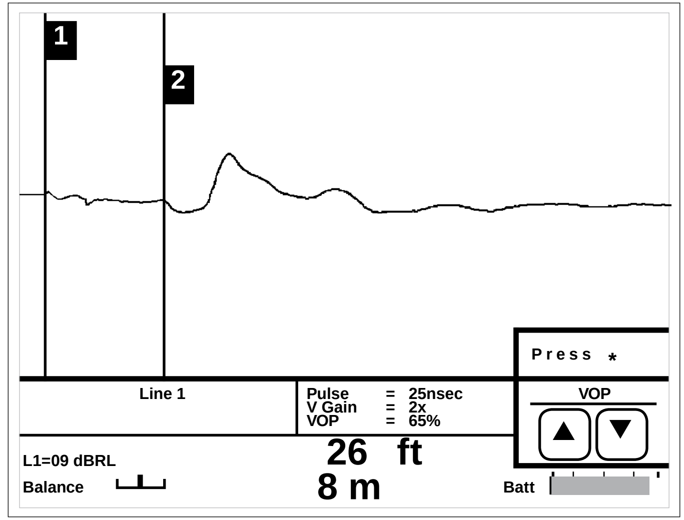


A reflection with downward polarity indicates a fault with SHORT (low impedance) tendencies. The reflection shown at the second cursor is a DEAD SHORT.

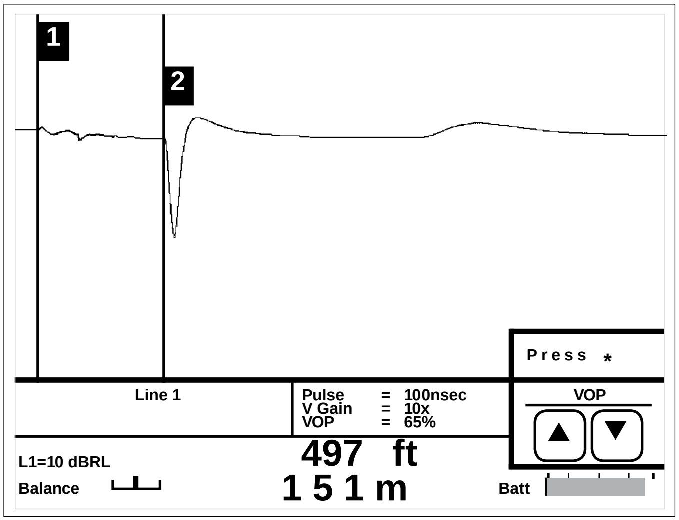
The middle reflection at the 2nd cursor is a ONE SIDE PARTIAL OPEN followed by a COMPLETE OPEN (end of the cable). The more severe the fault, the larger the reflection will be.



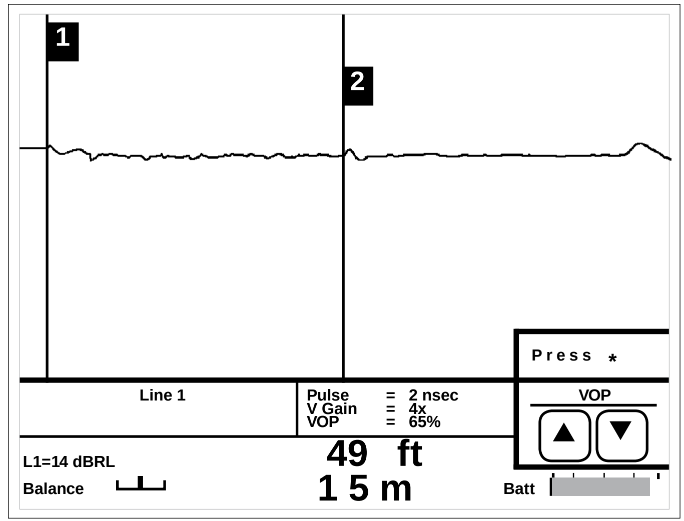
A 10 Ohm series resistance fault at the 2nd cursor (1003 feet) followed by a complete open at 2000 feet.



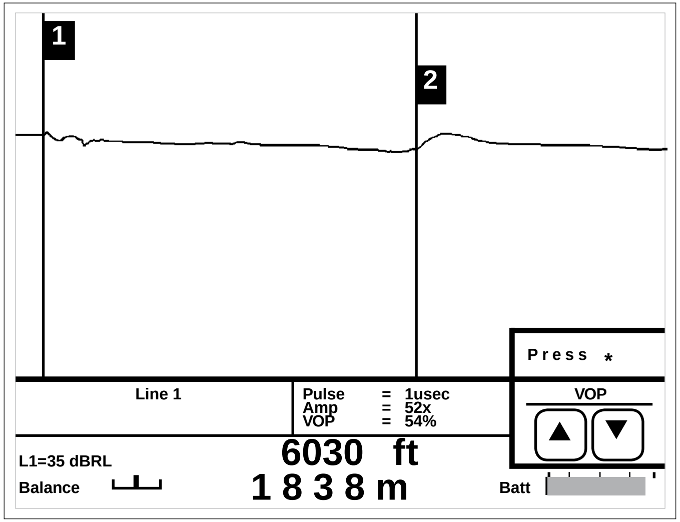
A wet splice at the 2nd cursor. This is the first splice out from the cross connect.



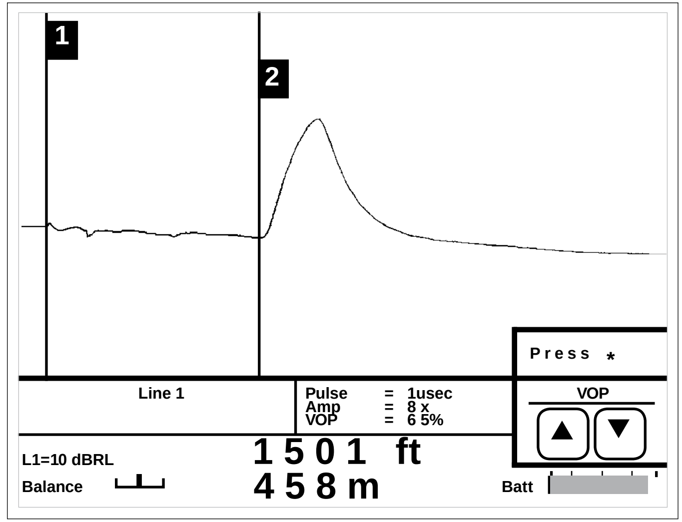
A telephone BUILD-OUT CAPACITOR causes a low impedance DOWNWARD reflection (similar to a SHORT) followed by a smaller positive reflection.



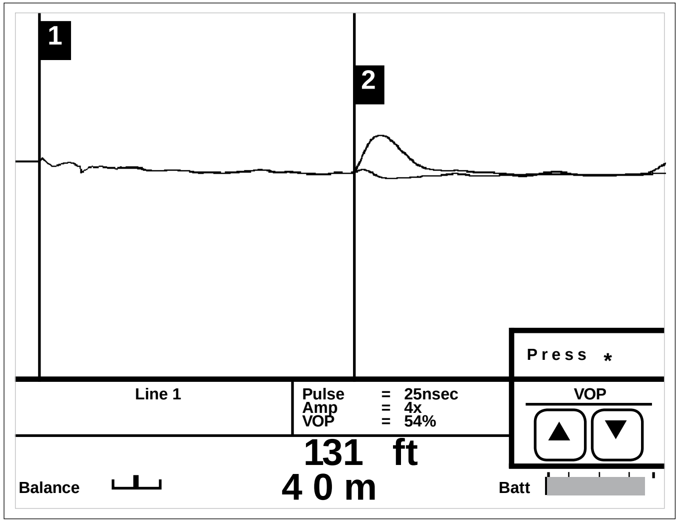
A joint or splice at the 2nd cursor. The visibility of a splice will depend on the type and quality of the splice, and the distance away.

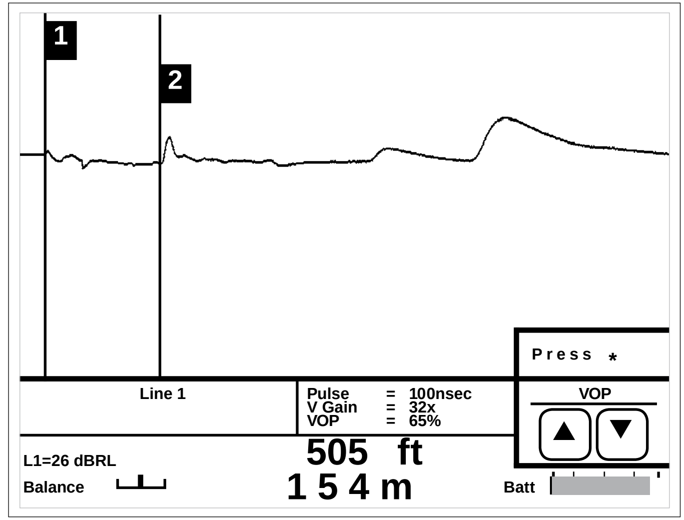


An open at 6030 feet on twisted pair cable. Increasing the pulse width and vertical gain is necessary to see a distant fault.



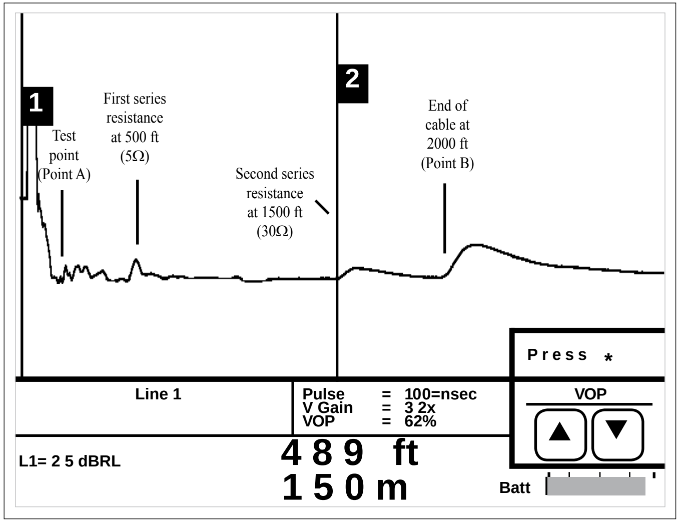
A telephone load coil will cause a high impedance UPWARD reflection (similar to a COMPLETE OPEN).



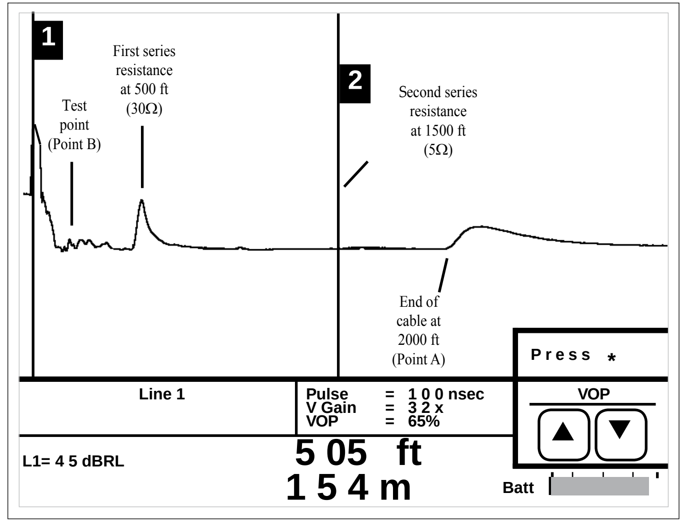


An intermittent open at the 2nd cursor is trapped by the Intermittent Fault Detection (IFD) Mode.

After the first major reflection, the second event could be a more severe fault. It appears smaller to due absorption of signal at the first fault. Always shoot the cable from both ends to eliminate this problem.

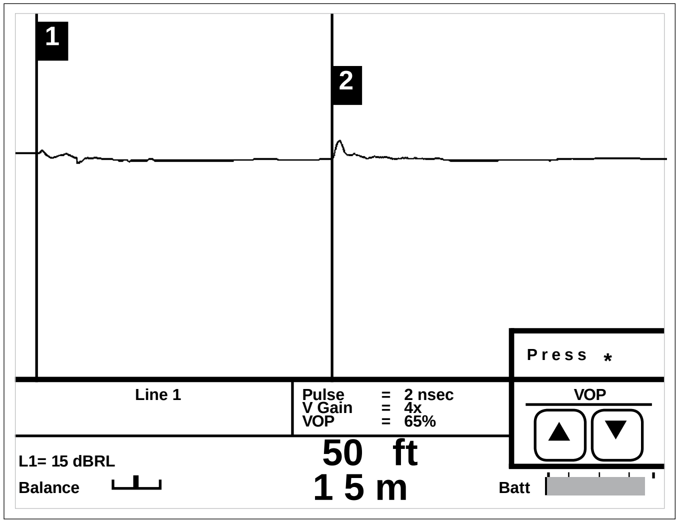


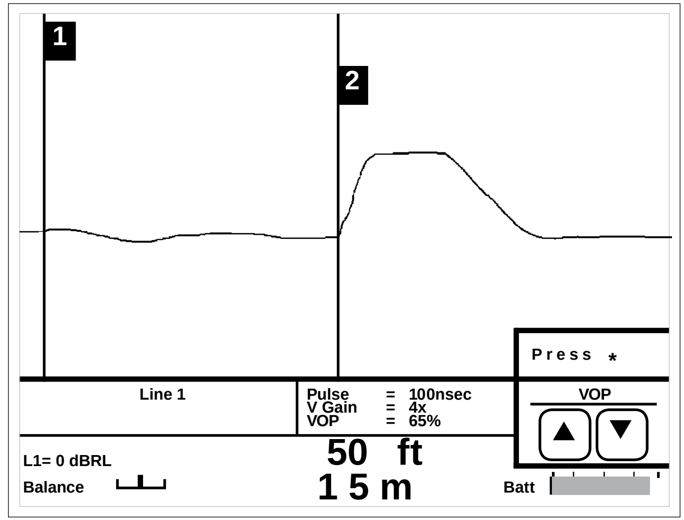
After the first major reflection, the second event could be a more severe fault. It appears smaller due to absorption of signal at the first fault. Always test the cable from both ends to help eliminate this problem.



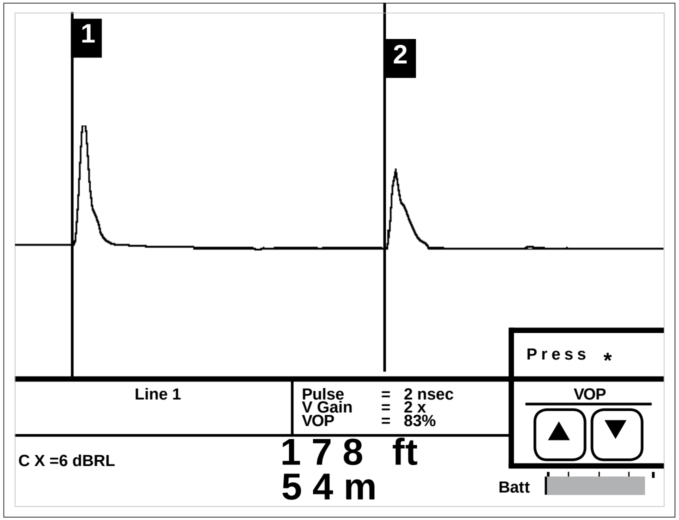
This describes test setup, measuring from the far end.

The next two waveforms illustrate how changing one setting can change the way a waveform appears. Both tests are of the same cable. Only the pulse width setting of the instrument has been changed.

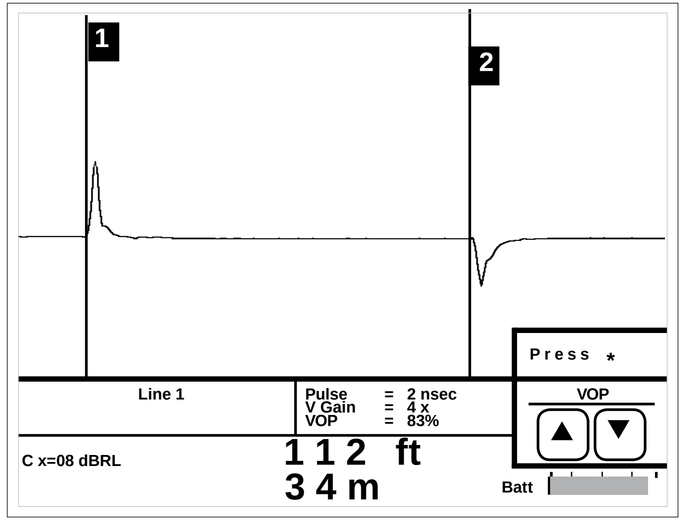




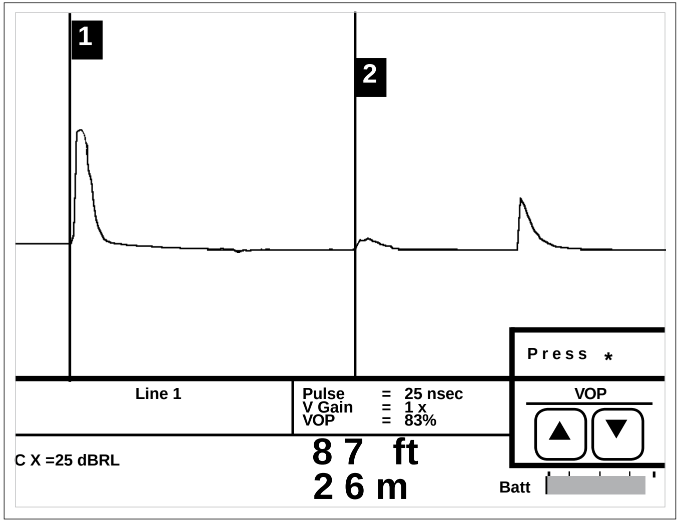
The following pages contain samples of waveforms you may encounter when testing coaxial cable:



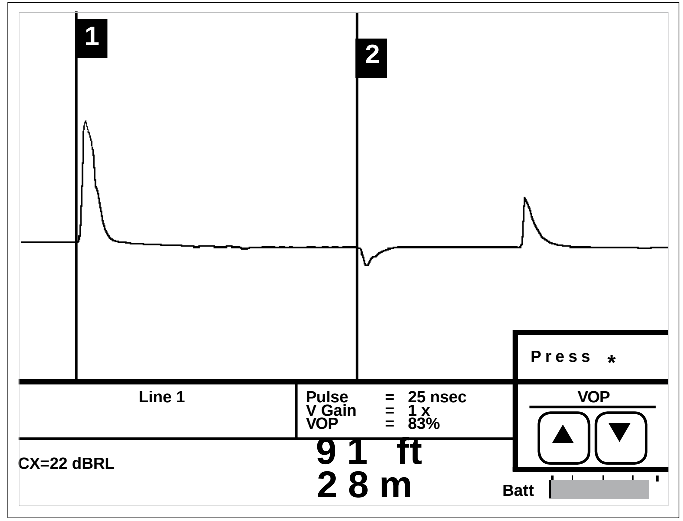
A reflection with the same polarity indicates a fault with OPEN (high impedance) tendencies. The reflection shown at the 2nd cursor is a complete open.



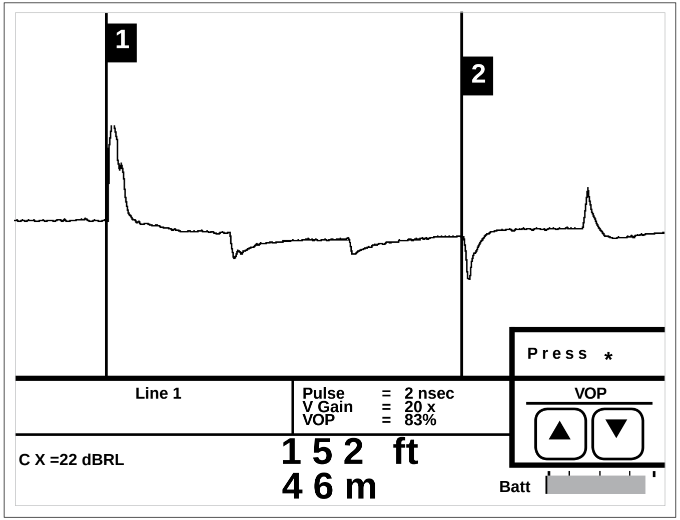
A reflection with the opposite polarity indicates a fault with short (low impedance) tendencies. The reflection shown at the 2nd cursor is a dead short.



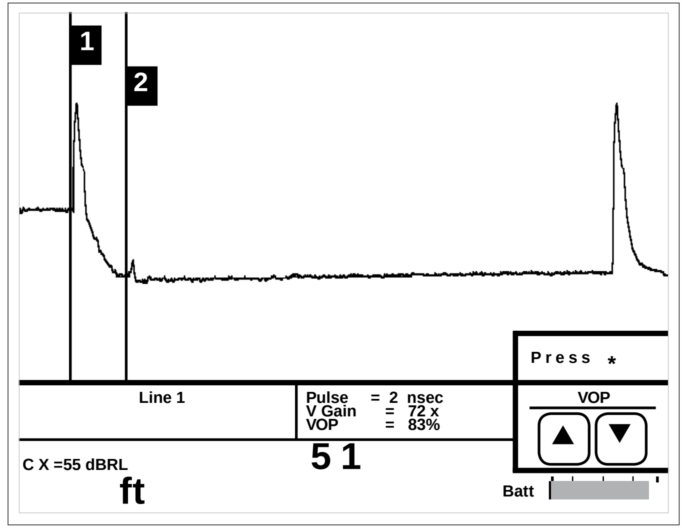
The middle reflection at the 2nd cursor is a partial open followed by a complete open (end of the cable). The more severe the fault, the larger the reflection.



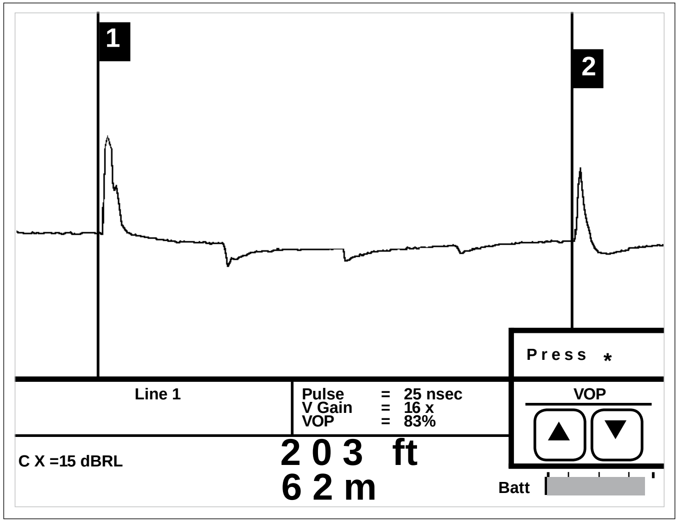
The middle reflection at the 2nd cursor is a partial short followed by a complete open (end of the cable). The more severe the fault, the larger the reflection.

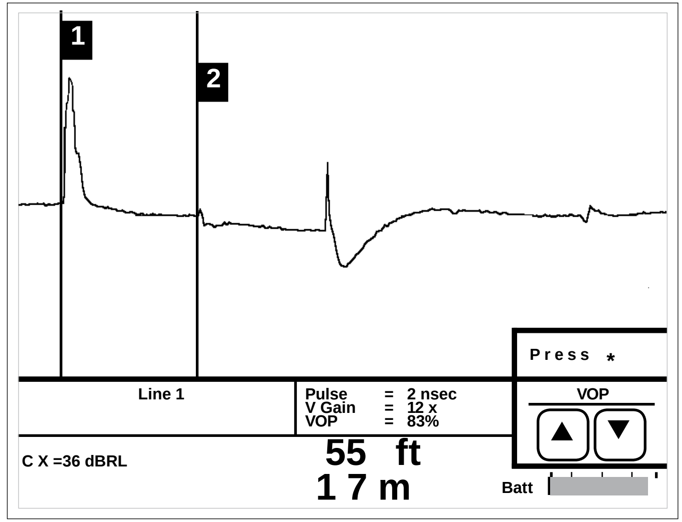


Due to attenuation, the reflections caused by each equally spaced taps are progressively smaller. A larger reflection (2nd cursor) beyond a smaller reflection may indicate an unterminated or faulty tap.



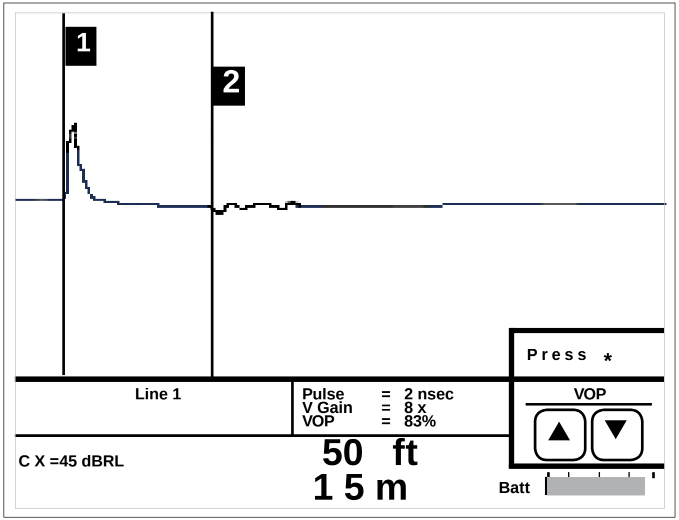
Two sections of cable with a splice shown at the 2nd cursor. The amount of reflection caused by the splice is directly proportional to the quality of the splice. A good splice = small reflection; a bad splice = large reflection.

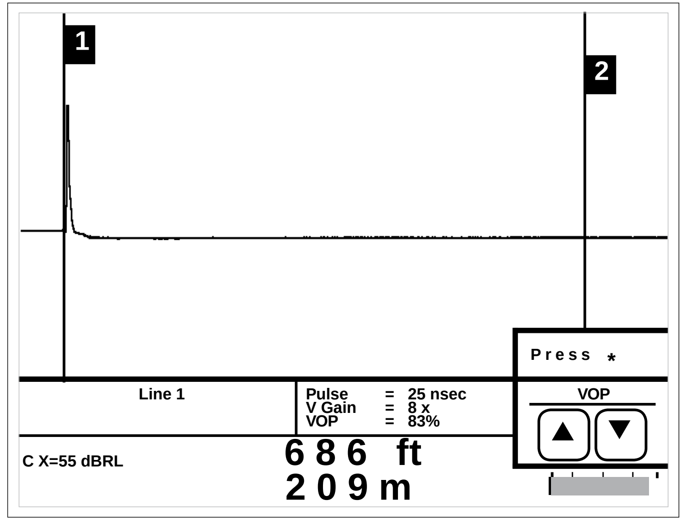




Coaxial taps (both indoor and outdoor) will cause reflections along the waveform. The quality and value of each tap determines the amount of reflection.

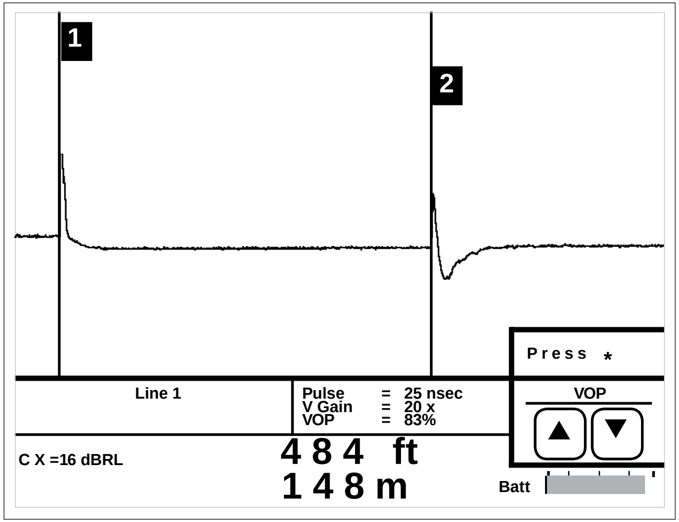
A splitter or directional coupler can be identified although accurate measurements are difficult due to multiple reflections. The 2nd cursor identifies the splitter. The two reflections following are the ends of each of the cable lengths.



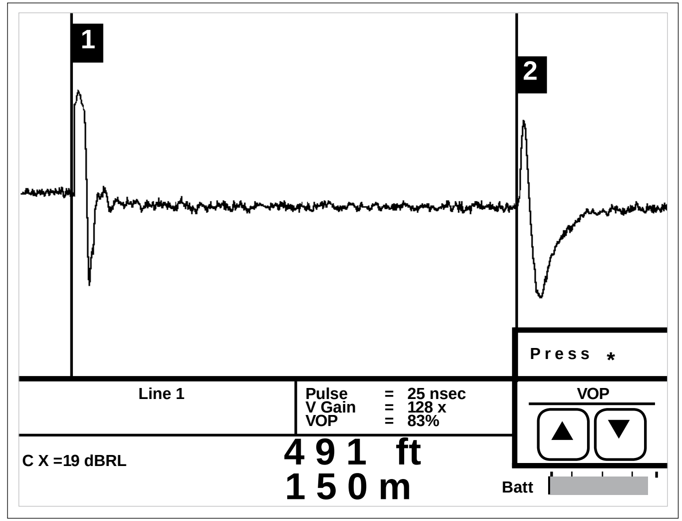


A water-soaked cable will display a waveform with a downward slope indicating the beginning of the water and an upward rise at the end of the water. Generally, the area between the two reflections will appear " noisy."

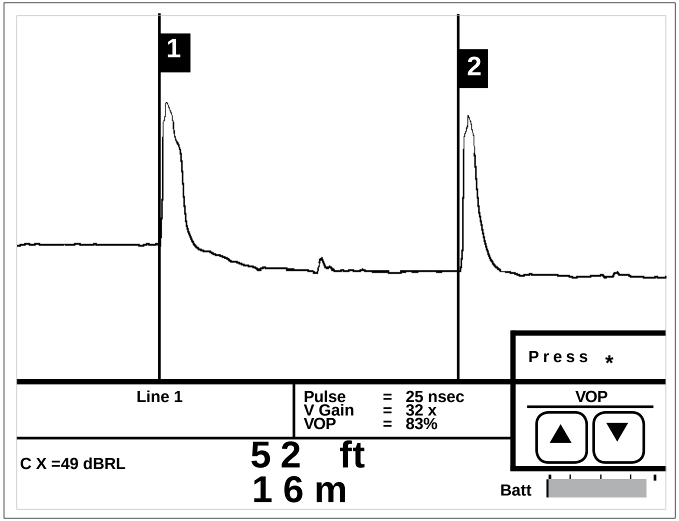
A properly TERMINATED cable will absorb the TDR signal, resulting in no reflection. Faults prior to the termination may appear as reflections along the waveform.



Testing through to an antenna usually results in a "S" shaped reflection, although reflections can vary greatly depending on the antenna.



Testing tower cables with antennas can be challenging due to energy induction from high RF areas as shown in this waveform. Stepping through various noise filter settings will result in a "cleaner" waveform.



Mechanical inner-connectors (known as bullets) connecting sections of broadcast transmission line sometimes burn open causing power outages. These bullets can be detected by a TDR.

SECTION 6: MAINTENANCE

Cleaning
Remove dust from the outside of the instrument and connectors with a lint free cloth or a small, soft brush.

Clean the case and instrument with a mild soap and water cleanser. Make sure the cloth is only damp to avoid getting water in the instrument.

Do not use harsh chemicals or abrasive cleaners. Damage to the front panel overlay may result.

Periodic Inspection
To maintain the TDR in peak operating condition, periodically inspect the instrument and accessories to make sure there is no damage, worn or missing parts or deformations in the enclosure. If the unit is regularly operated in harsh, dusty or wet environments, inspect after every use.

The instrument should be inspected and cleaned periodically. Inspect the front panel connectors for dirt, broken or deformed insulation and contacts. Clean or replace as necessary.

Inspect cable accessories for damaged insulation, bent or broken clips. Replace as necessary.

Service
There are no user serviceable parts on or in this instrument. It is recommended that service of any type, to the instrument or any accessories, be referred to Riser Bond Instruments or its designated distributor.

Warning: To avoid risk of electric shock, do not perform service of any type to the instrument or any accessory.

Instrument Disposal
This instrument is equipped with non-user serviceable Nickel Metal Hydride batteries. Should this instrument need to be disposed of, please consult your local regulations as to the standard disposal procedures.

SECTION 7: SPECIFICATIONS
Specifications for Model 1270A

Physical - Instrument Only
Height: 9.75 inches (25 cm)
Width: 10.5 inches (27 cm)
Depth: 5 inches (27 cm)
Weight: 6 pounds (2.72 kg)

Physical with nylon carry case and accessories
Height: 15 in (38 cm)
Width: 21 in (53 cm)
Depth: 6.5 in (16 cm)
Weight: 11 lb. (5.1 kg)

Environmental:
Operating Temperature: 0^0 C to 50^0 C (32^0 F to 122^0 F)
Storage Temperature: -20^0 C to 60^0 C (-4^0 F to 140^0 F)
Humidity: 95% maximum relative, non-condensing

Distance Accuracy:
Line 1, Line 2:
+/- 0.5 ft (0.15 m) plus +/- 0.01% of reading
COAX:
+/- 0.1 ft (0.03 m) plus +/- 0.01% of reading

Maximum Range
63,700 ft. (19,400 m) at 99% VOP
51,500 ft (16.4 km) at 80% VOP
41,700 ft. (12.7 km) at 65% VOP
Range varies with VOP. Maximum testable cable lenghts varies with pulse width and cable type.

Display:
320 x 240 dot-matrix liquid crystal display with cathode fluorescent (CFL) backlighting.

Power:
Battery: Internal, rechargeable, 7.2V Nickel metal hydride
Charging Source: External 12 VAC transformer, 1.3 A
Operating Time: greater than 6 hours, continuous without backlight operating

Output Signal:
Line 1, Line 2:
2ns, 25ns, 100ns, 1µs, and 6µs.
COAX:
Sub-nanosecond 2nsec, 25nsec, 100nsec, and 500nsec

Output Balance: (Line 1, Line 2 only)
Variable

Horizontal Resolution:
< 2,000 feet (610m) COAX:

<0.05ft. (0.03 m) at 99.9% VOP
<0.02 ft. (0.01 m) at 30.0% VOP

<2,000 feet (610m) LINE 1, LINE 2:
<0.25 ft. (0.08 m) at 99.9% VOP
<0.08 ft. (0.03 m) at 30.0% VOP

>2,000 feet (610m), Any test port:
1 foot (0.1m) at any VOP

Vertical Resolution
14 bits with 170 dots displayed.

Vertical Sensitivity: Greater than 65dB

Waveform Storage: (6144 samples/waveform)
32 SUPER-STORE waveforms

Software Noise Filters:
50/60 Hz
4x, 8x,16x, 32x, 64x,128x Averaging and Auto-Filter

Input Protection:
400V (AC+DC) from DC to 400 Hz, decreasing to 10V at 1MHz.

Velocity of Propagation: Two user-selectable display formats
VOP (%) with 3 digit precision ranging from 30.0% to 99.9%
V/2 with 4 digit precision (feet or meters per microsecond) ranging from 45.0 to 148.0 in meters mode or from 148.0 to 487.0 in feet mode

Standard Accessories:
Operator’s manual, 12 VAC charger, accessory bag, shoulder strap, 1 - CATV probe, 2 - telco probes, BNC/F adapter, Quick “F” M/F adapter, WAVE-VIEW Software disks, RS-232 cable

Optional Accessories:

APPENDIX A

Serial I/O Printer Port Connection

Epson LQ-860 Emulation

Riser Bond Model 1270A can interface to an Epson LQ-860 type printer through the Epson LQ-860 command set. Serial communication parameters: no parity, two-stop bits, and 9,600 baud.

Citizen PN60 Pocket Printer

Riser Bond Model 1270A interfaces to the Citizen PN60 Pocket Printer through the Epson LQ-860 command set. The printer setup parameters are as follows:

Language:	English
Font:	Roman
Font Lock:	Off
Line Spacing:	6 LPI
Character Set:	Italics
Code Page:	USA
Space Skip:	Enable
Stylewriter:	Auto
Protocol:	DTR
Emulation:	Epson
Pitch:	10 CPI
Compress:	Off
Form Length:	11 letters
Slash Zero:	On
Internal Char Set:	USA
Auto LF:	Off
Power Off:	3 minutes
Baud Rate:	9,600

APPENDIX B - VOP TABLE

TELEPHONE

CABLE	AWG	MM	VOP
PIC	19	.912	.72
	22	.643	.67
	24	.511	.66
	26	.404	.64
JELLY/	19	.912	.68
FILLED	22	.643	.62
	24	.511	.60
	26	.404	.58
PULP	22	.643	.67
	24	.511	.68
	26	.404	.66

CATV

CABLE	VOP	CABLE	VOP
Belden		Scientific Atlanta	.81
RG-59 Foam	.78	RG-59	
Solid	.66	Trunk	.87
Capscan		Times Fiber	
RG-59	.82	RG-59	.83
CC	.88	T 4, 6, & 10	.87
		TR+	.87
Commscope		TX,TX10	.89
Trunk/Dist PIII	.87	RG-6, 11, & 59	.82
QR	.88	Dynafoam	.90
Drop PIII	.82		
QR	.88	Trunk / Feeder	.83
		Drop (foam 59, 6,	
CZ Labs		& 11)	.82
RG-59	.82	7 Series	.93
		MC2	.93
General Cable			
RG-59	.82		
MC2	.93		

Index

WARRANTY

Subject to the conditions set out herein, Radiodetection Limited expressly and exclusively provides the following warranty to original end user buyers of Radiodetection products.

Radiodetection hereby warrants that its products shall be free from defects in material and workmanship for 1 year starting from point of sale to end customer. Extensions of this warranty period may be available where the same terms and conditions apply.

Statement of warranty conditions

The sole and exclusive warranty for any Radiodetection product found to be defective is repair or replacement of the defective product at Radiodetection's sole discretion. Repaired parts or replacement products will be provided by Radiodetection on an exchange basis and will be either new or refurbished to be functionally equivalent to new.

In the event this exclusive remedy is deemed to have failed of its essential purpose, Radiodetection's liability shall not exceed the purchase price of the Radiodetection product. In no event will Radiodetection be liable for any direct, indirect, special, incidental, consequential or punitive damages (including lost profit) whether based on warranty, contract, tort or any other legal theory.

Warranty services will be provided only with the original invoice or sales receipt (indicating the date of purchase, model name and dealer's name) within the warranty period. This warranty covers only the hardware components of the Radiodetection product.

Before a unit is submitted for service or repair, under the terms of this warranty or otherwise, any data stored on the unit should be backed-up to avoid any risk of data loss. Radiodetection will not be responsible for loss or erasure of data storage media or accessories.

Radiodetection is not responsible for transportation costs and risks associated with transportation of the product. The existence of a defect shall be determined by Radiodetection in accordance with procedures established by Radiodetection.

This warranty is in lieu of any other warranty, express or implied, including any implied warranty of merchantability or fitness for a particular purpose.

This warranty does not cover:

a. Periodic maintenance and repair or parts replacement due to wear and tear.

b. Consumables (components that are expected to require periodic replacement during the lifetime of a product such as non rechargeable batteries, bulbs, etc.).

c. Damage or defects caused by use, operation or treatment of the product inconsistent with its intended use.

d. Damage or changes to the product as a result of:

- i Misuse, including: - treatment resulting in physical, cosmetic or surface damage or changes to the product or damage to liquid crystal displays.
- ii Failure to install or use the product for its normal purpose or in accordance with Radiodetection instructions on installation or use.
- iii Failure to maintain the product in accordance with Radiodetection instructions on proper maintenance.
- iv Installation or use of the product in a manner inconsistent with the technical or safety laws or standards in the country where it is installed or used.
- v Virus infections or use of the product with software not provided with the product or incorrectly installed software.
- vi The condition of or defects in systems with which the product is used or incorporated except other 'Radiodetection products' designed to be used with the product.
- vii Use of the product with accessories, peripheral equipment and other products of a type, condition and standard other than prescribed by Radiodetection.
- viii Repair or attempted repair by persons who are not Radiodetection warranted and certified repair houses.
- ix Adjustments or adaptations without Radiodetection's prior written consent, including:
  - i upgrading the product beyond specifications or features described in the instruction manual, or
  - ii modifications to the product to conform it to national or local technical or safety standards in countries other than those for which the product was specifically designed and manufactured.
- x Neglect e.g. opening of cases where there are no user replaceable parts.
- xi Accidents, fire, liquids, chemicals, other substances, flooding, vibrations, excessive heat, improper ventilation, power surges, excess or incorrect supply or input voltage, radiation, electrostatic discharges including lightning, other external forces and impacts.

Global locations

Radiodetection (USA)
28 Tower Road, Raymond, Maine 04071, USA
Tel: +1 (207) 655 8525 Toll Free: +1 (877) 247 3797 rd.sales.us@spx.com www.radiodetection.com

Pearpoint (USA)
39-740 Garand Lane, Unit B, Palm Desert, CA 92211, USA
Tel: +1 800 688 8094 Tel: +1 760 343 7350 pearpoint.sales.us@spx.com www.pearpoint.com

Radiodetection (Canada)
344 Edgeley Boulevard, Unit 34, Concord, Ontario L4K 4B7, Canada
Tel: +1 (905) 660 9995 Toll Free: +1 (800) 665 7953 rd.sales.ca@spx.com www.radiodetection.com

Radiodetection Ltd. (UK)
Western Drive, Bristol, BS14 0AF, UK Tel: +44 (0) 117 976 7776 rd.sales.uk@spx.com www.radiodetection.com

Radiodetection (France)
13 Grande Rue, 76220, Neuf Marché, France Tel: +33 (0) 2 32 89 93 60 rd.sales.fr@spx.com http://fr.radiodetection.com

Radiodetection (Benelux)
Industriestraat 11, 7041 GD ’s-Heerenberg, Netherlands Tel: +31 (0) 314 66 47 00 rd.sales.nl@spx.com http://nl.radiodetection.com

Radiodetection (Germany)
Groendahlscher Weg 118, 46446 Emmerich am Rhein, Germany
Tel: +49 (0) 28 51 92 37 20 rd.sales.de@spx.com http://de.radiodetection.com

Radiodetection (Asia-Pacific)
Room 708, CC Wu Building, 302-308 Hennessy Road, Wan Chai, Hong Kong SAR, China
Tel: +852 2110 8160 rd.sales.asiapacific@spx.com www.radiodetection.com

Radiodetection (China)
13 Fuqianyi Street, Minghao Building D304, Tianzhu Town, Shunyi District, Beijing 101312, China Tel: +86 (0) 10 8146 3372
rd.service.cn@spx.com http://cn.radiodetection.com

Radiodetection (Australia)
Unit H1, 101 Rookwood Road, Yagoona NSW 2199, Australia Tel: +61 (0) 2 9707 3222 rd.sales.au@spx.com www.radiodetection.com