

OPERATING MANUAL

TV90 Cable SCOUT™

Tempo Customer Training & Technical Support



Tempo®

Knowledge. Solutions. Success.



TEMPO – TV90 CABLESCOUT™

Time-Domain Reflectometer

OPERATING MANUAL

CUSTOMER TRAINING & TECHNICAL SUPPORT

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CE



Read and understand all of the instructions and safety information in this manual before operating or servicing this tool.

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TV90 CableScout User Guide

Description

Designed specifically for Cable TV and other coaxial cable applications, the TV90 applies the newest technology to provide both ease of use and coaxial cable testing performance not found in any other TDR.

Simply select the cable type to be tested and the TV90 does the rest. Pulse width, V_p , gain, and vertical position are automatically selected and adjusted as you scan the cable. Move the cursor to the fault and use the one-button zoom function to pinpoint its location.

The TV90 uses a 6 ns pulse width for close-in resolution. Faults as near as 3 feet from the pedestal are located with ease. Optimized pulsing and sampling, coupled with advanced filtering and signal-processing techniques, provide a clean waveform for easy event identification.

Safety

Safety is essential in the use and maintenance of Tempo tools and equipment. This manual and any markings on the tool provide information for avoiding hazards and unsafe practices related to the use of this tool. Observe all of the safety information provided.

Purpose of This Manual

This manual is intended to familiarize all personnel with the safe operation and maintenance procedures for the TV90 CableScout Time-Domain Reflectometer.

Keep this manual available to all personnel. Replacement manuals are available upon request at no charge.

All specifications are nominal and may change as design improvements occur. Greenlee Textron Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

CableScout is a trademark of Greenlee Textron Inc.



Do not discard this product or throw away!

For recycling information, go to www.tempo.textron.com.

KEEP THIS MANUAL

Important Safety Information



SAFETY ALERT SYMBOL

This symbol is used to call your attention to hazards or unsafe practices which could result in an injury or property damage. The signal word, defined below, indicates the severity of the hazard. The message after the signal word provides information for preventing or avoiding the hazard.

DANGER

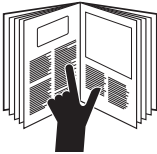
Immediate hazards which, if not avoided, **WILL** result in severe injury or death.

WARNING

Hazards which, if not avoided, **COULD** result in severe injury or death.

CAUTION

Hazards or unsafe practices which, if not avoided, **MAY** result in injury or property damage.



WARNING

Read and understand this material before operating or servicing this equipment. Failure to understand how to safely operate this tool could result in an accident causing serious injury or death.

Important Safety Information



⚠️ WARNING

Electric shock hazard:

Measuring terminals: This tool is not intended to be connected to voltages above 30 VAC or 60 VDC (referenced to earth).

Failure to observe this warning could result in severe injury or death.

⚠️ WARNING

Fire hazard:

Do not operate this tool in an explosive atmosphere.

Failure to observe this warning could result in severe injury or death.

⚠️ CAUTION

Electric shock hazard:

- Recharge batteries properly. Recharge batteries for the recommended charge cycle time only.
- Do not remove the covers or panels of the unit, nor operate the unit without the covers and panels in place.
- Do not operate with suspected failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.
- Use this unit for the manufacturer's intended purpose only, as described in this manual. Any other use can impair the protection provided by the unit.

Failure to observe these precautions may result in injury and may damage the unit.

Batteries: The unit is powered by either a NiCad battery pack or six AA alkaline batteries (9 V total). Dispose of depleted batteries in accordance with Local, State, and Federal Laws.

Fuse: The unit contains a 1.5 A fast-acting fuse, which is **not** user replaceable.

Features and Applications

Features

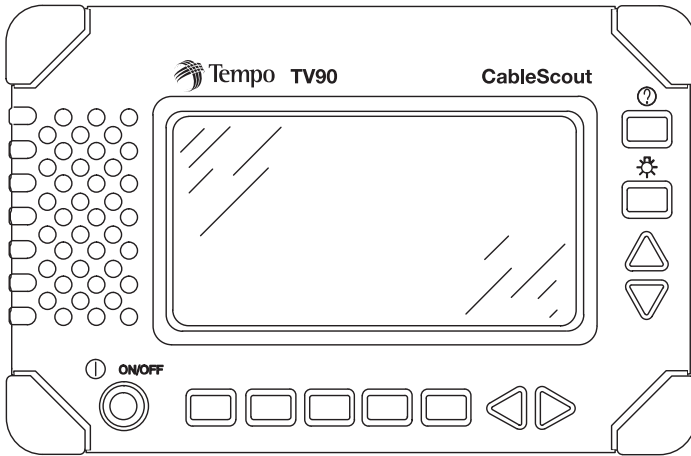
- Easy to use
- Large, high-resolution, backlit display
- Splash, dust, and shock resistant packaging
- Rechargeable battery pack
- One-button expand/full-view function
- 75 ohm F-connector
- Intermittent fault location
- Context-sensitive Help (Help screens available for all functions)
- Small, portable, lightweight package (2.2 lb)
- Accurate (± 2 ft up to 200 ft, 1% beyond)
- 4000 ft fault-location capability
- Internal cable types for fast, accurate testing
- User-selectable languages

Applications




- Find location of damage in drops
- Find impedance mismatches
- Locate bad passive devices
- Determine length of cable

Front Panel Controls

Front Panel





Controls


	<p>Power: This button turns the instrument on and off. It does not turn off the battery power to the memory used for saving setups and measurements.</p>
	<p>Help: Press HELP to display detailed information on the current display and the operation of the controls. Press HELP a second time to remove the help display.</p> <p>In selected menus, Lesson softkeys are available that provide tutorials about using the unit.</p>
	<p>Backlight: Press this button to switch the display backlight on and off. The instrument default is OFF, and when the user turns on the instrument, the backlight is always OFF. The backlight button can only be turned ON by pressing this button.</p>

Front Panel Softkeys and Connector

Softkeys

	<p>Five Softkeys: Located across the bottom of the LCD. These are called softkeys because their labels are displayed on the LCD. Their functions vary according to the instrument function.</p> <p>Softkeys let you:</p> <ol style="list-style-type: none">1) change functions or modes,2) select a menu item, and3) turn functions on and off.
	<p>Left, right, up, and down arrow buttons serve the functions of moving the cursor left and right across the displayed waveform, changing values and raising or lowering gain, or scrolling through a menu.</p>

Connector Input

	<p>F-Connector: This connector consists of an F-connector adapter for connecting to the cable under test.</p>
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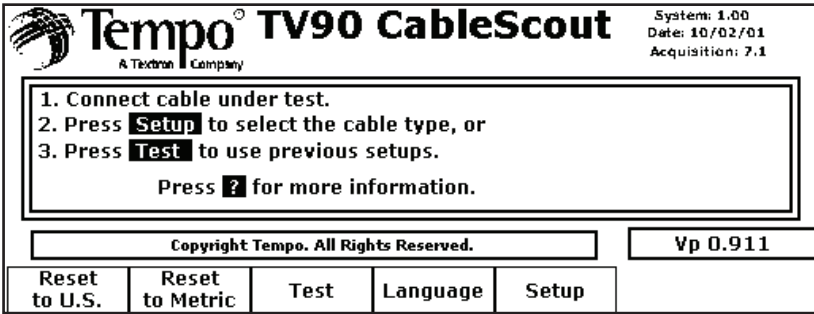
Powering Up the TV90

Connect the Cable

Select the connector adapter and/or jumper cable from the TV90 accessory package that is appropriate.

TV90 Main Display Screen

Press the Power button to turn on the instrument and reach the Main Display.



TV90 Main Display

The instrument powers up with the same settings in place as when it was last powered off. Press **Setup** or **Test** and the TV90 does the rest.

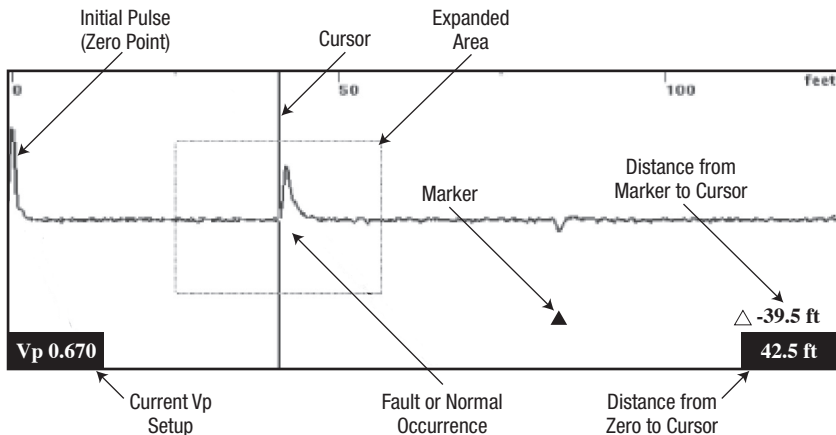
- Press **Setup** to select the cable type:
 - The cable type defines the velocity of propagation (V_p) and cable loss values for the test cable. Press **▲▼** to select the cable type to be tested. Then press **Exit** to go to Autotest mode.
 - If your cable type is not listed on the User List, refer to “Coax Cable V_p Table” in the “Reference Guide” section of this manual.

OR

- Press **Test** to use the previous cable setup.
- Press **Language** to choose the menu language:
 - A list of the available menu languages is displayed. Press **▲▼** to highlight the language to be used. Press **Use Language** to activate the chosen language.

Testing a Cable

Pulse width, gain, and vertical position are automatically adjusted as you scan the cable.



Move the cursor to the fault, and use the one-button expand function to pinpoint its location.

- Use ◀▶ to position the cursor on the left edge of the event.
- The distance to the event is displayed in the box in the lower right corner of the display.

The following softkeys are available:

- **MARKER**: Sets and clears the event marker (▲). When set, the cursor readout shows both distance from zero to the cursor and distance from the marker to the cursor. When set, marker is always located and remains at the current position of the cursor.
- **EXPAND**: Expands the waveform around the cursor.
- **FULL VIEW**: Returns the waveform to normal view.
- **LESS CABLE** or **MORE CABLE**: Press **LESS CABLE** or **MORE CABLE** to look further in or further out along the cable. Less Cable and More Cable decrease and increase the waveform distance view one range setting for each press of the softkey.

Additional Setup

Setup Softkeys

The Setup menu allows you to select the cable type to be tested and is the gateway to all other setup menus.

The following additional softkey functions are available:

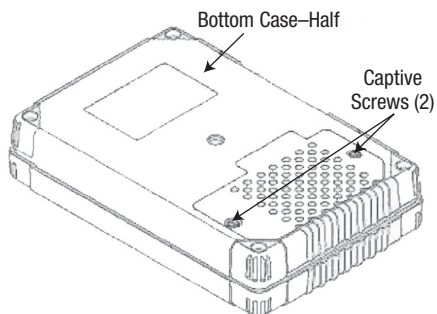
- **TEST TYPE:** Enables you to select either the AUTOTEST mode or the INTERMITTENT TEST mode.
 - In AUTOTEST mode the TV90 automatically controls the vertical positioning, pulse width, and noise filtering (smoothing).
 - In INTERMITTENT mode, the TV90 records changes on screen to the cable condition such as a swinging or intermittent trouble.
- **DEFINE CABLES:** Allows you to select a cable type from a built in menu, or create or change custom cable types.
- **MORE SETUPS:** Allows you to change the default settings for the TV90, including the following:
 - **DISTANCE UNITS:** Feet, Nanoseconds or Meters
 - **VELOCITY OF PROPAGATION UNITS:** percent speed of light (0.XXX), or Feet per Nanosecond (FT/ μ S), or Meters per Nanosecond (M μ S)
 - **DISPLAY CONTRAST:** Adjusts the display contrast for viewing.
 - **AUTO SHUTOFF TIME:** 5 to 30 minutes, or Disable – when unit is not in use.
 - **HIGH-PASS FILTER:** Off, or On, or Automatic. Reduces AC noise for a cleaner waveform.
 - **ATTENUATOR:** Off, or On, or Automatic. Provides a 20 dB reduction in signal level to lower system noise.
- **SMOOTH:** Allows you to select smoothing levels 1–7, or Off. Higher levels reduce noise on the waveform, but also increase time between waveform updates.

Battery Removal & Replacement

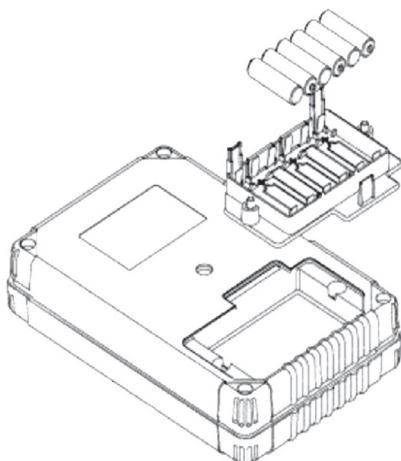
Replacing the Battery

Replace the batteries when the low-battery icon  appears.

A “Low-Battery/Power Off” message is displayed when the battery level is too low to continue operation of the unit.



Use a flat blade screwdriver to loosen the two captive screws attaching the battery door holder to the unit.



Always replace all six cells at the same time.

Never mix new and old cells.

Never mix cell types (alkaline and non-alkaline).

Insert cells as shown in the battery holder (reversed cells may leak and damage the instrument).

NiCad Battery Charger

Charging Information

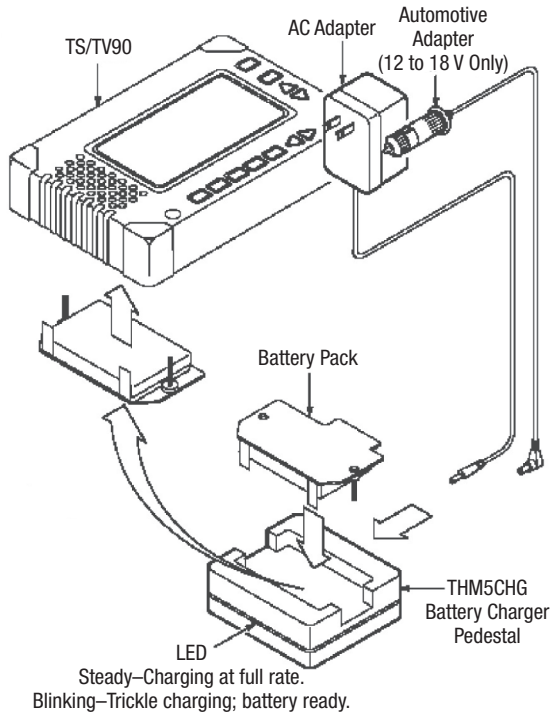
Charge in a dry location, not to exceed 45 °C (113 °F).

The battery charger will not overcharge the battery pack.

To maintain peak performance of NiCad batteries, it is recommended to fully discharge them before recharging.

Safety

Only charge battery packs in the battery charger. Do not charge nonrechargeable batteries. This may cause explosion. Do not lay the battery pack with its terminals against a conductive surface. NiCad batteries must be recycled or disposed of properly.



Charge Time

A fully discharged battery pack is recharged in one hour. A partially discharged battery pack recharges in less time.

Cleaning the Unit

Remove dust from the outside of the instrument by wiping with a lint-free cloth or small brush. Use the brush to remove dust from the connectors.

Clean the remaining dirt with a lint-free cloth dampened with a mild detergent and water solution. Do not use abrasive cleaners or harsh chemicals (e.g., alcohol or acetone) as damage to the enclosure might result.

Specifications

- Test Signal Output: 1/2 sine
- Amplitude (into 75 ohm):
 - 6 ns pulse: 5 V
 - 12 ns pulse: 6 V
- Pulse Widths: 6 and 12 ns
 - Output Impedance: 75 ohm
- Input Protection: 200 VAC + peak DC to a maximum of 440 Hz, 30 second duration
- Display Ranges: Eight automatic display ranges
- Gain: 0 to 63 dB
- Filter: High pass, cutoff frequency 150 kHz, plus averaging
- Distance Accuracy:
 - 0 to 200 ft: ± 2 ft
 - Beyond 200 ft: 1% + zero offset
- Display:
 - Resolution: 520 x 200 pixels
 - Size: 5.25 inches
 - Type: High contrast LCD
 - Backlight: Operator switchable
- Distance Measurements: Meters, feet, nanoseconds
- Auto Shutoff Time: Operator selectable, 5 to 30 minutes
- Temperature Range:
 - Operating: 0 °C to +45 °C (+32 °F to +113 °F)
 - Non-operating: -20 °C to +60 °C (-4 °F to +140 °F)
- Humidity:
 - Operating: 95% RH, noncondensing at +30 °C to +40 °C (+86 °F to +104 °F)
- Field Usage: Shock, splash, and dust resistant
- EMI Emissions: FCC Part 15, Subpart B, Class A; EN55022, Class A

Standard Accessories

- BNC Female-to-Alligator Clips: 013026100
- 2 m Coaxial Jumper Cable: 174367400
- F-to-BNC Barrel Adapter: 01328800
- F-to-F Barrel Adapter: 103036400
- F-to-KS Test Adapter: 131636100
- Soft Carrying Case: TS90-350
- Users Manual: TV90-3000
- Six AA Alkaline Batteries: 0010-0030
- Rechargeable NiCad Battery Pack: THM5BAT
- External Charger for NiCad Battery Pack: THM5CHG
Includes DC Adapter, Charger, Pedestal, and one of the following wall transformers (specify when ordering):
 - Standard: 110 V US
 - Opt. A1: 220 V Universal Europe
 - Opt. A2: 240 V UK

WARNING

For safety, accessories to be used only for TDR measurements with TV90.
Failure to observe this warning could result in severe injury or death.

Warranty Service Contract Information

GENERAL WARRANTY PROVISIONS

Seller warrants to Buyer that products furnished hereunder will be merchantable, free from defects in design, material and workmanship, fit and sufficient for the purposes intended by Buyer, free from all liens and encumbrances and will conform to and perform in accordance with the specifications set forth in this Agreement for a period of One Year, commencing with the date of acceptance thereof by Buyer.

Defective products will, at Buyer's option, be either returned to Seller, or Seller's Authorized Repair Agency, for repair or replacement, with risk of in-transit loss and damage borne and transportation charged paid by Seller, or repaired or replaced by Seller, or Seller's Authorized Repair Agency, on site at Seller's expense. Unless otherwise agreed upon by the parties, Seller, or Seller's Authorized Repair Agency, will complete repairs and ship the repaired product within five (5) days of receipt of the defective product or, at Buyer's option, ship replacement product within five (5) days after receipt of oral notification from Buyer. Seller, or Seller's Authorized Repair Agency, will bear the risk of in-transit loss and damage and will prepay and bear the cost of transportation charges for shipments to Buyer of repaired or replaced products. If requested by Buyer, Seller, or Seller's Authorized Repair Agency, at Seller's expense, will begin onsite repairs within three (3) days after receiving verbal notification from Buyer.

If product returned to Seller, or Seller's Authorized Repair Agency, or made available to Seller, or Seller's Authorized Repair Agency, on site for repair, as provided for in this clause is determined to be beyond repair, Seller, or Seller's Authorized Repair Agency, will promptly so notify Buyer and, unless otherwise agreed to by the parties, ship replacement product without charge within five (5) days of such notification.

Any replacement, repair, modification, installation or other service performed by Seller, or Seller's Authorized Repair Agency, pursuant hereto will be warranted as herein provided based upon the date performance of the service is completed and accepted by Buyer for the remainder of the unexpired period of the original warranty or for a new period of one (1) year, whichever is longer.

All services, if any, provided under this Agreement will be provided in a fully professional manner.

WORK HEREUNDER

It is understood that visits by representatives of Seller or its suppliers for inspection, adjustment or other similar purposes in connection with products purchased hereunder will for all purposes be deemed "work hereunder" and will be at no charge to Buyer unless otherwise agreed in writing with Buyer.

SPECIFIC WARRANTY PROVISIONS

FACTORY WARRANTY:

Tempo warrants all products against defects in material or workmanship for a period of one year from date of shipment to the original purchaser. All units returned to a Tempo authorized repair center, delivery charges prepaid, that are deemed defective under this warranty will be replaced or repaired at Tempo's option. This warranty shall not apply to any defect, failure or damage caused by improper use or inadequate maintenance.

Warranty Service Contract Information (cont'd)

This warranty does not apply to worn or damaged accessories such as test leads, batteries and soft cases. Calibration is not covered under factory warranty.

Product sold through distribution carries a 15-month warranty due to turn around time.

CONTRACTED SERVICE:

Tempo offers contracted warranty for specific products. The Sales Department negotiates these contracts at the time of purchase. Such contracts are customer and/or marketing driven. Contracts are product/customer specific.

EXTENDED WARRANTY:

Extended warranty is available at the Buyer's option.

WARRANTY ON REPAIRED PRODUCTS:

Tempo offers a 90-day warranty against defects in material or workmanship for repaired products. Extended repair warranty may be available for select customers and is negotiated by sales department.

FLAT RATE REPAIR CONTRACTS:

Flat rate repair contracts for pricing and product coverage are available for nonwarranty repairs. The sales department negotiates these contracts.

PCB (MODULE) EXCHANGE:

It is the discretion of Tempo to exchange defective or damaged PCB modules with refurbished PCB modules.

NON-WARRANTY REPAIRS:

Tempo will charge time and material for all product repairs that are non-warranty. Any Tempo manufactured unit that is received with a broken seal (opened by someone other than Tempo authorized personnel) will be considered non-warranty and repaired as such.

SPARE PARTS:

Spare parts are sold to Tempo authorized repair centers only.

Tempo considers spare parts to be any internal part that the unit must be opened to have replaced.

ACCESSORIES:

Accessories can be ordered through Tempo's sales department or distribution centers. Contact our sales department for a list of accessories per product.

Tempo considers accessories to be any item that is not required for unit operation, with the exception being test leads and cables. I.e.: straps, cases, software.

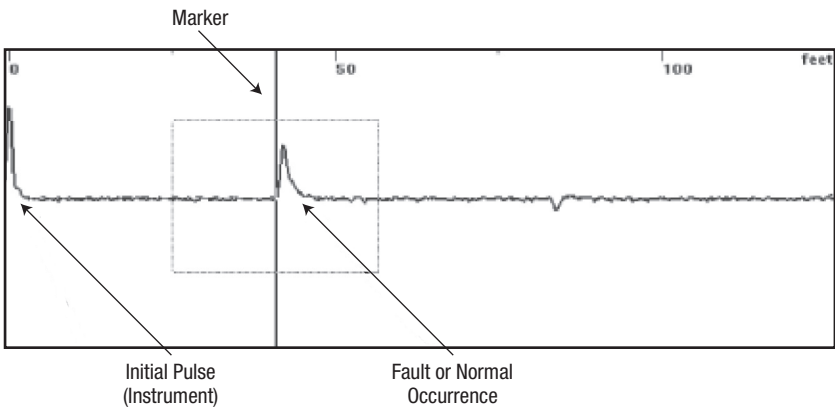
TV90 CableScout Reference Guide

Time-Domain Reflectometer Principles

A Time-Domain Reflectometer (TDR) is a device using a principle similar to radar to measure time and distance over a length of cable. A TDR sends out a pulse of energy and measures the reflections to events along the length of the cable. The TDR measures the time taken for the reflections to return and converts this into distance along the cable. The results are shown on the screen.

The events that a TDR can detect are normal occurrences such as Taps, Splitters, Couplers, Loop Extenders, etc., as well as accurately pinpointing trouble such as Shorts and Opens. A TDR can also provide a rough estimate of the total amount of cable that is wet, and the exact location of the wet section.

The TDR displays a graph of the tested cable with distance (time to reflection) on the horizontal axis. The on-screen cursor helps by displaying feet or meters to a point on the cable. The vertical axis on the TDR display shows the type and severity of fault. Several kinds of problems, as well as normal occurrences, are demonstrated in the next sections of this manual.



Typical TDR Display

Time-Domain Reflectometer Concepts

There are several basic concepts that will help you to accurately locate and interpret the waveforms you will see on the TDR. You can use these concepts to help identify the waveforms you are analyzing.

Velocity of Propagation (Vp)

A cable's velocity of propagation (VoP or Vp) specification is simply a measure of how fast a signal travels in the cable. It is typically expressed as a percentage of the speed of light. For example, a cable with a Vp value of 0.85 indicates that the signal is traveling down the cable at 85% of the speed of light. Since a time-domain reflectometer (TDR) is really making measurements in the time domain, the distance accuracy of the TDR is dependent upon having the correct Vp value. (Refer to "Coax Cable Vp Table" near the end of this manual.)

- Pulses travel at different velocities on different cables just as an object travels at different speeds through different thickness of liquids.
- Vp varies between cable types, sizes, and manufacturers, and the type of insulation and cross section geometry of a cable will affect the velocity of a pulse.
- Identifying the correct Vp for the cable being tested is imperative to have accurate distance measurements.

Cable Impedance

Cable impedance is made up of resistance, inductance, and capacitance inherent in a cable. Reflected pulses are caused by impedance changes.

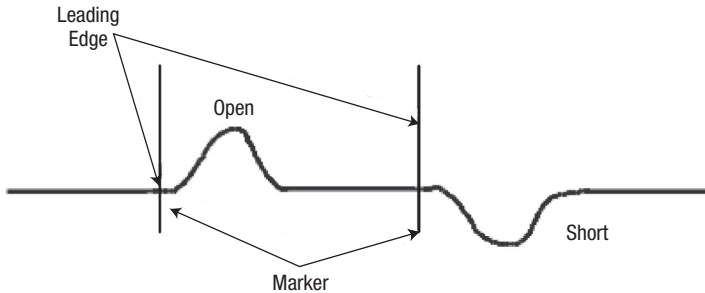
- TDRs can measure reflections caused by series impedances from several hundred ohms down to a few ohms.
- TDRs can also measure reflections caused by shunt impedances up to several hundred ohms.

Proper Cable Termination

Cable TV requires a 75 ohm termination on all cable ends, taps, and terminations. When properly terminated, the ability to distinguish faults from normal occurrences in a cable is greatly enhanced. The 75 ohm termination absorbs the TDR pulse reflection normally caused by an open cable. (Refer to "Properly Terminated Cable" under the "Sample Waveforms" section of this manual.)

Time-Domain Reflectometer Concepts (cont'd)

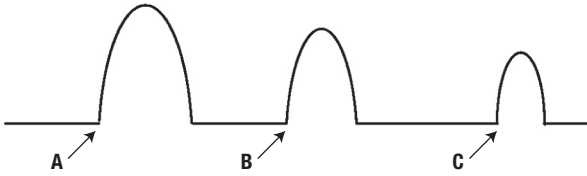
Interpreting Waveforms



- **OPEN (Capacitive Fault):** Will cause the waveform display to break above the plane of the pulse reference line.
- **SHORT (Resistive Fault):** Will cause the waveform to dip below the plane of the pulse reference line.
- **LEADING EDGE:** Indicates where the event is located. The leading edge is the precise point where the waveform breaks the plane above or below the pulse reference line.
- **MARKER:** A Cursor or Marker can be set at the Leading Edge of the pulse break so that distances can be read on the TDR. Markers may be moved anywhere on the screen to mark distance from the left-hand zero reference point.
- **GAIN:** Acts like an amplifier control. Adjusts the vertical amplitude (height) of the waveform displayed. However, amplitudes that are too high may produce distorted waveforms.

Sample Waveforms

Splitter / Directional Coupler



A: Distance to Splitter

B & C: Distance to end of each of the split lines

Line Extender



D: Distance to L.E.

Note: The TDR will **not** see beyond the Amplifier.

Properly Terminated Cable (No Event Present)



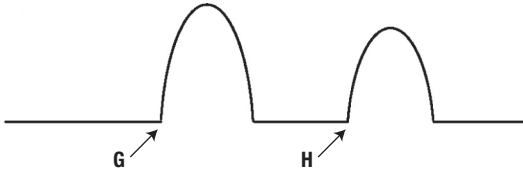
E: Launch pulse.

F: End of cable with proper 75 ohm Termination is **not** present – the waveform appears as a continuous line

Note: A Terminated Cable (normally 75 ohm) will absorb the pulse, resulting in no reflection returned back from the end of the cable.

Sample Waveforms (cont'd)

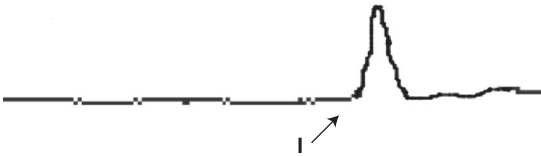
Coaxial Taps



G & H: Distance to each Tap.

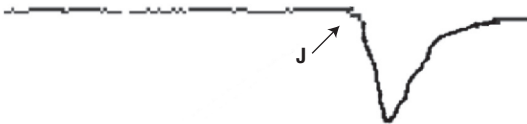
Note: The quality of connection and the Tap Value will determine waveform and the amount of reflection.

Open in Coax Cable



I: Distance to Open

Short in Coax Cable

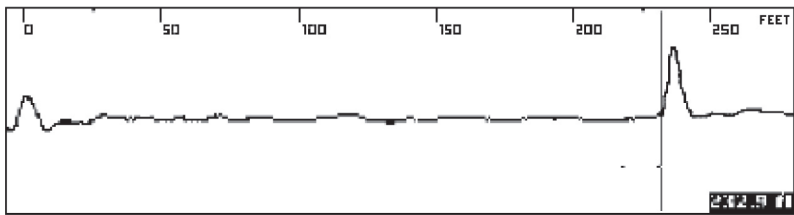


J: Distance to Short

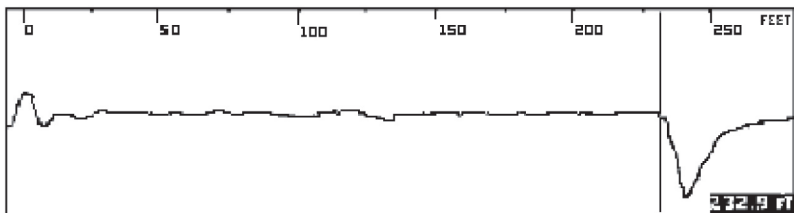
TV90 Quick Reference

Identifying Distance to Open or Short

1. Press **RESET TO METRIC** or **RESET TO US** (not necessary if previously set).
2. Press **SETUP**.
3. Use **▲▼** to select the cable type to be tested.
4. Connect the cable under test to the TV90.
5. Press **TEST TYPE**.
6. Use **▲▼** to select type.
7. Press **EXIT**.
8. Press **MORE CABLE** until the reflection is seen.
9. Use **▲▼** Gain Adjustment to adjust the waveform height.
10. Press **◀▶** to move the cursor to the leading edge of the reflection.



Typical Open

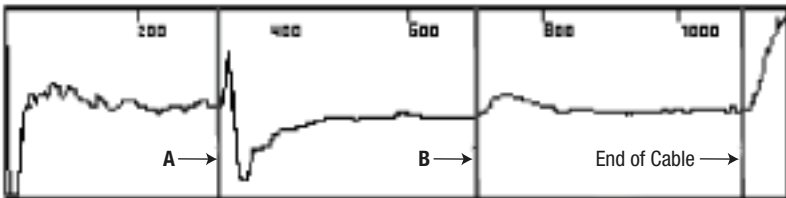


Typical Short

TV90 Quick Reference

Identifying a Wet Section

1. Press **RESET TO METRIC** or **RESET TO US** (not necessary if previously set).
2. Press **SETUP**.
3. Use **▲▼** to select the cable type to be tested.
4. Connect the cable under test to the TV90.
5. Press **TEST TYPE**.
6. Use **▲▼** to select type.
7. Press **EXIT**.
8. Press **MORE CABLE** until the reflection is seen.
9. Use **▲▼** Gain Adjustment to adjust the waveform height.
10. Press **◀▶** to move the cursor to the beginning of the wet section (see **A** below). This is the distance to the water.
11. Press **◀▶** to move the cursor to the end of the wet section (see **B** below).
12. **A to B** is the wet section.



Typical Wet Section

Note: The distance from the launch point (zero) to the water (**A**) is correct. The wet section distance (**A to B**) is not correct due to the V_p being changed by the water. Subtract the dry section distance from a cable map to obtain the wet distance, or measure from both ends of the cable to the wet section.

Coax Cable Vp Table

Manufacturer	Family	Vp
BELDEN	Belden Drop Foam	0.78
	Solid	0.66
	Capscan CC	0.88
	Drop (RG59, RG6, RG7, RG11)	0.82
COMM SCOPE	Trunk/Dist P11, P-3/P-3+/P-500/P-625/P-875/P-1000	0.87
	QR	0.88
	Drop P11	0.82
	59/6/7/11	0.82
	P750	0.89
FUJIKURA	8C-5AF/12C-5AF/17C-5AF	0.900
FURUKAWA	AH-C-8ZE/12ZE/17ZE	0.910
GENERAL	MC2	0.93
IKX		0.67
NKX		0.877
QKX	5C-5A	0.887
SCIENTIFIC ATLANTA	Trunk	0.87
	Drop	0.81
SKX		0.887
SUMITOMO	5C-5A/8-C/12-C/17-C	0.880
SYOUWA	MFH-8AC/12AC/17AC	0.910
	TC3/TC4	0.88
TIMES FIBER	Trunk/Dist T4, 6, 10/T10- (412, 500, 625, 750, 875, 1000)	0.87
	Dynafoam	0.90
	Drop T4, 6, 10	0.83
	TX10	0.89
	T10 59/6/611/11	0.85
TRILOGY	59/6/7/11	0.82
	Trunk/Dist MC2 (440, 500, 650, 750, 1")	0.93
TKK		0.911



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