



# **TDR 2040 Cable Fault Locator**



## **OPERATION MANUAL**

# Trilithic Company Profile

Trilithic is a privately held manufacturer founded in 1986 as an engineering and assembly company that built and designed customer-directed products for telecommunications, military and industrial customers. From its modest beginnings as a two-man engineering team, Trilithic grew over the years and broadened its offerings of RF and microwave components by adding broadband solutions to its product line. This was accomplished with the acquisition of components manufacturer Cir-Q-Tel and instruments manufacturer Texscan.

Today, Trilithic is an industry leader providing telecommunications solutions for major broadband, RF and microwave markets around the world. As an ISO 9000:2001 certified company with over 40 years of collective expertise in engineering and custom assembly, Trilithic is dedicated to providing quality products, services and communications solutions that exceed customer expectations.

Trilithic is comprised of three major divisions:

- **Broadband Instruments & Systems**  
Offers test, analysis and quality management solutions for the major cable television systems worldwide.
- **RF Microwave Components**  
Provides components and custom subsystems for companies specializing in cellular, military and other wireless applications.
- **Emergency Alert Systems**  
Leading supplier of government-mandated emergency alert systems used by HFC service providers.

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## Helpful Website

The following website contains general information which may be of interest to you:

<http://www.trilithic.com>

Trilithic's website contains product specifications and information, tips, release information, marketing information, Frequently Asked Questions (FAQs), bulletins and other technical information. You can also check this website for product updates.

## Where to Get Technical Support

Trilithic technical support is available Monday through Friday from 8:00AM to 5:00PM EST. Callers in North America can dial 1-317-895-3600 or 1-800-344-2412 (toll free). International callers should dial 1-317-895-3600 or fax questions to 1-317-895-3613. You can also e-mail technical support at [techsupport@trilithic.com](mailto:techsupport@trilithic.com).

For quicker support response when calling or sending e-mail, please provide the following information:

- Your name and your company name
- The technical point of contact (name, phone number, e-mail)
- The TDR 2040 serial number and firmware version number
- A detailed description of the problem you are having, including any error or information messages

# How this Manual is Organized

This manual is divided into the following chapters:

- Chapter 1, “General Information” provides Trilithic contact information and describes how this Operation Manual is structured.
- Chapter 2, “Introduction” describes what the TDR 2040 is and what it does. This chapter lists supplied equipment and shows mechanical features. Finally, this chapter describes the battery operation and installation.
- Chapter 3, “Setup” describes how to setup the TDR 2040.
- Chapter 4, “Operation” describes the modes of operation of the TDR 2040.
- Chapter 5, “Specifications” shows the technical specifications of the TDR 2040.

# Conventions Used in this Manual

This manual has several standard conventions for presenting information.

- Connections, Menus, menu options, and user entered text and commands appear in **bold**.
- Section names, Web and email addresses appear in *italics*.



**Note:** A note is information that will be of assistance to you related to the current step or procedure.



**CAUTION:** A caution alerts you to any condition that could cause a mechanical failure or potential loss of data.



**WARNING:** A warning alerts you to any condition that could cause personal injury.

## Precautions



**CAUTION:** Do not perform a length measurement or tone function if more than 6 volts is present on the cable.



**CAUTION:** Always disconnect any cable before opening the battery compartment cover.



**CAUTION:** Do not use the TDR 2040 in any manner not recommended by the manufacturer.

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This Chapter:

- Describes the TDR 2040 features
- Lists the TDR 2040 equipment
- Identifies the TDR 2040 mechanical features
- Describes the battery installation

## What is the TDR 2040?

The TDR 2040:

- Measures the length of a cable or distance to a fault (open or short) up to 2500 feet
- Provides a continuous reading of any voltages (AC or DC) present on the cable
- Generates four different tone frequencies and patterns for tracing cables with a tone probe

The TDR 2040 features a CATV and a General library of pre-stored cable types and their associated NVP (Nominal Velocity of Propagation). Each library has 8 cable list locations for favorite cable types and four custom cable locations.

## How Does the TDR 2040 Work?

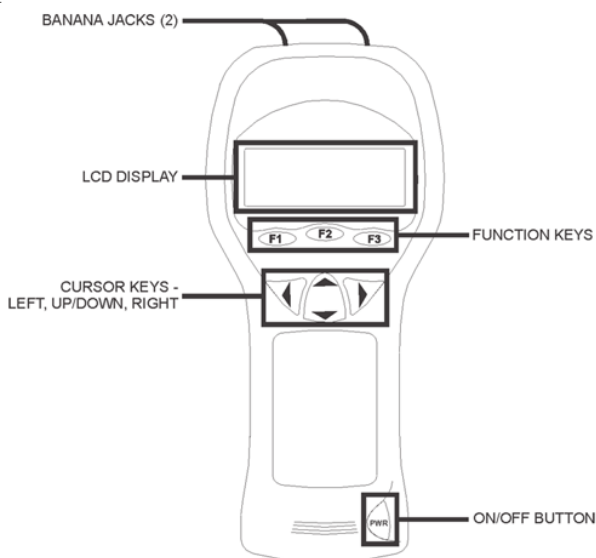
The TDR 2040 electrically measures the length of a cable or the distance to a fault using Time Domain Reflectometry (TDR) technology. It transmits an electrical pulse into the connected cable, which then travels along the cable until it hits a discontinuity (either a short or an open) and is reflected back to the TDR 2040. The time between launching the pulse and receiving the reflected pulse is precisely measured and then converted to distance using the cable's Nominal Velocity of Propagation (NVP). A cable's NVP is the relative speed that an electrical signal travels through it.

## Equipment Supplied with the TDR 2040

The TDR 2040 comes with the following:

- TDR 2040 Multifunction Cable Meter
- Four AA Alkaline Batteries
- Two Banana Jack to Alligator Test Leads
- One Banana Jack to BNC Adaptor
- One BNC to "F" Adaptor
- Operation Manual

## Mechanical Features



# Battery Operation and Installation

The TDR2040 operates on four AA alkaline batteries and will typically provide 9 hours or more of operation from a set of batteries.

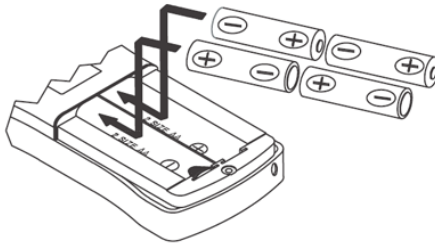
When the batteries are below the level required for the TDR2040 to operate properly, a “LO BATT” message will appear on the display.



**CAUTION:** To avoid electrical shock, disconnect all cables from the TDR2040 before removing the battery compartment cover.

To install batteries:

- Remove the battery cover from the back of the meter.
- Insert the batteries with the orientation shown below. Battery polarity is also marked inside the battery well for reference.
- Replace the battery cover.



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This chapter:

- Measurement Units Setup
- Cable Library Setup
- Cable List Setup
- Custom Cable Setup
- Default Cable Setup
- Toner Setup
- Power Down Setup

## Before Beginning

For a new TDR 2040, the protective film placed over the display for protection during shipping should be removed.

The TDR 2040 can be used straight out of the box with its default settings.

The default settings are:

“UNITS”: Feet

“LIBRARY”: General

“POWER DOWN”: Time = 5 MIN.

“TONER”: Pattern = 1 and Band = 1

“CABLE LIST”: Cable = 1, Type = EMPTY, and Nvp = 65

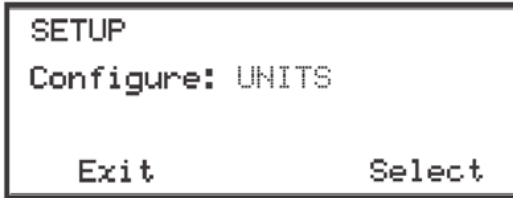
“DEFAULT CABLE”: Cable = 1, Type = EMPTY 1, and Nvp = 65

The settings can be customized based on usage needs. The following sections describe how to setup the instrument.

Press the **PWR** button to turn on the TDR 2040. The startup screen is shown for a few seconds and then the “MODE” Screen is displayed.



To display the “SETUP” Menu, choose “Select” by pressing the **F3** Function Key.



The **UP/DOWN** Cursor Key is used to display the following setup options:

1. Units Setup
2. Default Cable Setup
3. Cable List Setup
4. Custom Cable Setup
5. Toner Setup
6. Power Down Setup
7. Library Setup

When the desired setup option is displayed, choose “Select” by pressing the **F3** Function Key to access the corresponding setup menu.

## Units Setup

The “UNITS SETUP” Menu allows users to select the units of measure (feet or meters) to be used when length measurements are performed.

From the “SETUP” Menu, use the **UP/DOWN** Cursor Key to display “Configure: UNITS” and choose “Select” by pressing the **F3** Function Key.



Use the **UP/DOWN** Cursor Key to highlight the desired measurement units. Then, choose “Save” by pressing the **F2** Function Key to store the selection or choose “Exit” by pressing the **F1** Function Key to exit without saving the selection.

## Library Setup

The “LIBRARY SETUP” Menu allows users to select the type of cable library that the TDR 2040 uses. The TDR 2040 has two libraries with pre-stored cable types and their NVP. One library is for CATV installers and the other is for general electrical applications.

From the “SETUP” Menu, use the **UP/DOWN** Cursor Key to display “Configure: LIBRARY” and choose “Select” by pressing the **F3** Function Key.



Use the **UP/DOWN** Cursor Key to highlight the desired library. Then, choose “Save” by pressing the **F2** Function Key to store the selection or choose “Exit” by pressing the **F1** Function Key to exit without saving the selection.



**Note:** The selected library is available to scroll when in Length Measurement Mode. Also, a cable list of 8 favorite cable types and 4 custom cable locations are available for each library.



**Note:** A list of abbreviations used for prestored cable types is shown at the end of this chapter.

## Power Down Setup

The TDR 2040 will automatically turn off to extend battery life if the device remains idle for the amount of time selected in the “POWER DOWN” Menu.

From the “SETUP” Menu, use the **UP/DOWN** Cursor Key to display “Configure: POWER DOWN” and choose “Select” by pressing the **F3** Function Key.



Use the **UP/DOWN** Cursor Key to highlight the desired power down time setting of “5 MIN.”, “15 MIN.”, “30 MIN.”, and “ON”. Then, choose “Save” by pressing the **F2** Function Key to store the selection or choose “Exit” by pressing the **F1** Function Key to exit without saving the selection.




**Note:** When the power down time setting is set to “ON”, the TDR 2040 must be turned off manually.

# Toner Setup

The default tone pattern and frequency are set in the “TONER SETUP” Menu. The TDR 2040 can generate four different tone patterns and four different tone frequencies that can be used to trace a cable with a tone probe. The frequencies and patterns are compatible with tone probes from different manufacturers. The different tone patterns and frequencies allow multiple technicians to work in the same area.

From the “SETUP” Menu, use the **UP/DOWN** Cursor Key to display “Configure: TONER” and choose “Select” by pressing the **F3** Function Key.



```
TONER SETUP
▶Pattern 1
Band      3
Exit      Select  Setup
```

Use the **UP/DOWN** Cursor Key to scroll between the four transmitted patterns.

With the desired pattern selected, choose “Select” by pressing the **F2** Function Key to advance the selection arrow to the “Band” field. Use the **UP/DOWN** Cursor Key to scroll between the four frequencies.

Then, choose “Save” by pressing the **F2** Function Key to store the selections or choose “Exit” by pressing the **F1** Function Key to exit without saving the selections.

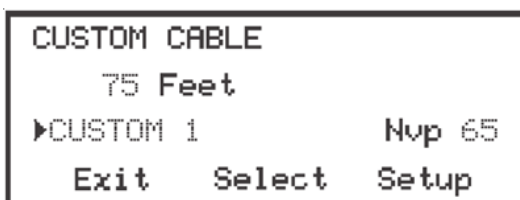
## Custom Cable Setup

The NVP for electrical cables can vary significantly between manufacturers. The NVP of a cable can also be different if it is wound on a spool or lying flat (installed).

The NVP values prestored in the TDR 2040 provide typical values for cable types. Custom Cable Setup is used to measure and store the NVP of a cable with a known length. The Custom NVP can then be used for accurate measurements of the cable type.

Using the appropriate supplied adaptor, connect the TDR 2040 to a known length of cable that is between 50 and 100 feet long and is open at the far end. Cables less than 50 feet or longer than 100 feet may not yield accurate NVP results.

From the “SETUP” Menu, use the **UP/DOWN** Cursor Key to display “Configure: CSTM CABLE” and choose “Select” by pressing the **F3** Function Key.



Use the **UP/DOWN** Cursor Key to scroll between the four custom cable storage locations (“C1” to “C4” if the CATV library is selected or “G1” to “G4” if the General Library is selected).

With the desired custom cable storage location selected, choose “Select” by pressing the **F2** Function Key to advance the selection arrow to the “Length” field. Use the **UP/DOWN** Cursor Key to adjust the displayed cable length until it matches the known length. The NVP will change as the displayed cable length is adjusted.

Then, choose “Save” by pressing the **F2** Function Key to store the selections or choose “Exit” by pressing the **F1** Function Key to exit without saving the selections.



**Note:** Repeat this process to store other custom cables. Up to four custom cables can be stored for each library selection (CATV or General).

## Cable List Setup

The “CABLE LIST” menu allows the user to store up to eight of the most used cable types at the top of the list for quick access (and to store with a modified NVP when the actual NVP is known to be a different valve).

From the “SETUP” Menu, use the **UP/DOWN** Cursor Key to display “Configure: CABLE LIST” and choose “Select” by pressing the **F3** Function Key.



Use the **UP/DOWN** Cursor Key to scroll between the eight storage locations.

With the desired cable list location selected, choose “Select” by pressing the **F2** Function Key to advance the selection arrow to the “Type” field. Use the **UP/DOWN** Cursor Key to scroll through all the prestored cable types in the selected library.

With the desired cable type selected, choose “Select” by pressing the **F2** Function Key to advance the selection arrow to the “Nvp” field. Use the **UP/DOWN** Cursor Key to adjust the NVP value.

Then, choose “Save” by pressing the **F2** Function Key to store the selections or choose “Exit” by pressing the **F1** Function Key to exit without saving the selections.



**Note:** Repeat this process to store other favorite cable types. Up to eight cable types can be stored in the cable list.



**Note:** A list of abbreviations used for prestored cable types is shown at the end of this chapter.



**Note:** A separate Cable List of eight types can be stored for each library selection (CATV or General)

## Default Cable Setup

The “DEFAULT CABLE” menu allows the user to set the most often used cable type as the default for the Length Measurement Mode. Any of the eight cable list locations or four custom cable locations can be set for the default cable type.

From the “SETUP” Menu, use the **UP/DOWN** Cursor Key to display “Configure: DFLT CABLE” and choose “Select” by pressing the **F3** Function Key.

```
DEFAULT CABLE
▶Cable 1
Type EMPTY 1      Nvp 65
Exit   Save      Setup
```

Use the **UP/DOWN** Cursor Key to scroll through eight cable list locations and four custom cable locations. With the desired cable displayed, choose “Save” by pressing the **F2** Function Key to store the selection or choose “Exit” by pressing the **F1** Function Key to exit without saving the selection.

# Cable Type Abbreviations

A list of the most common cable types is prestored in the TDR 2040. The following abbreviations are used in this list:

**NM** - Non-Metallic (Romex)

**BX** - Aluminum Armored Cable with Aluminum Ground

**MC** - Aluminum Armored Cable with Copper Ground

**HC** - Aluminum Armored Cable for Health Care Applications

**UF** - Underground Feeder (Direct Burial Cable)

**SOOW** - 600V Rubber Jacketed Portable Cord

**EXTEN** - Outdoor Extension Cable (Typically Orange Color)

**W/G** - With Ground Wire

**ZIP** - Lamp Cord

**THHN xCDT** - THHN Wire in Conduit

**CAT** - Category

**PLNM** - Plenum Grade

**UTP** - Unshielded Twisted Pair

**STP** - Shielded Twisted Pair

**COAX** - Coaxial Cable

**SPKR** - Speaker Wire

**TEL** - Telephone Twisted Pair

**PIC** - Plastic Insulated Conductor (Aerial Telephone Cable)

**THERM** - Thermostat Wire

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This chapter:

- Mode Screen and Voltmeter Function
- Length Measurements
- Toner Operation

## Mode Screen and Voltmeter Function

Attach the appropriate adaptor or test leads to the TDR 2040.

Press the **PWR** button to turn on the TDR 2040. The startup screen is shown for a few seconds and then the “MODE” Screen is displayed.



Connect the adaptor or test leads on the TDR 2040 to the cable to be tested.

When the “MODE” Screen is displayed, the TDR 2040 immediately starts measuring voltage and updates the reading several times per second. The TDR 2040 can withstand continuous input voltages up to 250 Vrms AC or DC.



**CAUTION:** If more than 6 volts are present on the cable, do not perform a length test or toner operation until the circuit is de-energized.

## Length Measurement

With the TDR 2040 connected to the cable to be tested and turned on with the “Mode” screen displayed, confirm the voltage indicated is not more than 6 volts.



Choose “Length” by pressing the **F1** Function Key to display the “Length” Screen.



The TDR 2040 automatically starts measuring the distance to a fault (open or short) using the NVP of the Default Cable (See Default Cable Setup). The length measurement is continuously updated.

If you wish to use another cable type for your test, use the **UP/DOWN** Cursor Key to scroll through the eight cable list types, four custom cables, and the selected library of prestored cable types.

When the NVP for a cable is known to be different than the displayed NVP, change the NVP by choosing “Select” by pressing the **F2** Function Key to move the arrow to the “Nvp” Field.



Press the **UP/DOWN** Cursor Key to modify the NVP. The NVP can also be modified and stored as shown in the *Cable List Setup* Section on Page 19.



**Note:** Before starting a job with a new spool or box of cable that has a known length, a Length measurement can be made with the TDR 2040 to determine if the prestored NVP for that cable type provides the most accurate length measurement.

1. Confirm that the correct cable type is selected in the “Type” Field.
2. Choose the “Select” button by pressing the **F2** Function Key to move the arrow to the “Nvp” Field.
3. Press the **UP/DOWN** Cursor Key until the displayed length matches the known length.

This will determine the best NVP for the cable under test. The modified NVP will be reset to it’s original value once you exit the “Length” Screen or turn power off. To store the cable type with the modified NVP, see the *Cable List Setup* Section on Page 19. The prestored NVP is a typical value and adjusting the NVP to the actual length will provide more accurate results.



**Note:** The correct NVP for a flat (unrolled) cable is always accurate to find the length of an open cable or distance to a short. When using the correct NVP for an open length measurement of a spool of cable (or rolled up cable), the measured length to a short may be displayed slightly longer (by approximately 3%) than the actual distance. Although rolled cable is normally measured to an open end, the NVP could be adjusted, if desired, for a more accurate measurement to a short.

## Toner Operation

With the TDR 2040 connected to the wires or cable for tone injection and turned on with the “Mode” Screen displayed, confirm the voltage indicated is not more than 6 Volts.



Select “Tone” by pressing the **F2** Function Key to display the “Tone” Screen.



The TDR 2040 starts transmitting the user selected tone pattern and frequency (see the *Toner Setup* Section on Page 17).

The TDR 2040 provides four different tone patterns that can be changed by pressing the **UP/DOWN** Cursor Key. Also, change the frequency band by choosing “Select” by pressing the **F2** Function Key to move the arrow to the “Band” Field. Press the **UP/DOWN** Cursor Key to change the frequency band.

The Tone transmitted by the TDR 2040 can then be traced with a tone probe. The TDR 2040 is compatible with the standard tone probes available from various manufacturers.

**Length:**

Accuracy:	± 2% plus ± 2 feet (with correct NVP)
Resolution:	1 foot or 0.2 meters
Maximum:	2500 feet or 750 meters
Minimum:	0 feet or meters

**Voltage: (True RMS Responding)**

Range:	0 - 250 Volts (AC or DC)
Accuracy:	± 3% plus 1 Volt

**Tracing Tone:**

Frequencies:	575 Hz, 977 Hz, 1.0 KHz, 7.82 KHz
Patterns:	Four

**Miscellaneous:**

Dimensions:	7.0 in. x 3.2 in. x 1.4 in. 17.8 cm x 8.1 cm x 3.6 cm
Weight:	8.7 ounces (247 g) (w/ batteries)
Display:	Graphical 122 x 32 pixels
Working Temperature:	0 °C to 50 °C
Storage Temperature:	-10 °C to 55 °C

**Battery:**

Four AA Alkaline Batteries

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## Warranty Information

Trilithic, Inc. warrants that each part of this product will be free from defects in materials and workmanship, under normal use, operating conditions and service for a period of one (1) year from date of delivery. Trilithic, Inc.'s obligation under this Warranty shall be limited, at Trilithic, Inc.'s sole option, to replacing the product, or to replacing or repairing any defective part, F.O.B. Indianapolis, Indiana; provided that the Buyer shall give Trilithic, Inc. written notice.

Batteries are not included or covered by this Warranty.

The remedy set forth herein shall be the only remedy available to the Buyer under this Warranty and in no event shall Trilithic, Inc. be liable for incidental or consequential damages for any alleged breach of this Warranty. This Warranty shall not apply to any part of the product which, without fault of Trilithic, Inc., has been subject to alteration, failure caused by a part not supplied by Trilithic, Inc., accident, fire or other casualty, negligence or misuse, or to any cause whatsoever other than as a result of a defect.

Except for the warranty and exclusions set forth above, and the warranties, if any, available to the Buyer from those who supply Trilithic, Inc., there are no warranties, expressed or implied (including without limitation, any implied warranties of merchantability of fitness), with respect to the condition of the product or its suitability for any use intended for it by the Buyer or by the purchaser from the Buyer.



**TRILITHIC**  
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9710 Park Davis Drive  
Indianapolis, IN 46235  
(317) 895-3600  
[www.trilithic.com](http://www.trilithic.com)