# Pro400

## TDR Cable Fault Locator
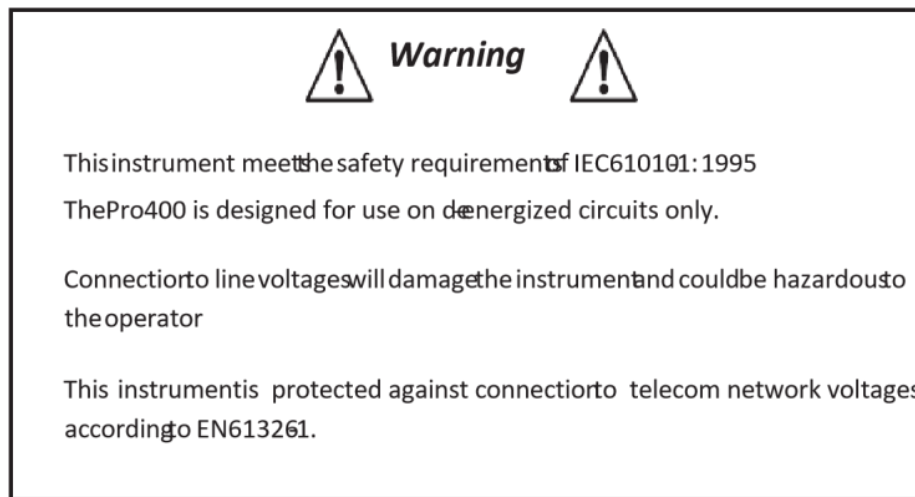## Operating Instructions

## Section 1 - Receiving the Pro400

Upon delivery of the Pro400, ensure the contents are consistent with the packing list, notify your supplier of any missing items.

If the equipment appears damaged, notify your carrier and supplier immediately, giving a detailed description of any damage, save the damaged packaging to substantiate your claim.

The Pro400 includes 18-inch test leads, soft case, batteries, and user manual.

> ⚠️ **Warning** ⚠️
>
> This instrument meets the safety requirements of IEC61010-1: 1995
>
> The Pro400 is designed for use on de-energized circuits only.
>
> Connection to line voltages will damage the instrument and could be hazardous to the operator
>
> This instrument is protected against connection to telecom network voltages according to EN61326-1.

## International Electrical Symbols

▣ This symbol signifies that the instrument is protected by double or reinforced insulation. Use only specified replacement parts when servicing the instrument.

⚠️ This symbol on the instrument indicates a WARNING, and that the operator must refer to the user manual for instructions before operating the instrument. In this manual, the symbol preceding instructions indicates that if the instructions are not followed,

bodily injury, installation/sample and product damage may result.

⚠ Risk of electric shock. The voltage of the parts marked with this symbol may be dangerous.

## 1.2  Standards

The Pro400 has been manufactured in accordance with and meets the requirements of the following international standards:

SAFETY          IEC 61010-1

                EN 60950

EMC             BS/EN 61326-1

Water/Dust Proof to IP54

## Section 2 - Introducing the Pro400

The Pro400, 20,000-foot range Time Domain Reflectometer (TDR) weighing 13 oz. fits neatly into the hand. With its 128x64 pixel backlight display, provides accurate and easy to read fault locations on metallic cables. With a 3-nanosecond pulse rise time "close in" cable faults can be clearly identified. Housed in a rugged IP54 rated ABS enclosure, the Pro400 is suitable for outside use.

Using pulse widths and gain settings which are pre-determined for the length range selected and with only 7 operating buttons, all major operating and setting parameters can be easily accessed. In addition to the pre-determined gain settings there is a user variable gain control to further enhance the displayed trace. A long cable run can be scanned in seconds. By using the Pro400 scan lock facility, cable can be continually scanned, or the trace held for closer analysis. To enable the Pro400 to test all metallic cables, four user selectable output impedances are provided 25, 50, 75 & 100 ohms.

Faulty cables may be traced using the Pro400 warble tone feature, an oscillating tone that allows a cable to be identified with a tone tracing probe like the Armada Pro210F.

## 2.1 Pro400 Features
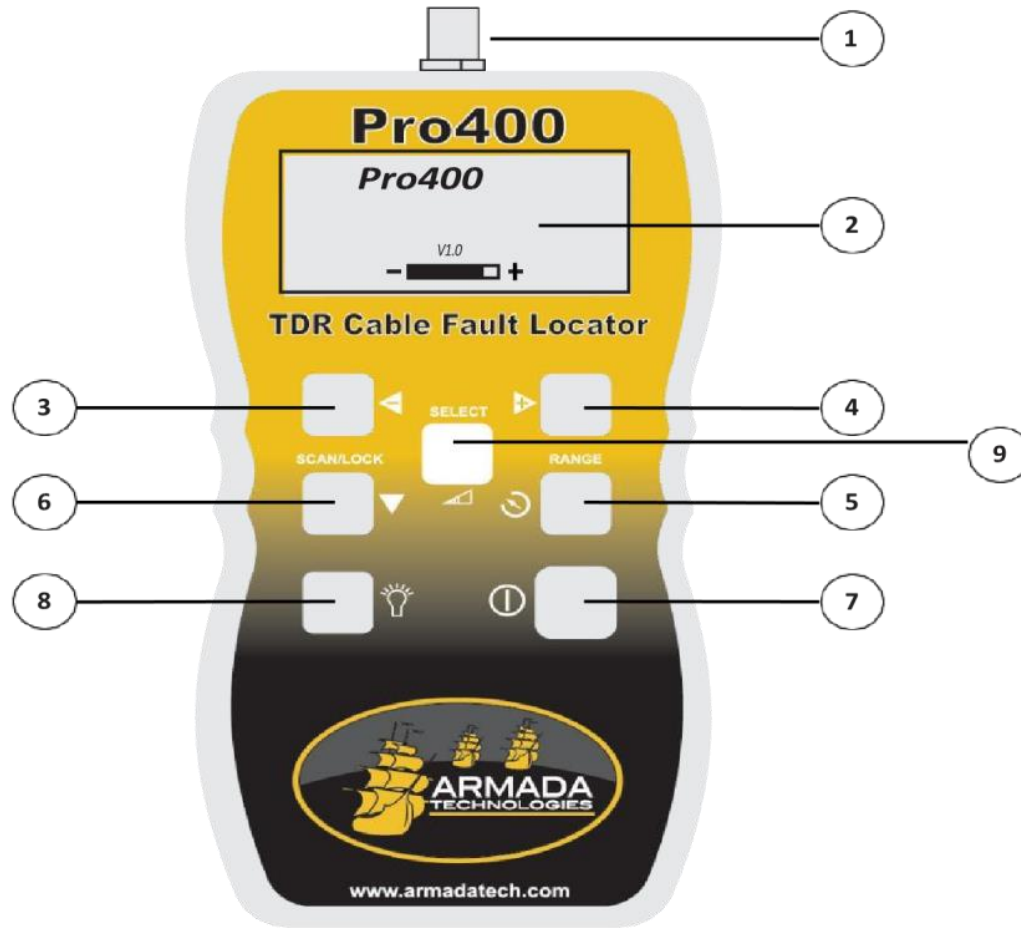


1. BNC Test Connector
2. LCD Display
3. Left ◄ ( ) button / Decrease
4. Right ► (+) button / Increase
5. Menu and Range ↻ Adjust Button
6. Test Start ▼ Button
7. Power On/Off Button
8. Backlight On/Off Button
9. Select and Gain Adjust Button

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## 2.2 Specifications

| | |
|---|---|
| Preset Ranges (ft) | 20, 45, 90, 180, 360, 750, 1500, 3000, 6000, 12000, 20000 |
| (Meters) | 7, 15, 30, 60, 120, 250, 500, 1km, 2km, 3km, 6km |
| Range Select | Range ⟳ + ◄► |
| Accuracy | 1% of selected range* |
| Resolution | Approx 1% of range |
| Sensitivity | Min 3-pixel return at 10,000 ft on 22 AWG, PE, TP |
| Velocity Factor | Adjustable from 1% to 99% |
| Output Pulse | 5 volts peak to peak into open circuit |
| Output Impedance | Selectable 25, 50, 75 & 100 ohms |
| Output Pulse Width | 3 ns to 3 ms, automatic with range |
| Scan Rate | 2 scans / second or scan held |
| User Gain Adjustment | From default up to +7 dB |
| Tone Generator | 810 – 1100 Hz |
| Battery Life | 7 hours continuous scanning |
| Power Supply | 6 volts (4 x 1.5 AA alkaline cells) |
| Power Down | Selectable 1, 2, 3, 5 minutes or disabled |
| Back Lit Display | 128 x 64 pixels |
| Voltage Protection | 250 volts AC |
| Operating Temp | 14° F / 120° F (-10° / 50°C) |
| Storage Temp | 0° F / 150° F (-20° / 70°C) |
| Dimensions | 6.5 x 3.5 x 1.5 in (165 x 90 x 37 mm) |
| Weight | 12 ounces (350 g) |
| Safety | IEC 61010-1 EN 60950 |
| EMC | EN 61326-1 |
| Water/Dust Proof | IP54 |

\* Measurement accuracy of <+/- 1% assumes the instrument setting for velocity of propagation (Vp) of the cable under test to be accurately set, homogeneity of the Vp along the cable length, and accurate cursor positioning.

## 2.3 Accuracy

The Pro400 can measure distances to faults and cable lengths to an accuracy of +/- 1%.

This measurement accuracy is based on the correct value of Vp being used for the cable under test, and homogeneity of the Vp along the cable length.

If the Vp is set incorrectly by the operator, or the Vp varies along the length of the cable, then additional errors will be incurred, and the measurement accuracy will be affected.

**Note:** The Vp is less well defined with unshielded multi-wire cable, including power cable, and is lower when a cable is tightly wound on a reel than when installed.

## Section 3 - First Operation
## 3.1 Preparing the Pro400 for Use

Press button ① to power the tester, the following screen will be displayed:



1. Model

2. Software version programmed into tester.

3. Battery condition indicator (all black battery symbol indicates full charge, as charge decreases symbol changes to white).
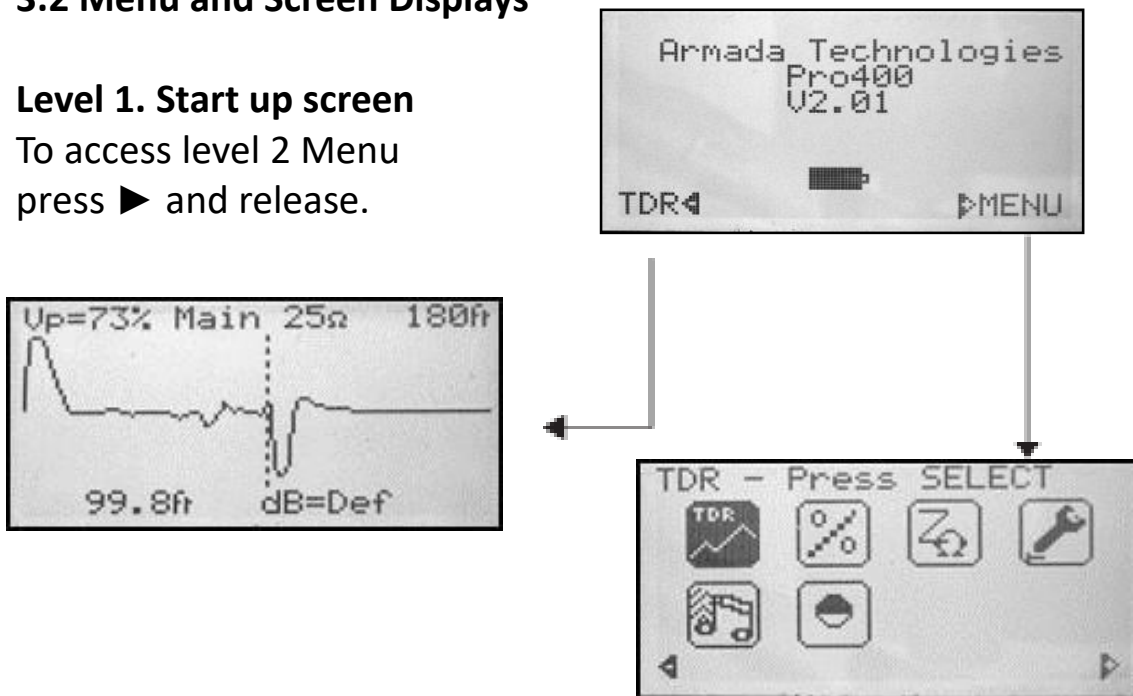
Prior to use the following parameters will need to be set

1. Auto shutdown
2. Set contrast
3. Select unit of measure
4. Select velocity of propagation

**3.2 Menu and Screen Displays**

**Level 1. Start up screen**

To access level 2 Menu press ► and release.



**Level 2. Menu**

To change the following settings from the menu, select ⌷ using the ◄► keys. Press Select key to open.

**3.3 Set Auto Shutdown**

| TDR |
| --- |
| Vp %Vc |
| VP=67% |
| Main 25Ω |
| Feet |
| Contrast |
| Shutdown: 3 minutes |

To preserve battery life, the Pro400 has an auto shutdown feature. Shutdown time is selectable between disabled, 1 minute, 2 minutes, and 3 minutes. To Change settings press ▼ to move ➡ to shut down, use ◄► to select the setting. To exit, press ↺ selected values will automatically be stored.

## 3.4 Set Unit of Measure (Level 2)

```
TDR
Vp  %Vc
VP=67%
Main 25Ω

➡ Feet

Contrast ▬▬▬▭
Shutdown:  3 minutes
```
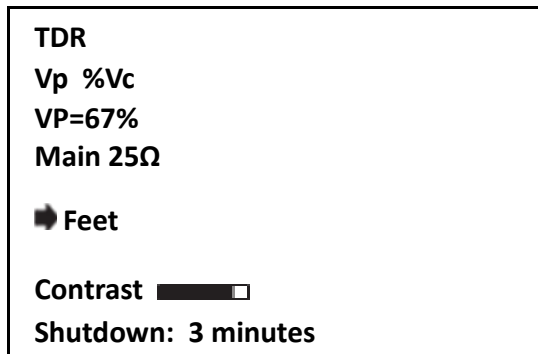
Press ▼ to move ➡ to unit of measure (feet or meters). Press ◄ or ►to scroll between feet and meters. Press ↺ button to exit, selected value will be automatically stored.

**Note:** Vp is the correction factor for your cable needed to keep the distance cursor accurate. 67% = 0.67. Experiment to get the best value.

## 3.5 Set Cable Impedance (Z)

```
TDR
Vp        %Vc

VP=67%   ➡
Main    25Ω
Feet

Contrast ▬▬▬▭
Shutdown: 3 minutes
```
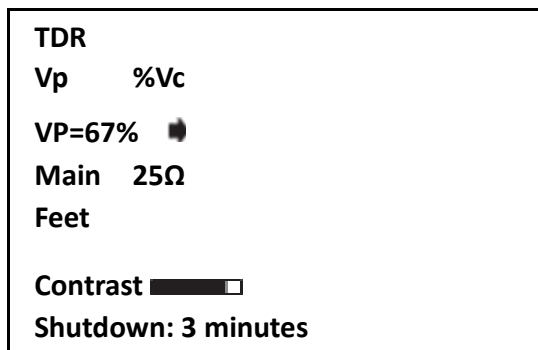
Press ▼ to move cursor to Z. ➡To scroll between values press ◄ or ►. To exit press ↺. Selected values will be automatically stored.

## 3.6 Set Velocity of Propagation (Vp)

Velocity of propagation may be set as % or speed in microseconds (ms). The unit of measure, the speed is displayed in (feet or meters),

```
TDR
Vp %Vc
VP=67%
Main 25Ω Feet

Contrast ▬▬▬▭
Shutdown: 3 minutes
```

will be determined by the setting selected in section 3.4.
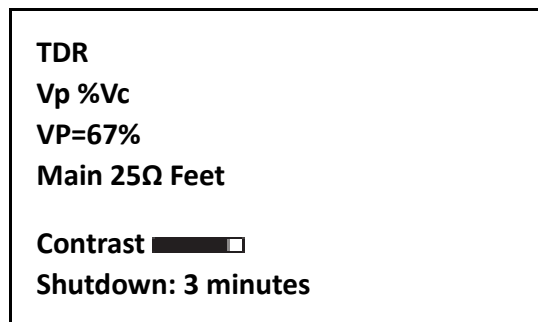
Press ▼ to move to Vp type, press ► to set to Vp % Vc. Press ◄ or ►to increase or decrease displayed value. Press ↺ to return to screen. Selected values will be automatically stored.

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### 3.7 Backlight

The LCD display is fitted with an LED backlight to enable easy viewing under a variety of different lighting conditions. The backlight is switched on and off with 🔆 key.

### 3.8 How to Determine Vp Settings

If the Pro400 TDR is to be used with a cable type for which the Vp is unknown, this must first be determined by following the steps below.

1.  Take a sample of the cable at least 300 ft long.
2.  Measure the actual length of cable using a rule or tape measure, or some other reliable method.
3.  Connect the Pro400 TDR and adjust the Vp setting such that the tester gives a correct reading of the sample length.

### Section 4 – Using the Pro400
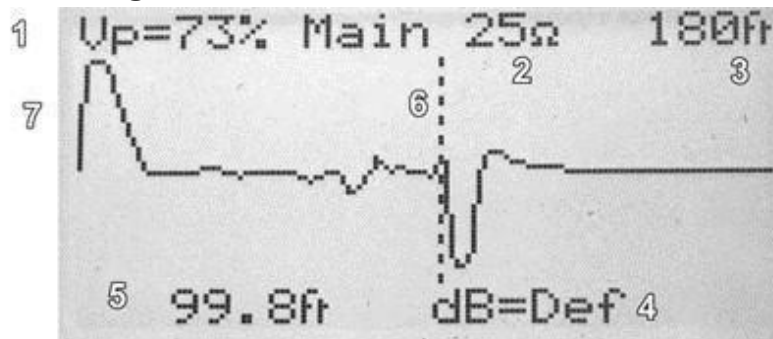


Upon completion of the set-up procedures in section 3, press button ▼ and the test screen above will be displayed.

1.  Vp setting
2.  Impedance setting (Z)
3.  Range scale
4.  Selected gain value
5.  Distance of cursor
6.  Cursor
7.  Output pulse

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⚠ Attach the test lead set to the Pro400 via the BNC connector located at the top of the unit,

1. Ensure that no power supply or equipment is attached to the cable to be tested.
2. Ensure that the far end of the cable under test is open or shorted (not fitted with a resistive termination).
3. Attach the Pro400 to one end of the cable to be tested.



Coaxial Cable

Shielded Cable

Twisted Pair

Multi-conductor Cable
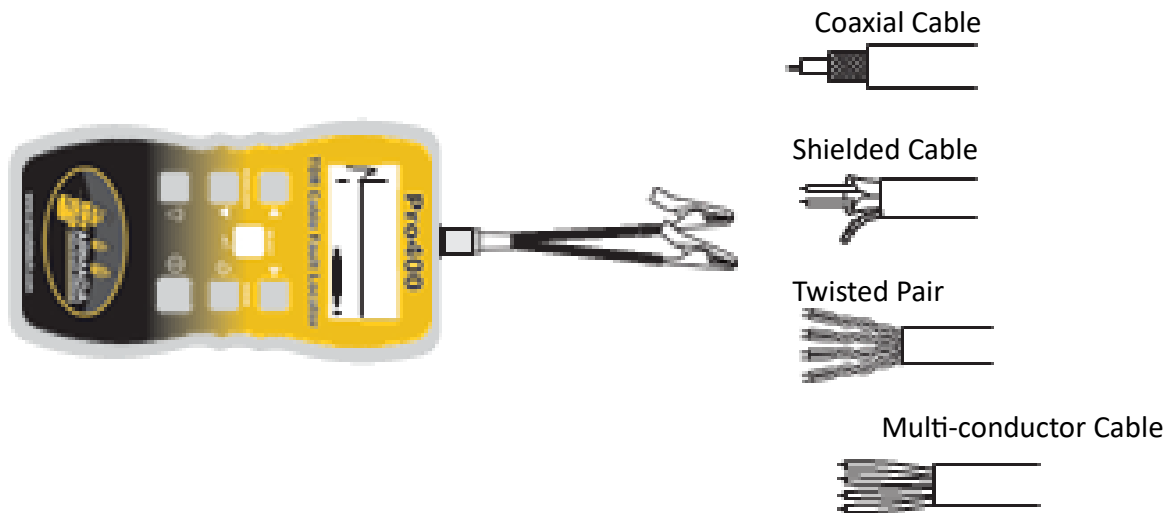
**Coaxial Cable:** Connect the red clip to the center wire and the black clip to the shield/screen.

**Shielded Cable:** Connect the red clip to a wire adjacent to the shield and the black clip to the shield.

**Twisted Pair:** Separate out one pair and connect the red and black clips to the two wires of the pair.

**Multi-wire Cable:** Connect the clips to any two wires.

### 4.1 Testing a Cable

Having followed the set-up procedures in the preceding sections, a typical display showing impedance anomalies is shown below. Further examples are shown in section 4.6.
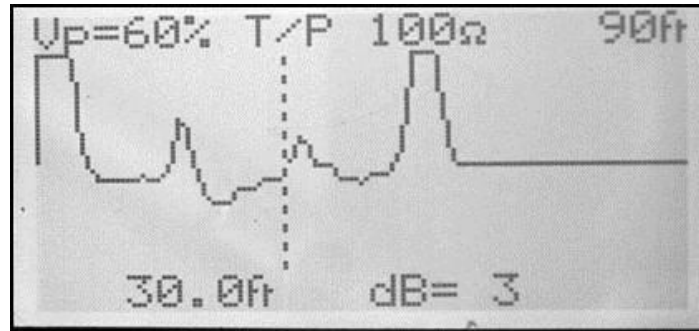


The vertical cursor line is moved left or right along the line of the trace by pressing ◄ and ► buttons to determine the distance to the event. Position the cursor at the beginning of the event and read off the distance at the bottom left corner.

On the fault display shown above, an Open cable has a splice at 30 feet. To increase the gain of the return, see section 4.4. The open end of the cable is shown as a large positive spike. This is used to determine the end of the cable run and the overall length of the cable.

### 4.2 Selecting Range Scales

The Pro400 has 11 range scales covering the range of 20 to 20,000 feet. The maximum range for 25-ohm cables is 3,000 feet.
To select a range scale, or scan the cable run, press, and hold down the Range button and press ◄ to decrease range or ► to increase range.

### 4.3 Single Shot and Continuous Scanning Modes

When the Pro400 is first switched on, it is set to "Single Shot" mode. In this mode the Pro400 only fires a pulse into the cable under test when either the ◄► buttons or ▼ button is pressed.

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> **Single Shot Mode:** Saves on battery life and enables the Pro400 to be disconnected from the cable while still leaving the fault display on the screen.

To enter "**Continuous Scanning**" mode press down and hold the ▼ button.

The 🔨 icon will appear at the bottom right of the display when continuous scanning mode is activated.

> **Continuous Scanning Mode:** Fires the pulses into the cable under test. In this mode the Pro400 can more easily identify intermittent cable faults.

## 4.4 Gain Adjustment

To increase the gain of the return pulse, align cursor at the beginning of the event. Press and hold ◁ button, press ◀▶ keys to increase or decrease gain.

## 4.5 Tone Generator

The Pro400 may also be used as a tone generator to trace and identify cables and wires. The user will need a conventional inductive tone probe within the range of 810 Hz to 1110 Hz.

To select tone generator (Level 2)
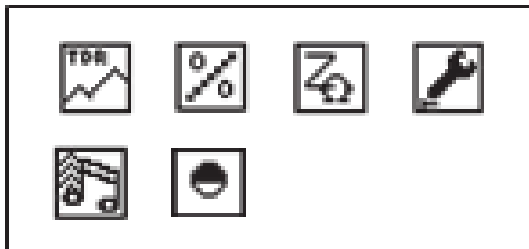
Press ◀▶ to select 🎵. To open press [ Select ]

To escape press ↻.

When tone has been selected, connect test lead to cable pair to be traced. Then use a tone probe, which will emit a tone. The volume of the tone will increase the nearer it is to the cable being traced. **Note:** The auto off function is disabled in tone generator mode so that the tone can be injected into a cable for extended periods while tracing takes place.

## 4.6 Set Contrast (Level 2)
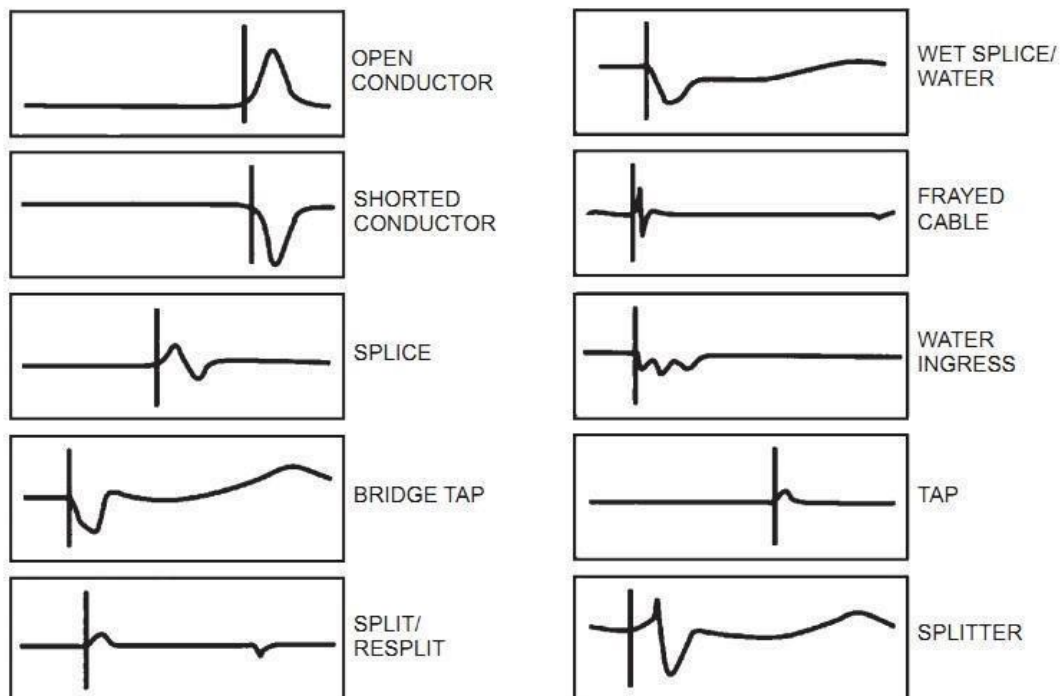
Press ◄► to select ⊡

Then press [ Select ]

Press ◄► to increase or decrease contrast. Press ↺ to return.

## 4.7 Typical Fault Displays

The following diagrams show typical fault traces to assist you in the identification of faults using the Pro400.



OPEN CONDUCTOR

WET SPLICE/ WATER

SHORTED CONDUCTOR

FRAYED CABLE

SPLICE

WATER INGRESS

BRIDGE TAP

TAP

SPLIT/ RESPLIT

SPLITTER

## 4.8 Typical Cable V.P. and Impedance (Z) Values

| Cable Type | Vp | Z | | Cable Type | Vp | Z |
|---|---|---|---|---|---|---|
| | | | | | | |
| Cat5 STP | 72 | 100 | | T/Pair Jelly PE | 64 | 100 |
| Cat5 UTP | 70 | 100 | | T/Pair PE | 67 | 100 |
| ID1 Decoder Buried | 57 | 25 | | T/Pair PTFE | 71 | 100 |
| MAXI Decoder Buried | 53 | 25 | | T/Pair PVC | 58 | 100 |
| ID1 Decoder Spool | 70 | 25 | | Coax Foam PE | 82 | 75 |
| MAXI Decoder Spool | 57 | 25 | | Coax Solid PE | 67 | 75 |

## Section 5 – Maintenance

### 5.1 Battery Replacement

Disconnect the instrument from any cable or network link.

- Turn the instrument off
- Loosen the two black screws and remove the battery compartment cover.
- Replace the batteries with (4) 1.5-volt Alkaline batteries, observing the polarities.
- Refit the battery compartment cover and tighten the two screws.

### 5.2 Cleaning

Disconnect the instrument from any source of electricity.

- Turn the instrument off
- Using a soft cloth lightly dampened with soapy water, wipe over the instrument. Rinse the cloth in clean water squeezing out any excess water.  Wipe over the instrument removing any soap residue. Then dry the instrument with a dry cloth. Do not splash water directly on the instrument.
- Do not use alcohol, solvents, or hydrocarbons to clean instruments.

### 5.3 Storage

⚠ If the instrument is not to be used for a period of more than 60 days, it is recommended that the batteries are removed and stored separately (see 5.1).

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## Section 6 – Repair and Warranty

This instrument contains static sensitive devices and is not user serviceable. If an instrument fails, or its protection has been impaired, it should not be used but sent back for repair by suitably trained and qualified personnel.

New instruments are guaranteed against breakdown due to manufacturing or component defects for 36 months after the purchase date by the user.

**Note:** Any unauthorized prior repair or adjustment to the instrument will automatically invalidate the warranty.