SPX®

Where Ideas Meet Industry

RD6000

Multi-Function Cable Test Instrument

Radiodetection
Riser Bond

Revision 6
P/N 250-0035-05

Thank you for purchasing the Riser Bond Model 6000 Telephone Network Analyzer. Our goal is to provide you with a high-quality troubleshooting tool that is both powerful and easy to use. Please read the Operator's Manual thoroughly to help ensure the best results from your Telephone Network Analyzer. Record your serial number on the line below. If you have questions, comments or suggestions, please contact:

Radiodetection
154 Portland Road
Bridgton
ME 04009
USA

Tel: (207) 647 9495
Toll Free: (877) 247 3797
Fax: (207) 647 9496
E-mail:bridgton@radiodetection.spx.com

Model 6000 Serial Number _____

Radiodetection
Riser Bond

CE

250-0035-05

WARRANTY

The Model 6000 is warranteed for a period of ONE YEAR from the date of shipment from Radiodetection/Riser Bond's factory or its designated distributor, that the Telephone Network Analyzer Model 6000 shall be free from defects in material and workmanship that develop under normal use in accordance with Radiodetection/Riser Bond's operating instructions.

Items returned for repair or replacement shall be shipped with a copy of the dated invoice, freight charges prepaid, to:

Radiodetection
154 Portland Road
Bridgton
ME 04009
USA

Tel: (207) 647 9495
Toll Free: (877) 247 3797
Fax: (207) 647 9496
E-mail:bridgton@radiodetection.spx.com

This warranty will be void if products are modified by the purchaser during the period of warranty without the manufacturer's written consent. This warranty is expressly made in lieu of all other warranties expressed or implied, including merchantability, whether arising by law, custom or conduct. The rights or remedies provided herein are exclusive and in lieu of any other rights or remedies unless specifically stated in the purchase order for this equipment. This warranty covers repair or replacement of the purchased item only and does not cover any subsidiary damages to associated customer equipment. If the extended warranty is purchased, it does not apply to the battery pack.

CONTENTS

Appendix A
Serial I/O Printer Port Connection

Citizen PN 60 Pocket Printer

The Riser Bond Model 6000 interfaces to the Citizen PN60 Pocket Printer. The printer setup parameters are as follows:

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

Seiko DPU-411/414 Printer

The Model 6000 can be used in conjunction with the Seiko DPU-411 thermal Printer. It uses the Seiko DPU-411 command set. Serial communication parameters are: no parity, two-stop bit, and 9,600 baud.

The printer setup parameters areas follows:

Input Method:	Serial
CR Function:	Carriage return
Print Mode:	Normal printing
Character Set:	Ordinary char.
Zero Font:	Slash zero
Intern Char Set:	USA
Data Bit Len:	Eight bits
Parity Permission:	Without
Parity Condition:	Odd
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

Software Noise Filters
Standard: 8x, 50/60 Hz
Optional: 4x, 8x, 16x, 32x, 64x, 128x, 50/60 HZ

Resistance Fault Locator (RFL)
Location Range: 0 to 150 kft
Resistance fault range: 0 to 50MΩ
Accuracy:
- 3 wire test: ±0.25% of DTS ±0.4 ohms
- 4 wire test: ±0.25% of DTS ±0.25 ohms
- Kupfmuller Test: ±1.0% of DTS ±1 ohm

Noise/Balance Measurements
Loop current: 0 to 120mA
Resolution: 0.1mA
Accuracy: 5% ±0.2mA

Longitudinal Balance: 40 to 62 dB
Frequency: 1004 Hz
Resolution: 1 dB
Accuracy: ±2 dB

Noise Metallic: 0 to 50 dBrnC
Transverse Noise: -90 to -40 dBmp
Resolution: 1 dB
Accuracy: ±2 dB

Power Influence: 40 to 100 dBrnC
Longitudinal Noise: -50 to 10 dBmp
Resolution: 1 dB
Accuracy: ±2 dB

Standard Accessories
Operator's Manual, 12VDC charger, nylon carry/accessory bag, shoulder strap, 2 sets telephone connection leads plus ground lead, pair shorting strap, VOP card.

Options
Additional waveform memory. Additional waveform filtering. Riser Bond Oscillator and Probe. Additional warranty.

Section 1: General Information

1.1 Safety Information


WARNING - If a procedure or process is not correctly followed, personal injury may result.


CAUTION - If a procedure or process is not correctly followed, the equipment may be damaged or data lost.


HAZARDOUS VOLTAGE - The hazardous voltage symbol indicates the high voltage source on the Model 6000 is active or there is a hazardous voltage present on the cable under test.


WARNING - Before using, review all safety precautions. Note and follow all safety information on equipment and in 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 and secure the product from use by others.

Read and follow the Operator's Manual. Failure to do so could compromise the safety of the operator.

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

When Hazardous Voltage Warning dialog box appears on the screen, stop test immediately and remove voltage source. Failure to do so could compromise the safety of the operator.

CAUTION

Store your Model 6000 indoors during extreme hot or cold weather. If the Model 6000 is stored overnight in a vehicle, bring the instrument to specified operating temperatures before using. Do not expose the equipment to extreme temperatures.

1.2 Introduction

The Model 6000 is an open meter multi-function telephone test instrument. It combines diagnostic and fault location tools into a single instrument, and includes a Multi-Meter, a full function Time Domain Reflectometer (TDR), Resistance Fault Locator (RFL), Insulation Resistance (IR) Tester, and Pair Balance and Noise Measurements. Telephone test technicians use the Model 6000 to troubleshoot voice and high-speed telephone data cable.

Use the Multi-Meter, IR, Pair Balance and Noise tools to determine the type of fault, and which fault tool to use: the TDR or RFL. Use the fault locator tools to locate opens and partial opens, high and low resistance shorts, water, bridge taps, load coils, bad splices, faulty connectors and cable damage.

1.3 General Features (Open Meter)

- Compact, lightweight, portable
- Rugged carrying case
- RS-232 port
- Battery charger
- WAVE-VIEW computer software
- Auto test functions
- Hazardous voltage test
- Diagnostic and fault location tools
  - Multi-Meter
  - Insulation Resistance Tester
  - Pair Balance and Noise Measurements
  - RFL
  - TDR

Time Domain Reflectometer
loaded and non-loaded cable
Horizontal Resolution:
For distances less than 2,000 ft:
<0.25 ft at 99.0% VOP, <0.07 ft at 30.0%
<0.07 m at 99.0% VOP, <0.02 m at 30.0%

For distances over 2,000 ft:
1 foot at any VOP
0.1 meter at any VOP

Vertical Resolution:
14 bits with 137 dots displayed

Vertical Sensitivity: >65dB

Output signal: Pulse widths of 2ns, 25ns, 100ns, 500ns, 1.5µs, 4.4µs and 330µs.

Output balance: Variable from 80Ω to 120Ω

Distance Accuracy:
±0.5 ft plus ±0.01% of reading
±0.15 m plus ±0.01% of reading

Maximum Range
Live waveform:
63,700 ft (19,400 m) at 99.0%VOP
38,600 ft (11,700 m) at 60.0%VOP
Range varies with VOP. Maximum testable cable length varies with pulse width and cable type.

Input Protection
400 VDC or VAC up to 60 Hertz

- V/2 ranging from 45.0 to 148.4 m/µs or 147.5 to 486.9 ft/µs
  Loaded cable: V/2 ranging from 1.2 to 30.0 m/µs or 3.9 to 98.4 ft/µs

Velocity of Propagation (VOP)
Two user-selectable display formats:
- VOP (%) ranging from 30.0% to 99.0%
  Loaded cable: VOP (%) ranging from 0.8% to 20.0%

Waveform Storage
Standard: 8 SUPER-STORE waveforms at 6144 samples each
Optional: 32 SUPER-STORE waveforms at 6144 samples each

10.0 Mohm to 99.9 Mohm
Resolution: 0.1 Mohm
Accuracy: 4% +/- Mohm

100.0 Mohm to 999 Mohm
Resolution: 1 Mohm
Accuracy: 10% +/- Mohm

Open/Capacitance Meter
0 to 999 ft (0 to 99.9 m)
Resolution: 1 ft (0.1 m)
Accuracy: 2%±3 ft (1 m)

1000 ft to 9,999 ft (100 m to 999 m)
Resolution: 10 ft (1 m)
Accuracy: ±3%

10,000 ft to 99,999 ft (1000 m to 9990 m)
Resolution: 100 ft (10 m)
Accuracy: ±5%

100,000 ft to 149,999 ft (10,000 m to 49900 m)
Resolution: 1000 ft (100 m)
Accuracy: ±8%

0 to 9.99nF
Resolution: 0.01nF
Accuracy: 2% +/- 0.06nF

10.0 to 99.9nF
Resolution: 0.1nF
Accuracy: 3% +/- nF

100 to 999nF
Resolution: 1nF
Accuracy: 5% +/- nF

1000 to 2000nF
Resolution: 1nF
Accuracy: 8% +/- nF

Section 2: Operating Procedures

2.1 Theory of Operation
The Model 6000 is a multiple use instrument. Use any or all of the various diagnostic and fault locating tools or use the automated test function to step through typical pair diagnostic tests and fault location procedures.

The Model 6000 is easy to operate (Figure 1 below)

A) Keys on the left side of the Front Panel control instrument operations.

B) Keys on the bottom of the Front Panel control the menu items that are displayed on the screen.

C) Keys on the right side of the Front Panel are used for fast access to common TDR controls.

D) The LED in the bottom right hand corner indicates the battery charger is plugged in.

E) The battery charger socket is conveniently located on the front.

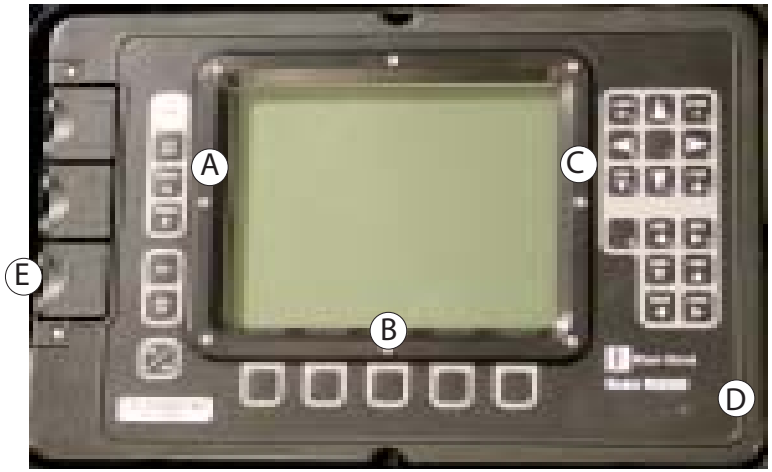


Figure 1 - Front panel

2.2 Front Panel Description

2.2.1 Keypad

The keys on the front panel control the functions displayed on the screen (Figure 2).

Instrument Operation Keys (A)

Power. On/Off.

Backlight. Turn the backlight On/Off. Use backlighting for low light situations.

Contrast. Increase or decrease LCD screen contrast.

Help. Press to access the Help Menu.

Auto Test. Press to start an automatic process for fault diagnosis and location.

Menu Control Softkeys (B)

End/Back. Use the End/Back key to stop a test or to return to previous screen.

Softkey menu. The softkey menu is displayed on the screen. Press the softkey underneath the menu items to make your selection or move between selected items.

TDR Keys (C)

Horizontal Zoom In, Zoom Out. Use the two zoom keys to zoom in or out on an area in 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 increase and decrease the vertical waveform amplitude or gain.

Mode. Use the two mode keys to change various live and stored waveform modes.

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 cursor keys move the distance cursor along the wave-form. Use these keys to move the distance cursor to the point of interest on the wave-form. Cursors should be set on the leading edge of the reflection. When you change the cursor placement or adjust VOP, the distance between cursors automatically updates.

Physical - with nylon carrying case & accessories

Height:	7.80 inches (198 mm)
Width:	11.18 inches (284 mm)
Depth:	7 inches (178 mm)
Weight:	7.9 pounds (3.6 kg)

Environmental

Operating Temperature:	32°F to 122°F (0°C to 50°C)
Storage Temperature:	-4°F to 140°F (-20°C to 60°C)
Humidity:	95% max. relative, non-condensing
Vibration:	IEC 68-2-6
Shock (Bump):	IEC 68-2-29
Drop:	IEC 68-2-27
Moisture rating:	IP 54

Power

Internal:	Rechargeable, 7.2V nickel metal hydride battery pack
External:	12 VAC or VDC, 1250mA power supply
Operating Time:	Greater than 6 hours without backlight

Display

320 X 240 dot-matrix liquid crystal display with CCFL backlighting.

Multi-Meter

DC Voltage:	0 to 400V
Resolution:	0.1V
AC Voltage:	0 to 400V
Resolution:	0.1V
Accuracy:	2%±0.1V

Foreign Battery: 2 to 400V

Resolution:	0.1V
Accuracy:	1%±0.1V

Resistance

0 to 1.999.9 ohm

Insulation Resistance

Test Voltage: 50V, 100V, 250V, 500V

0.00 Mohm to 9.99 Mohm

Resolution:	0.01 Mohm
Accuracy:	2% +/- 0.01 Mohm

Use a damp cloth and a mild soap and water to clean the case, front panel and outside of the instrument. Do not get water in the instrument to help ensure proper operation. Do not use harsh chemicals and abrasive cleaners: they may damage the Front Panel and case.

7.3 Periodic Inspection

Inspect the Model 6000 and accessories regularly for damaged, worn or missing parts or deformations in the enclosure. If the unit is operated in harsh, dusty or wet environments, inspect after every use. If repairs are necessary, return the unit immediately to Riser Bond or a designated representative.

Clean the Model 6000 regularly, following the manufacturer's cleaning instructions. Inspect the back panel connectors for dirt, broken or deformed insulation and contacts, and clean and repair as needed.

Inspect cable accessories for damaged insulation, bent or broken clips. Replace damaged parts immediately.

7.4 Service

WARNING

Do not perform service or repair on this instrument. There are no user serviceable parts on or in this instrument. Return the instrument to Riser Bond or another authorized repair facility for repairs or service. Failure to do so could result in electric shock and/or void your manufacturer's warranty.

Instrument Disposal

This instrument is equipped with non-user serviceable nickel metal hydride batteries. If you need to dispose of this instrument, consult your local regulations for standard disposal procedures.

Section 8: Specifications

General Specifications for Model 6000

Physical - without carrying case & accessories

Height: 6.93 inches (176 mm)
Width: 10.71 inches (272 mm)
Depth: 3.15 inches (80 mm)
Weight: 4.8 pounds (2.2 kg)

Figure 2 - Front panel

2.2.2 Battery Charger Socket (E)

Connect the external battery charger or the optional 12-volt cigarette lighter to the Battery Charger Socket to recharge the Model 6000 internal 7.2V nickel metal hydride battery pack. See "Maintenance" for complete instructions on recharging the battery.

You may operate the Model 6000 while the batteries are charging, but this will increase the charging time.

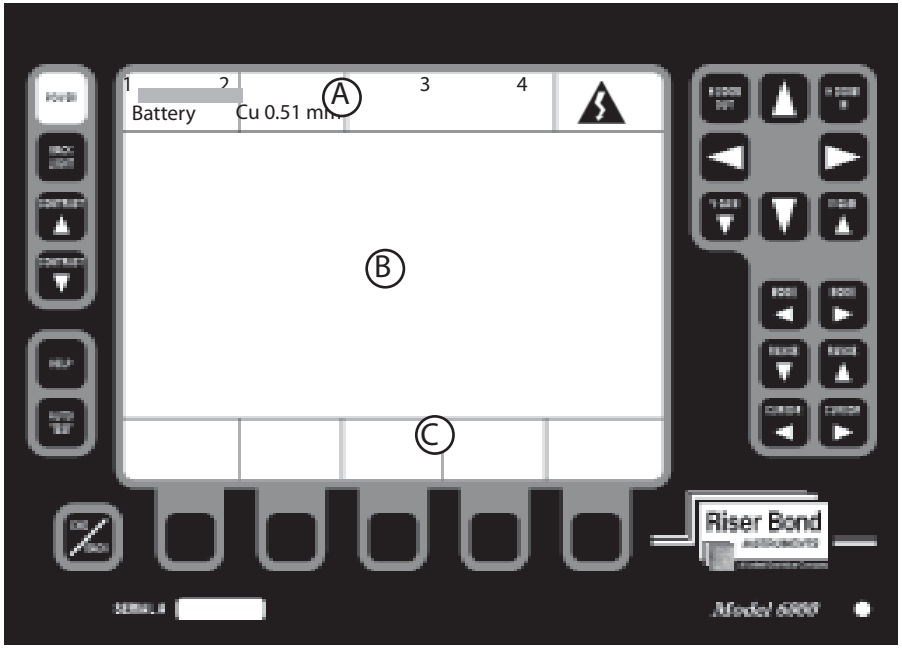


Figure 3 - Display Panel

2.2.3 Display (Fig. 3)
The display is a high contrast, SUPERTWIST Liquid Crystal Display. The center of the display is used to display test result information. A softkey menu, instrument settings and status bar are displayed on the top and bottom of the display.

(A) Status Bar. Displays information about the configuration and condition of the Model 6000:

1) Battery Level Indicator. Low battery message is activated when the battery level reaches 1/4 full.
2) Current Cable Type Indicator and RFL Temperature.
3) Progress Bar.
4) High Voltage Source Active Indicator.

(B) Test Display Area. Test results and waveforms are displayed in this area.

(C) Softkey Menu. Press the softkey underneath the menu item to make your selection.

Press End/Back to end a test or return to a previous screen.

Section 6: Helpful Hints

☐ Read the Operator's Manual thoroughly.
☐ Know your equipment. If you have questions, call Riser Bond at (877) 247-3797
☐ Get as close to the fault as possible.
☐ Make a quality connection to the cable under test.
☐ Enter the correct cable type or VOP.
☐ Start in the shortest range/pulse width.
☐ Test from both ends of the cable.
☐ When locating a fault, determine cable path and depth accurately to improve accuracy.
☐ Retest the cable after repairing the fault.
☐ Use common sense when troubleshooting.
☐ Use multiple tests to locate a fault and to verify the distance before digging.

Section 7: Maintenance

7.1 Charging the Batteries
The Battery Charger Socket is for recharging the Model 6000 internal 7.2V nickel metal hydride battery pack. The batteries may be recharged with the external battery charger or with an optional 12-volt cigarette lighter adapter.

The Model 6000 is shipped with battery discharged:

1) Plug the external battery charger (or adapter) jack into the Charger Socket.
2) Plug the charger into an AC or DC power source with correct voltage and current specifications.
3) For a fully charged battery, charge the instrument for a maximum of 16 hours. The green LED on the Front Panel will illuminate to indicate the charger is plugged in and the batteries are being charged.

You may operate the Model 6000 while the batteries are charging, but this will increase the charging time.

The Model 6000 has a built-in circuit which limits battery charge current. As the batteries approach maximum charge, the charging rate will decrease. Do not leave the batteries charging for long periods of time; their useful life will be shortened.

7.2 Cleaning
Use a lint-free cloth or small, soft brush to remove dust from the Model 6000 display screen and connectors.

5.4 Capacitive Fault Locator (Open/Cap Meter)

The Capacitive Fault Locator is used to measure capacitance of the pair to the end of the cable or the distance of an open circuit in the span of the cable.

5.4.1 Setting up and using the Open/Cap Meter (Figure 19)

1) Use the connection described in section 2.4.2 to connect the pair to the Model 6000.
2) Press Fault Location.
3) Press Open/Cap Meter.
4) Press Cable Type and use the Select and Set controls to select the cable type. This step is not necessary if the cable type has been selected for previous tests.
5) Press End/Back to return to the test screen.
6) Press the softkey for the desired measurement, A-B (Ring-Tip), A-E (Ring to Earth), B-E (Tip to Earth).

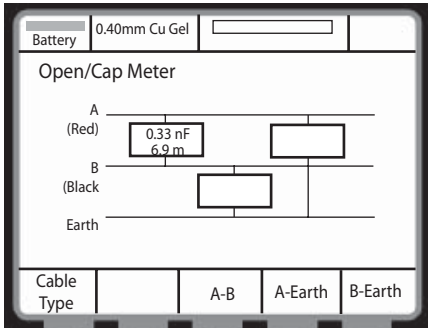


Figure 19 - Open/Cap Meter Results screen

Figure 4
Back panel

2.3 Back Panel Description (Fig. 4)

The Model 6000 has two connector areas on the back panel:

1) The serial port
2) The Line 1, Line 2, and Earth (Ground) test lead cables.

2.3.1 Serial Port

Use the serial port to connect a printer to the Model 6000. To print:

1) Press the softkey button General Settings to select the printer: Seiko DPU411; DPU414; or Citizen PN60.
2) Connect the printer cable to the serial port.
3) Press "Print" from the TDR, RFL, or Auto Test softkey menu.

The serial port is also used to transfer TDR waveforms to WAVE-VIEW software for display, storage, or printing. See the WAVE-VIEW manual for instructions.

2.3.2 Line 1, Line 2 and Earth (Ground) Test Lead Cable Assy.

Make pair connections to the Model 6000 with telephone test leads and color-coded cables. Plug the red and black leads into the red and black cables. Plug the blue and yellow leads into the blue and yellow cables. Connect the leads to the pair(s) under test.

Plug the green test lead into the green cables and connect to the network Earth (Ground).

Test lead color connection instructions are displayed on the LCD screen. It is very important that the correct color test leads are connected to the cables. Only use Riser Bond test leads; using other test leads may damage the Model 6000 and/or void the manufacturer's warranty.

2.4 Instrument Operation

2.4.1 Start-up

To set up your Model 6000 for operation, or to change settings:

1) Press Power. A Start-up screen with a softkey menu at the bottom is displayed on your instrument (Figure 5). The Start-up screen lists the Model number, firmware version, release date, system, options, and copyright message.
2) Press General Settings. The General Settings menu shows the various instrument settings:Measurement Units, Backlight at Start-up, Serial Printer Type, Auto Off, and active remove.
3) Press Select to highlight the desired option; press Adjust to scroll through the list.
4) Press End/Back to go back to the previous screen. Your Model 6000 is now ready for operation.
5) The General Settings menu includes a Cable Type menu, controls to load the defaults or "factory" settings, and an Instrument Calibration function. Use the Instrument Calibration function to verify that the Multi-Meter and Resistance Fault Locators are operating properly, or if the Model 6000 has been subjected to extreme temperatures since the last time the calibration function was performed.
6) The Model 6000 performs a Hazardous Voltage Test of the pair when the instrument is turned on or when a different test is selected. If an AC voltage greater than 30VAC is detected, the Hazardous Voltage Warning dialog box is displayed on the screen.

When you see the warning, stop testing immediately and remove the voltage source.

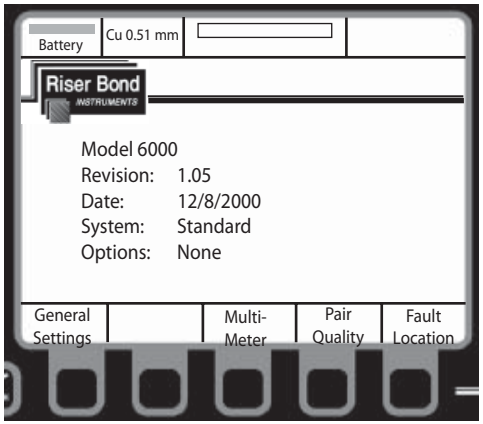


Figure 5 - Start-up screen

- Stress Voltage.
- Stress Starts IFD.
- Stress Polarity.

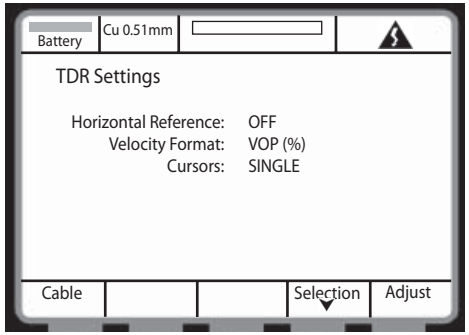


Figure 18 - TDR settings

5.3.3 Using the TDR

To use the TDR:

- Use the connection described in Section 2.4.2 to connect the pair to the Model 6000 for a single pair or two pair operation.
- Start in the shortest distance range to examine the cable close to the instrument. NOTE: To test through load coils, step through the ranges until you reach the 330µs pulse width. A symbol will appear in the left hand corner of the LCD to confirm you are in the loaded mode.
- To test longer cable, press the Range up button to increase the test distance.
- Look for events (reflections) on the cable signature. Scan all the way to the end of the section you are testing.
- IFD - used to allow the user to take a snap shot of the cable under test on line 1 and store this in memory and then overlay a live trace over this on line 1 for random events on that line. These can be positive or negative excursions and could be caused by mechanical problems with the cable under test or other non-constant problems. Select by pressing the "Mode" button until IFD (Line 1) shows on the bottom left of the LCD display above the soft keys.
- Stress TDR - a unique feature primarily used to help augment and identify problems in cables caused by, for example, wet joints. The user is able to adjust the level of voltage applied, the polarity of that voltage and whether entering the modes starts up IFD or not in order to mitigate problems of this kind.

Unloaded Samples/Loaded Samples (without load coils/with load coils). Press Control until the Unloaded Samples and Loaded Samples keys appear. Press either key to access sample waveforms of typical cable faults. Press Selection to scroll through the waveforms. As each is highlighted, a description is displayed at the bottom of the screen. Select a waveform and press Recall to view it. The waveform is displayed along with the current live waveform. The Mode keys can be used to view Line 1, recalled waveform or Line 1 and recalled simultaneous.

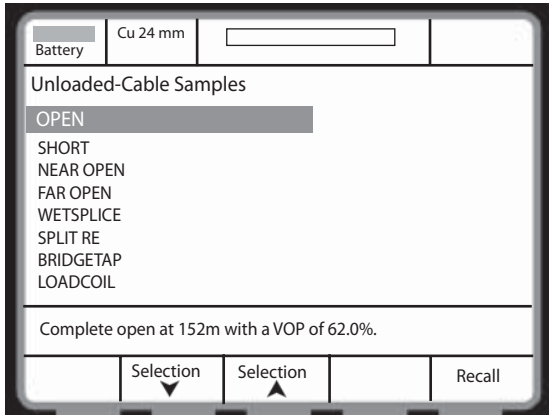


Figure 17 - Unloaded Samples screen

5.3.2 Adjusting TDR Settings

To adjust TDR settings:

1) Press Settings.
2) Press Cable Type. Highlight the gauge, size or type of cable under test.
3) Press Select to highlight menu items. Press Adjust to scroll through and set options:
   - Horizontal Reference. Select On to display a Horizontal Reference Line on the screen.
   - VOP. Display velocity of propagation as a percentage of the speed of light (VOP), or as meters or feet per microsecond velocity divided by 2 (V/2).
   - Cursors. Select Single or Dual. If dual is selected, press the softkey cursor buttons in the TDR menu to operate the second cursor.
   - Cancel Test Leads. Select Yes to cancel the 6 foot test lead. The leads provided are 6 feet long, the TDR will automatically cancel out the test lead when you select yes. Let the TDR do the math.
   - TDR Start. Select whether the TDR will start in the shortest possible distance range and pulse width or will start by running an Autosearch to scan the cable for major faults.

2.4.2 Typical Connection

The Model 6000 uses a consistent connection scheme to the pair for most tests. Once this connection is made to the pair, use the Model 6000 to measure the DC and AC parameters and locate faults.

A typical connection is:

- Red test lead connects to the A leg (Ring) of the pair.
- Black test lead connects to the B leg (Tip) of the pair.
- Green test lead connects to earth (Ground).

For a two-pair connection, to compare pairs using the TDR or four-wire RFL connections:

1) Connect the blue test lead to the A leg (Ring) of pair two.
2) Connect the yellow test lead to the B leg (Tip) of pair two or 2nd good wire in the four-wire RFL test.

Section 3: Multi-Meter Functions

The Multi-Meter function measures DC Volts, AC Volts, Foreign Battery, Resistance, and Insulation Resistance (Figure 6).

The operation of each test is similar; the user has the option to test the pair, or exit the function.

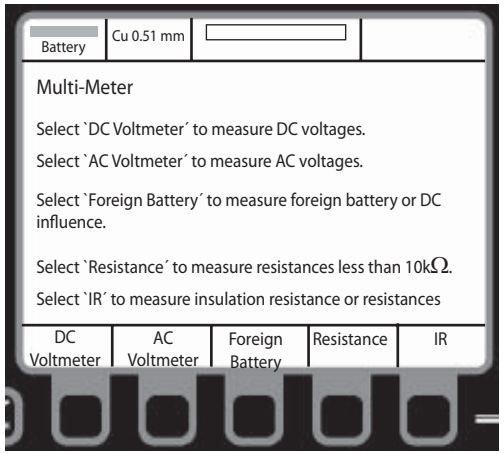


Figure 6 - Multi-Meter screen

Press the Multi-Meter button to start.

3.1 Measuring AC or DC volts (Figure 7)

1) Use the connection described in section 2.4.2 to connect the pair to the Model 6000.
2) Press the AC Voltmeter or DC Voltmeter softkey.
3) Press the softkey for the desired measurement, A-B (Ring-Tip), A-E (Ring to GND), B-E (Tip to GND).

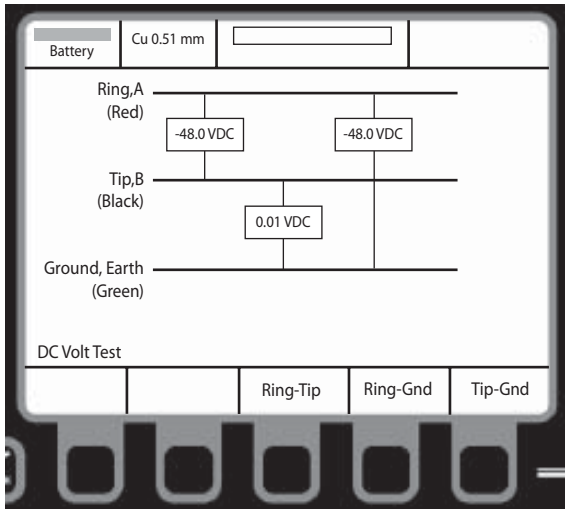


Figure 7 - DC Voltage test screen

3.2 Measuring Foreign Battery

1) Use the connection described in Section 2.4.2 to connect the pair to the Model 6000. Make sure the links in the exchange have been pulled and/or the pair is isolated with no exchange battery.
2) Press Foreign Battery.
3) Press the softkey for the desired measurement, A-E (Ring to GND), B-E (Tip to GND).

3.3 Measuring Resistance

1) Use the connection described in Section 2.4.2 to connect the pair to the 6000.
2) Press Resistance.
3) Press the softkey for desired measurement, A-B (Ring to Tip), B-E (Tip to GND), A-E (Ring to GND).

Pulse Width. Press Control until the Pulse keys appear. Press the keys to increase and decrease Pulse Width.

Balance Control. Press Control until the Balance Left and Balance Right keys appear. Press the keys to adjust the output balance circuit.

Filter. Press Control until the Filter keys appear. Use the keys to cycle through available software filters. Filters are not available in intermittent fault mode.
Search. Press Control until the Search key appears. Press the key to automatically search the cable for major faults or the end of the cable

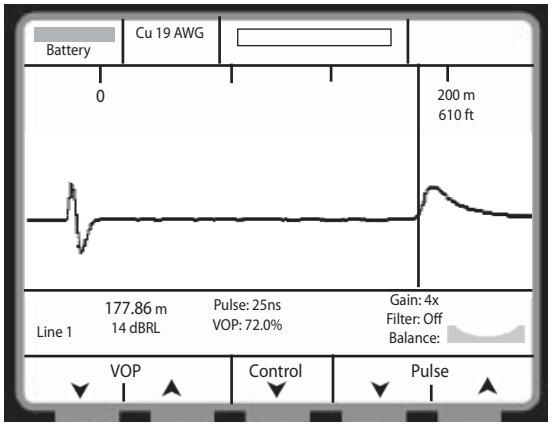


Figure 16 - TDR screen

Storage. Press Control until the Storage key appears. Press Storage to select a memory location, store a waveform, recall a waveform, or erase all waveforms.

Serial Printing. Press Control until the Print key appears. Press the key to print the screen on a connected serial printer.

Cursor 1. Set TDR Cursors to "Dual," then press Control until Cursor 1 appears. Press left or right keys to move Cursor 1.

Overlay. Available when two waveforms are displayed on screen. Press Control until Overlay keys appear. Press the keys to adjust waveform separation.

5.2.3 Multiple Gauge (Diameter) Sections

If DTS is known or if a cable has multiple sections of different wire gauge (diameter) cables, then use the DTS Setup to define each cable section and type of cable (Figure 15).

1) Press Setup DTS.
2) Use the Adjust arrows to enter the number of cable sections in the Number of Sections field.
3) Edit the section data using the Selection arrows to scroll to each section and the Adjust arrows to select the proper cable type.
4) Press End/Back to return to the Resistance Fault Locator screen once the cable sections are defined.

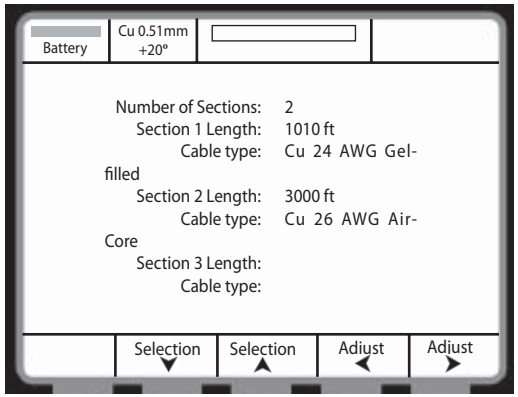


Figure 15 - Multiple gauge (diameter) sections

5.2.4 After the RFL Test

Once the RFL test is completed and a result has been obtained, the softkeys will have the following options:

1) Print. Print to a serial printer.
2) Transfer to TDR. The results of the RFL test can be transferred to the TDR. The cursor marked "F" indicates the fault and the cursor marked "S" indicates the strap.
3) Relocate. Run the same test again.
4) New Pair. Select a new test.

5.3 TDR Operation

From the main menu press "Fault Location: and then press TDR. Press the softkeys underneath the menu items to control TDR operations. The more commonly used controls are on the keys on the right side of the Front Panel. See Section 2.2.1.

5.3.1 How to Use Softkey TDR Controls

VOP. Press Control until the VOP keys appear. Press the keys to increase and decrease the VOP.

3.4 Measuring Insulation Resistance (Figure 8)

1) Use the connection described in Section 2.4.2 to connect the pair to the 6000.
2) Press IR.
3) To adjust the IR test voltage, press Test Voltage to scroll through voltage options. For the initial test, use the 50V IR test setting only. Using a higher voltage may damage anything still connected to the network. If a full test is required, make sure that the pair is isolated and the exchange battery is disconnected and remove any other components or electronics off the pair.
4) Press and hold the softkey for the desired measurement, A-B (Ring to Tip), A-E (Ring to GND), B-E (Tip to GND).

Note: For accurate insulation resistance measurements on long cable, the Model 6000 may need 20 to 30 seconds to display a measurement. This will ensure the voltage has been applied and discharged before the next test selection is made.

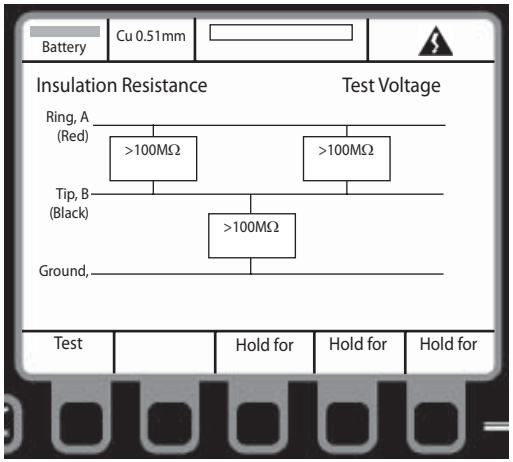


Figure 8 - Insulation Resistance screen

Section 4: Pair Quality

Use the Pair Quality key to test Loop Current, Noise Metallic (transverse noise), Power Influence (longitudinal noise), and Longitudinal Balance.

4.1 Testing Loop Current

1) Use the connection described in Section 2.4.2 to connect the pair to the Model 6000.
2) Press Loop Current. Loop Current is drawn and the measurement is displayed in mA.

4.2 Noise Metallic and Power Influence

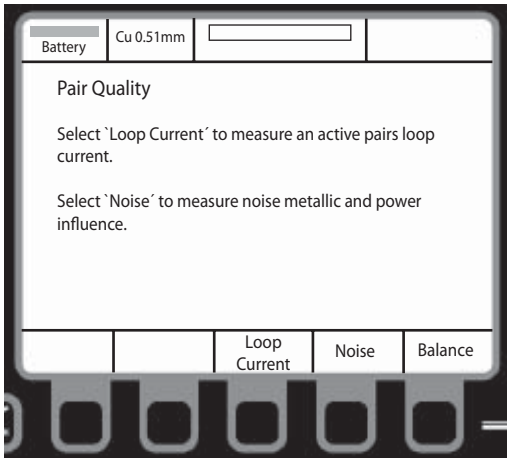


Figure 9 - Pair Quality screen

1) Use the connection described in section 2.4.2 to connect the pair to the Model 6000.
2) Press Noise. Screen displays Noise Metallic (NM) and Power Influence (PI). Calculated balance (PI - NM) is displayed.
3) Noise metallic is sometimes referred to as transverse noise and power influence is sometimes referred to as longitudinal noise.

	Good	Fair	Bad
Noise Metallic Transverse Noise	<=20 dBrnC <=-70 dBmp	21 to 30 dBrnC -69 to -60 dBmp	>30 dBrnC >-60 dBmp
Power Influence Longitudinal Noise	<=80 dBrnC <=-10 dBmp	81 to 90 dBrnC -9 to 0 dBmp	>90 dBrnC >0 dBmp
Calculated Balance	>60 dB	50 to 60 dB	<50 dB

Table 1

If you don't know the distance to the strap point:

1) Press Settings.
2) Press Cable Type. Use Select and Set to select cable type.
3) Press End/Back to return to the test screen.

To test:
- For 3-or 4-wire modes, connect the strap at the far end of the cable. Press Test.
- For the Kupfmuller mode, leave the strap disconnected and Press Test; the instrument will tell you when the strap should be connected.

First, the Model 6000 measures the fault value. Then it checks that the pair is shorted (strapped) at the end. Next, the Model 6000 calculates distance to strap and distance to fault.

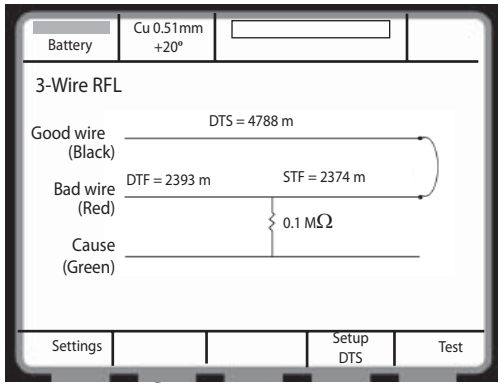


Figure 13 - RFL test with results

If a fault is not detected, or the strap is not connected properly, a warning is displayed (Figure 14). Re-test or exit the screen.

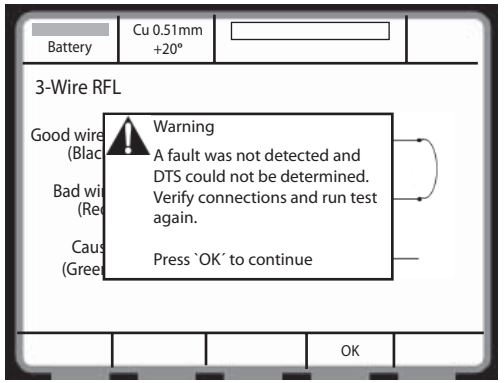


Figure 14 - Strap not connected warning

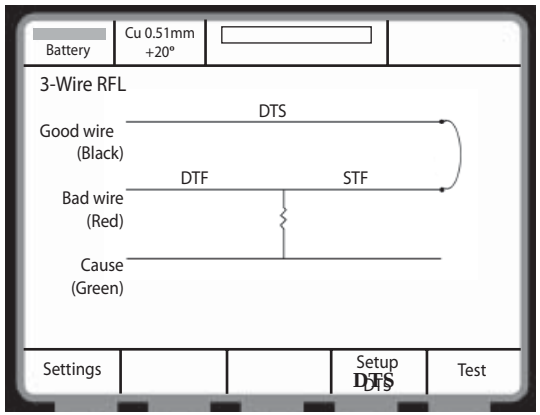
Follow the on-screen diagram for correct connection and test procedures.

In all three modes, the opposite ends of the pair must be shorted together (strapped) at a point past the fault, normally at the end of the cable span. A yellow clip is supplied for strapping.

With the optional Oscillator and Probe, four modes (open, short, tone, and connect exchange) enable the technician to change the far end device remotely to optimize cable pair for the required test.

5.2.1 Setting up the Resistance Fault Locator (RFL)

1) Press Fault Location.
2) Press RFL.
3) Press Settings. The RFL must be configured properly for accurate fault location.
4) Press Select to highlight the desired option cable temperature, RFL test type, and measurement units (ohms, feet, or meters). Press Adjust to move between options. Enter the actual cable temperature, not the ambient temperature.
5) Press Cable Type. Use Select and Set to select cable type.
6) Press End/Back to return to the test screen.



5.2.2 Using the RFL

Use the connection described in Section 2.4.2 or as described on screen to connect the pair to the Model 6000.

If the distance to the strap point is known:

1) Press Setup DTS (Distance to Strap).
2) Use Selection and Adjust to enter distance and cable type for each section of cable before the strap point.

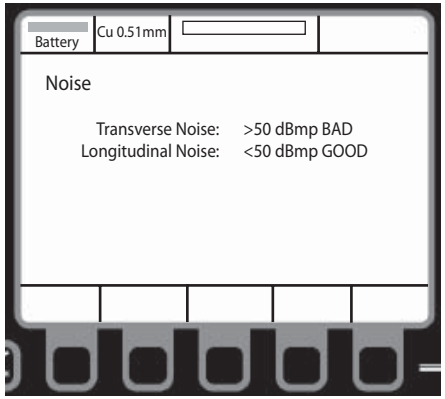


Figure 10 - Noise Metallic test screen

4.3 Testing Longitudinal Balance

1) Use the connection described in Section 2.4.2 to connect the pair to the Model 6000.
2) Press Balance. Screen displays Longitudinal Balance.

	Good	Fair	Bad
Longitudinal Balance	>60 dB	50 to 60 dB	<50 dB

Table 2

4.4 Auto Test

The Auto Test function allows you to press a single button and perform a diagnostic test of the pair, consisting of DCV, ACV, Foreign Battery, Resistance, Loop Current, and Noise and Balance tests. The results of the tests are displayed on a comprehensive table on the screen.

To Auto Test:

1) Use the connection described in Section 2.4.2 to connect the pair to the Model 6000.
2) Press Auto Test on the Front Panel.
3) Press Start to test.
4) Press Storage to view stored test results.

At the end of the test, four softkeys are displayed.

1) Press Storage to store test results to a dedicated memory location.
2) Press Print to print test results.
3) Press Analysis to analyze test data. A fault location method is suggested.
4) Press Start to test again.

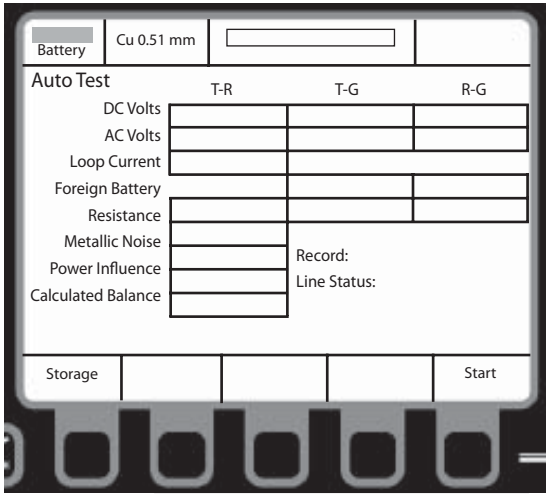


Figure 11 - Auto Test screen

Section 5: Fault Location

The Fault Location Softkey allows you to select an RFL or full function TDR. Use the RFL function to locate a resistance fault on a pair or single conductor. Use the TDR to locate other faults such as opens, shorts, water, bad splices, and cable damage.

5.1 Selecting a Fault Location Tool

Use the following table to determine which tool is best suited to locating specific types of faults.

Type of Fault	Excellent	Good	Fair
Open Circuit	TDR		
Short Circuit	TDR RFL		
High Resistance Joint	TDR		
Split Pairs	TDR		
Crosstalk		TDR	
Low Insulation Resistance	RFL		TDR
Low Insulation Resistance to Ground	RFL		TDR
Contact Fault	RFL	TDR	
Earth Fault	RFL	TDR	
Water in Cable		TDR	
Locate Load Coil	TDR		

Table 3

5.2 Resistance Fault Locator (RFL)

There are three possible RFL test modes:

- 3-wire mode is used when only one leg of the pair is faulty
- 4-wire mode is used when both legs of the faulty pair are affected. In this case, you need two good wires. Attach the yellow and black leads to the good wires. None of the three wires have to be the same gauge.
- The Kupfmuller mode is used when a good wire cannot be found.

To help ensure accurate results:

1) The fault ratio between the two conductors has to be at least 2 to 1. For example, if the "good" wire has a fault of 2MΩ, the fault on the "bad" wire must be less than 1MΩ.

2) The loop resistance must be 100 times smaller than the two faults added together. For example, if one fault is 10kΩ and the other is 90kΩ (10kΩ + 90kΩ = 100kΩ), then the loop has to be 1000Ω or less.

Global Headquarters
13515 Ballantyne Corporate Place
Charlotte, North Carolina 28277
United States

Where Ideas Meet Industry