FLUKE networks™

990DSL

CopperPro Loop Tester

Users Guide

PN 1554870
September 2001, Rev 1, 4/02

LIMITED WARRANTY & LIMITATION OF LIABILITY

Each Fluke Networks product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year and begins on the date of purchase. Parts, accessories, product repairs and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke Networks authorized reseller, and does not apply to disposable batteries, cable connector tabs, cable insulation-displacement connectors, or to any product which, in Fluke Networks' opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Fluke Networks warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke Networks does not warrant that software will be error free or operate without interruption.

Fluke Networks authorized resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Fluke Networks. Warranty support is available only if product is purchased through a Fluke Networks authorized sales outlet or Buyer has paid the applicable international price. Fluke Networks reserves the right to invoice Buyer for importation costs of repair/replacement parts when product purchased in one country is submitted for repair in another country.

Fluke Networks' warranty obligation is limited, at Fluke Networks' option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Fluke Networks authorized service center within the warranty period.

To obtain warranty service, contact your nearest Fluke Networks authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB Destination). Fluke Networks assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Fluke Networks determines that failure was caused by neglect, misuse, contamination, alteration, accident or abnormal condition of operation or handling, or normal wear and tear of mechanical components, Fluke Networks will provide an estimate of repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. FLUKE NETWORKS SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY.

Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

Fluke Networks, Inc.
PO Box 777
Everett, WA 98206-0777
USA

Table of Contents

Chapter	Title	Page
1	**Introduction**	**1-1**
	Using This Guide	1-1
	Introduction	1-2
	Design Highlights and Features of the CopperPro	1-3
	Physical Features	1-3
	User Interface Features	1-3
	Testing Features	1-4
	Safety Information	1-5
	Care and Maintenance	1-7
	Service and Adjustment	1-7
	Checking the Shipping Container	1-8
	Technical Support	1-10
2	**Controls and Connections**	**2-1**
	Introduction	2-1
	The CopperPro Loop Tester: at a Glance	2-2
	Front Panel	2-2
	LCD	2-3
	Keypad	2-3
	Top Connector Panel	2-6
	Side Connector Panel	2-6
	Back Panel	2-7
	Connecting the CopperPro	2-8
	Connecting to AC Power	2-8
	Connecting to an Automobile Battery	2-8
	Connecting to a Printer	2-9
	Connecting to a PC	2-9
	The Battery	2-10
	Checking the Remaining Battery Capacity	2-10
	Responding to Low Battery Warnings	2-11
	Charging the Battery	2-11
	Discharging Battery	2-13

3 Setting Up and Operating the CopperPro 3-1
Introduction 3-1
Turning the CopperPro On and Off 3-2
The Menus 3-3
Displaying the Main Menu 3-3
Displaying the Previous Menu or Screen 3-4
Displaying a Setup Menu 3-4
Auto-Test Setup Menu 3-5
Toolbox Test Setup Menu 3-5
Generic and Test-Specific Setup Parameters 3-5
Editing the Setup for a Test 3-7
Configuring the Tester 3-10
Setting the Date and Time 3-11
Setting a Timer to Conserve Power 3-12
Selecting a Language and Associated Units of Measure 3-13
Creating a Phone List 3-14
Storing the Serial Number and Property Information 3-16
Configuring the Serial Port 3-17
Creating a Custom Header for Test Result Files 3-17
Performing Basic Operations 3-20
Calibrating the CopperPro 3-20
Turning the Backlight On and Off 3-21
Adjusting the Contrast of the LCD 3-21
Adjusting the Volume of the Speaker 3-22
Displaying System Information 3-22
Operating the Tester as a Dial Set 3-23
Running a Self-Test 3-24
Printing Displayed Results and Setup Information 3-24

4 POTS Testing and Fault Location 4-1
Introduction 4-1
POTS Auto-Test 4-2
Setting Up a POTS Auto-Test 4-2
Starting and Stopping a POTS Auto-Test 4-5
POTS Auto-Test Results 4-6
The POTS Toolbox 4-7
Starting and Stopping a Test in the POTS Toolbox 4-8
Voltage Test 4-9
Setting Up a Voltage Test 4-9
Voltage Test Results 4-10
Shorts & Grounds Test 4-13
Setting Up a Shorts & Grounds Test 4-13
Shorts & Grounds Test Results 4-14
Opens Test 4-16
Setting Up an Opens Test 4-17
Opens Test Results 4-17
Splits Test 4-20

Resistance Fault Location (RFL) Test 4-23
Setting Up an RFL Test 4-23
Running an RFL Test 4-24
Short or Double-Sided Fault Location (3 Wire) Test Results 4-31
Load Coils Test 4-34
Setting Up a Load Coils Test 4-35
Load Coils Test Results 4-35
Loop Devices Test 4-36
Setting Up a Loop Devices Test 4-36
Loop Devices Test Results 4-36
Leakage Stress Test 4-37
Setting Up a Leakage Stress Test 4-37
Leakage Stress Test Results 4-37
Tracing Tone Test 4-39
Setting Up a Tracing Tone Test 4-39
Running a Tracing Tone Test 4-39
VF Noise Test 4-40
Setting Up a VF Noise Test 4-40
VF Noise Test Results 4-41
VF Loss Test 4-43
Setting Up a VF Loss Test 4-43
Running a VF Loss Test 4-43
VF Loss Test Results 4-44
VF Longitudinal Balance Test 4-46
Setting Up a VF Longitudinal Balance Test 4-46
VF Longitudinal Balance Test Results 4-47
Send VF Tone Test 4-48
Setting Up a VF Tone Test 4-48
Running a VF Tone Test 4-48
Dial-Up Test Group 4-51
Setting Up a Dial-Up Test 4-51
Running a Dial-Up Test 4-53
Smart-Pro Tests 4-55
SASS Tests 4-59
DATU Tests 4-60
Milliwatt VF Loss Test 4-62
Quiet Termination VF Noise Test 4-62
Loop Current and Ground Ohms Test 4-62
Number ANI Test 4-63
On-Hook Caller ID Test 4-63
Call Waiting Caller ID Test 4-64
Terminated VF Tests 4-65
Setting Up a Terminated VF Test 4-65
Running a Terminated VF Test 4-66
Monitor Line Test 4-68

5 XDSL Testing and Loop Qualification 5-1
Introduction 5-1
ADSL Auto-Test 5-2

Setting Up an ADSL Auto-Test 5-2
Starting and Stopping an ADSL Auto-Test 5-3
ADSL Auto-Test Results 5-4
ADSL G-Lite Test 5-7
XDSL Auto-Test 5-7
Setting Up an XDSL Auto-Test 5-8
Starting and Stopping an XDSL Auto-Test 5-9
XDSL Auto-Test Results 5-11
The XDSL Toolbox 5-13
Starting and Stopping a Test in the XDSL Toolbox 5-14
WB Noise/Level Test 5-15
Setting Up a WB Noise/Level Test 5-15
WB Noise/Level Test Results for a Spare Pair 5-16
WB Noise/Level Test Results for a Working ADSL Pair 5-17
WB Loss Test 5-19
Setting Up a WB Loss Test 5-19
Running a WB Loss Test 5-19
WB Loss Test Results 5-20
WB Longitudinal Balance Test 5-21
Setting Up a WB Longitudinal Balance Test 5-22
Running a WB Longitudinal Balance Test 5-22
WB Longitudinal Balance Test Results 5-23
Send WB Tone Test 5-24
Setting Up a Send WB Tone Test 5-24
Running a Send WB Tone Test 5-25
Terminated WB Tests 5-26
WB Impulse Noise Test 5-28
Setting Up a WB Impulse Noise Test 5-28
Running a WB Impulse Noise Test 5-29
WB Impulse Noise Test Results 5-30

6 TDR Testing and Fault Location 6-1

Introduction 6-1
Comparing Parametric Tests to the TDR Test 6-2
What Happens During a TDR Test: An Overview 6-3
Length Measurements and VOP 6-3
Reflections 6-4
TDR Auto-Test 6-4
Setting Up a TDR Auto-Test 6-5
Starting and Stopping a TDR Auto-Test 6-6
TDR Auto-Test Results 6-6
Saving TDR Auto-Test Results 6-10
The TDR Toolbox 6-10
Starting and Stopping a Test in the TDR Toolbox 6-11
Saving TDR Test Results 6-11
Pair 1 Test 6-11
Pair 1 and 2 Compare Test 6-12
Pair 1 - 2 Difference Test 6-13

Pair 1 Monitor 6-14
Pair 2 to 1 Crosstalk Test 6-15
Displaying and Deleting Saved Traces 6-16
Compare Recall and Pair 1 Test 6-16
TDR Test Operating Tips 6-17
Determining the VOP 6-17
Double-ended Testing 6-18
Testing for Faults Close to the CopperPro 6-19

7 Saved Test Results 7-1
Introduction 7-1
Saving Test Results 7-2
Storage Limitations of Saved Result Files 7-2
Result File Header 7-3
Storing Test Results Automatically 7-5
Saving a Displayed Waveform or Frequency Graph 7-6
Viewing Stored Test Results 7-6
Viewing Text-based Results 7-7
Viewing All Results 7-8
Viewing Results for a Particular Wire Center 7-9
Viewing Results for a Particular Period of Time 7-9
Erasing All Results 7-10
Viewing TDR Waveforms 7-10
Deleting a Saved Waveform 7-11
Viewing Stored a Frequency Sweep Graph 7-11
Deleting a Saved Frequency Graph 7-12
Printing Test Results 7-12
Uploading Test Results to a PC 7-13

8 Updating the CopperPro with New Software 8-1
Introduction 8-1
Before You Begin 8-2
Step One: Connect the Tester to a PC 8-2
Step Two: Put the Tester in Download Mode 8-2
Step Three: Updating the Tester's Software 8-3

Appendices
A Features and Specifications A-1
B Replacement Parts and Accessories B-1

Index

List of Tables

Table	Title	Page
1-1.	International Electrical Symbols	1-6
2-1.	Functions of the CopperPro Keys	2-3
3-1.	Generic Setup Parameters	3-7
3-2.	Operating the Tester in Edit Mode	3-9
4-1.	User Selectable Tests for the POTS Auto-Test	4-4
4-2.	Voltage Test Setup Parameters	4-9
4-3.	Shorts & Grounds Test Setup Parameters	4-13
4-4.	Opens Test Setup Parameters	4-17
4-5.	RFL Test Setup Parameters	4-23
4-6.	Leakage Stress Test Setup Parameter	4-37
4-7.	VF Noise Test Setup Parameters	4-40
4-8.	VF Loss Setup Parameter	4-43
4-9.	VF Longitudinal Balance Setup Parameters	4-46
4-10.	VF Tone Test Setup Parameter	4-48
4-11.	Types of VF Tones	4-50
4-12.	Dial-Up Tests and Associated Subtests	4-52
4-13.	Dial-Up Test Setup Parameters	4-53
4-14.	Smart-Pro Tests	4-55
4-15.	Smart-Pro Test Key Commands	4-57
4-16.	SASS Test Key Commands	4-59
4-17.	DATU Manual Termination Codes	4-61
5-1.	ADSL Auto-Test Setup Parameters	5-3
5-2.	XDSL Auto-Test Setup Parameters	5-8
5-3.	WB Noise/Level Test Setup Parameters	5-15
5-4.	Longitudinal Balance Test Setup Parameters	5-22
5-5.	Send WB Tone Test Setup Parameter	5-24
5-6.	WB Impulse Noise Test Setup Parameters	5-29
6-1.	TDR vs. Parametric Fault Location Tests	6-2
6-2.	TDR Auto-Test Setup Parameters	6-5
6-3.	TDR Auto-Test Softkeys	6-8
7-1.	Storage Limitations of Saved Result Files	7-3
B-1.	Replacement Parts for the CopperPro Loop Tester	B-2
B-2.	Optional Accessories for the CopperPro Loop Tester	B-4

List of Figures

Figure	Title	Page
1-1.	Standard Accessories	1-9
2-1.	Top, Front, and Side Panels	2-2
2-2.	Back Panel	2-7
3-1.	CopperPro Startup Screen	3-2
3-2.	Main Menu	3-3
3-3.	Typical Setup Menu	3-6
3-4.	USER OPTIONS Menu	3-10
3-5.	System Setups Screen	3-18
4-1.	POTS Auto-Test Setup Screen	4-2
4-2.	POTS Auto-Test Summary Results	4-6
4-3.	POTS Toolbox	4-8
4-4.	Voltage Test Results: Idle POTS Line	4-10
4-5.	Continuous Voltage Test Result Screen	4-12
4-6.	Shorts & Grounds Test Results: Short	4-14
4-7.	Opens Test Result: Good Pair	4-17
4-8.	Adjusted Opens Test Screen	4-19
4-9.	Opens Test Result Screen: Possible Split or Water	4-20
4-10.	Splits Test: Connection Diagram	4-21
4-11.	Splits Test Result Screen	4-22
4-12.	RFL Test Results: Fault Value and Position	4-24
4-13.	RFL Test Results: Double-sided Fault or Short	4-25
4-14.	Two-Wire RFL Test Results: Tip Ground	4-26
4-15.	Two-Wire RFL Test Results: Distance to Fault	4-28
4-16.	RFL Multiple Wire Gauge Entry Screen	4-29
4-17.	Three-Wire RFL Test Results: Good Wire Strap	4-31
4-18.	Three-Wire RFL Test Results: Distances	4-32
4-19.	Three-Wire RFL Test: Good Pair Strap	4-33
4-20.	Three-Wire RFL Test Results Good Pair Resistances	4-34
4-21.	Load Coils Test Results	4-35
4-22.	Leakage Stress Test Results: Faulty Pair	4-38
4-23.	VF Noise Test Results	4-41
4-24.	Continuous Metallic Noise Reading	4-42
4-25.	Connection Diagram for the VF Loss Test	4-44
4-26.	VF Loss Test Results	4-45
4-27.	Continuous VF Loss Measurements	4-45
4-28.	Longitudinal Balance Test Results: Good Pair	4-47
4-29.	Send VF Tone Screen	4-49

4-30. Dial-Up Tests Selection Screen 4-54
4-31. Dialing Mode Selection Screen 4-56
4-32. Smart-Pro N-Tone Slope Test Results..... 4-58
4-33. FED VF Auto-Test Summary Results 4-66
4-34. Detailed Results from a FED Tone Loss Test 4-67
5-1. ADSL Auto-Test Connection Screen 5-3
5-2. ADSL Auto-Test Result Screen..... 5-4
5-3. ADSL Auto-Test Results: SNR Values..... 5-6
5-4. ADSL Auto Test Results: Bit Count 5-6
5-5. XDSL Auto-Test Connection Screen 5-10
5-6. XDSL Auto-Test Result Screen..... 5-11
5-7. XDSL Auto-Test: Pass/Fail Results for Service Types.. 5-12
5-8. XDSL Toolbox 5-14
5-9. WB Noise/Level Test Results: ISDN Crosstalk 5-16
5-10. WB Noise/Level Test Results: Working ADSL Line..... 5-18
5-11. WB Loss Test Connection Diagram..... 5-20
5-12. WB Loss Test Result Screen 5-21
5-13. WB Longitudinal Balance Test Results..... 5-23
5-14. Send WB Tone Test: Send Frequency Screen..... 5-25
5-15. FED WB Auto-Test Results 5-27
5-16. WB Impulse Noise Test Results..... 5-30
6-1. TDR Auto-Test Results: Open 6-6
6-2. TDR Toolbox..... 6-10
6-3. Pair 1 and 2 Compare Test Result Screen 6-13
6-4. Pair 1 Monitor Test Result: Intermittent Splice..... 6-14
7-1. Saved Results Selection Screen..... 7-5
7-2. Saved Results Screen: Viewing Text Results..... 7-7
7-3. Saved Results: All Text Results 7-8
7-4. Saved Results: List of TDR Waveforms 7-10
7-5. Saved Results: List of Frequency Sweep Graphs..... 7-11
8-1. Download Screen: Waiting for File..... 8-3
8-2. Final Download Screen 8-4
B-2. Optional Accessories..... B-6

Chapter 1
Introduction

Using This Guide

This *990DSL CopperPro Loop Tester Users Guide* shows you how to operate the 990DSL CopperPro Loop Tester (hereafter referred to as the “CopperPro”). It provides instructions for configuring the CopperPro and using it to precisely locate common faults on a loop and to verify the ability of a copper loop to transport various classes of high-speed data services.

This guide is intended for users who want to start using the CopperPro immediately with minimal instruction. It describes the main features of the tester and explains how to set up, operate, and care for it. For your protection, it is important that you observe all warnings and important safety information in this guide and on the tester itself.

Introduction

The 990DSL CopperPro Loop Tester is a portable, battery-operated handheld tester that is used for cable installation testing, fault location, and digital service qualification of outside plant (OSP) paired copper cables.

As a cable installation test tool, you can use the CopperPro with an external multiple-pair access module in a PC-controlled mode to perform automated, single-ended conformance testing of a newly installed cable according to operating company guidelines. If more rigorous conformance testing is required, you can use a second CopperPro with a multiple-pair access module at the far end of the cable to perform precision-terminated transmission testing.

As a fault location test tool, you can use the CopperPro to precisely locate common physical cable faults, including shorts, grounds, crosses, opens, splits, and pair imbalances that are caused by poor splice joints. The tester can also be used to expose corroded metallic faults on unused pairs. This type of problem, which is virtually undetectable by conventional meters, can eventually cause a pair to be noisy after it is cut into service.

The CopperPro is also a useful tool for helping you find the root cause of transmission problems, such as excessive loss and noise. Additionally, it can detect and identify loop treatment and fault-sectionalizing devices that are commonly installed on lines, such as range extenders (REGs), Network Interface Devices (NIDs), and Maintenance Termination Units (MTUs).

As a digital service qualification test tool, you can use the CopperPro to verify that a cable pair is suitable for voice frequency POTS services (such as Caller ID and analog modem data) and for special services, such as DDS, ISDN, T1, E1, HDSL, HDSL2, and ADSL. The CopperPro uses wideband loss, Gaussian noise, impulse noise, and crosstalk measurements, as well as load coil detection and location capability to qualify copper pairs for these high-speed services.

Design Highlights and Features of the CopperPro

The CopperPro's design and performance features are highlighted in the lists that follow.

Physical Features

- Rugged, wide-temperature design that is specifically made for the harsh OSP environment
- Lightweight and compact in size (4 lbs.)
- Replaceable internal option board for functional scalability
- High contrast, sunlight-readable graphics display with a backlight
- Large, tactile keys that provide an audible response when pressed
- High capacity, rechargeable battery pack that provides a full eight hours of operation
- Modular field-replaceable test leads (two pair plus Ground)
- Test pair expansion of up to 100 pairs.

User Interface Features

- One-button "test suite" menu for automated high-level testing
- Comprehensive "toolbox" menu for individual, in-depth testing
- Context-sensitive softkeys that provide easy navigation
- Graphic pictorial test setup and results display for easy interpretation
- Graphical loss, noise, and SNR displays with a scrolling cursor
- Continuous test result mode with large numerals and a relative-change scale for marking and recording peak signal excursions
- Remote control operation and program download capability through a serial port
- Test result storage and printout
- User-settable fault limits with industry-standard defaults.

Testing Features

Note

An asterisk following an item in this list indicates that the item requires the Wideband Time Domain Reflectometer (TDR) Option module.

- Integrated SmartStrap control for automated, terminated testing
- Double-ended “same-pair testing” capability (requires no control pair)
- AC/DC Voltage, Shorts & Grounds, Opens, Leakage, and Resistance Fault Location (RFL) physical tests
- Load Coil, Noise, Loss, SNR*, and Longitudinal Balance transmission tests
- Impulse Noise test with E, F, and G filters*
- Voiceband (0 – 20kHz) and Wideband* (10kHz – 1.2 MHz) transmission tests
- PSD mask overlays that depict crosstalk patterns for common interference types*
- Automated dial-up testing that is compatible with a variety of C.O. tone equipment
- Full TDR capability with Auto-Test waveform interpretation software*
- Tracing Tone, Monitor, and a fully integrated Dial Set operation
- Caller ID and automatic number ID (ANI) tests
- Non-intrusive “footprint analysis” of service types on working pairs*.

Safety Information

The CopperPro is intended for use by qualified personnel only. The tester is designed for use with circuits that have a maximum of 350 VDC or peak AC, line-to-line or line-to-ground.

The following general safety precautions must be observed during all phases of operation, service, or repair of the CopperPro. Failure to comply with these precautions or with specific warnings in this guide violates the safety standards of design, manufacture, and intended use of the tester. Fluke Networks assumes no liability for the customer's failure to comply with these requirements.

⚠Warning

If this product is used in a manner not specified by the manufacturer, the protections provided by the product may be impaired.

Never connect the CopperPro to a circuit when lightning storms are nearby.

Do not open the case. There are no user-serviceable parts inside.

Should the LCD become damaged, the liquid crystal material can leak. Avoid all contact with this material, especially swallowing. Use soap and water to thoroughly wash all skin and clothing contaminated with the liquid crystal material.

When using an AC power source, use only the supplied AC Adapter/Charger to power or charge the CopperPro.

Do not use the CopperPro if it operates abnormally. Protection may be impaired.

Inspect the CopperPro before using. Do not use it if it is damaged.

When servicing the CopperPro, use specified replacement parts only.

This product is not intended to be used to measure mains voltages (CAT I, II, III or IV) and should only be connected to powered circuits where over-voltage protections have been incorporated.

Table 1-1 describes the international electrical symbols that are found on the CopperPro and used in this guide.

Table 1-1. International Electrical Symbols

Symbol	Meaning
	Warning: Risk of electric shock.
	Important Information. See specific explanations where this symbol is displayed in this guide.
	Equipment is protected by double insulation or reinforced insulation to protect the user against electric shock.
	Battery should be recycled.
	Do not mix with solid waste stream. Dispose using a qualified recycler or hazardous material handler.
	Conforms to the requirements of the European Union and European Free Trade Association (EFTA).
	Canadian Standards Association. Conforms to relevant safety standards in Canada and the United States.
	This instrument contains a Nickel Metal Hydride battery pack. Fluke Networks subscribes to the U. S. Rechargeable Battery Recycle Corporation (RCRB) program. Contact your authorized Fluke Networks Service Center for recycling information.

Care and Maintenance

The CopperPro is designed to be maintenance free. Treat it with care to ensure the best performance. The suggestions below will help you to fulfill the obligations of the warranty and enjoy the tester for many years.

- Avoid rough handling

  Although the CopperPro is designed for use in the rugged OSP environment and can absorb a generous amount of shock and vibration, avoid dropping the tester. If you must ship the tester, use the original packaging.

- Clean carefully

  The plastic casing for your CopperPro has a finish that should retain its durability for many years. To clean the tester, use a soft, slightly damp cloth. To remove any stains, use a mild soap. Never use detergents, solvents, or abrasive cleaners on the CopperPro.

Service and Adjustment

Service and adjustment of the CopperPro should be performed by trained Fluke Networks service personnel only.

If you experience a problem with the CopperPro, visit the Fluke Networks Web site at www.flukenetworks.com. Click **Support** to display the **Support Solutions** page. You can also send email to fluke-assist@flukenetworks.com or call one of the following numbers to report a problem:

USA: 1-888-993-5853

Canada: 1-800-363-5853

Europe: +31-402-675-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

Anywhere in the world: +1-425-446-4519

If the CopperPro requires repair, service center personnel will provide you with shipping information and repair prices. If the CopperPro is covered under warranty, it will be promptly repaired or replaced (at Fluke Network's option) and returned to you, postage paid, at no charge. See the registration card for warranty terms. If the warranty has lapsed, Fluke Networks will repair the CopperPro for a fixed fee and return it, postage paid, to you.

Checking the Shipping Container

Remove the items from the shipping container and check that the package contains all of the standard accessories in the following list. Match each item with those shown in Figure 1-1. If any item is missing or damaged, contact your place of purchase.

- 990DSL CopperPro Loop Tester
- NiMH Rechargeable Battery Pack (installed; PN 665083)
- Test Lead Bag (PN 1610449)
- Power Supply INTL (PN 944223)
- Shoulder Strap (PN 1576950)
- RS-232 Cable (PN 944806)
- 12V Vehicle Battery Charger/Adapter (PN BE720)
- Line Cord (as appropriate for the country of usage)
- RFL Strapping Cord (PN 1320505)
- Wire Gauge (not shown; PN 1312371)
- This User's Guide (not shown; PN 1554870)
- Warranty Registration Card (not shown; PN 929158)

For a list of replacement parts and optional accessories that you can order for your CopperPro, see Appendix B.

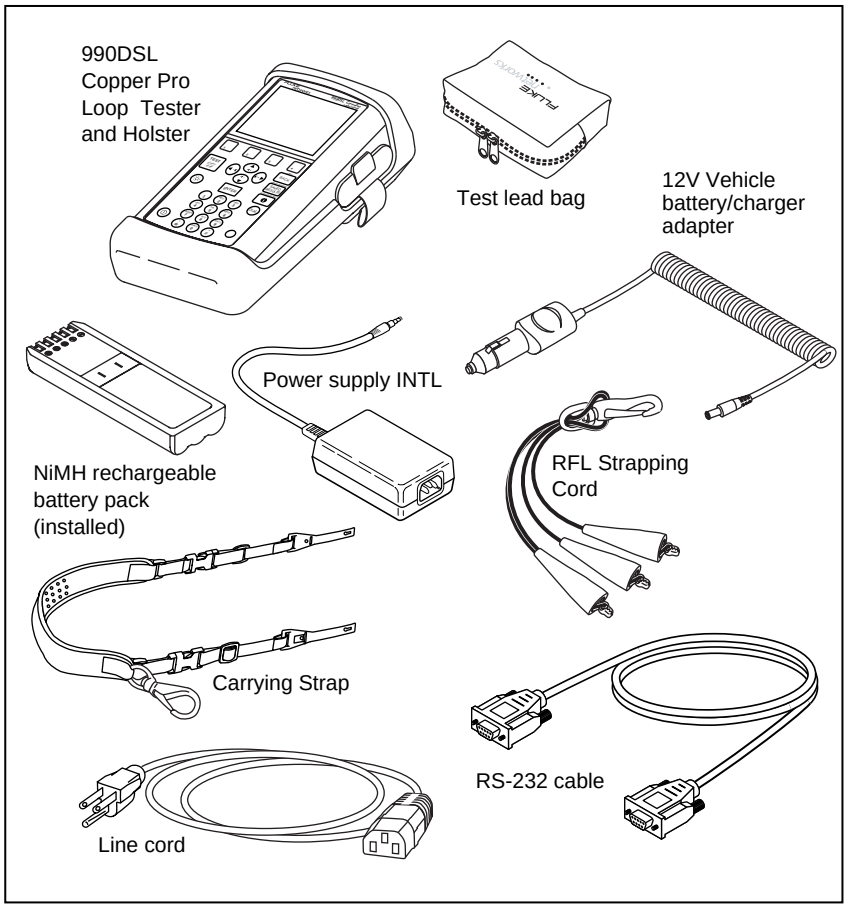


Figure 1-1. Standard Accessories

Technical Support

Fluke Networks offers a variety of support options to help you get the most from your CopperPro. If you require technical support, please have the following information available:

- Your name and company
- Model number and serial number of the CopperPro
- A description of the problem and any error messages that appear on the LCD.

For application or operation assistance or information about the tester, you can send email to fluke-assist@flukenetworks.com or call one of the following numbers:

USA: 1-800-283-5853

Canada: 1-800-363-5853

Europe: +31-402-675-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

Anywhere in the world: +1-425-446-4519

You can also visit the Fluke Networks Web site at www.flukenetworks.com. Click **Support** to display the **Support Solutions** page.

Chapter 2
Controls and Connections

Introduction

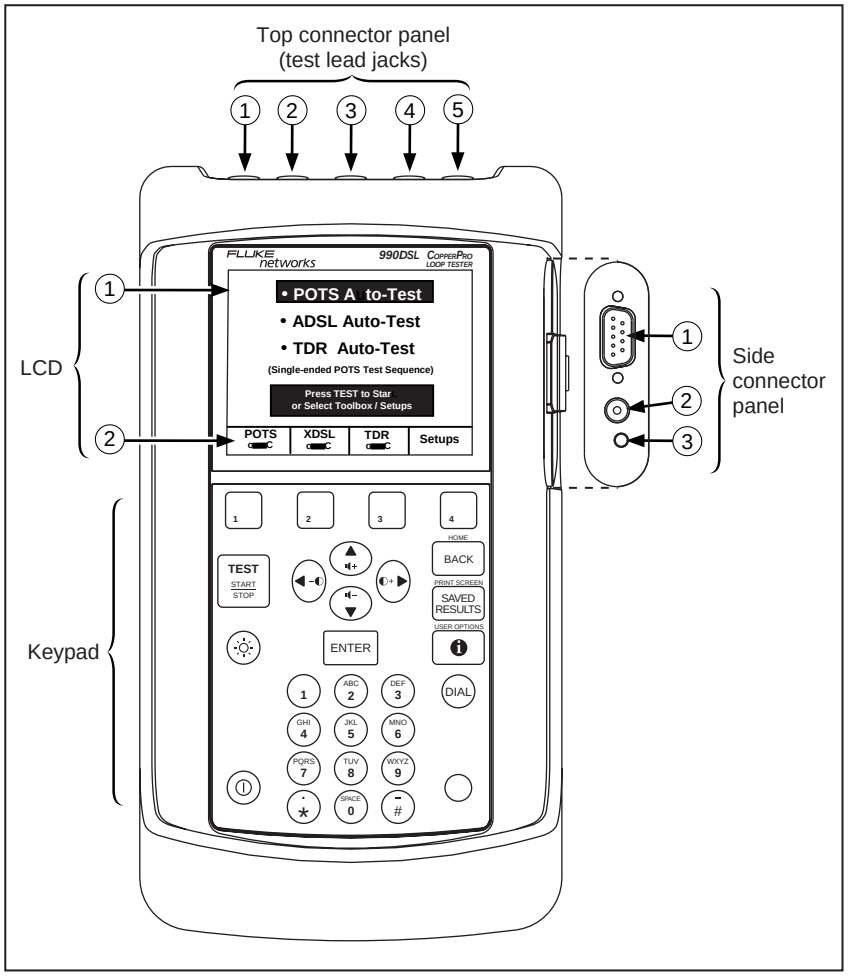
This chapter describes the physical layout of the CopperPro. The chapter begins with an overview of the tester's front, side, and back panels so that you know where the various controls and connectors are located and so that you can familiarize yourself with the functions of the keys and indicators. You will then learn how to connect the CopperPro to an external power supply and a printer and how to charge the tester's internal battery pack.

The CopperPro Loop Tester: at a Glance

This section acquaints you with the physical layout of the CopperPro.

Front Panel

Figure 2-1 identifies the elements on the tester's front, top, and side panels. Following the figure are descriptions of the numbered items in the illustration.



acy02f.eps

Figure 2-1. Top, Front, and Side Panels

LCD

The LCD is a shock-mounted, sunlight-readable, ¼-VGA (320 x 240 pixel) graphic Liquid Crystal Display. A low-power Electro-luminescent (EL) module provides backlighting to the LCD.

The LCD has two areas:

- Display area (①)

  This area displays the prompts, test and setup menus, test results, and messages.

- Four softkey labels (②)

  These labels identify the screen-dependent function keys. To activate a function, press its softkey (1, 2, 3, or 4), which is located on the tester's keypad directly below the label.

Keypad

The keypad is a sealed, waterproof membrane that has 29 keys. Table 2-1 describes the function of each key.

Table 2-1. Functions of the CopperPro Keys

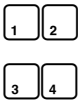
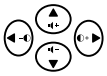
Key	Function
	Four rectangular numbered keys that are located directly under the LCD. These are software-defined keys (called "softkeys") that carry out commands related to the currently displayed screen. To locate the function of a key, look on the LCD directly above the key.
	Starts the selected test and stops the currently running test.

Table 2.1. Functions of the CopperPro Keys (continued)

Key	Function
☼	Turns the LCD's backlight on or off.
⏻	Turns the CopperPro on or off.
◯	Yellow Shift key. Some keys have two functions (for example, the **BACK** key). When you press and release the Yellow Shift key, then press a key that has two functions, the alternate function of the key is activated. If a key has two functions, its alternate function is printed in yellow letters above the key.
DIAL	Causes the CopperPro to go "off-hook" on the T & R test leads and function as a telephone dial set. Hangs up when pressed again.
USER OPTIONS ℹ	Press ◯ then ℹ to display the **USER OPTIONS** menu.
PRINT SCREEN SAVED RESULTS	Has two functions: • Press SAVED RESULTS to access stored results files. • Press ◯ then SAVED RESULTS to print the contents of the currently displayed screen.

Table 2-1. Functions of the CopperPro Keys (continued)

Key	Function
HOME BACK	Has two functions: • Press BACK to return to the previously displayed screen. • Press ◯ then BACK to display the **Main** menu (see Figure 3-2).
	Four directional arrow keys have the following functions: • To select a test or edit a parameter, press an arrow key to move the cursor in the direction in which the arrow points (up, down, left, or right). • Press ◯. Then press ◀ to decrease or ▶ to increase the contrast of the LCD. • Press ◯. Then press ▲ to increase or ▼ decrease the volume of the speaker.
ENTER	Does the following: • Selects test options. • Exits Edit mode.
Alphanumeric Keys	Provide a 12-key telephone pad so that you can enter numbers, the asterisk (*), and pound sign (#). Press ◯, then press the associated number key to select an alphabetic character, the decimal, space, or dash. Press ◯ again to exit alphabetic entry mode and return to number entry mode. *Note* *To display an alphabetic character, press ◯, then continue to press the associated number key until the desired alphabetic character appears.*

Top Connector Panel

The top connector panel has five 2 mm test lead connectors. These connectors are color-coded for easy identification. The test lead connectors are identified in Figure 2-1 as follows:

① Tip test lead (black)

② Ring test lead (red)

③ Ground test lead (green)

④ Tip 1 test lead (yellow)

⑤ Ring 1 test lead (blue)

Side Connector Panel

The side connector panel is protected from rain by a tethered plug that is attached to the holster. This panel has the following components, which are identified in Figure 2-1:

- RS-232 port (①)

  A nine-pin male D-Sub connector with locking nuts. The RS-232 port and the supplied RS-232 cable are needed when you download programs from a PC to the tester and when you control the tester remotely from a PC. With a printer cable connected, the RS-232 port enables you to print serial data.

- DC power jack (②)

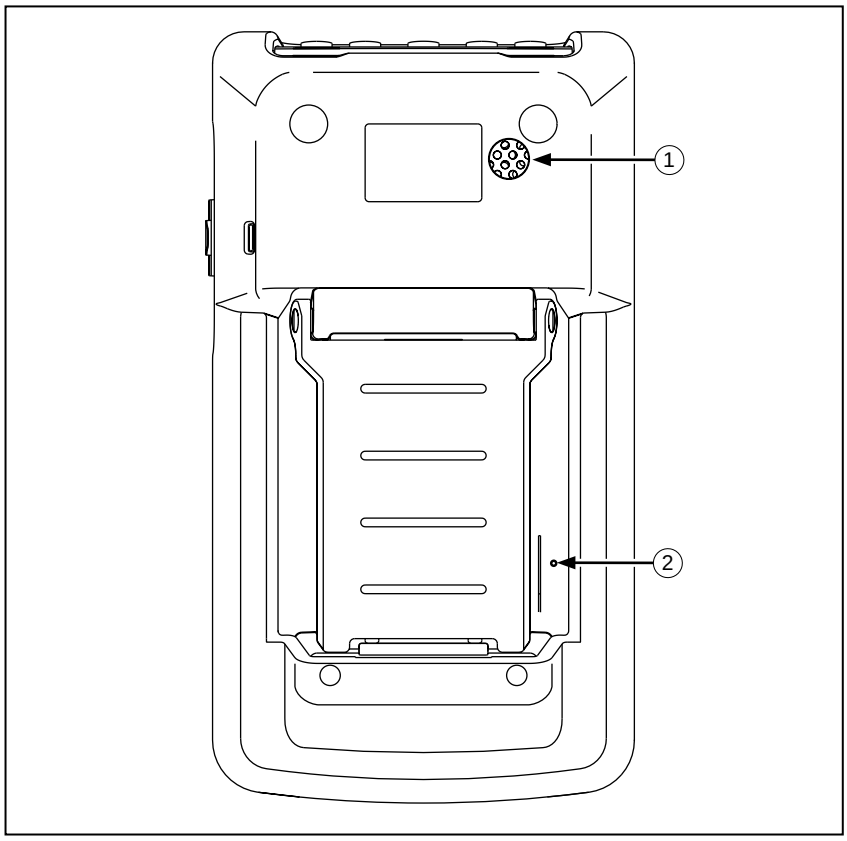
  A barrel jack that is used to power the tester externally and charge the battery. This jack accepts a 12-15 VDC center-positive voltage that is provided either by the supplied AC power supply or the optional Vehicle Power Cord.

- Charging status LED (③)

  A bicolor (red and green) LED that indicates the charging status of the internal battery pack (see "Charging the Battery" for details).

Back Panel

The tester's back panel is shown in Figure 2-2. This panel contains a speaker (item ①) and a microphone (item ②). The speaker and microphone enable you to use the CopperPro as a dial set (see "Operating the Tester as a Dial Set" in Chapter 3 for instructions).



acy04f.eps

Figure 2-2. Back Panel

Connecting the CopperPro

This section shows you how to connect the CopperPro to AC power, an automobile battery, a printer, and a PC.

Connecting to AC Power

When the tester is connected to AC power, you can use the power supply as a continuous power source. In this way, you can test for long periods of time without depleting the tester's batteries.

To connect the CopperPro to AC power, follow these steps:

1. Plug the AC power cord into an AC outlet.
2. Connect the power cord DC Barrel plug into the DC connector. This connector is located on the tester's side panel (see Figure 2-1).
3. Do one of the following:
    - Turn off the tester to begin charging (see "Charging the Battery" for details).
    - Turn on the tester and begin using.

Connecting to an Automobile Battery

To connect the CopperPro to a 12 VDC automobile battery, follow these steps:

1. Plug the male cigarette lighter plug on the Vehicle Power Cord into the vehicle lighter socket.

2. Connect the DC barrel plug on the Vehicle Power Cord into the DC connector. This connector is located on the tester's side panel (see Figure 2-1).
3. Do one of the following:
   - Turn off the tester to begin charging.
   - Turn on the tester to begin using.

Connecting to a Printer

To connect the CopperPro to a serial graphics printer, do the following:

1. Attach the nine-pin female connector on the printer cable to the CopperPro D-Sub connector.
2. Attach the nine-pin male cable connector to the printer.

Connecting to a PC

If the CopperPro is connected to a PC, you can download and upload files and control the tester remotely from the PC. To connect the CopperPro to a PC, do the following:

1. Attach one end of the supplied RS-232 cable to the RS-232 port, which is located on the tester's side panel (Figure 2-1).
2. Attach the other end of the supplied RS-232 cable to an available port on the PC.

The Battery

The CopperPro operates on a replaceable NiMH battery pack. The battery typically provides between 16 to 24 hours of operating time. This section shows you how to check and recharge the battery.

Checking the Remaining Battery Capacity

To find out what the remaining capacity of the internal battery pack is, do the following:

1. Press ◯ then [i] to display the **USER OPTIONS** menu.

2. Select **Battery Status**, then press [ENTER].

   The **Battery Status** screen is displayed. This screen gives you the following information about the internal battery pack:

   - Battery voltage (VDC)
   - Battery capacity (%)
   - Estimated remaining run-time (in hours, based on normal usage)
   - Battery temperature (°F)

   Note

   After you turn on the tester, the startup screen displays this same status information about the battery.

In the upper right corner of the screen, the tester displays two icons, which indicate the following:

- External power source in use (AC power or not AC power)
- Battery capacity

Responding to Low Battery Warnings

When the NiMH battery pack has about 30 minutes of operating time remaining, the tester issues a tone and displays a low-battery warning on the LCD. This warning overlays the currently displayed screen.

Note

To remove the warning, press ENTER.

If the low battery warning appears while you are operating the tester, it is advisable to connect the CopperPro to an external power source within the next several minutes to guarantee that the currently displayed test data is not lost due to a power failure. If you continue to operate the CopperPro without an external power source, the tester issues a final distinctive audible tone and powers itself off.

Charging the Battery

To charge the battery, either connect the CopperPro to AC power (see "Connecting to AC Power") or connect it to an automobile battery (see "Connecting to an Automobile Battery").

During operation from either external power source, the battery receives a "trickle" charge that allows you to operate the tester for extended periods of time without discharging the internal battery pack. When the CopperPro is connected to an external power source but turned off, the battery automatically undergoes a fast-charging cycle.

A full charging cycle can take between two to three hours to complete. The charging status LED on the side connector panel indicates the state of the charge as one of the following:

- Flashing red: indicates that the battery is being prepared for fast charging. This state lasts for several seconds before the battery enters the fast charging mode. This state will be extended for extremely low-voltage or high temperature battery conditions.
- Steady red: indicates that the battery is in fast charging mode. In this mode, it can take up to three hours for a completely discharged battery pack to charge.
- Steady green: indicates that the battery is in the final stages of charging. The first stage, which typically lasts for about 30 minutes, occurs after the fast charging mode is the "top off" state. The final stage is the "trickle charge" state. In this state, the battery is fully charged. The CopperPro can be left in the trickle charge state for an indefinite period of time, without harm.

Discharging Battery

To properly discharge the battery, you can leave the tester on until the battery drains or you can use the discharge facility. To use the discharge facility, complete the following:

1. Press ◯ then [i] to display the **USER OPTIONS** menu.
2. Select **Battery Status**, then press [ENTER].
3. Press [TEST START STOP].
4. Follow the on-screen instructions to disconnect the tester from the external power source. Then, press [1](**Okay**).
5. Press [TEST START STOP].

   The tester begins to discharge the battery.

Chapter 3
Setting Up and Operating the CopperPro

Introduction

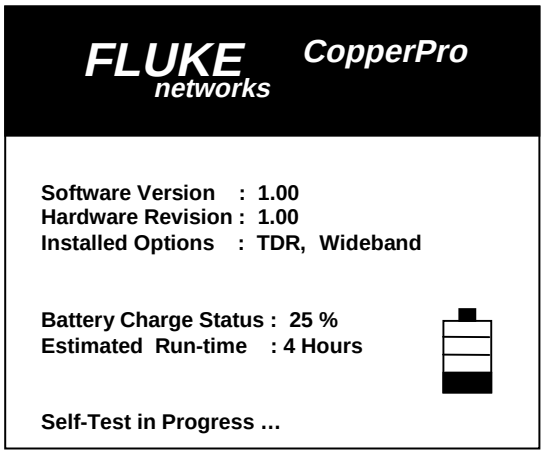
This chapter shows you how to set up the CopperPro so that it suits your particular testing needs and operating preferences. The chapter begins with an introduction to the menu system and shows you how to locate desired tests, operational functions, and setup parameters. The chapter concludes by showing you how to perform basic tasks, such as adjusting the speaker volume, changing the contrast and brightness of the LCD, and using the CopperPro to dial a telephone number.

Turning the CopperPro On and Off

To turn on the CopperPro, do the following:

1. Press ⏻. This is the green On/Off key, which is located in the bottom left corner of the keypad (see Figure 2-1).

   The CopperPro startup screen (Figure 3-1) is displayed:



acy03s.eps

Figure 3-1. CopperPro Startup Screen

   The startup screen displays general information about the tester: the software version and hardware revision, installed options (if any), and battery status and estimated remaining run-time.

2. To turn the tester off, press ⏻ again.

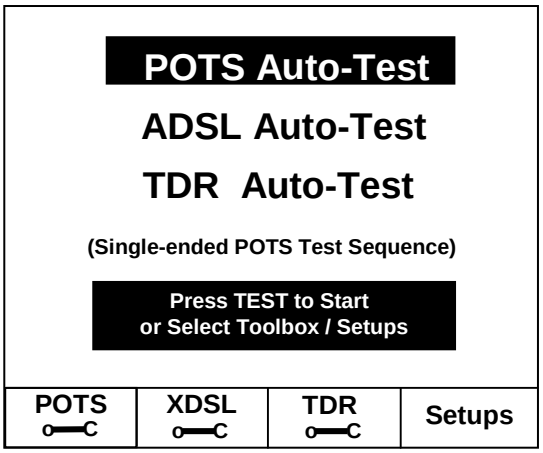
The Menus

The CopperPro's test selections, setup configurations, and results are accessed through a menu system. This section shows you how to display the **Main** menu. You will then learn how to display the test and setup menus.

Displaying the Main Menu

The **Main** menu is the top-level menu. From this menu, you can access all of the CopperPro's setup and testing functions.

After you turn on the CopperPro, it conducts a series of self-tests, then displays the **Main** menu (Figure 3-2). If the CopperPro is already turned on, you can return to the **Main** menu from anywhere in the menu hierarchy by pressing ◯, then pressing BACK.



acy05s.eps

Figure 3-2. Main Menu

From the **Main** menu, you can access the following:

- Auto-Tests

  The menu lists the three Auto-Tests: POTS, ADSL, and TDR. Each Auto-Test is comprised of a series of individual diagnostic tests that run in sequence automatically with the press of a single key. The POTS, ADSL, and TDR Auto-Tests are described in Chapters 4, 5, and 6, respectively.

- "Toolbox" tests

  Each "toolbox" contains a group of functionally related individual tests. The POTS, XDSL, and TDR softkeys, which are located at the bottom of the **Main** menu, each let you access a group of tests. For descriptions of the tests in the POTS, XDSL, or TDR toolbox, see Chapter 4, 5, or 6, respectively.

- Test setup menus

  The **Setups** softkey provides direct access to the setup menu for a selected (highlighted) test. For information on setting up a test, see the setup section for that test in Chapter 4, 5, or 6.

Displaying the Previous Menu or Screen

To display the previously displayed menu or screen, press BACK.

Displaying a Setup Menu

This section shows you how to display the setup menus for an Auto-Test and a test in a toolbox. For descriptions of the setup parameters found on these menus, see "Generic and Test-Specific Setup Parameters".

Auto-Test Setup Menu

To display the setup menu for an Auto-Test, do the following:

1. From the **Main** menu (Figure 3-1), press ⊕ to select the desired Auto-Test.
2. Press 4 (**Setups**).

   The **Setups** menu for the Auto-Test you selected is displayed.

Toolbox Test Setup Menu

To display the setup menu for a test in a toolbox, do the following:

1. From the **Main** menu, press 1(**POTS**), 2(**XDSL**), or 3(**TDR**).

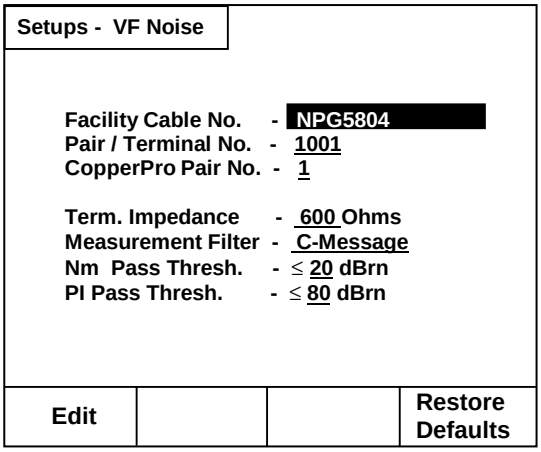
   A menu of tests in the toolbox is displayed.
2. Select the test that you want to set up. Then, press 4(**Setups**).

   The **Setups** menu for the selected test is displayed.

Generic and Test-Specific Setup Parameters

Figure 3-3 shows a typical setup menu for a toolbox test (VF Noise). Every setup menu has two groups of parameters. The first group consists of three generic parameters (described in Table 3-1). The parameters are considered "generic" because they apply to *all* of the CopperPro's tests.

You can change the value of a generic parameter from any setup screen (see "Editing the Setup for a Test"). Just be aware that when you save the change, it is stored in the tester's memory and applies to *every* CopperPro test.



acy07s.eps

Figure 3-3. Typical Setup Menu

The second group of setup parameters consists of those that are specific to the selected test. On the **Setup-VF Noise** screen (shown in Figure 3-2), the four parameters on the bottom of the screen apply to the VF Noise test only. For descriptions of the setup parameters for a particular test, refer to the table in the setup section for that test.

Table 3-1. Generic Setup Parameters

Parameter	Description
Facility Cable No.	This number defines the cable name of the pair on which the test is being conducted. In the highlighted field, supply the alphanumeric cable name (16 characters maximum).
Pair/Terminal No.	This number defines the specific single cable pair, the cross-box binding post, or the inside terminal number on which the test is being conducted. In the highlighted field, supply the number (five digits maximum).
Instrument Pair No.	The CopperPro test lead pair number. In the highlighted field, type a **1** (for **T** & **R)** or **2** (for **T1** & **R1**, if no external multiple-pair access modules are attached).

Editing the Setup for a Test

To edit the setup for a test, complete the following:

1. To change the value of a generic parameter, refer to the information in Table 3-1 and complete the following for each parameter you want to change:

   a) Press ⊕ or ⊕ to select the parameter. Then, press [,](**Edit**).

   The tester is now in Edit mode.

   b) In the highlighted field, use the keypad to type the desired value. When you finish, press [ENTER].

   The values are saved in the tester's memory and apply to all CopperPro tests until you change them.

2. To change the value of a test-specific parameter, complete the following:

   a) Press ⊕ or ⊖ to select the value you want to change. Press [1](**Edit**).

      The tester is now in Edit mode.

      Note

      Consult Table 3-2, which provides some helpful tips for operating the tester in Edit mode.

   b) Do the following:

      - If the parameter you want to change has a fixed group of choices, press ⊕ or ⊖ until the desired choice appears in the field. Then, press [ENTER] to save the selection.

        OR

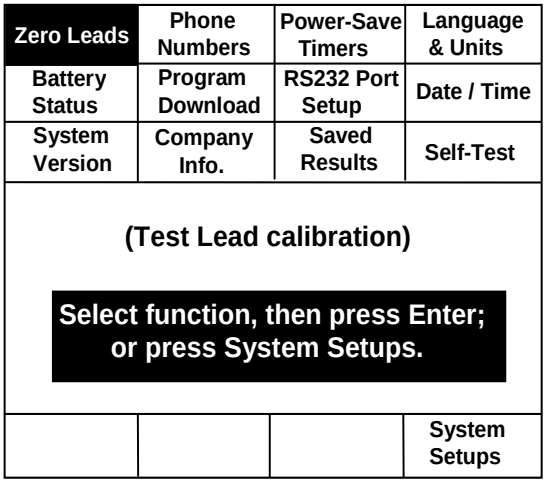
      - If the parameter has an alphanumeric field, a blinking cursor appears on the first (left-most) character in the field. To change the parameter's value, use the keypad to type the new value. As you type each character, it appears in the field and the cursor advances to the next position, allowing you type the next character. When you finish, press [ENTER] to save the change.

Table 3-2. Operating the Tester in Edit Mode

If you want to	Do this
Put the tester in Edit mode	Press 1 (**Edit**).
Enter numbers, asterisk (*) or pound sign (#)	Type the values directly from the keypad by pressing the number keys, asterisk (*), or pound sign (#).
Enter alphabetic characters	Press ◯ to put the tester in alphabetic text entry mode. Then, press the key with the desired alphabetic character. Keep pressing the key until the desired alphabetic character is displayed.
Exit alphabetic text entry mode and return to numeric entry mode	Press ◯.
Move the cursor forward one position without changing the displayed character	Press ⊕.
Move the cursor backward one position without changing the displayed character	Press ⊕.
Move the cursor back one position and overwrite the previous character	Press BACK.
Exit Edit mode and save the changes	Press ENTER.
Exit Edit mode, without saving the changes	Press 1 (**Edit**).
Restore factory default setup values	Press 4 (**Restore Defaults**).

Configuring the Tester

This section shows you how to configure the CopperPro so that it functions appropriately for your particular work environment and testing situations. The **USER OPTIONS** menu (Figure 3-4) lists the options available for configuring the tester and customizing it to your needs.



acy08s.eps

Figure 3-4. USER OPTIONS Menu

Setting the Date and Time

To set the date and time, follow these steps:

1. Press ◯, then [i] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **Date/Time**. Press [ENTER].

   The **Date/Time** menu is displayed.
3. Press ↕ to move the cursor down to the **Time Display Mode** field. Press [1](**Edit**). Then, press ↔ to select one of the following formats for displaying the time:

   - 12-hour (default)
   - 24-hour

   Press [ENTER] to save your selection.
4. Press ↕ to move the cursor down to the **Date Display Mode** field. Press [1](**Edit**). Then, press ↔ to select one of the following formats for the date:

   - MM/DD/YYYY
   - DD.MM.YYYY

   Press [ENTER] to save your selection.
5. Press ↕ to move the cursor up to the **Current Time** field and set the time. To do this, complete the following:

   a) Press [1](**Edit**). In the Hour field, type the hour. Then press [ENTER] to save the value.

   b) Press ↔ to move the cursor to the Minutes field. Press [1](**Edit**). Type the minutes, then press [ENTER] to save the value.

   c) If you selected **12-hour** as the time format, press ↔ to move the cursor to the Time of Day field. Press [1](**Edit**). Press ↕ to select **AM** or **PM**, then press [ENTER] to save the selection.

6. Press ⊕ to move the cursor to the **Current Date** field and set the date. To do this, complete the following:

   d) Press 1 (**Edit**). In the first field, type the number for the current month (or day, if you selected DD.MM.YYYY as the display mode). Press ENTER to save.

   e) Press ⊕ to move the cursor to the next field. Press 1 (**Edit**). Type the number for the current day (or month), then press ENTER to save.

   f) Press ⊕ to move the cursor to the Year field. Press 1 (**Edit**). Type the year, then press ENTER to save.

Your tester is now programmed with the current time and date.

Setting a Timer to Conserve Power

To conserve battery power, you can program a timer that automatically switches the tester into low-power mode or power-down mode after a specified period of inactivity.

The CopperPro has two timers:

- "Snooze" Timer

  Causes the CopperPro to go into low-power mode if no keypad activity is detected for the user-specified time period. When the time elapses, the tester emits a distinctive tone and the display goes blank.

  Press any key to reactivate the tester and reset the timer.

- "Power Down" Timer

  Causes the CopperPro to automatically turn off if no keypad activity is detected for the user-specified time period. The tester emits distinctive tone when the time elapses and turns itself off.

  Press ⏻ to turn the tester back on.

To set a timer, follow these steps:

1. Press ◯, then [i] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **Power-Save Timers**. Press [ENTER].
3. To change a timer's setting, position the cursor on the timer. Then, press [1](**Edit**).
4. Supply the desired period of inactivity. Then, press [ENTER] to save the value.

Note

The default period of inactivity is 10 minutes for the Snooze timer and 20 minutes for the "Power Down" timer.

Selecting a Language and Associated Units of Measure

The CopperPro displays and prints information in the following languages:

- English (U.S., U.K., and Canada)
- Spanish (S.A. and Mexico)
- Portuguese (S.A.)
- French
- German

The tester also displays length in different units of measure.

When you select a language for the tester's displays, the units of measure associated with that language (and country) are automatically chosen. These include units of measure for temperature, distance, and VF Noise, as well as conductor names and the typical wire gauges that are employed for the language/country you selected.

The default language for the tester's displays is **English (USA)**.

To change the language and associated units of measure, complete the following:

1. Press ◯ then [i] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **Language & Units**. Press [ENTER].

   The cursor is positioned on the **Language** field.
3. Press [1](**Edit**). Then, press ⇔ to display the desired language/country. Press [ENTER] to save your selection.

The language you selected now appears in the **Language** field. The units of measure associated with that language are also displayed.

Creating a Phone List

You can create and store a list of telephone numbers that you use frequently. The list can save you time when you run the dial-up tests described in Chapter 4. The tester can store up to 20 telephone numbers. If a number changes or is no longer needed, you can edit it or delete it from the list. This procedure shows you how to add and delete phone numbers.

To create a phone list:

1. Press ◯ then [i] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **Phone Numbers**. Press [ENTER].
3. Press **Add Number**.
4. Use the tester's keypad to type the number, then press [ENTER].

   The number is added to the phone list.

To delete a phone number:

1. Select the number that you want to delete.
2. Press **Delete Line**.

   The selected number (and associated information in the "Remarks" column) is removed from the phone list.

To edit a phone number or notes in the **Remarks** field:

1. Press the ◀ or ▶ key to select the **Number** or **Remarks** field. Then, press 1 (**Edit**).
2. Press the ◀ or ▶ key to move the cursor to the desired position within the selected field. Do the following:

   - To type numbers, the asterisk (*), and pound (#) characters, press the desired key.
   - To type alphabetic characters (uppercase only), press ◯ then press the desired key.

   Notes

   To put in a space, press ◯ then press 0.

   To toggle between alphabetic and numeric entry modes, press ◯.

3. Press ENTER when done.

Storing the Serial Number and Property Information

If desired, you can store the serial number and owner information for your CopperPro in the tester's memory.

To store property information for the tester, follow these steps:

1. Press ◯ then [ⓘ] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **Company Info**. Press [ENTER].

   The **Company Info**. screen is displayed. The cursor is positioned on the **Name** field.
3. To supply information on this screen, complete the following:

   Note

   Zipcode *and* ***Phone No****. can have up to 16 alphanumeric characters. All other parameters can have up to 30 alphanumeric characters.*

   a) Position the cursor on the desired field. Then, press [1](**Edit**).

   b) Use the keypad to enter alphabetic or numeric information.

   To enter alphabetic information, press ◯ to put the tester in Shift mode. Then, press the desired alphabetic key until the character you want is displayed. Press ⊕ to advance the cursor to the next position and type the next character. Continue in this manner until the desired information is displayed.

   To enter numeric information, press the desired number key. Press ⊕ to advance the cursor to the next position and type the next number. Continue in this manner until the information you want is displayed.

   c) Press [ENTER] to save.

Configuring the Serial Port

If you want to print, download and upload files, or operate the CopperPro remotely, you need to enable communications between the tester and an external PC or printer. The baud rate is pre-configured at 38.4 kb/s for PC uploading and downloading operations.

To configure the tester's serial port for communications with a serial printer, complete the following:

1. Press ◯ then [i] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **RS232 Port Setup**. Press [ENTER].
3. The **RS-232 Port Setup** screen is displayed. The cursor is positioned on the **Baud Rate** parameter.
4. To change the information on this screen, complete the following for each parameter:
   a) Position the cursor on the parameter, then press [1](**Edit**).
   b) Press ↔ until you display the desired choice.
   c) Press [ENTER] to save your selection.

Creating a Custom Header for Test Result Files

You can create a custom header for your test result files. The purpose of the header is to identify the operator, company name, test site, and job number. When you view or print a test report, the information that you supply in the following procedure can be selected to appear in the header of the file. This information applies to all of your saved result files until you change it.

To create a header, follow these steps:

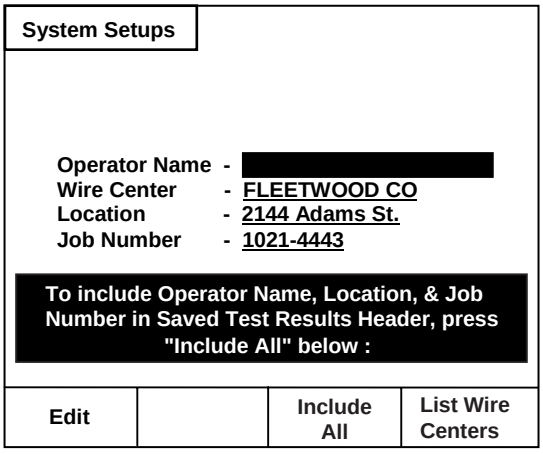
1. Press ◯ then [i] to display the **USER OPTIONS** menu (Figure 3-4)

2. Press 4 (**System Setups**). Press ENTER.

   The **System Setups** screen (Figure 3-5) is displayed. This screen has four parameters. The cursor is positioned on **Operator Name**.

   Note

   The information you supply for each parameter on this screen can be up to 30 alphanumeric characters long.



acy09s.eps

Figure 3-5. System Setups Screen

3. To supply an operator name, press 1 (**Edit**). In the **Operator Name** field, type the name. When you finish, press ENTER.

   Note

   Consult Table 3-2 for assistance with operating the tester in the Edit mode.

4. Press ⊕ to move the cursor to **Wire Center**. Press 1 (**Edit**) and supply the desired information. When you finish, press ENTER.

Note

Wire Center *defines the primary work location, such as a Central Office Exchange, Cross-Connect Box, or Inside Terminal name.* The tester automatically includes the information that you supply for ***Wire Center*** in the header.

5. Press ⊕ to move the cursor to **Location**. Press 1 (**Edit**) and supply the desired information. When you finish, press ENTER.
6. Press ⊕ to move the cursor to **Job Number**. Press 1 (**Edit**) and supply the desired information. When you finish, press ENTER.
7. To include the information you supplied for the **Operator Name**, **Location**, and **Job Number** in the header for your result files, press 3 (**Include All**).

Note

If you do not press 3 *(**Include All**), the tester includes only the information you supplied for **Wire Center** and a timestamp.*

Performing Basic Operations

This section shows you how to perform basic CopperPro operations so that you can quickly get started using the tester. Read this section before you run any tests.

Calibrating the CopperPro

To ensure maximum accuracy of test results, you should calibrate the CopperPro at the start of the day, whenever a significant temperature change occurs, or before you make extremely critical measurements.

The Zero Leads utility is a test lead calibration function that allows the CopperPro to compensate for test lead resistance and capacitance in subsequent Resistance Fault, RFL, and Opens measurements. The constants generated from this test are stored in non-volatile memory and are retained even after you turn off the tester.

To calibrate the CopperPro, complete the following:

1. Press ◯ then [i] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **Zero Leads**. Press [ENTER].
3. As instructed, connect the Pair 1 and Ground test leads together, then press [TEST].
4. When prompted, disconnect the test leads, then press [TEST].

   If no faults are detected, a “Zero Leads Completed” message is displayed. If a problem with measurement values is detected, an error message is displayed.

Turning the Backlight On and Off

When you use the tester in low light conditions, you can turn on the backlight for better viewing.

To turn the backlight on and off, press ☼. This key is located halfway down the keypad on the left side of the front panel (see Figure 2-1).

To display the screen in reverse video so that it is easier to view in low-light conditions, press ◯ then ☼. To return to normal video, press ◯-☼ again.

Adjusting the Contrast of the LCD

To adjust the viewing contrast of the LCD, complete the following

1. Press ◯.

   Note

   This is the yellow Shift key, which is located in the lower right corner of the keypad (see Figure 2-1). In the lower left corner of the screen, the word *"Shift" appears to indicate that the tester is in Shift mode.*

2. Press ◁ to decrease the contrast or ▷ to increase the contrast.
3. After the level of contrast is acceptable to you, press ◯ again to save the setting.

Adjusting the Volume of the Speaker

The CopperPro has a speaker that emits a distinctive sound when a key is pressed or when certain testing operations are being performed.

To adjust the volume of sound, do the following:

1. Press ◯. Then, press ⊕ to increase the volume or ⊖ to decrease the volume.

   When you press the arrow key, the speaker emits a tone at the newly adjusted volume, giving you a sample of the level of sound.

2. When the volume is acceptable to you, press ◯ again.

   The new setting is saved in memory and remains in effect even after you turn off the tester.

Displaying System Information

To find out what version of software you have or what options are installed on the tester, complete the following:

1. Press ◯ then [i] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **System Version**. Press [ENTER].

   The **System Version** screen displays the following information about the tester:

   - Software version loaded
   - Top assembly hardware revision
   - Installed options (if any).

Operating the Tester as a Dial Set

To operate the CopperPro as a dial set, do the following:

1. Turn on the CopperPro.
2. Connect the **T** (Tip) and **R** (Ring) test leads to a working POTS line. If the line is a ground-start line (as opposed to loop-start), connect the **G** (Ground) test lead to the cable sheath or C.O. ground.
3. Press DIAL.

   The **Dialing Mode Selection** screen is displayed.
4. Do one of the following:
   - To automatically dial the number, press 1 (**Auto-Dial**). Select the number from the list, then press TEST.
   - To manually dial the number, press 2 (**Manual Dial**). Then, dial the number from the keypad.
5. When you finish dialing, turn the tester over.

   You can now use the speaker and microphone as a standard handset.

Note

If the volume of the speaker needs to be adjusted, see "Adjusting the Volume of the Speaker" in the 990DSL CopperPro Loop Tester Users Guide for instructions

Running a Self-Test

The self-test is a rigorous test of the internal CopperPro hardware. Run a self-test to verify that your tester is operating properly. If the self-test fails, a diagnostic message is displayed.

The CopperPro has the following self-tests:

- POTS self-test
- WB self-test
- TDR self-test

To run a self-test, complete the following:

1. Press ◯ then [ⓘ] to display the **USER OPTIONS** menu (Figure 3-4).
2. Select **Self-Test**. Press [ENTER].
3. Press the softkey for the self-test that you want to run. Then, press [TEST].

Printing Displayed Results and Setup Information

You can print any setup information or test results that are currently displayed on the tester's LCD. To do this, follow these steps:

1. Connect one end of the optional serial printer cable to the CopperPro's RS-232 port. Connect the other end to the serial printer.
2. Display the setup or result screen that you want to print.
3. Press ◯ then [SAVED RESULTS].

   The contents of the currently displayed screen are sent to the printer.

   If you want to print saved test results, see Chapter 7, "Saved Test Results".

Chapter 4
POTS Testing and Fault Location

Introduction

This chapter shows you how to use the CopperPro to identify and locate common physical problems on OSP copper pairs. The chapter begins by showing you how to set up and run a POTS Auto-Test. The POTS Auto-Test is comprised of a sequence of individual parametric tests that run automatically. Results from an Auto-Test test can give you a quick overall assessment of the performance characteristics of a pair.

The chapter then describes the tests in the POTS toolbox. This toolbox contains a group of individual, specialized tests that can provide detailed information to help you diagnose specific problems in a cable. In the POTS toolbox, you will find a set of copper media tests, which are designed to identify and locate faults and test for continuity in a cable. Also included in the POTS toolbox are a group of transmission tests. When a pair shows signal transmission problems, these tests provide accurate measurements of signal loss, metallic noise, and power influence to help you analyze faults and resolve transmission-related issues.

POTS Auto-Test

The POTS Auto-Test is an automatic test that is comprised of a prioritized series of single-ended parametric tests. With the press of a single key, the CopperPro runs these tests in a specified order until a fault is detected that prohibits further testing. The POTS Auto-Test is ideal for use by the novice or infrequent operator because it can provide a starting point in the process of testing and analyzing faults on a pair of copper telephone cables.

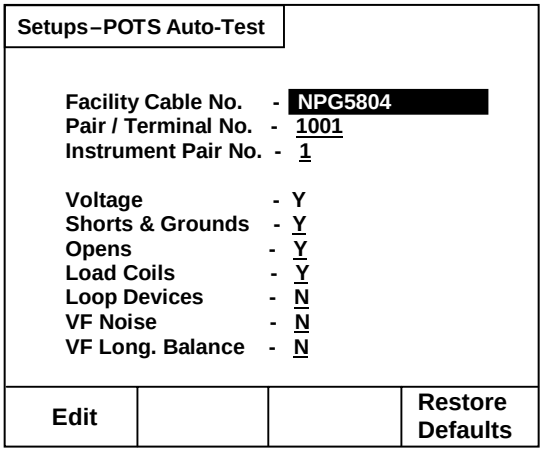
Table 4-1 lists the individual tests that comprise the POTS Auto-Test. Most of the tests are user selectable, which gives you the flexibility to customize an Auto-Test that fits your particular testing situation. The tests listed in Table 4-1 can also be run individually (see "POTS Toolbox Tests" for details).

Setting Up a POTS Auto-Test

To set up a POTS Auto-Test, complete the following:

1. Display the **Main** menu (Figure 3-2). Then, select **POTS Auto-Test**.
2. Press 4 (**Setups**).

   The **Setups**–**POTS Auto-Test** screen (Figure 4-1) is displayed:



acy11s.eps

Figure 4-1. POTS Auto-Test Setup Screen

Two groups of setup parameters are listed on this screen. The first group consists of the generic setup parameters, and the second group lists the tests that you can run under the POTS Auto-Test (refer to Table 4-1).

3. If desired, supply a value for each generic setup parameter.

Note

Table 3-1 describes the generic setup parameters. If you need instructions for changing their values, see "Editing the Setup for a Test" in Chapter 3.

4. Select the tests that you want to include in the Auto-Test. For each test, do the following:

   a) Press ▲ or ▼ to select the test. Then, press 1 (**Edit**).

   b) Press ▲ or ▼ to select **Y** if you want to include the test or **N** if you do not want to include the test.

   c) Press ENTER to save your selection.

Note

*To restore the factory default values of the setup parameters, press 4 (**Restore Defaults**).*

To change the setup for any of the individual tests, see "Editing the Setup for a Test" in Chapter 3.

Table 4-1 lists the tests you can include in the POTS Auto-Test.

Table 4-1. User Selectable Tests for the POTS Auto-Test

Test	Description	Settings (default in bold)
Voltage	Measures AC and DC voltages on each leg (TR, TG, and RG) of the pair.	No choices. The test is always performed (ACV and DCV).
Shorts & Grounds	Measures the resistance on each leg (TR, TG, and RG) of the pair.	No choices. The test is always performed.
Opens	Measures the capacitance of the pair, converting to distance based on the setting selected for the **Cable Type** parameter.	**Y** enables the test. N disables the test. Shorts & Grounds is a prerequisite test.
Load Coils	Detects the number of coils.	**Y** enables the test. N disables the test. Opens is a prerequisite test.
Loop Devices	Detects the presence of loop treatment devices, fault-sectionalizing devices, and Mechanical Bell Ringers.	Y enables the test. **N** disables the test. There are no prerequisites for this test.

Table 4-1. User-Selectable Tests for the POTS Auto-Test (continued)

Test	Description	Settings (default in bold)
VF Noise	Detects metallic (T-R) and noise to ground.	Y enables the test. **N** disables the test. There are no prerequisites for this test.
VF Long. Balance	Detects the susceptibility of the pair to external noise sources.	Y enables the test. **N** disables the test. There are no prerequisites for this test.

Starting and Stopping a POTS Auto-Test

You can start a POTS Auto-Test in one of two ways:

- From the **Main** menu (Figure 3-2), select **POTS Auto-Test**. Then, press TEST.

  OR

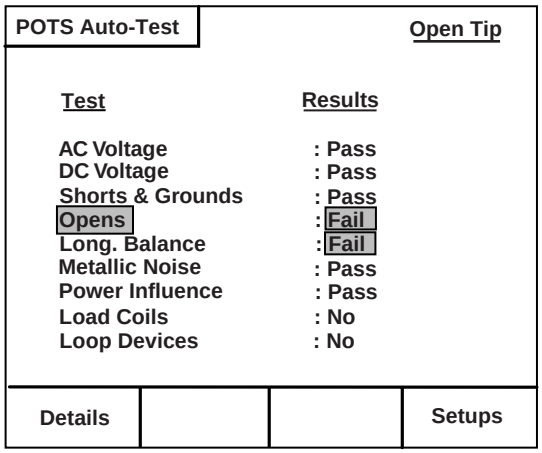
- From the **Setups - POTS Auto-Test** screen, press TEST.

The POTS Auto-Test begins, running each of the tests that you specified in the setup.

To stop a POTS Auto-Test at any time, press TEST.

POTS Auto-Test Results

When the Auto-Test ends, the CopperPro displays a list of the tests that were conducted and reports an overall Pass or Fail result for each test. A POTS Auto-Test results screen is shown in Figure 4-2:



acy101s.eps

Figure 4-2. POTS Auto-Test Summary Results

Note

"N/S" in the ***Results*** *column indicates that in the setup for the Auto-Test, the test was not selected for inclusion. "N/A" indicates that the test was selected for inclusion but was not run because of severe voltage or resistance faults.*

If one or more tests fail, the cursor is automatically positioned on the first failed test (note that the cursor is positioned on the Opens test shown in Figure 4-2). The failing test is highlighted in steady, reverse-video format. If all tests pass, the cursor is positioned on the first test in the list and that test is highlighted.

To view the summary result for a test, press ⊕ or ⊖ to scroll through the list of tests. As the cursor is positioned on the name of a test, it is highlighted and its summary result (Open Tip for the Opens test in Figure 4-2) is displayed in the upper right corner.

Note

If an "N/S" or "N/A" designation is given for a particular test, no summary result is displayed.

To view the details behind a summary result, press ⊕ or ⊖ to position the cursor on the name of the test, then press 1(**Details**).

Note

To return to the summary results screen from a "Details" screen, press BACK.

To view the setup for a test, press ⊕ or ⊖ to position the cursor on the name of the test, then press 4(**Setups).**

The POTS Toolbox

The POTS Toolbox includes the same tests that are available in the Auto-Test (see Table 4-1) as well as other fault location tests. From the toolbox, you can run the tests individually and in any order that you want. This section introduces the tests in the POTS toolbox, shows you how to run them, and describes the results they provide.

Starting and Stopping a Test in the POTS Toolbox

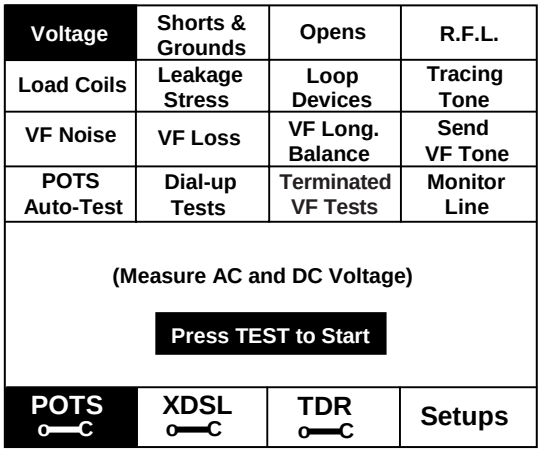
Unless otherwise noted under the description for a particular test, follow one of these procedures to start a test in the POTS toolbox:

- From the **Main** menu, press 1 **(POTS)** to display the POTS toolbox (Figure 4-3). Press an arrow key to select the desired test, then press TEST.

  OR

- Display the setup menu for the desired test (see "Displaying a Setup Menu" in Chapter 3), then press TEST.

To stop a running test, press TEST.



acy14s.eps

Figure 4-3. POTS Toolbox

Voltage Test

The Voltage test gives you a "snapshot" measurement of the AC and DC voltages on each leg (TR, TG, and RG) of a pair. The test can automatically determine a hazardous DC or AC voltage condition. It can also detect an idle or busy POTS line, a special services circuit, or cross battery condition.

Setting Up a Voltage Test

To set up a Voltage test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. When you set up the test, refer to Table 4-2, which describes the setup parameters for the Voltage test.

Table 4-2. Voltage Test Setup Parameters

Parameter	Settings (default in bold)
ACV Hazard. Volt Threshold	≥**50** VAC Value ranges from 40 to 120.
ACV Pass Threshold	≤**10** VAC Value ranges from 1 to 30.
DCV Hazard. Volt Threshold	≥**130** VDC Value ranges from 70 to 150.
DCV Pass Threshold	≤**5** VDC Value ranges from 1 to 20.
DCV Test Impedance	**100** KΩ or 10M fixed selections (2)

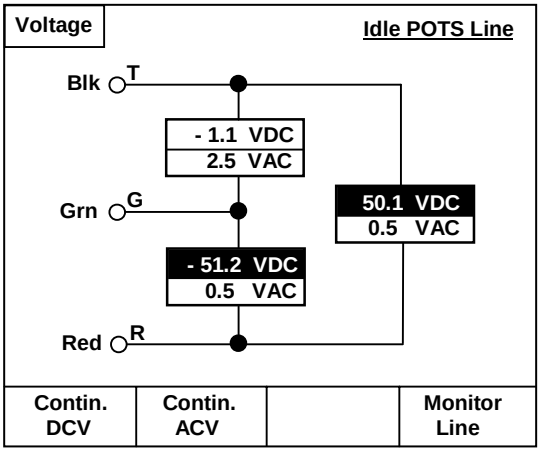
Table 4-2. Voltage Test Setup Parameters (continued)

Parameter	Settings (default in bold)
DCV Idle POTS Voltage	**High side = -60 to -46 VDC** **Low side = 4 to -4 VDC** Values range from 0 to ± 99. Low absolute value < high.
DCV Busy POTS Voltage	**High side = -46 to -26 VDC** **Low side = -4 to -25 VDC** Values range from 0 to ± 99. Low absolute value < high.

Voltage Test Results

To run a Voltage test, follow the instructions under "Running a Test in the POTS Toolbox", earlier in this chapter.

When the Voltage test ends, it automatically displays results. Figure 4-4 shows an example of a Voltage test result screen.



acy15s.eps

Figure 4-4. Voltage Test Results: Idle POTS Line

In Figure 4-4, the Voltage test reports that it detected an idle POTS line. This overall result is reported in the status area in the upper right corner. In the center of the screen, the test reports voltage readings that are outside the acceptable limits (as defined in the setup) for a spare pair. These readings are emphasized on the diagram in flashing, reverse video format.

Depending on the results reported, you may want to run additional tests. From the result screen, you can do the following:

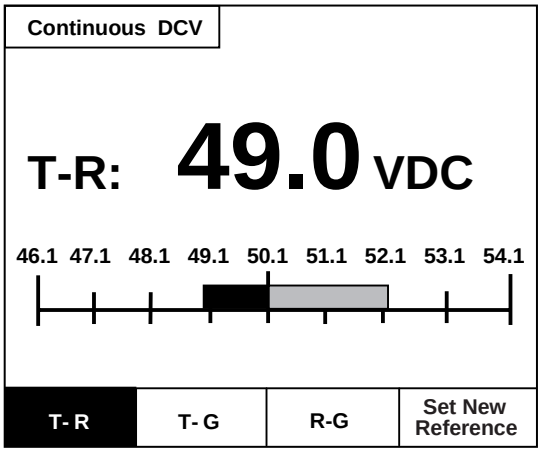
- Press 1(**Contin. DCV**) to obtain continuously updated DCV values for any selected leg (see "Running a Continuous Voltage Test" for details).
- Press 2(**Contin. ACV**) to obtain continuously updated ACV values for any selected leg.
- Press 4(**Monitor Line**) to non-intrusively monitor the pair using the tester's built-in speaker (see "Monitor Line Test" later in this chapter).

Running a Continuous Voltage Test

The Continuous Voltage test continuously monitors DC voltage on a pair. To run this test, do the following:

1. Press 1(**Contin. DCV**).

   The **Continuous DCV** screen (Figure 4-5) is displayed.



acy16s.eps

Figure 4-5. Continuous Voltage Test Result Screen

Figure 4-5 displays a continuously updated DCV value for the T-R leg. The bar graph plots real-time voltage readings against the reference (center) value of the initial reading. Peak voltage excursions are recorded as half-tone shaded portions of the bar, while the current reading is shown in the center of the screen in large, solid black numbers. Each horizontal scale marking on the bar graph corresponds to one unit of measure (in this case, 1 volt) of the parameter.

The current reading of 49.0 VDC is below the initial reference value of 50.1 VDC by slightly more than one scale division. The solid bar indicates this. Note, however, that at some point, there was a temporary excursion to 52.2 VDC, as shown by the shaded bar. This “recent history” feature can prove to be valuable when you are monitoring lines with intermittent faults.

Note

If the current value drifts off of either end of the bar graph, press [4] *(**Set New Reference**) to re-center the reading.*

2. To continuously test another leg, press 2(**TG**) or 3(**RG**).
3. To stop a continuous test and return to the previous screen, press TEST or BACK.

Shorts & Grounds Test

The Shorts & Grounds test provides a "snapshot" measurement of the resistances on each leg (TR, TG, and RG) of a pair.

Setting Up a Shorts & Grounds Test

To set up a Shorts & Grounds test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. When you set up the test, refer to Table 4-3, which describes the setup parameters for the Shorts & Grounds test.

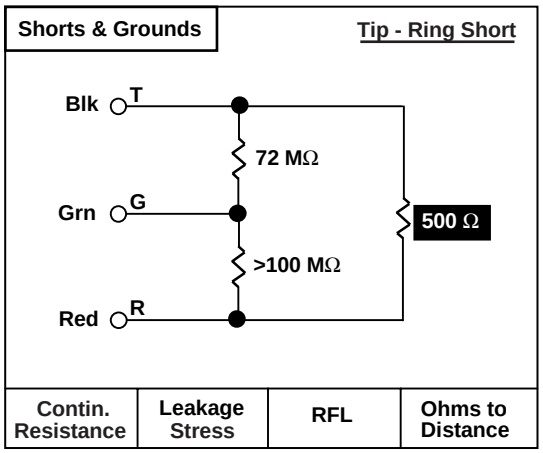
Table 4-3. Shorts & Grounds Test Setup Parameters

Parameter	Settings (default in bold)
Resist. Fault Pass Threshold	≥**150** KΩ Value ranges from 2 to 9999
Cable Gauge	19 AWG, 22AWG, **24 AWG**, 26 AWG, or 28 AWG
Cable Temperature	**68**° **F** Ranges from –99 to 199

Shorts & Grounds Test Results

To run a Shorts & Grounds test, follow the instructions under “Running a Test in the POTS Toolbox”, earlier in this chapter

Figure 4-6 shows an example of a result screen for a Shorts & Grounds test. The test was conducted on a pair with a 500 Ohm Tip-to-Ring fault.



acy17s.eps

Figure 4-6. Shorts & Grounds Test Results: Short

In Figure 4-6, the Shorts & Grounds test detected a short (**Tip-Ring Short**) on the pair. The test also reports a fault resistance reading (500 Ω) that is outside the acceptable limits (as defined in the setup for the test). This reading is shown in flashing, reverse video format.

Depending on the results reported, you may want to run additional tests on the pair. From the results screen, you can do the following:

- Press 1(**Contin. Resistance**) to obtain a continuous resistance reading.
- Press 2(**Leakage Stress**) to run a Leakage Stress test (see "Leakage Stress Test" for details).
- Press 3(**RFL**) to run an RFL test (see "See Resistance Fault Location (RFL) Test" for details).

You can also convert fault resistance values (Ohms) to distance values. To do this, press 4(**Ohms to Distance**). See "Converting Fault Resistance Values to Distance Values", which follows, for instructions.

Converting Fault Resistance Values to Distance Values

Often the fault resistances that are displayed are "hard" shorts or grounds. This means that the fault is at zero Ohms, and the resistance shown is only the conductor resistance itself to that fault. In these situations, the CopperPro can convert the resistances to distances— if you supply the cable gauge and temperature.

To convert the fault resistance values to distances, complete the following:

1. On the Shorts & Grounds result screen, press 4(**Ohms-to-Distance**).

2. If the cable gauge or temperature is different from that specified in the setup for the test, press 4(**Setups**). Then, do the following:
   - If the pair consists of only one gauge, select the gauge from the list of displayed choices.
   - If the pair consists of more than one gauge, press 3(**Multiple Gauge**). Then, follow the prompts to enter each section length (see "Entering Multiple Wire Gauge Information" for details). When done, press BACK to return to the resistance display.
3. Press 1(**Convert to Distance**) to display the resistances in terms of distance.

Opens Test

The Opens test performs a true three-terminal test on a pair. To run the test, you need to supply either the cable type or mutual capacitance of the cable (see Table 4-4).

Note

You do not need to provide the TG /TR ratio. This ratio, which is not generated in conventional two-terminal test sets, is actually measured by the CopperPro. Because of this, it makes no difference what percentage of pairs within the measured cable are workers, and you are not required to ground a percentage of the pairs at the C.O. to allow an accurate reading.

The Opens Test performs a snapshot measurement of the pair capacitance, requiring only that you select the appropriate cable type in the setup for the test.

Setting Up an Opens Test

To set up an Opens test, see the instructions under "Displaying a Setup Menu" in Chapter 3. When you set up the test, refer to Table 4-4, which describes the setup parameters for the Opens test.

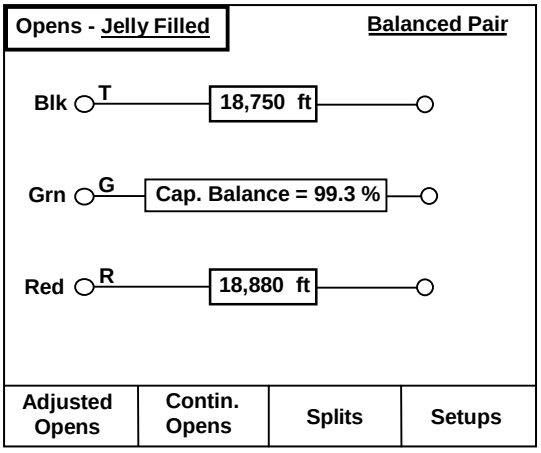
Table 4-4. Opens Test Setup Parameters

Parameter	Setting (default in bold)
Cable Type	**Jelly Filled**, Air Core, JKT, 5 Pr. Bur. Drop, 2 Pr. Bur. Drop, 1 Pr. Aer. Drop, 1 Pr. Universal, or Custom
Cap. Balance Pass Threshold	≥**95%** Ranges from 0 to 99

Opens Test Results

To run an Opens test, see "Running a Test in the POTS Toolbox".

Figure 4-7 shows a result screen from an Opens test that was conducted on a good, balanced pair:



acy18s.eps

Figure 4-7. Opens Test Result: Good Pair

Depending on the results you obtain, you may want to run additional tests on the pair. From the Opens test results screen, you can do the following:

- Press 1(**Adjusted Opens**) to run an Adjusted Opens test (see "Adjusted Opens Test" for details).
- Press 2(**Contin. Opens**).
- Press 3(**Splits**) if the pair is known to be a split pair (see "Splits Test" later in this chapter).

Adjusted Opens Test

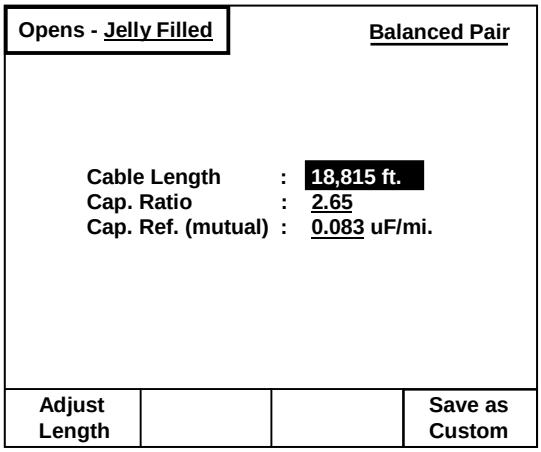
A cable manufacturer's data can vary by as much as 7% among cables. Therefore, for greater precision, it is strongly recommended that you first perform an Opens test on a *known good pair* in the cable to be tested. The data from the good pair can then be saved as a custom cable type for further use on faulted pairs in the same cable. Alternatively, if the length of a good pair is known by another more accurate means, you can supply that length and store the data as a custom cable type. This is called an *Adjusted Opens* measurement.

Figure 4-8 shows the results from the balanced pair (shown in Figure 4-7) being used to create a custom cable type that can be used when future Open tests are run on other pairs in the same cable. This method *always* yields the most accurate results.

To conduct an Adjusted Opens test, do the following:

1. Run an Opens Test on a good, balanced pair in the test cable.
2. Press 1(**Adjusted Opens**).

   A screen like the one in Figure 4-8 is displayed:



acy19s.eps

Figure 4-8. Adjusted Opens Test Screen

3. Do one of the following:

   - Press 1(**Adjust Length**) then supply a value for **Cable Length** (if known), using a maximum of five digits maximum and no commas or **Cap. Ref.** (mutual capacitance). When finished, press 4(**Save as Custom**).

     OR

   - Press 4(**Save as Custom**) to create a custom cable type with the same **Cap. Ratio** value as the good pair.

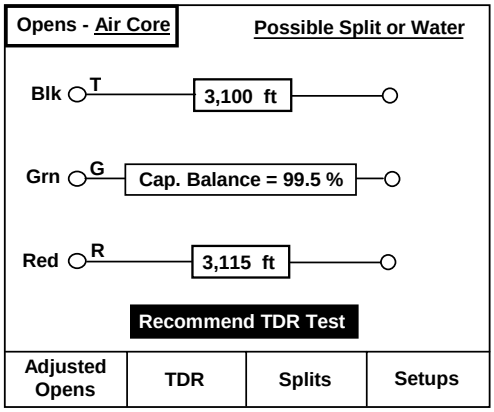
Splits Test

The Splits test is typically conducted after you run an Opens test that has reported a split pair condition. The results from a Splits test can help you quickly determine the *approximate* location of the detected split.

Note

The Splits test provides an approximate distance to a split. If you want to precisely locate a split, it is recommended that you run a TDR test (see Chapter 6 "TDR Testing and Fault Location" for details).

Figure 4-9 shows Opens test results screen, which indicates a possible split in a pair.



acy20s.eps

Figure 4-9. Opens Test Result Screen: Possible Split or Water

Notes

This type of result is generated whenever the Capacitance Ratio (TG to TR) of a balanced pair is greater than the average ratio for Air Core or Jelly Filled cable.

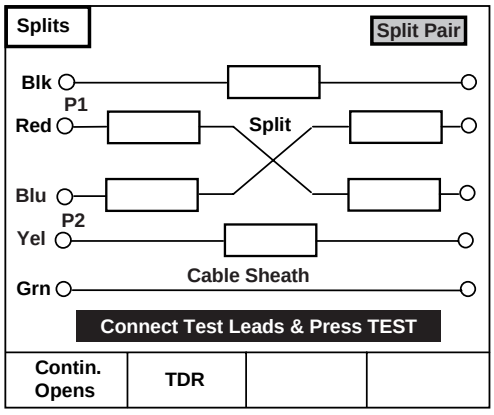
If the results are actually those of a known good pair (with a nonstandard Cap Ratio), you can save them by pressing ***Adjusted Opens*** *then pressing* ***Save as Custom****.*

Occasionally, a split pair tests as a balanced good pair because the pair's parameters fall within the normal range for ***Cap Ratio****. If the pair tests as a split pair or if the pair is known to be split but the Opens test indicates that it is a good, balanced pair, run a Splits test.*

To determine the approximate location of the split, proceed as follows:

1. On the Opens test result screen, press 3 (**Splits**).

   A connection diagram is displayed, as shown in Figure 4-10:



acy21s.eps

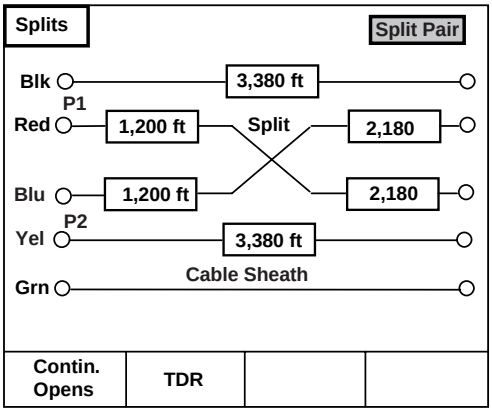
Figure 4-10. Splits Test: Connection Diagram

2. Verify that the pair is actually split with another pair. Then locate the second split pair by using a tracing tone probe or some other method.
3. As prompted, connect the CopperPro Pair 1 and 2 test leads to the two split pairs as shown in the connection diagram (Figure 4-10).
4. Press TEST.

Note

The two split pairs must be the same lengths(within ±5 %) for the CopperPro to obtain a meaningful measurement. If not, the CopperPro detects the imbalance and displays an error message.

The CopperPro makes the required measurements, as shown in Figure 4-11:



acy96s.eps

Figure 4-11. Splits Test Result Screen

Note that the tester fills in the cable section boxes with the distance to the split, the distance from the split to the end of the pair, and the length of the unsplit conductors.

5. Press [,](**Contin. Opens**) to view continuous two-terminal information, which includes the selected leg length or capacitance.

Resistance Fault Location (RFL) Test

The RFL test provides a highly accurate method of locating resistance faults (shorts, grounds, or crosses) that are too large for the TDR test to locate. It does this by using cable gauge and temperature values and a "nulling bridge" process. In this process, half of a resistance bridge is formed within the CopperPro and the faulted pair (strapped at the far end) forms the other half of the bridge. The internal bridge ratio is then changed until it precisely mirrors the ratio of the faulted pair leg to the good leg.

Setting Up an RFL Test

To set up an RFL test, follow the instructions under "Displaying a Setup Menu" in Chapter 3.When you set up the test, refer to Table 4-5, which describes the setup parameters for the RFL test.

Table 4-5. RFL Test Setup Parameters

Parameter	Settings (default in bold)
Cable Gauge	19AWG, 22AWG, **24AWG**, 26AWG, or 28AWG
Cable Temperature	**68**° F Ranges from –99 to 199.
Mult. Gauge Entry Limits	Sect. Length: 0 to 9999 Gauge / mm: same as Ca. Gauge Load: Y (Yes) or N (No)

Running an RFL Test

To run an RFL test, do one of the following:

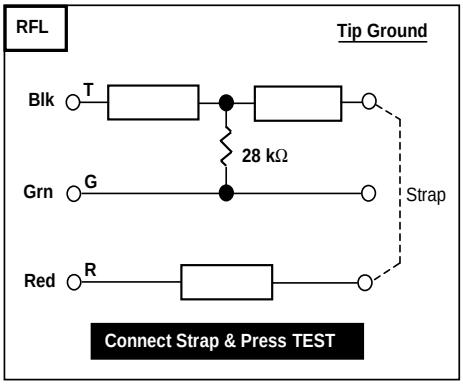
- From the **Main** menu, press **POTS** to display the toolbox (Figure 4-3). Select **R.F.L.**, then press TEST.

  OR

- From the **Setups - R.F.L.** menu, press TEST.

The CopperPro automatically finds and calculates the exact distance to all of the resistances on the pair.

If the fault is simple and one-sided, the tester displays a screen like the one shown in Figure 4-12:

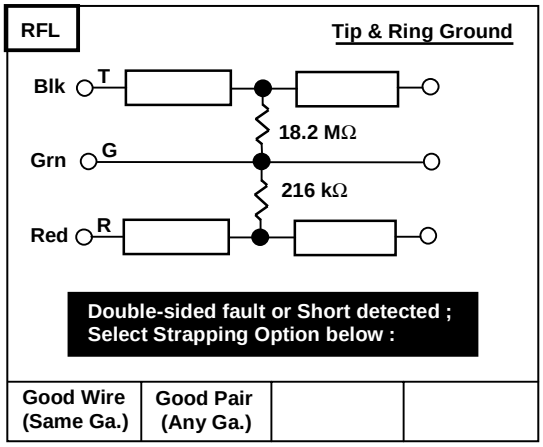


acy22s.eps

Figure 4-12. RFL Test Results: Fault Value and Position

Figure 4-12 shows all of the fault resistances and leg locations. If your screen looks like Figure 4-12, go to “Single-Sided Fault Location Test Results” for instructions on how to obtain distances to the fault resistances.

If the fault is a short or if both conductors are faulted, the tester displays a screen like the one shown in Figure 4-13:



acy25s.eps

Figure 4-13. RFL Test Results: Double-sided Fault or Short

If your screen looks like the one in Figure 4-13, go to "Short or Double-Sided Fault Location Test Results" for instructions on how to obtain distances to the fault resistances.

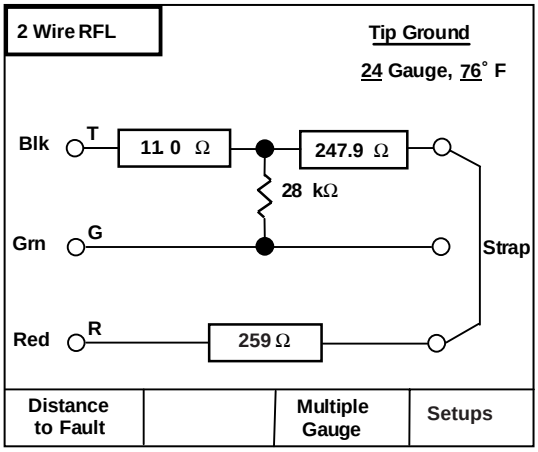
Single-Sided Fault Location Test Results

To view results for a one-sided fault, complete the following:

1. Connect the strap as shown in Figure 4-12, then press TEST.

   If the strap is not found, a "*Strap Connection Error*" message is displayed.

   If the strap is correctly connected, the CopperPro performs a "fault null" operation and displays a screen similar to the one in Figure 4-14.



acy23s.eps

Figure 4-14. Two-Wire RFL Test Results: Tip Ground

Figure 4-14 shows the resistance values of the conductor sections to the fault and the strap (shown in the diagram as a solid line).

2. Do one of the following:

   - If you received an error message, connect the strap again and restart the test.

     OR

   - If you supplied the correct cable gauge and temperature in the setup for the test, press [1](**Distance to Fault**).

     The relevant distances are displayed (see Figure 4-15). The values used to calculate the distance are displayed in the upper right corner of the screen along with status information for the pair.

OR

- If you did not supply the cable gauge and temperature in the setup for the test (or if the values have changed), you can provide the information now. Press 4(**Setups**) then enter the gauge and temperature values (see "Entering Multiple Wire Gauge Information" for details).

  When you finish, press BACK to return to the screen that displays the resistance values. Then, press 1(**Distance to Fault**) to view the location of the fault.

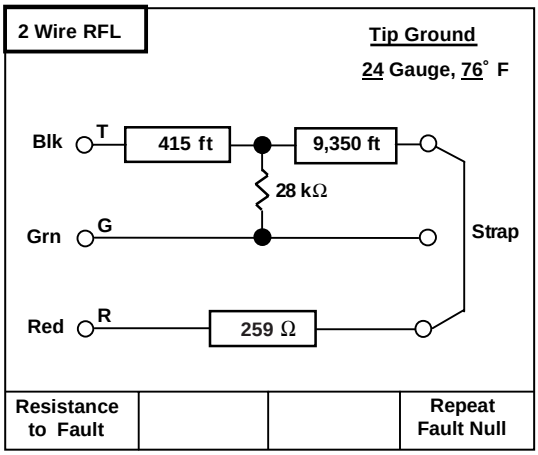
  The new values used in the calculation are displayed in the upper right corner of the screen along with the pair status information.

3. If you want to obtain a second reading, press 4(**Repeat Fault Null**).

   The CopperPro repeats the "nulling bridge" process, without again measuring the fault resistances.

Note

If you turn off the tester before the straps are placed and the RFL test is completed, RFL fault results and requested connection information are automatically saved in non-volatile memory. When you turn on the tester again and select the RFL function, a message is displayed asking whether you want to continue the previously unfinished RFL test or whether you want to start a new RFL test.



acy24s.eps

Figure 4-15. Two-Wire RFL Test Results: Distance to Fault

Entering Multiple Wire Gauge Information

For pair counts composed of multiple wire gauge sections or load coils, use this procedure to store multiple gauge information.

The CopperPro lets you store up to 20 “sections” of data. A section is defined as a length of cable having a gauge that is different from the preceding length or a length of cable containing a load coil at the end.

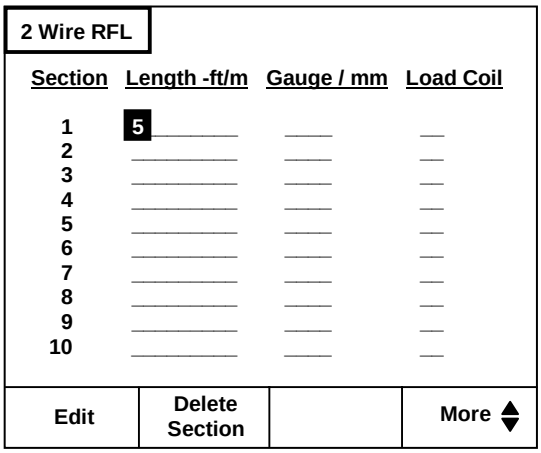
To enter multiple wire gauge information, do the following:

1. On the **Setups - RFL** screen, press 3 (**Multiple Gauge**).

   An entry screen is displayed. The **Length** field is highlighted.

2. Press ⌐(**Edit**).

   A blinking cursor appears in the first character position of the **Length** field as shown in Figure 4-16:



acy32s.eps

Figure 4-16. RFL Multiple Wire Gauge Entry Screen

3. Type the length of the first section (five digits maximum and no commas are allowed). Use the same unit of measure (feet or meters) that you selected when you configured units of measure for the tester (see "Selecting a Language and Associated Units of Measure" in Chapter 3 for details).

Note

After you type a digit, the cursor automatically advances one position to the right.

Press ⊖ or ⊕ to move the cursor forward or backward to select a previously typed digit without changing it. If you type a new digit, it overwrites the highlighted digit.

4. When you finish typing the length, press [ENTER].

   The cursor moves to the **Gauge** field.

5. Press [1](**Edit**). Press ⊕ or ⊖ until the desired gauge is displayed. Then, press [ENTER].

   The cursor moves to the **Load Coil** field.

6. Press [1](**Edit**). Press ⊕ or ⊖ to select **Y** if a load coil terminates the section or **N** if it does not. Then, press [ENTER].

   The cursor moves to the **Length** field of the next section.

7. Repeat Steps 2-6 until you enter information for all of the sections. When you finish, press [BACK] to return to the **RFL** results screen.

Note

It is important to make sure that the last section that you enter contains the strap position. If an "Insufficient Length Entered" message is displayed during the subsequent RFL test, it may be because the sum of the entered lengths is shorter than the Distance-to-Strap length measured by the CopperPro. In this situation, increase the length you entered for the last section. This change does not affect the accuracy of the results, but allows agreement between the entries and measurements.

Deleting an Wire Gauge Entry

To delete a wire gauge entry, press ⊕ or ⊖ to select the desired section. Then, press [2](**Delete Section**).

Scrolling Through the List of Wire Gauge Entries

To move forward to backward to other pages of section entries, press [4](**More**). Then, press ⊕ or ⊖.

Short or Double-Sided Fault Location (3 Wire) Test Results

To view test results for a short or double-sided fault, select the desired strapping option to complete the bridge (as prompted in Figure 4-13).

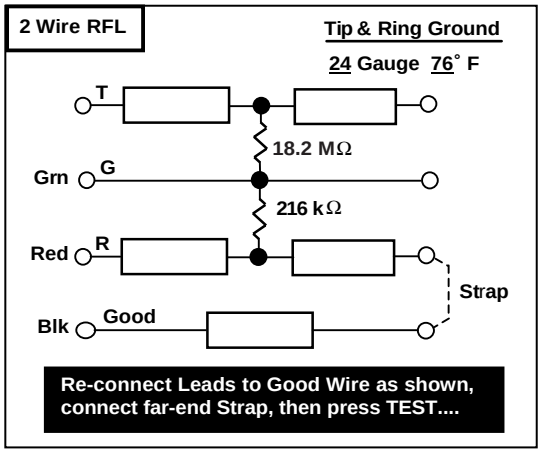
Note

If the fault is a short or if both conductors are faulted, you must use either a good conductor or pair to complete one leg of the bridge. It is best to use a separate good pair for the leg because it can be any length or gauge. If only one good conductor is available, it can work as well, but it must be the same length and gauge as the faulted pair.

Do *one* of the following:

- If only one good conductor is available, press 1 (**Good Wire**).

  A connection diagram like that shown in Figure 4-17 is displayed:



acy29s.eps

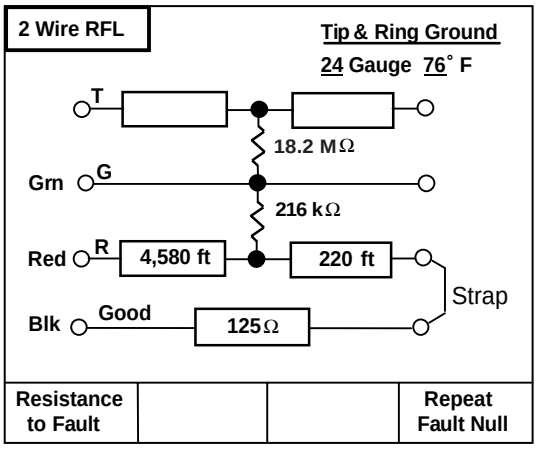
Figure 4-17. Two-Wire RFL Test Results: Good Wire Strap

a) As prompted, reconnect the leads to the good wire and connect the far-end strap. Then, press TEST.

   When the test finishes, the resistance values are displayed.

b) Press 1 (**Distance to Fault**).

All of the distances are displayed, as shown in Figure 4-18:



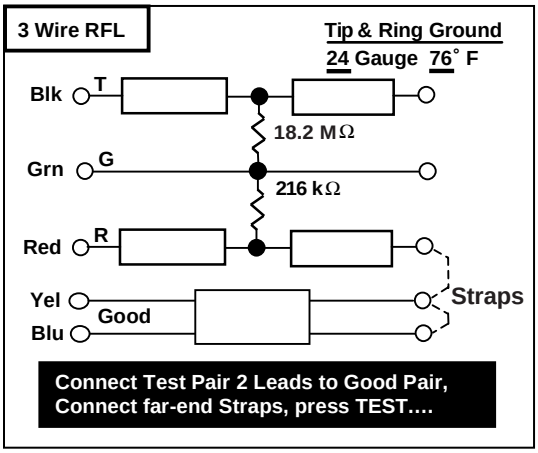
acy30s.eps

Figure 4-18. Two-Wire RFL Test Results: Distances

OR

- If a good pair is available, press [2](**Good Pair**).

  A connection diagram like the one shown in Figure 4-19 is displayed.



acy26s.eps

Figure 4-19. Three-Wire RFL Test: Good Pair Strap

This diagram shows the T1 and R1 test leads connected to the good pair and a far-end strap (in dotted lines). You are prompted to connect the far-end straps.

a) Connect the Pair 2 test leads (T1 and R1) to the good strapping pair and connect the far-end straps. Then, press TEST.

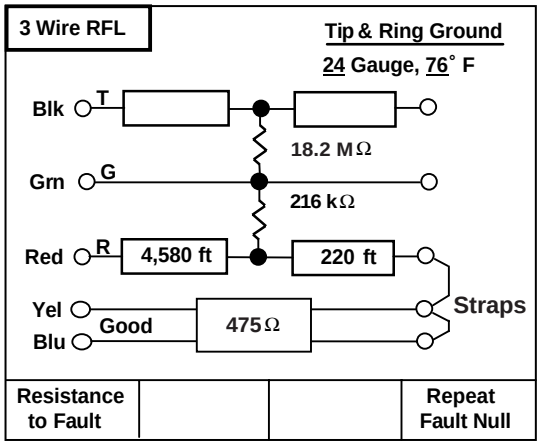
   The CopperPro performs the test using the separate good pair as the strap. When the test is completed, the resistance values are displayed.

Note

The process for the Three-Wire RFL test is slightly longer because the tester has to perform the nulling bridge process on both the strap pair and the faulted pair.

b) Press 1 (**Distance to Fault**).

All of the distances are displayed (see Figure 4-20). Note that values used to calculate the distances are displayed in the upper right corner of the screen along with status information for the pair.



acy27s.eps

Figure 4-20. Three-Wire RFL Test Results Good Pair Resistances

Load Coils Test

The Load Coils test performs a frequency sweep of the pair to determine the number of load coils present.

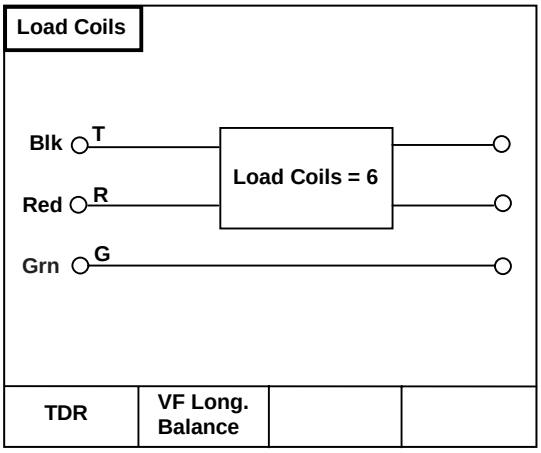
Setting Up a Load Coils Test

The Load Coils test has no test-specific setup.

Load Coils Test Results

To run this test, follow the instructions under “Running a Test in the POTS Toolbox” earlier in this chapter.

Figure 4-21 shows the results of a Load Coils test that was conducted on a pair with six loads:



acy33s.eps

Figure 4-21. Load Coils Test Results

Results from this test tell you the total number of coils that were detected. In Figure 4-21, the test reports that it detected six coils.

To find out the distance to the first coil, you can run a TDR test. To do this, press 1(**TDR**). See Chapter 6 "TDR Testing and Fault Location" for details.

To check for possible misloading due to the presence of half-loads, you can run a VF Longitudinal Balance test. From this screen, press 2(**VF Long. Balance**). See "VF Longitudinal Balance Test" for details.

Loop Devices Test

The Loop Devices test detects the presence of the following devices:

- Loop treatment devices, such as Loop Extenders and Range Extenders with Gain (REGs)
- Fault-sectionalizing devices, such as Maintenance Termination Units (MTUs) and Network Interface Devices (NIDs)
- Mechanical Bell Ringers (C4 and C5).

Setting Up a Loop Devices Test

The Loop Devices test has no test-specific setup.

Loop Devices Test Results

To run this test, follow the instructions under "Running a Test in the POTS Toolbox", earlier in this chapter.

Upon completion of the test, the CopperPro displays a result screen that lists each loop device and indicates whether or not it was detected on the test pair. A **Y** indicates that the device was detected, and an **N** indicates that the device was not detected.

Leakage Stress Test

The Leakage Stress test is a continuous resistance test that uses a higher test voltage than normal (approximately 150 VDC) to "punch through" a metallic wire fault that has oxidized over time. During normal resistance testing, this type of fault does not typically show up on a spare pair. It gradually appears under the application of a C.O. battery after a supposedly "good" pair is cut into service.

Setting Up a Leakage Stress Test

To set up a Leakage Stress test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. The test has one setup parameter, which is listed in Table 4-6.

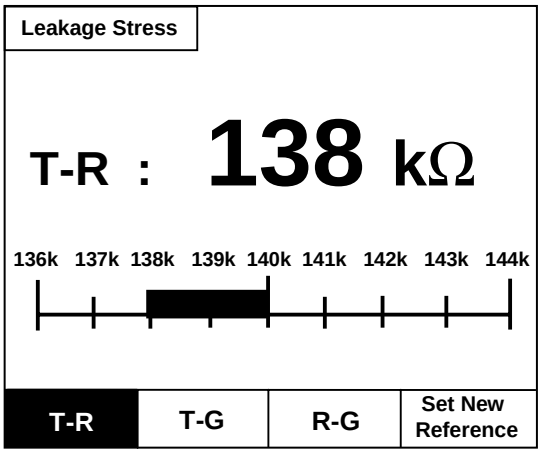
Table 4-6. Leakage Stress Test Setup Parameter

Parameter	Settings (default in bold)
Leakage Fault Pass Threshold	**500** kΩ

Leakage Stress Test Results

To run this test, follow the instructions under "Running a Test in the POTS Toolbox", earlier in this chapter.

Figure 4-22 shows results from a Leakage Stress test that was conducted on a faulty pair:



acy34s.eps

Figure 4-22. Leakage Stress Test Results: Faulty Pair

Note that the T-R resistance fault initially started at a reading of 140 kilohms, but during the applied stress voltage its value decreased to 138 kilohms. This reduction indicates the presence of a T-R short that has oxidized.

Under normal resistance fault testing, the T-R short would not be detected. After stress testing, a fault of this type usually remains long enough so that you can run an RFL test to determine its exact location.

Tracing Tone Test

The Tracing Tone test places a warbled, high-level ID tone on a test pair. You can choose to apply the following types of tones:

- Simplex (SX): a non-intrusive tone applied equally on the Tip and Ring Test Leads with respect to Ground
- T-G: a tone applied only between Tip and Ground
- R-G: a tone applied only between Ring and Ground
- T-R: an audible tone applied only between Tip and Ring.

Setting Up a Tracing Tone Test

The Tracing Tone test has no test-specific setup.

Running a Tracing Tone Test

To run a Tracing Tone test on a pair, complete the following:

1. From the **Main** menu, press **POTS** to display the POTS Toolbox (Figure 4-3).
2. Select **Tracing Tone**, then press ENTER.

   A Tracing Tone diagram is displayed.
3. Press the softkey for the type of tone you want to apply, then press TEST.

   A diagram depicting the type of tone you selected is displayed. The transmitting arrow indicates that the tone is being sent.
4. To stop sending the selected tone, press TEST.

VF Noise Test

This test performs a "snapshot" measurement of the voice frequency (VF), Metallic Noise (Nm), and Power Influence (PI) on a test pair.

Setting Up a VF Noise Test

To set up a VF Noise test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. When you set up the test, consult Table 4-7, which describes the parameters used to set up a VF Noise test.

Table 4-7. VF Noise Test Setup Parameters

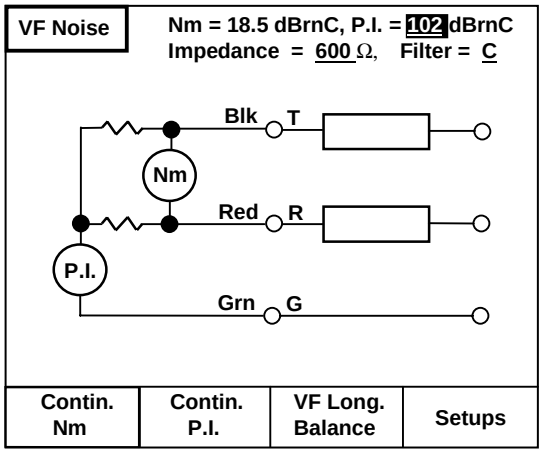
Parameter	Setting (default in bold)
Metallic Noise (Nm)	
Term. Impedance	**600 Ω** or 900 Ω
Term Mode	**Terminated** or Bridged
Measurement Filter	**C-Message**, C-Notched, 3K Flat, or 15K Flat
Pass Threshold	≤ **20 dBrn** Ranges from 0 to 99.
Power Influence (PI)	
Term. Impedance	**600 Ω** or 900 Ω
Term Mode	**Terminated** or Bridged
Measurement Filter	**C-Message**, C-Notched, 3K Flat, or 15K Flat
Pass Threshold	≤ **80** dBrn Ranges from 30 to 99.

VF Noise Test Results

To run this test, follow the instructions under "Running a Test in the POTS Toolbox", earlier in this chapter.

Figure 4-23 contains an example of a VF Noise test results screen. In this example, the pair has acceptable Metallic Noise (Nm). The Power Influence (PI) value, however, is outside acceptable thresholds (as defined in the setup for the test). Note that the PI value is displayed in flashing, reverse video to indicate that it exceeds the threshold setting.

The diagram in Figure 4-23 also shows how the CopperPro's internal circuits are actually connected to perform the Nm and PI measurements.

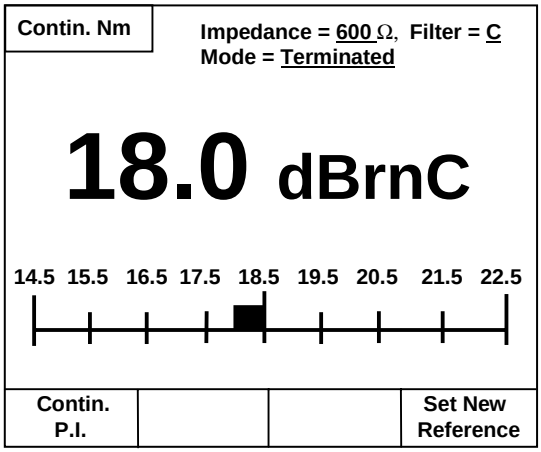


acy35s.eps

Figure 4-23. VF Noise Test Results

To obtain a continuous Metallic Noise reading on the pair, press 1 (**Contin. Nm)**.

The CopperPro displays a screen similar to the one shown in Figure 4-24:



acy36s.eps

Figure 4-24. Continuous Metallic Noise Reading

To obtain a continuous Power Influence reading, press 1 (**Contin. PI**).

Note

If the Power Influence reading is low, it is often helpful to see the resulting effect on the pair by applying a local disturbing influence (see "VF Longitudinal Balance Test" for details).

VF Loss Test

The VF Loss test requires that a generic VF transmitting device (such as a C9925BLT or another CopperPro) be connected at the far end of the test pair. The device must be capable of transmitting single tones or swept tones at a 0 dBm level. The CopperPro measures the signal level at the near end then displays the resulting information for pair loss.

Setting Up a VF Loss Test

To set up a VF Loss test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. Table 4-8 describes the one setup parameter for the test.

Table 4-8. VF Loss Setup Parameter

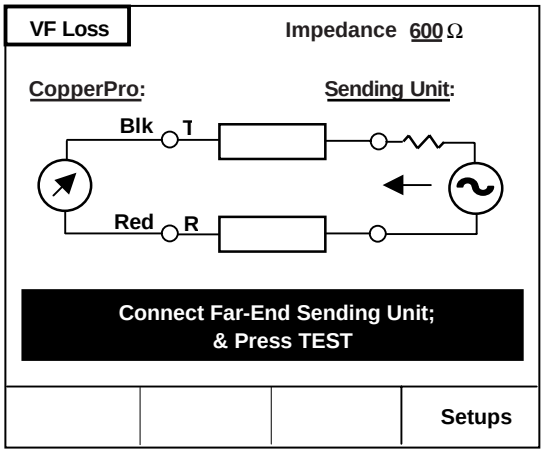
Parameter	Settings (default in bold)
Termination Impedance	**600** Ω or 900 Ω

Running a VF Loss Test

To run a VF Loss test, complete the following:

1. From the **Main** menu, press **POTS** to display the POTS Toolbox (Figure 4-3).
2. Select **VF Loss**, then press ENTER to

   A connection diagram is displayed, as shown in Figure 4-25:



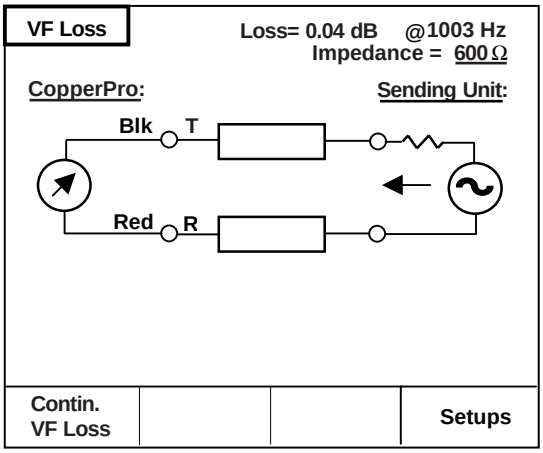
acy108s.eps

Figure 4-25. Connection Diagram for the VF Loss Test

3. As prompted, connect the far-end sending tester as shown in the diagram. Then, press [TEST] to start the test.

VF Loss Test Results

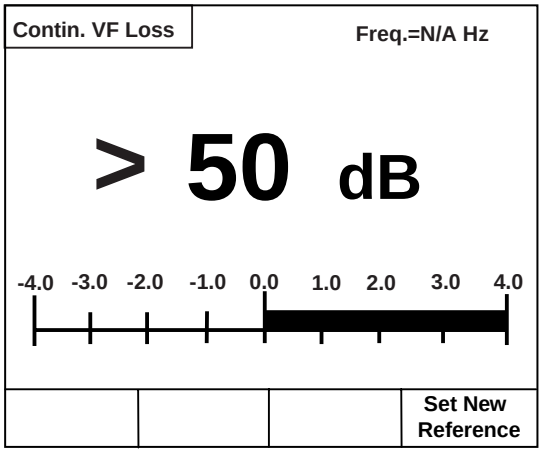
The VF Loss test gives you a "snapshot" measurement of loss at a given frequency and level. This measurement is provided in the upper right corner of the result screen (see Figure 4-26) along with the setup information for the test.



acy97s.eps

Figure 4-26. VF Loss Test Results

To view continuous loss measurements, press 1 (**Contin. VF Loss**). The CopperPro displays a screen similar to the one shown in Figure 4-27:



acy98s.eps

Figure 4-27. Continuous VF Loss Measurements

If the current value drifts off one of the ends of the graph, press [4](**Set New Reference**) to re-center the reading on the bar graph.

VF Longitudinal Balance Test

The VF Longitudinal Balance test applies a locally generated, high-level, common-mode (longitudinal) disturbing tone to the test pair and simultaneously measures the metallic noise caused by the tone. Longitudinal balance is displayed as the difference in dB between the applied and measured signals.

Setting Up a VF Longitudinal Balance Test

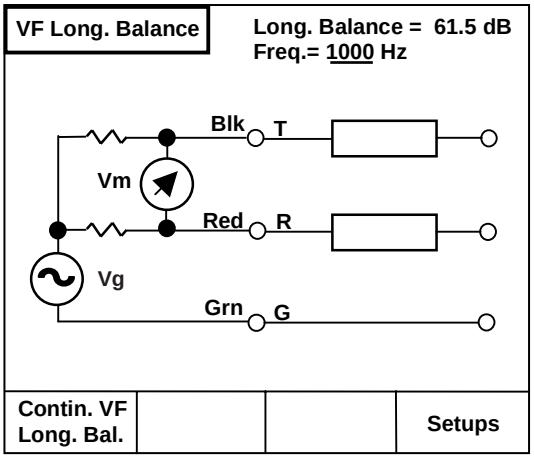
To set up a Longitudinal Balance test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. When you set up the test, refer to Table 4-9, which describes the setup parameters for the test.

Table 4-9. VF Longitudinal Balance Setup Parameters

Parameter	Setting (default in bold)
Pass Thresh.	≥**60 dB** Ranges from 0 to 80.
Disturbing Frequency	**1000 Hz** Ranges from 200 to 2500.

VF Longitudinal Balance Test Results

Figure 4-28 shows the results of a VF Longitudinal Balance test conducted on a good pair.



acy38s.eps

Figure 4-28. Longitudinal Balance Test Results: Good Pair

The value for Longitudinal Balance (**Long. Balance= 61.5 dB**) is shown in the upper right corner along with the test's setup information (**Freq.= 1000 Hz**).

Vg represents the locally applied longitudinal disturbing signal. **Vm** is the resulting metallic signal due to pair imbalance (measured by the tester as metallic noise).

To obtain continuous Longitudinal Balance test results, press ↓(**Contin. VF Long. Bal.**).

Send VF Tone Test

In this test, the CopperPro generates a variety of precision single tones, swept tone sets, or a composite VF tone set.

Setting Up a VF Tone Test

To set up a VF Tone test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. The test has one setup parameter, which is listed in Table 4-10.

Table 4-10. VF Tone Test Setup Parameter

Parameter	Setting (default in bold)
Term. Impedance	**600 Ω** , 900 Ω

Running a VF Tone Test

To run a VF Tone test, follow these steps:

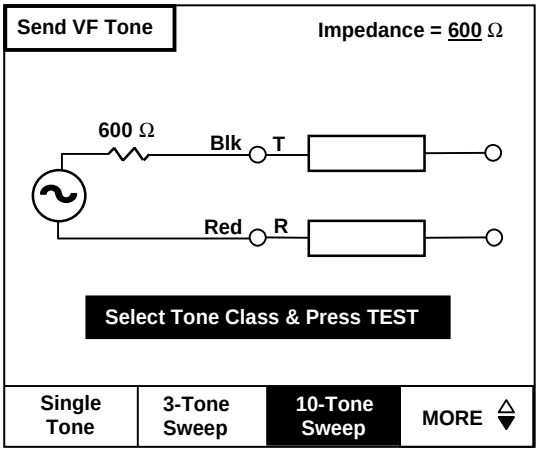
1. Do one of the following:

   - From the **Main** menu, press **POTS** to display the POTS Toolbox (Figure 4-3). Select **VF Tone**, then press ENTER.

     OR

   - From the **Setups - VF Tone** screen, press TEST START STOP.

The **Send VF Tone** screen is displayed, as in Figure 4-29:



acy40s.eps

Figure 4-29. Send VF Tone Screen

2. Press the softkey for the type of tone (see Table 4-11 for descriptions) that you want to send, then press TEST.

   The CopperPro sends the selected tone. A transmitting arrow is displayed to indicate that the tone you selected is being sent.

Table 4-11. Types of VF Tones

Tone	Description
Single Tone	• Continuously transmitted single tone • Settable level from +3 to -20 dBm • Settable frequency from 24 Hz to 20 kHz
3-Tone Sweep	• Sequence of 3 tones, each lasting four seconds • 404, 1004, 2804 Hz • 0.0 dBm fixed level per tone
10-Tone Sweep	• Sequence of 10 tones, each lasting three seconds • 404, 804, 1004, 1204, 1404, 1604, 1804, 2004, 2804, 3004 Hz • 0.0 dBm fixed level per tone
30-Tone Sweep	• Sequence of 30 tones, each lasting two seconds • 304 Hz to 3304 Hz (in 100 Hz increments) • 0.0 dBm fixed level per tone
SmartTone	• Composite signal (100 simultaneous tones) • 300 Hz to 3400 Hz

Dial-Up Test Group

The Dial-Up Test group consists of VF-terminated transmission tests that are conducted on working POTS lines. These tests operate by dialing various C.O. equipment. Following is a list of tests in this group:

- Smart-Pro Test Group
- SASS Test Group
- DATU Test Group
- Milliwatt VF Loss test
- Quiet Termination VF Noise test
- Loop Current & Ground Ohms test
- Number ANI test
- On-hook Caller ID test
- Call Waiting Caller ID test

To access the tests, display the POTS toolbox (Figure 4-3).

Setting Up a Dial-Up Test

To set up a Dial-Up test, do the following:

1. For each Dial-Up test that you want to run, set the Pass thresholds for each associated subtest (consult the list in Table 4-12).

Table 4-12. Dial-Up Tests and Associated Subtests

Dial-Up Test	Associated Subtests
Smart-Pro (VF Tone sending device	VF Loss, VF Slope, VF Noise, and Caller ID
SASS (VF Tone sending device)	VF Loss, VF Slope, VF Noise, and Caller ID
DATU (Metallic Termination Device)	Shorts & Grounds, Loop Resistance, and Resistive Unbalance
Milliwatt Generator (generic 1 kHz tone generator)	VF Loss
Quiet Termination (generic 600/900 Ohm termination circuit)	VF Noise
Loop Current and Ground Ohms	Loop Current, R-G Current, and Ground Ohms.

2. Set up the Dial-Up Test. To do this, follow these steps:

   a) From the **Main** menu, press **POTS**.

   b) From the POTS Toolbox, select **Dial-up Tests**, then press 4(**Setups**).

   c) Select a setting for each Dial-up Test setup parameter (see Table 4-13).

Table 4-13 lists the setup parameters for the Dial-Up test.

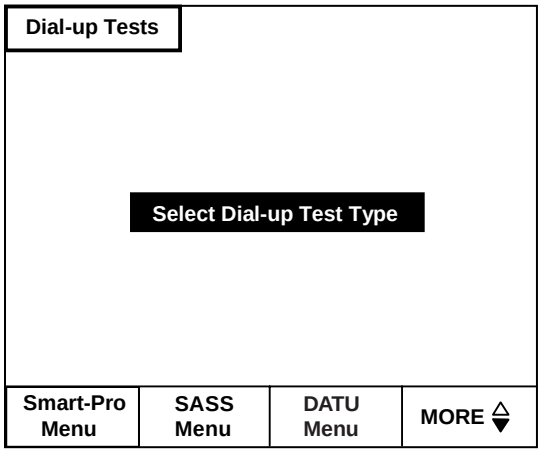
Table 4-13. Dial-Up Test Setup Parameters

Setup Parameter	Setting (default in bold)
Dialing Mode	**Tone** or Pulse Dialing
Start Mode	**Loop** or Ground Start
Centrex Mode	**Disabled** or Enabled
Centrex Prefix Digit	**None** or user entry (for example, 9)
Feature Disable Prefix	**None** or user entry (for example, *82)
Dialtone Detection	**Enabled** or Disabled

Running a Dial-Up Test

This section describes each test in the Dial-up Test group and shows you how to run it. Unless otherwise indicated, follow this procedure to run a test in this group:

1. From the **Main** menu, press 1 (**POTS**). Then, select **Dial-up Tests**.
2. Press ENTER to display the **Select Dial-up Test Type** screen:



acy43s.eps

Figure 4-30. Dial-Up Tests Selection Screen

3. Press the softkey for the test that you want to run.

Note

*Press (**MORE**) to display softkeys for the remaining tests in the Dial-Up Test group. To redisplay the first set of softkeys, press (**MORE**) again.*

Smart-Pro Tests

The tests in this group allow the CopperPro to dial a C.O.-based Fluke Networks Smart-Pro unit and run various VF tests over a POTS dial-up pair.

The following procedure shows you how to run a 10-Tone Slope test. Use this procedure as a guide when running any of the tests in the Smart-Pro test group.

To run a 10-Tone Slope test, complete the following:

1. From the **Select Dial-up Test Type** screen, press 1 (**Smart-Pro Menu**).

   The **Smart-Pro Menu** is displayed. Table 4-14 describes the tests that you can access from the softkeys on this menu:

Table 4-14. Smart-Pro Tests

Test	Description
N-Tone Slope	The SmartPro applies a sequential set of 3, 10, or 30 tones to a line. The CopperPro measures the frequency, level, and slope of these tones.
SmartTone Loss	The Smart-Pro applies a composite set of 100 VF tones to a line. The CopperPro uses DSP techniques to measure the tones.
Quiet Term. VF Noise	The Smart-Pro applies a quiet termination to the line for 20 seconds. The CopperPro measures the Metallic Noise and Power Influence on the pair.
Caller ID Callback	The Smart-Pro receives a command to return a call back to the test line. After receiving the command, it issues a three-second tone (heard through the CopperPro's speaker), prompting the user to hang up for the return call. Press ENTER to hang up. The CopperPro then automatically captures and displays unterminated Caller ID information during the return call.

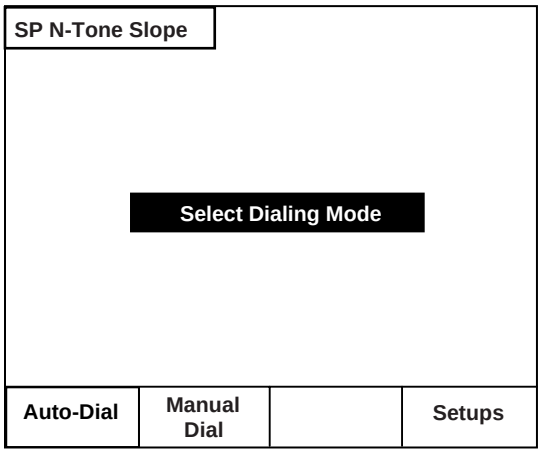
2. Press the softkey for the subtest that you want to run.

Note

*Press 4(**MORE**) to display additional softkeys.*

3. Press 2(**N-Tone Slope**).

   The **Select Dialing Mode** screen is displayed:



acy107s.eps

Figure 4-31. Dialing Mode Selection Screen

4. Select a method of dialing. Do one of the following:

   - If you want the CopperPro to automatically dial the number of the C.O equipment, press 1(**Auto-Dial**). Select the telephone number from the displayed list, then press TEST.
   - If you want to manually dial the number of the C.O. equipment, press 2(**Manual Dial**). Dial the number from the CopperPro's keypad.

After the CopperPro successfully connects, the Smart-Pro announces the calling number.

You are prompted to enter the code for the test that you want to run.

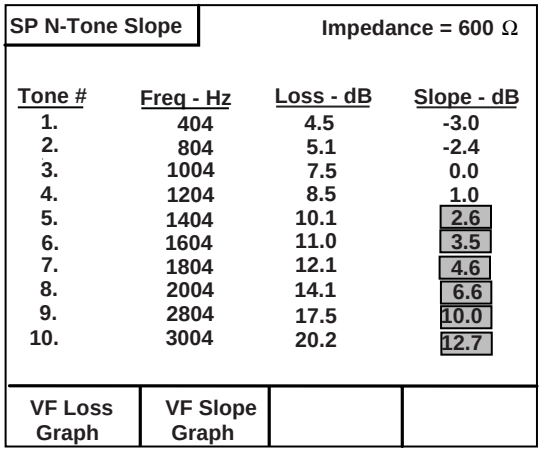
Each Smart-Pro test and its corresponding code (key to press) is listed in Table 4-15:

Table 4-15. Smart-Pro Test Key Commands

To run this test:	Press key:
Milliwatt	1
Quiet Termination	2
3-Tone Sweep	3
10-Tone Sweep	4
30-Tone Sweep	5
SmartTone	6
Callback	7
Keypad	8

5. To start a 10-Tone Sweep test, press **4** then ENTER.

   The CopperPro measures the frequency, loss, and slope of each tone it receives and displays results in real time, as shown in Figure 4-32:



acy100s.eps

Figure 4-32. Smart-Pro N-Tone Slope Test Results

Failing slope and 1004 Hz loss values are identified in flashing reverse-video format.

6. To view detailed graphs depicting loss or slope, press [1](**VF Loss Graph**) or [2](**VF Slope Graph**), respectively.

SASS Tests

The SASS (Single Access Service System) tests allow the CopperPro to dial a C.O.-based Harris SASS unit over a POTS pair and run various VF tests.

To run the tests in this group, follow the procedure under “Smart-Pro Tests”, earlier in this chapter. When prompted to enter the code for the test you want to run, consult Table 4-16.

Table 4-16. SASS Test Key Commands

To run this test:	Press key(s):
Milliwatt	86
Quiet Termination	85
3-Tone Sweep	83
10-Tone Sweep	80
Program. Sweep	87
Callback	7
Keypad	5

DATU Tests

The DATU (Direct Access Test Unit) tests allow a C.O.-based Harris DATU to be dialed over a POTS pair. In this test, the pair is dialed from a test line, then the battery feed is split off so that various VF tests can be run over the dial-up pair.

To run a DATU test, complete the following:

1. From the **Select Dial-up Test Type** screen, press 3(**DATU Menu**).

   The **DATU** screen is displayed.

2. Do one of the following:

   - Press 1(**Automatic Open**). Then, follow the on-screen prompts and instructions.

     This test allows the DATU Auto-Open or "dry line" number (typically a unique number that is separate and distinct from the normal DATU access number) to be dialed from the test line. After the number is dialed, the battery feed circuit is split from the line for one to two minutes (with no termination applied).

     Note

     After you obtain automatic access, it is recommended that you conduct a POTS Auto-Test on the test line. Auto-Test results will give you the most information quickly (before the line battery is restored).

     OR

   - Press 2(**Manual Termination**). Then, follow the on-screen prompts and instructions.

     This test allows the DATU to be manually or automatically dialed from the test line.

During the test, you are prompted to supply the following:

- Password (if required)
- Phone number of the line-under-test
- Termination code (see table below)
- Number of minutes (**Hold Time**) to apply the termination.

Table 4-17 lists the tests you can run and their termination codes.

Table 4-17. DATU Manual Termination Codes

To run this test:	Press key(s):
Open Line	6
Short Line	7
Shorts & Grounds	33
Ground Ring	37
Ground Tip	38
Hi-Level TR Tone	44
Hi-Level RG Tone	47
Hi-Level TG Tone	48

3. When prompted to hang up, press ◯ then BACK.

   The CopperPro goes off-hook, and you return to the **Main** menu.

4. Wait 30 seconds to allow the DATU to apply the termination. Then, run the appropriate tests for the selected termination.

Note

You must complete all testing within the period you specify for ***Hold Time****. If the battery is restored in the middle of a test, the CopperPro reports erroneous measurements.*

Milliwatt VF Loss Test

The Milliwatt test allows the CopperPro to dial a centralized Milliwatt signal generator (0 dBm, 1004 Hz) to conduct a mid-band Loss test on a POTS dial-up pair. In this test, the test tone or termination is automatically placed on the line after the equipment answers.

Quiet Termination VF Noise Test

The Quiet Termination VF Noise test allows the CopperPro to dial a centralized Quiet Termination (900 Ω and 2.19 uF) to obtain Metallic Noise and Power Influence measurements.

Loop Current and Ground Ohms Test

During the Loop Current and Ground Ohms test, the CopperPro uses the attached POTS line interface to make its measurements. The CopperPro goes off-hook and measures loop current followed by Ring-to-Ground current through a 430 Ω resistance. It calculates the cable sheath ground resistance to the C.O. switch.

Number ANI Test

The Number ANI (Automatic Number Identification) test allows the CopperPro to dial a centralized ANAC unit to obtain the directory number of the test pair (compatible with both Voice and DTMF ANAC units).

On-Hook Caller ID Test

The On-Hook Caller ID test allows the CopperPro to receive a call on the line-under-test from another line. The connected CopperPro remains "on-hook" on the test line to obtain unterminated Caller ID information.

Note

Both the SmartPro and SASS units have a callback function that allows Caller ID information to be retrieved without requiring that the equipment be called from a separate line. See the SmartPro menu description for details.

To run this test, do the following:

1. From the **Select Dial-up Test Type** screen, press 4(**MORE**) twice.
2. Press 2(**On-Hook Caller ID**).

   The CopperPro is in now in a "wait for call" state.
3. Have another party call the line to which the CopperPro is connected.

   Note

   The CopperPro will wait indefinitely for the party to call the line.

   When the CopperPro receives the call, it displays the Caller ID information on the LCD.
4. To exit this mode, press TEST or BACK.

Call Waiting Caller ID Test

The Call Waiting Caller ID test allows the CopperPro to place a call on the line-under-test then wait to be called from another line. The CopperPro is "off-hook" on the test line to obtain terminated Caller ID information.

To run this test, do the following:

1. From the **Select Dial-up Test Type** screen, press 4(**MORE**) twice.
2. Press 3(**Call Waiting Caller ID**).

   The **Dialing Mode** screen is displayed.
3. Dial the number. Do one of the following:

   Note

   A Quiet Termination number is typically called, but the number dialed can be answered by a person.

   - To have the CopperPro dial, press 1(**Auto-Dial**). Then select a telephone number that will answer.

     The CopperPro is in a "wait-for-call" state.
   - To dial the number yourself, press 2(**Manual Dial**). Then, dial a telephone number that will answer.

     The CopperPro is in a "wait-for-call" state.
   - Have another person call the number of the test line.

   When the tester receives the call, it displays the Caller ID information on the LCD.
4. To exit the "wait-for-call" state, press TEST or BACK.

Terminated VF Tests

The Terminated VF test group includes double-ended, voice frequency Auto-Tests. These tests require a far-end terminator or sending device, such as a 3M "FED" or future devices (reserved). The CopperPro automatically controls the far-end device, so you do not have to use a separate control pair.

During the Auto-Tests, the CopperPro first runs a sequence of single-ended parametric tests then conducts a series of terminated voice frequency transmission tests to effectively qualify the test pair for voice frequency services. The following individual tests are conducted:

- AC & DC Voltage
- Shorts & Grounds
- Opens
- Load Coils
- VF Noise
- VF Longitudinal Balance
- Tip, Ring, Loop and Ground Resistance
- Resistive Unbalance
- 100-Tone VF Loss (reserved for future)
- 10-Tone Slope

Setting Up a Terminated VF Test

To set up a test, complete the following:

1. Set the Pass thresholds for each individual test (see previous list).
2. Set up the Auto-Test. Do the following:
   a) From the POTS Toolbox, select **Terminated VF Tests**. Then press ENTER.
   b) From **Select Terminated Test Type** screen, press 4 (**Setups**).
   c) Select a setting for each VF Terminated test parameter.

Running a Terminated VF Test

Notes

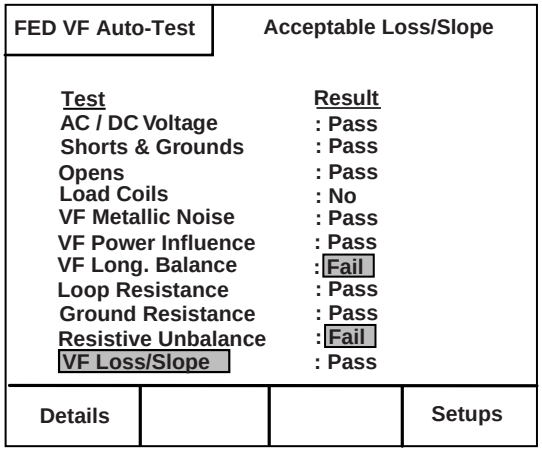
"Reserved" indicates that the [,] key is reserved for future use.

This procedure shows you how to run a FED Auto-Test. You can use this procedure to run any of the tests in this group (when they become available).

To run a Terminated VF Test, do the following:

1. From the **Select Terminated Test Type** screen, do the following:
2. Press [2](**FED Auto-Test**) then follow the on-screen instructions.

   When the test ends, the CopperPro displays results. Figure 4-33 shows a an example of a summary result screen from a FED VF Auto-Test:



acy103s.eps

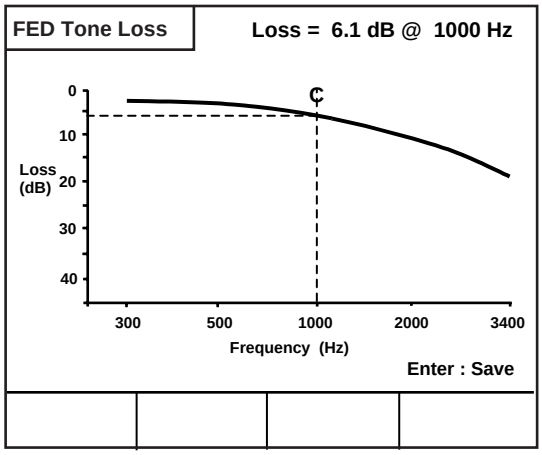
Figure 4-33. FED VF Auto-Test Summary Results

This screen lists the tests that were conducted during the Auto-Test. Tests with failing results have **Fail** highlighted in reverse video format.

3. To view the overall summary result for a test in the list, press ⊕ or ⊖ to move the cursor to the name of the test.

4. To view detailed results for a test, press ⊕ or ⊖ to move the cursor to the name of the test. Then, press 4 (**Details**).

   For example, if you select **VF Loss/Slope**, then press 4 (**Details**) followed by **VF Loss Graph**, a detailed result screen like the one shown in Figure 4-34 is displayed:



acy104s.eps

Figure 4-34. Detailed Results from a FED Tone Loss Test

   Note that Loss (**6.1 dB**) at the selected cursor frequency (**1000 Hz**) is displayed in the upper right corner.

5. To view loss at other frequencies press ⊕ or ⊖ to move the cursor to any point along the curve.

Monitor Line Test

The Monitor Line test provides a high-impedance, non-intrusive method for monitoring the audio status of a pair.

To monitor a pair, complete the following:

1. From the **Main** menu, press **POTS** to display the POTS Toolbox (Figure 4-3).
2. Select **Monitor Line**, then press TEST

   The CopperPro displays this message: "*Audio Monitor Enabled. Press TEST to stop*".

   The audio signal for the test pair is sent to the CopperPro speaker.

   Note

   Press◯, then ⊕ to increase or ⊖ or decrease the volume of the speaker.

To stop monitoring a pair, press TEST or BACK.

Chapter 5
XDSL Testing and Loop Qualification

Introduction

The tests described in this chapter can help you determine an OSP cable's qualifications for carrying modern high-speed digital services.

The chapter begins by showing you how to set up and run an ADSL and an XDSL Auto-Test. Like the POTS Auto-Test, the ADSL and XDSL Auto-Tests contain a series of individual automatic tests that you can run on a pair. As a general practice, you can use these Auto-Tests to obtain a quick overall assessment of the transmission capabilities of a cable and its suitability for various grades of service.

The second half of this chapter focuses on the individual tests in the XDSL toolbox. This toolbox contains both single-ended physical parametric tests and two-ended wideband transmission tests. As a group, the tests in the XDSL toolbox are useful for identifying the presence of line trouble that can disqualify a pair from carrying a particular digital data service. Additionally, the tests can help you determine the maximum service data rate that a pair is capable of carrying.

ADSL Auto-Test

The ADSL Auto-Test is a two-ended test that performs a rapid— yet comprehensive— ADSL DMT (Discrete Multi-Tone) transmission test on a pair. The test complies with ANSI T1.413 standard frequencies and provides the following results:

- Predicted downstream and upstream data rates
- Insertion loss measurements
- Signal-to-Noise Ratio (SNR)
- Bits-per-tone measurements.

To run this test, you need two CopperPro testers—one as far-end transmitting tester and the other as the receiving tester—at either end of the test pair. The testers communicate over the test pair so you do not need a separate control pair.

Setting Up an ADSL Auto-Test

To set up an ADSL Auto-Test, complete the following procedure on both CopperPro testers:

1. From the **Main** menu, select **ADSL Auto-Test**. Then, press 4(**Setups**).

   The **Setups – ADSL Auto-Test** menu is displayed. The test-specific setup parameters are located at the bottom of this screen. Refer to Table 5-1 for descriptions of the parameters and their settings.

2. For each parameter that you want to change, complete the following:

   a) Press ⊕ to move the cursor to the parameter's setting. Press 1 (**Edit**).

   b) Press ⊕ to display the desired setting. Then, press ENTER to save the selection.

Table 5-1. ADSL Auto-Test Setup Parameters

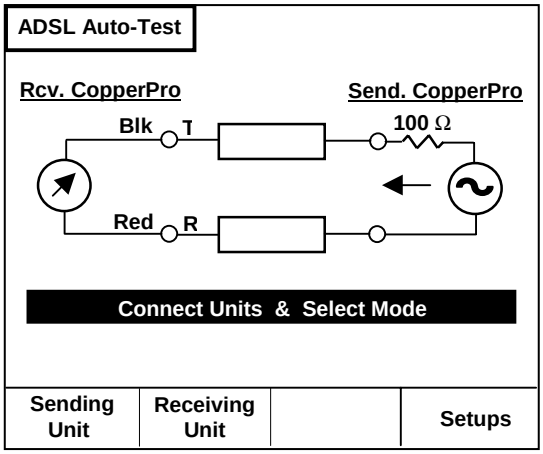
Parameter	Setting (default in bold)
ADSL Standard	**ANSI** or G.Lite
Noise Measurement Filter	E, F, G, or **None**

Starting and Stopping an ADSL Auto-Test

To start an ADSL Auto-Test, complete the following procedure on both CopperPro testers:

1. From the **Main** menu (Figure 3-2), select **ADSL Auto-Test**. Then, press ENTER.

   The **ADSL Auto-Test** connection screen (Figure 5-1) is displayed:



acy53s.eps

Figure 5-1. ADSL Auto-Test Connection Screen

2. Using Figure 5-1 as a guide, connect the two CopperPro testers.

   Note

   While the test is in progress, the receiving unit operates as the "master" and the sending unit operates as the "responder".

3. On the sending tester, press 1(**Sending Unit**). Then, press TEST.

   The tester displays an "Idle" message and waits for control signals from the receiving tester.

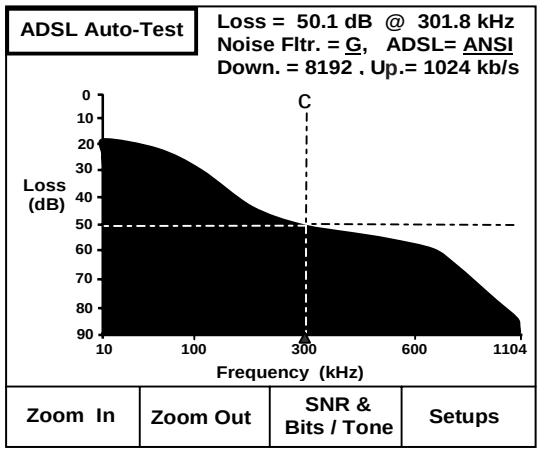
4. On the receiving tester, press 2(**Receiving Unit**). Then, press TEST.

   The test begins.

To stop an ADSL Auto-Test, press TEST.

ADSL Auto-Test Results

After the ADSL Auto-Test ends, the **ADSL Auto-Test** result screen (Figure 5-2) is displayed:



acy54s.eps

Figure 5-2. ADSL Auto-Test Result Screen

Figure 5-2 is an example of a typical ADSL Auto-Test result screen. This screen displays a graph of insertion loss results for the test pair at the ADSL DMT frequencies.

Note

The following paragraphs describe the elements appearing in Figure 5-2. These descriptions and operations apply to all of the ADSL Auto-Test result screens.

The graph is comprised of loss levels at each of the DMT frequency bins. Dashed lines mark the location of the cursor, which is positioned on one of the bins. The exact Loss and Frequency values where the cursor is positioned are displayed in the upper right corner of the screen. Beneath these values the setup information for the test and predicted data rates are listed.

To view Insertion Loss values at other DMT frequency bins, momentarily press ◄ or ► to move the cursor one bin at a time across the graph.

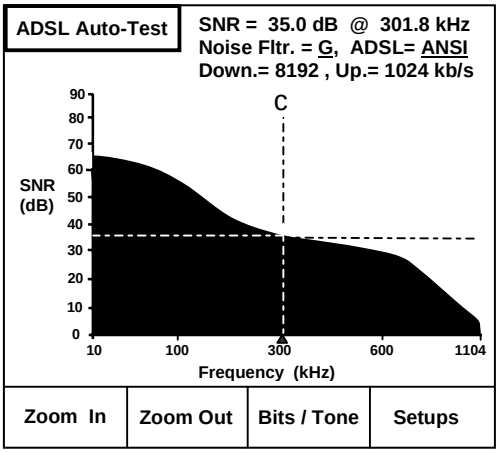
Note

If you press and hold the arrow key, the cursor moves more rapidly across the graph.

To see the values on the graph in more detail, press F1(**Zoom In**). The cursor remains at the selected frequency, but the value bars for the individual frequency bins are now visible on the scale. To view the frequency bins at even greater resolution, press F1(**Zoom In**) again. To return to the original resolution, press F2(**Zoom Out**) until the original screen is redisplayed.

To change the vertical scale of the graph, press ▲ to increase or ▼ to decrease the size of the bar (and adjust the scale).

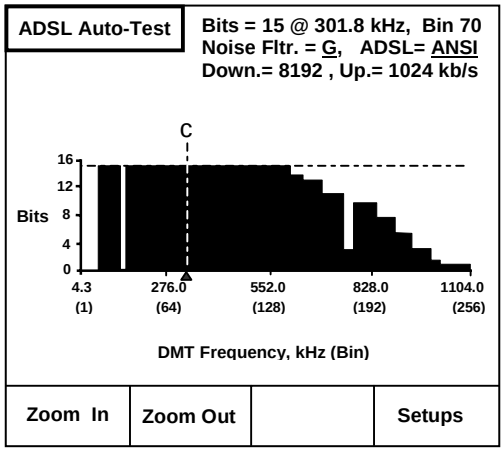
To view SNR values for the pair, press F3(**SNR & Bits/Tone**). A graph similar to the one shown in Figure 5-3 is displayed:



acy55s.eps

Figure 5-3. ADSL Auto-Test Results: SNR Values

To view bit counts for the pair, press 3(**Bits/Tone**). A graph of bit counts at various frequencies is displayed, as shown in Figure 5-4:



acy56s.eps

Figure 5-4. ADSL Auto Test Results: Bit Count

ADSL G-Lite Test

The ADSL G-Lite test is a shorter version of the ADSL test. In this test, only the first half of the DMT frequency bins are used and only a maximum of eight bits per tone is encoded (as opposed to the 15 tones encoded in the ANSI ADSL test).

To run a G-Lite test, follow these steps:

1. From any ADSL screen, press 4 (**Setups**).
2. Select **G-Lite**. Then press TEST START STOP.

After the test ends, ADSL G-Lite test results are displayed. These results are similar to those described under “ADSL Auto-Test Results”.

XDSL Auto-Test

The XDSL Auto-Test is somewhat similar to the ADSL Auto-Test. The XDSL Auto-Test is different because it measures the frequency response on spare pairs at ten unique frequencies instead of at the 256 DMT bin frequencies used by DMT ADSL. These ten frequencies represent the Nyquist or maximum energy frequencies of ten common types of high-speed data services.

To run this test, you also need two CopperPro testers—one as the far-end transmitting tester and the other as the receiving tester. The far-end tester transmits the Nyquist tone set, and the receiving tester measures the signal amplitude and displays Insertion Loss results.

Setting Up an XDSL Auto-Test

To set up an XDSL Auto-Test, follow these steps:

1. On the **Main** menu (Figure 3-2), press 2(**XDSL**).
2. Select **XDSL Auto-Test**, then press 4(**Setups**).

   The **Setup – XDSL Auto Test** menu is displayed. On this menu, you can set a Pass threshold for each service type. Table 5-2 lists the range of the threshold setting for each service type.

Table 5-2. XDSL Auto-Test Setup Parameters

Parameter	Setting (default in bold)
40 kHz (ISDN "U") Loss Pass Thresh.	≤**38 dB** Ranges from 0 to 99.
82 kHz (DDS) Loss Pass Thresh.	≤**34 dB** Ranges from 0 to 99.
96 kHz (ISDN "S") Loss Pass Thresh.	≤**38 dB** Ranges from 0 to 99.
150 kHz (HDSL Euro) Loss Pass Thresh.	≤**35 dB** Ranges from 0 to 99.
196 kHz (HDSL, 2 Pr. T1) Loss Pass Thresh.	≤**35 dB** Ranges from 0 to 99.

Table 5-2. XDSL Auto-Test Setup Parameters (continued)

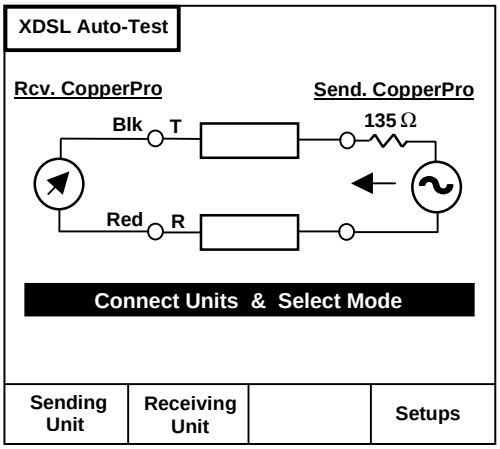
Parameter	Setting (default in bold)
260 kHz (HDSL, 1Pr. E1) Loss Pass Thresh.	≤**35 dB** Ranges from 0 to 99.
392 kHz (HDSL2, 1 Pr. T1) Loss Pass Thresh.	≤**42 dB** Ranges from 0 to 99.
772 kHz (T1) Loss Pass Thresh.	≤**32 dB** Ranges from 0 to 99.
1024 kHz (E1) Loss Pass Thresh.	≤**32 dB** Ranges from 0 to 99.
1200 kHz (CAP ADSL) Loss Pass Thresh.	≤**32 dB** Ranges from 0 to 99.

Starting and Stopping an XDSL Auto-Test

To start an XDSL Auto-Test, complete the following:

1. On the **Main** menu (Figure 3-2), press 2 (**XDSL**).
2. Select **XDSL Auto-Test**. Then, press ENTER.

   The **XDSL Auto-Test** connection screen (Figure 5-5) is displayed:



acy57s.eps

Figure 5-5. XDSL Auto-Test Connection Screen

3. Using Figure 5-5 as a guide, connect the two testers.

Note

While the test is in progress, the receiving unit is the "master" and the sending unit is the "responder".

4. On the sending CopperPro, press 1 (**Sending Unit**). Then, press TEST.

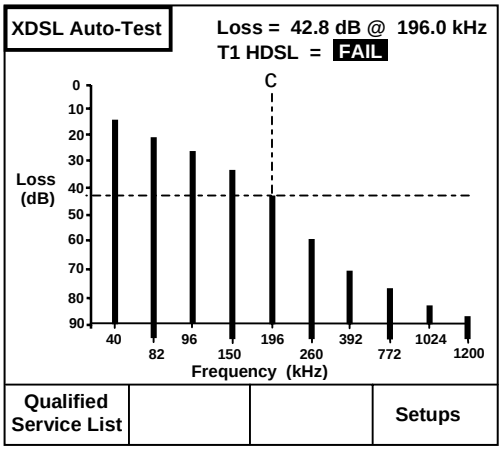
   The tester displays an "*Idle*" message and waits for control signals from the receiving tester.

5. On the receiving CopperPro, press 2 (**Receiving Unit**). Then, press TEST to start the test.

To stop a running XDSL Auto-Test, press TEST.

XDSL Auto-Test Results

Figure 5-6 shows a typical **XDSL Auto-Test** result screen:



acy58s.eps

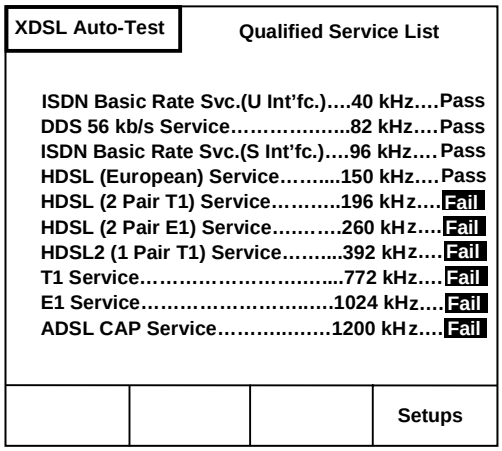
Figure 5-6. XDSL Auto-Test Result Screen

XDSL Auto-Test results are displayed graphically. The graph in Figure 5-6 shows insertion loss resulting from a DSP measurement of the Nyquist XDSL signal that was sent from the far-end CopperPro.

Insertion loss and frequency values at the cursor position are reported in the upper right corner of the screen.

To pinpoint attenuation at a specific frequency, press ⊕ or ⊖ to move the cursor along the graph to the desired frequency.

To see Pass/Fail results for ten service types, press 1 (**Qualified Service List**). A list like the one shown in Figure 5-7 is displayed:



acy59s.eps

Figure 5-7. XDSL Auto-Test: Pass/Fail Results for Service Types

The **Qualified Services List** displays the measured level of frequency for each service type. The CopperPro compares these frequencies against industry-standard Loss/Pass thresholds (as specified in the setup for the XDSL Auto-Test) and indicates whether the are acceptable (**Pass**) or not acceptable (**Fail**).

The XDSL Toolbox

The XDSL toolbox is shown in Figure 5-8. This toolbox contains two types of tests: parametric and transmission.

The parametric tests can be used for physical pair testing. The toolbox includes eight parametric tests:

- Voltage
- Shorts & Grounds
- Opens
- RFL
- Load Coils
- Leakage
- Loop Devices
- Tracing Tone

The parametric tests in this list are exactly the same as those in the POTS toolbox. For ease of use, they are also included in the XDSL toolbox. For descriptions of these tests and the results they provide, see the separate listings in Chapter 4.

The eight remaining tests in the XDSL toolbox are transmission tests. These tests are specifically designed for testing the wideband (WB) frequency. The following transmission tests are described in detail in this chapter:

- WB Noise/Level
- WB Loss
- Send WB Tone
- Impulse Noise

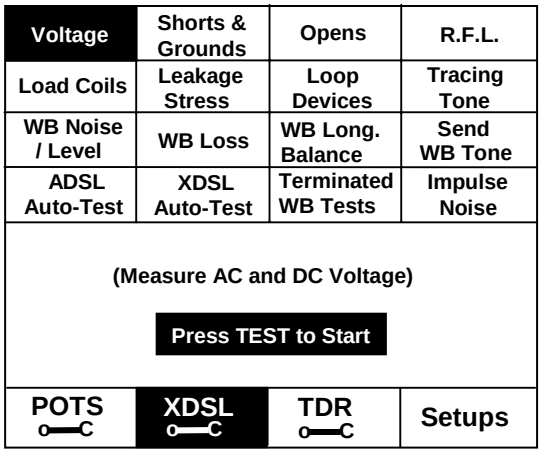
Starting and Stopping a Test in the XDSL Toolbox

Unless otherwise noted in the section for a particular test, use one of the following procedures to run a test in the XDSL toolbox:

- From the **Main** menu, press **XDSL** to display the XDSL toolbox (Figure 5-8). Select the test that you want to run, then press TEST START STOP.

  OR

- From the setup menu for a particular test, press TEST START STOP.



acy60s.eps

Figure 5-8. XDSL Toolbox

To stop a running test, press TEST START STOP.

WB Noise/Level Test

The WB Noise/Level test measures metallic noise or the signal level that is present on a pair. The test provides a snapshot wideband measurement on either a spare pair (in Terminated mode) or on active pairs (in Bridged mode).

The test employs DSP techniques to perform measurements at multiple frequencies at the same time. Depending on the choices you make in the setup for the test, the CopperPro takes measurements at either the higher resolution Nyquist frequency set ("Fine") or at the ADSL DMT frequency set ("Coarse"). The "Fine" (Nyquist) frequency set allows measurements at more than 2000 frequency points across the band, which results in very fine resolution for tests on spare pairs. The "Coarse" (DMT) frequency set allows measurements at the standard 256 DMT bin frequencies, which can be helpful when you monitor active ADSL DMT lines.

Setting Up a WB Noise/Level Test

To set up a WB Noise/Level test, follow the instructions under ""Displaying a Setup Menu" in Chapter 3. When you set up the test, refer to Table 5-3, which describes the setup parameters for the test.

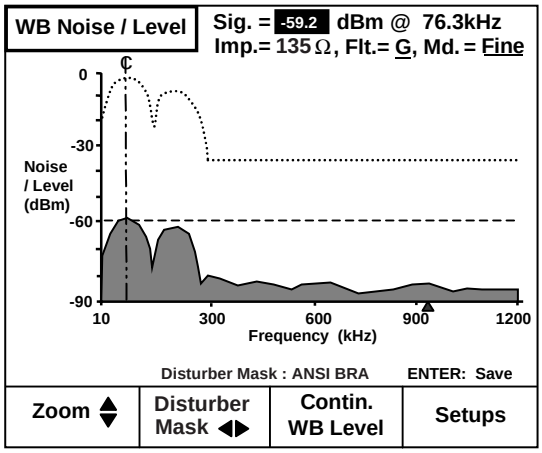
Table 5-3. WB Noise/Level Test Setup Parameters

Parameter	Setting (default in bold)
Measurement Mode	**Fine (Nyquist)** or Coarse (ADSL)
Termination Mode	**Terminated** or Bridged
Measurement Filter	**E**, F, G, or None
Noise Pass Threshold	≤ **-50** dBm Ranges from 0 to 99.

WB Noise/Level Test Results for a Spare Pair

To run a WB Noise/Level test on a spare pair, follow the instructions under "Running a Test in the XDSL Toolbox".

The graph in Figure 5-9 shows the results of a WB Noise/Level test that was conducted on a spare pair. The pair is suspected of having induced crosstalk from adjacent ISDN basic-rate circuits.



acy61s.eps

Figure 5-9. WB Noise/Level Test Results: ISDN Crosstalk

The values specified in the setup for the test are displayed in the upper right corner of the results screen. In this particular situation, the test was set up for Nyquist mode, using the **G** noise filter in **Terminated** Mode.

To zoom in or out horizontally, press 1 (Zoom), then press ⊕ to zoom in or ⊖ to zoom out.

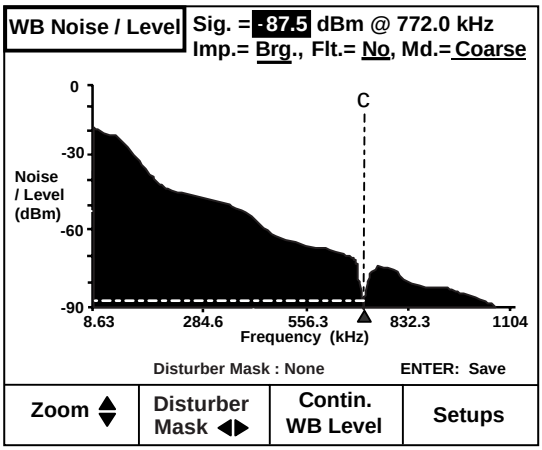
There are eight Disturber Masks that you can select. These masks are shown as dotted lines above the measured Noise/Level waveform. By comparing the dotted-line graph to the measured waveform, you can more easily identify the type of crosstalk interference. To select a Disturber Mask to overlay the existing graph, press 2 (**Disturber Mask**). Then, repeatedly press ◄ or ► until the desired mask is displayed.

To view a continuous wideband measurement, press 3 (**Contin. WB Level**). The signal level at the selected frequency (where the cursor is positioned) is continuously displayed in large numerals, along with a peak-detecting bar graph (see "Running a Continuous Voltage Test" in Chapter 4 for descriptions of this type of bar graph).

WB Noise/Level Test Results for a Working ADSL Pair

To run a WB Noise/Level test on a working ADSL pair, follow the instructions under "Running a Test in the XDSL Toolbox".

The graph in Figure 5-10 shows results from a WB Noise/Level test that was performed on a working ADSL circuit. The setup for the test, which is displayed in the upper right corner of the screen, indicates that the Termination Mode was set to **Bridged** to permit non-intrusive monitoring of the pair.



acy62s.eps

Figure 5-10. WB Noise/Level Test Results: Working ADSL Line

Results obtained from running a bridged WB Noise/Level test on a working ADSL circuit can be useful in helping you determine why the circuit is not performing "up to speed" when other characteristics of the line indicate that it should be. This non-intrusive test can often diagnose excessive bridge tap, interference from other data circuits or AM radio signals, or defective modems as the cause of a performance problem.

The 1 (**Zoom**) and 2 (**Disturber Mask**) keys operate in the same manner as those shown in Figure 5-9 (see the earlier descriptions of these keys).

To continuously monitor any one of the DMT bin signals, move the cursor to the desired frequency bin on the graph, then press 3 (**Contin. WB Level**). Instantaneous variations in frequency bins can be caused by impulse noise. If such variations are obtained, you can measure them by running an Impulse Noise test (see "Impulse Noise Test" for details).

WB Loss Test

The WB Loss test measures the level and frequency of a transmitted signal in the 10 kHz to 1200 kHz spectrum. The test uses a generic wideband single-frequency transmitter, such as the Fluke Networks C9925BLT or another CopperPro at the far end. The far-end tester continuously transmits at 0 dBm and 135 Ohms impedance.

Note

For the most accurate measurement, the sending tester's frequency should be as close as possible to an even multiple of 508.626 Hz. This setting allows the CopperPro to use the high-resolution Nyquist frequency bin spacing in its measurement so that the greatest number of possible measurement frequencies is covered. The sending CopperPro will automatically round off the entered frequency to the nearest "Fine" bin frequency.

Unlike the ADSL Auto-Test, the WB Loss test is manually controlled. There is no communication between the testers.

Setting Up a WB Loss Test

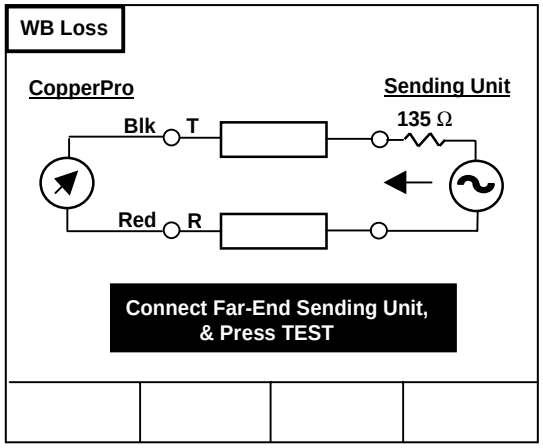
The WB Loss test has no test-specific setup.

Running a WB Loss Test

To run a WB Loss test, complete the following:

1. From the XDSL toolbox, select **WB Noise**.
2. Press ENTER.

The **WB Loss** connection diagram in Figure 5-11 is displayed:



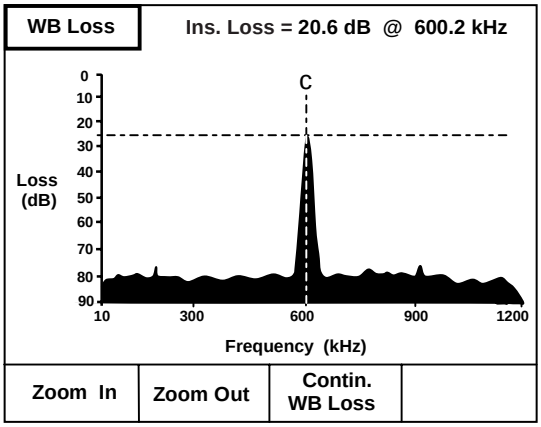
acy63s.eps

Figure 5-11. WB Loss Test Connection Diagram

3. As prompted, connect the far-end CopperPro (sending tester). Then, press TEST.

WB Loss Test Results

Figure 5-12 shows a typical WB Loss test result screen.



acy64s.eps

Figure 5-12. WB Loss Test Result Screen

On the WB Loss test result screen, the cursor, 1(**Zoom In**) and 2(**Zoom Out**) keys, and the ▲and ▼ keys operate in the same manner as they do on the ADSL Auto-Test result screens (see descriptions under "ADSL Auto-Test Results").

To display continuous WB Loss test results, press 3(**Contin. WB Loss**).

WB Longitudinal Balance Test

The WB Longitudinal Balance test measures the effect of applying a common-mode, wideband, and disturbing signal on a pair. This signal is directly related to the pair's balance. The test is two-ended; therefore, it requires either a CopperPro or Terminator module at the far end of the pair that functions as the sending device.

Setting Up a WB Longitudinal Balance Test

To set up a WB Longitudinal Balance test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. When you set up the test, refer to Table 5-4, which describes the setup parameters for the test.

Table 5-4. Longitudinal Balance Test Setup Parameters

Parameter	Setting (default in bold)
Disturbing Frequency	20 kHz Ranges from 20 kHz to 1104 kHz
Measurement Filter	E, F, G, or None
Pass Thresh.	≥40 dB (the same for all disturbing frequencies) Ranges from 0 to 99

Running a WB Longitudinal Balance Test

To run a WB Longitudinal Balance test, complete the following:

1. From the **Main** menu, press 2 (**XDSL**).
2. Select **WB Long. Balance,** then press ENTER.

   A connection diagram is displayed.
3. Follow the on-screen instructions to connect the two devices (two CopperPro testers or a CopperPro tester and a Fluke Networks Terminator module).

4. Do *one* of the following:

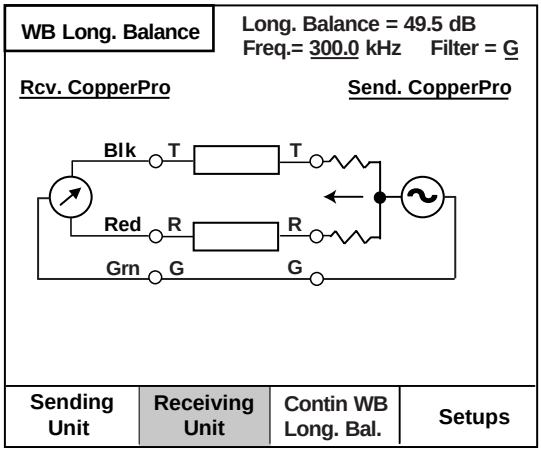
   - If you are using two CopperPro testers, on the far-end tester, press 1(**Sending Unit**). Then, press 2(**Receiving Unit**) on the near-end tester.
   - If you are using a CopperPro and a Fluke Networks Terminator module, press 2(**Receiving Unit**) on the near-end CopperPro and enable the Terminator module.

5. On the receiving tester, press TEST.

   The receiving tester commands the far-end device to send a disturbing (longitudinal) signal, then measures the longitudinal balance of the pair (at the specified frequency).

WB Longitudinal Balance Test Results

Test results are displayed on the receiving tester. A typical WB Longitudinal Balance test results screen is shown in Figure 5-13:



acy102s.eps

Figure 5-13. WB Longitudinal Balance Test Results

Test results are displayed in the upper right corner of the screen. Failing values are highlighted in flashing reverse-video format. Disturbing frequency and measurement filter setup information are also provided.

To view a continuous readout of longitudinal balance, press 1(**Contin WB Long. Bal.**).

The continuous measurement is displayed in large numerals, along with a peak-detecting bar graph (see the description of this bar graph under "Running a Continuous Voltage Test" in Chapter 4).

Send WB Tone Test

The Send WB Tone test continuously transmits a single precision tone at 0 dBm.

Setting Up a Send WB Tone Test

To set up a WB Tone test, follow the instructions under "Displaying a Setup Menu" in Chapter 3. When you set up the test, refer to Table 5-5, which describes the one setup parameter for the test.

Table 5-5. Send WB Tone Test Setup Parameter

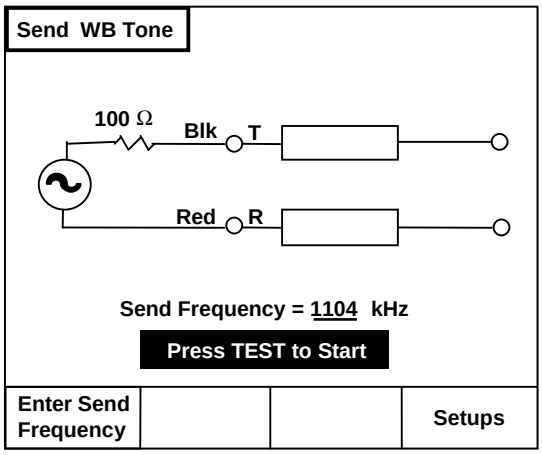
Parameter	Setting (default in bold)
Term. Impedance	**100 Ω** or 135 Ω

Running a Send WB Tone Test

To run a Send WB Tone Test, follow these steps:

1. From the XDSL toolbox (Figure 5-8), select **Send WB Tone**. Press ENTER.

   The **Send WB Tone** screen (Figure 5-14) is displayed:



acy66s.eps

Figure 5-14. Send WB Tone Test: Send Frequency Screen

2. Press 1 (**Enter Send Frequency**). Then, supply the desired frequency.

   Note

   The value you supply must be between 10 kHz and 1200 kHz.

3. Press ENTER.

   The value you specified is displayed in the **Send Frequency** field.

4. Press TEST START STOP.

   A WB tone is continuously sent at the frequency you specified.

5. To stop the test, press TEST START STOP.

Terminated WB Tests

The Terminated WB test group includes double-ended, wideband transmission Auto-Tests. These tests require a far-end terminator or sending device, such as a 3M "FED" or future devices (reserved). The CopperPro automatically controls the far-end device and issues commands over the test pair, so you do not have to use a separate control pair. The tests include the same single-ended parametric tests as the Terminated VF Auto-Tests plus a set of wideband transmission tests.

To run a Terminated WB test, complete the following:

Notes

"Reserved" indicates that the 7 key is reserved for future use.

This procedure shows you how to run a FED WB Auto-Test. You can use this procedure to run any of the tests in this group (when they become available).

1. From the **Main** menu, press 2(**XDSL**).
2. Select **Terminated WB Tests**, then press ENTER.

   The **Select Terminated WB Test Type** screen is displayed.

3. Press 2(**FED WB Auto-Test**). Then, follow the on-screen instructions to connect the two devices and run the test.

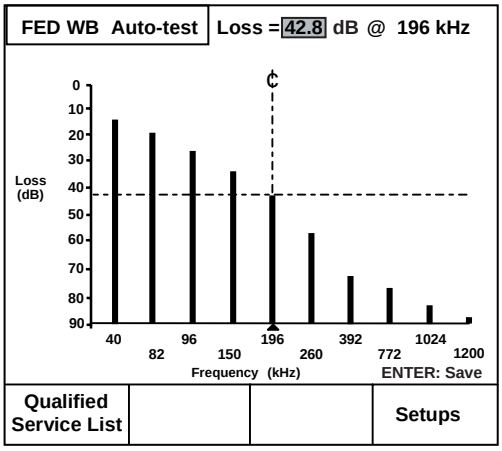
   When the test ends, the CopperPro displays a list of tests that were conducted and provides a Pass/Fail summary result for each test. Tests with failing results have the **Fail** result highlighted in reverse-video format.

4. To view the overall summary result for a test in the list, press ⊕ or ⊖ to move the cursor to the name of the test.

   The test is highlighted and its summary result is displayed in the upper right corner.

5. To view detailed results for a test, press ⊕ or ⊖ to move the cursor to the name of the test. Then, press 4 (**Details**).

   Figure 5-15 contains an example of a typical Wideband Loss "details" result screen for the FED WB Auto-Test:



acy105s.eps

Figure 5-15. FED WB Auto-Test Results

Figure 5-15 shows loss resulting from measurement of the Nyquist XDSL frequency set for ten common digital services.

6. To view loss measurements at a given frequency, press ⊕ or ⊖ to move the cursor to the desired frequency. Observe the values that are displayed for the selected frequency in the upper right corner.

   Failing values are emphasized in flashing, reverse-video format.

   The information from this test can be used to determine the suitability of the pair for various digital data services.

7. Press 1 (**Qualified Service List**).

   The displayed list enables you to view comparisons of obtained results against standard Loss/Pass thresholds (as specified in the setup for the test) for ten types of digital data services.

WB Impulse Noise Test

The WB Impulse Noise test is a single-ended test that allows wideband noise transients of specified amplitude to be counted and recorded over a user-specified period of time. The results of this test can be particularly helpful for tracking intermittent noise problems. Used in conjunction with the WB Noise/Level test, this test can help you pinpoint sources of external noise.

Setting Up a WB Impulse Noise Test

To set up a WB Impulse Noise test, follow the instructions under “Displaying a Setup Menu” in Chapter 3. When you set up the test, refer to Table 5-6, which describes the setup parameters for the test.

Table 5-6. WB Impulse Noise Test Setup Parameters

Parameter	Setting (default in bold)
Termination Mode	**Terminated** or Bridged
Termination Impedance	100 Ω or 135 Ω
Measurement Filter	E, F, **G**, or None
Test Time Duration	**1** minute Ranges from 1 minute to 9999 minutes.
Counter Level Threshold	-**40** dBm Ranges from -90 dBm to 0 dBm.
Count Pass Threshold	**10** counts Ranges from 0 to 999.

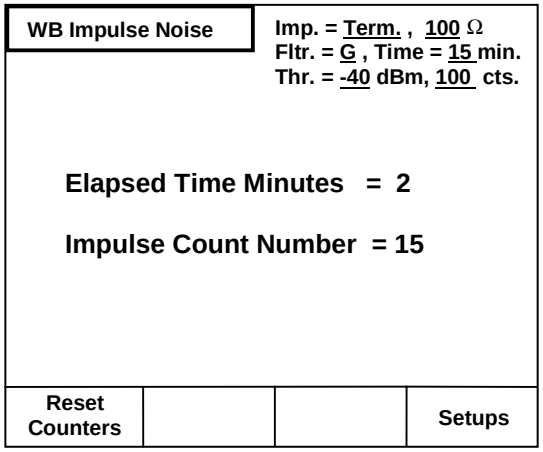
Running a WB Impulse Noise Test

To run a WB Impulse Noise test, follow these steps:

1. From the XDSL toolbox (Figure 5-8), select **WB Impulse Noise Test**.
2. Press TEST.

WB Impulse Noise Test Results

Figure 5-16 shows you an example of a **WB Impulse Noise** test results screen.



acy70s.eps

Figure 5-16. WB Impulse Noise Test Results

The **Elapsed Time Minutes** counter runs until the preset time (as specified in the setup for the test) is reached. The **Impulse Count Number** keeps track of the number of impulse noise counts. If the count exceeds the preset threshold, the value is displayed in flashing reverse video format.

To reset the elapsed time or impulse counter at any time during the test, press 1 (**Reset Counter**).

If you want to change the setup for the test, press TEST to stop the test. Then, press 4 (**Setups**). After you make changes to the setup, press TEST to re-start the test.

Chapter 6
TDR Testing and Fault Location

Introduction

This chapter describes the CopperPro's TDR (Time Domain Reflectometer) test. The TDR testing function is a separately packaged and purchased software option that can often help you locate loop faults with greater precision than the parametric fault location tests that are described Chapter 4. With TDR, not only can you confirm the results of the basic parametric tests, but when you use TDR in conjunction with those tests, you can also vastly improve your ability to accurately measure the distance to faults in a cable.

The TDR Auto-Test function combines both frequency domain (parametric) and time domain (TDR) testing functions in the same package. This combination not only provides a rapid learning curve (due to the consistent user interface), but also gives you with a truly powerful—yet cost-effective—testing solution.

Comparing Parametric Tests to the TDR Test

Table 6-1 provides an overall assessment of the accuracy of the TDR test and three parametric tests (Opens, Load Coils, and RFL) at locating six common cable faults. The table shows both the versatility of the TDR test as well as the complementary nature of all of the tests and their relative strengths and weaknesses. You may want to refer to this table when trying to decide which tests to use in a particular situation.

Table 6-1. TDR vs. Parametric Fault Location Tests

Type of Cable Fault	CopperPro Tests			
	TDR	**Opens**	**Load Coils**	**RFL**
Open Conductor	Excellent	Excellent	–	–
Partial Open (Bad Splice)	Excellent	Poor	–	–
Split Pair	Excellent	Fair	–	–
Bridged Tap	Excellent	–	–	–
Undesirable Load Coils	Distance: Excellent -	–	– Count : Good	–
Resistive Fault	Excellent (R_f < 1 kΩ)	–	–	Excellent (any R_f)

What Happens During a TDR Test: An Overview

You can use the TDR test to determine the length of a cable and to precisely locate faults along the cable. When making a TDR measurement, the CopperPro applies a balanced, high-frequency drive pulse to the test pair. Any fault in the cable causes some of this pulse to reflect back to the CopperPro. The tester captures these reflections (also called echoes), which can be caused by the faults described later (see "Reflections"). The CopperPro measures the amount of time it takes for the pulse it transmitted to return, then uses the time to calculate the distance to the source of the reflection (the fault).

The elapsed time between the transmission of a pulse and its reflection is measured by a highly accurate clock source. Based on the velocity of propagation (VOP) of the pulse, the CopperPro converts the time to distance. The type of cable you are testing determines the VOP, which is defined as the ratio of the speed of the pulse in the cable to the speed of light. For example, a cable with a VOP of 0.64 transmits a pulse at 64% of the speed of light.

Length Measurements and VOP

To obtain accurate length measurements you must choose the right cable type or supply the correct VOP of the cable that you are testing. The more accurate the VOP, the more accurate the CopperPro's measurement of the distance to the source of the reflection (the fault). The CopperPro stores VOP values for standard cable types in its memory. Be aware that actual VOP values can vary (see "Determining the VOP" later in this chapter). Therefore, if accurate length measurements are critical to your testing process, you should specify *actual* VOP values when you set up the test. Most cable manufacturers supply VOP information in their specifications.

Reflections

Reflections are caused by discontinuities in a cable's characteristic impedance, such as gauge changes, splices, faults, the cable's end, or series network elements. Positive (in-phase) reflections result from sudden increases in cable impedance, such as those due to opens, load coils, or resistive splices. Negative (out-of-phase) reflections result from decreases in cable impedance, such as those due to resistive faults (for example, shorts, grounds, and crosses), bridged taps, and build-out capacitors. A cable that has no faults or network elements and is properly terminated in its characteristic impedance generates no reflections.

TDR Auto-Test

The TDR Auto-Test is an automatic test. With the press of a single key, the Auto-Test runs a sequence of parametric tests and a TDR test. Results from a TDR Auto-Test can give you a quick— yet comprehensive— view of the status of a pair. For the novice or infrequent operator of TDR equipment, the TDR Auto-Test can provide a good starting point in the troubleshooting process.

The TDR Auto-Test automatically flags and pinpoints the location of the following types of faults:

- Open conductors
- Resistance shorts
- Load coils
- Bridged taps
- Bad splice joints.

Even though the individual TDR tests (described later in this chapter) can be performed on working pairs with voltage, the TDR Auto-Test should be run only on non-working pairs. This is because several of its integrated parametric tests (for example, Opens and Shorts & Grounds) are accurate only with moderate amounts of voltage on the line.

Setting Up a TDR Auto-Test

To set up the Auto-Test, complete the following:

1. From the **Main** menu, select **TDR Auto-Test**. Then, press F4 (**Setups**).
2. On the setup screen, select the cable type and gauge (refer to Table 6-2) for the cable you are testing.

   Note

   Before you run the test, you must select the proper cable type and gauge. If these two parameters are specified, the CopperPro automatically uses the industry-standard VOP for that cable type and gauge. If the actual VOP is known, however, you can supply it as well, thus creating a custom cable type for the test.
3. Set up the individual parametric tests.

   To do this, you need to display the setup screen for each test and complete the setup (see the relevant sections in Chapter 4 for setup instructions for each test).

Table 6-2. TDR Auto-Test Setup Parameters

Parameter	Setting (default in bold)
Cable Type	Jelly Filled, **Air Core**, Pulp
Cable gauge	19, 22, **24**, 26, 28 AWG
Cable VOP	**0.589** Ranges from 0.300 to 0.999

Starting and Stopping a TDR Auto-Test

To run a TDR Auto-test, display the **Main** menu. Select **TDR Auto-Test**, then press TEST.

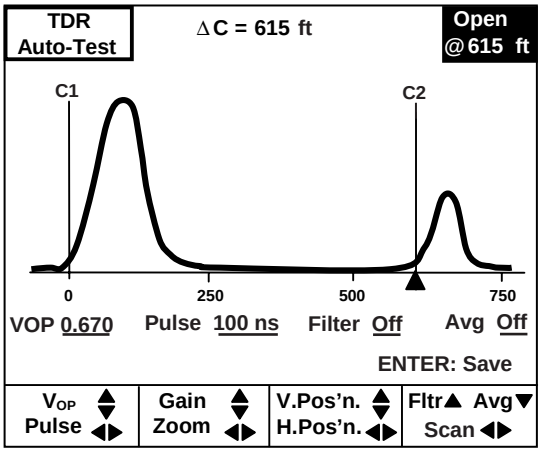
The Auto-Test begins, running the following tests in the order listed:

- Voltage
- Shorts & Grounds
- Opens
- Load Coils
- Auto-ranging TDR

To stop the Auto-Test at any time, press TEST.

TDR Auto-Test Results

When the TDR Auto-Test ends, the CopperPro displays the **TDR Auto-Test** result screen (Figure 6-1):



acy71s.eps

Figure 6-1. TDR Auto-Test Results: Open

Figure 6-1 is a typical TDR Auto-Test result screen. It has the following elements:

- **Pair Status Message**: shown in the upper right corner of the screen and highlighted (in Figure 6-1: **Open @ 615 ft**). This is a final overall result that the CopperPro derives by interpreting results from all of the individual tests that it runs.
- **Launch Pulse**: appears as the larger, positive pulse on the left side of the screen.
- **Launch Cursor (C1)**: the vertical line that marks the start of the launch pulse. To manually move the launch cursor, press ⊕ to move right and ⊖ to move left.
- **Reflection Pulse(s)**: appear as smaller positive pulses (as seen in Figure 6-1) or negative pulses to the right of the launch pulse.
- **Reflection Cursor (C2)**: the vertical line that marks the position of the largest reflection pulse. To manually move the reflection cursor, press ⊕ to move right and ⊖ to move left.
- **TDR test parameters**: shown in the top center portion and base of the screen. The symbols and abbreviations have the following meanings:
  - **ΔC**: distance between position of launch cursor and reflection cursor.
  - **Pulse**: pulse-width (in nanoseconds) that is used to locate the fault.
  - **Fltr**.: power filter status (in Figure 6-1, the user turned it off).
  - **Avg**.: Trace smoothing filter (in Figure 6-1, the user turned it off).
  - **VOP**: Velocity of propagation factor that is specified in the setup.

- **TDR softkeys**: alternate action softkeys that activate the functions described in Table 6-3. The softkey is highlighted when the function is activated. To deactivate a function, press its softkey again.

  The TDR Auto-Test is a snapshot function. After the test ends, you can press any of the softkeys that are listed in Table 6-3 except **Pulse**, **Fltr**, and **Avg**. You must select the filters before you run the Auto-Test. The pulse-width is automatically determined during the Auto-Test.

- **Highlighted TDR Auto-Test Result Types**: the types of fault that are automatically located and tagged are as follows:

  - **Open**, **T Open**, **R Open**
  - **Short**
  - **B. Tap** (Bridged Tap)
  - **L. Coil** (Load Coil)
  - **HRO** (High resistance open or bad splice joint).

Table 6-3. TDR Auto-Test Softkeys

Press this key first	Then press
	The ⊕or ⊖ key to respectively increase or decrease the current VOP value from 0.300 to 0.999. The ⊖ or ⊕ key to respectively decrease or increase the pulse width from 20 ns to 5000 ns.
	The ⊕ or ⊖ key to respectively increase or decrease the waveform vertical gain (size). The ⊖ or ⊕ key to respectively compress or expand the waveform horizontal scale about the reflection cursor.

Table 6-3. TDR Auto-Test Softkeys (continued)

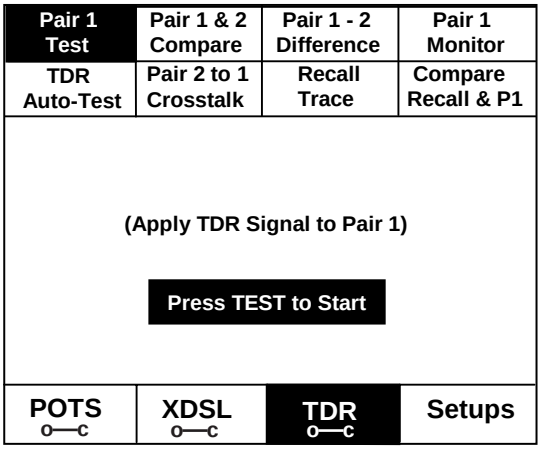
Press this key first	Then press
V.Pos'n. ▲▼ H.Pos'n. ◀▶	The ⊕or ⊖ key to respectively move the entire waveform up or down in the display window. The ⊖ or ⊕ key to respectively move the entire waveform left or right in the display window.
Fltr▲ Avg▼ Scan ◀▶	The ⊕ key to apply the Power Filter (**Fltr**). Press ⊕ again to remove the filter. The ⊖ key to apply the Averaging Filter (**Avg**). Press ⊖ again to remove the filter. The ⊖ or ⊕ key to respectively move Cursor 2 (C2) left or right (**Scan**) to the next detected reflection on the displayed waveform. If the next reflection is outside of the current view, the waveform automatically shifts position to bring it into view.

Saving TDR Auto-Test Results

The TDR Auto-Test waveform is a snapshot result that you can save in a file. To save a result, press ENTER, then follow the prompts for naming and saving the file.

The TDR Toolbox

The TDR toolbox is shown in Figure 6-2. The tests in this toolbox enable you to perform a variety of individual measurements on a pair. These tests are described separately later in this section.



acy72s.eps

Figure 6-2. TDR Toolbox

Starting and Stopping a Test in the TDR Toolbox

Unless otherwise instructed, use the following procedure to start a test in the TDR toolbox.

1. From the **Main** menu, press 3 (**TDR**) to display the TDR toolbox (Figure 6-2).
2. Select the test that you want to run, then press TEST.

To stop a running test, press TEST.

Saving TDR Test Results

For those tests that display a continuously updated "live" trace, you can save a snapshot of the trace. To do this, press ENTER. Then, follow the prompts for naming the file and saving it.

Pair 1 Test

The Pair 1 test is the basic TDR "auto-ranging" test tool. In this test, a launch pulse is continuously applied to Pair 1, and the resulting reflections are continuously displayed. The resulting waveform is a single trace on the screen.

The Pair 1 test result screen is similar to that shown in Figure 6-1 except that the CopperPro does not display pair status information. The launch cursor marks the beginning of the launch pulse. The reflection cursor marks the *approximate* start of the largest reflection, and "Delta C" automatically gives the approximate distance to the reflection.

The Pair 1 test uses pre-selected VOP and filter settings. However, you can change these settings in real time after the test begins. The test automatically searches for reflections, initially changing pulse-widths and vertical and horizontal scales to present the clearest possible picture of the largest reflection.

After determining the best set of parameters for the specific type of reflections that it detects, the CopperPro displays a *continuous* image of the waveform on the screen. If you want to see the effect of a different pulse width or filter, you can do so at any time, with the continuous test automatically displaying the resulting waveform.

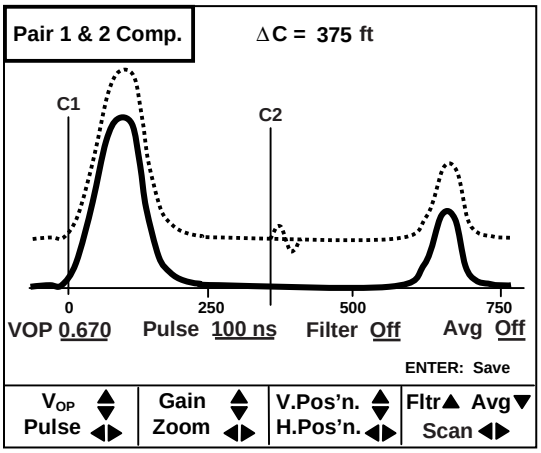
Note

The reflection cursor is automatically positioned as close as possible to the leading edge of the largest reflection. However, it is recommended that you manually expand the horizontal (Zoom) and vertical (Gain) scales in order to zero in on the reflection. You can also move the reflection cursor until it is at the leading edge of the reflection and until it just begins to move off the horizontal baseline. The "Delta C" value should now be the most accurate possible distance to the fault.

Pair 1 and 2 Compare Test

The Pair 1 and 2 Compare test enables you to see continuous TDR waveforms from Pair 1 (T and R) and Pair 2 (T1 and R1) simultaneously. This test is typically used to compare a good pair (Pair 1) with a suspected faulty pair (Pair 2) in the same count so that you can see the differences between the two more closely.

Figure 6-3 shows a typical Pair 1 and 2 Compare test result screen. The TDR softkeys operate in the same manner as those on the Pair 1 test result screen (see "Pair 1 Test Results" and Table 6-3 for descriptions).



acy73s.eps

Figure 6-3. Pair 1 and 2 Compare Test Result Screen

Pair 1is *always* depicted as the lower trace and shown as a solid line. Pair 2 is the upper trace, which is shown as a dotted line. In Figure 6-3, note that the trace for Pair 2 has a minor reflection (it is marked by the reflection cursor) that indicates a gauge change at a splice point.

Pair 1 - 2 Difference Test

This test is similar to the Pair 1 and 2 Compare test. The main difference between the two tests is that in the Pair 1-2 Difference test, the CopperPro internally computes the mathematical difference between the two waveforms and displays the difference as a *single* trace. This presentation is especially helpful for helping you see minor differences between two pairs—one good and one suspect.

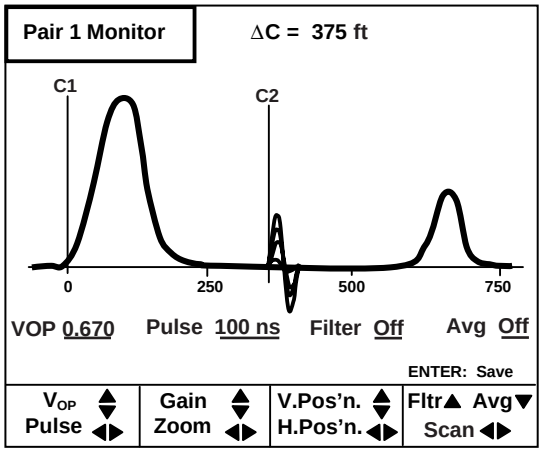
Pair 1 waveform data is used as the reference, and Pair 2 data is subtracted from it to obtain the "difference" waveform. If both pairs are identical (have *exactly* the same waveforms), the result is a straight line with no reflections.

The TDR softkeys operate in the same manner as those on the Pair 1 test result screen (see "Pair 1 Test" and Table 6-3 for descriptions).

Pair 1 Monitor

The Pair 1 Monitor test can help you track down intermittent faults. The test operates continuously (like the Pair 1 Test), but the CopperPro records waveform differences over time on the screen.

Figure 6-4 shows the results from a Pair 1 Monitor test that was conducted on a pair with an intermittent splice connection.



acy74s.eps

Figure 6-4. Pair 1 Monitor Test Result: Intermittent Splice

The TDR function keys operate in the same manner as they do on the Pair 1 test result screen (see “Pair 1 Test” and Table 6-3 for descriptions).

You can change the cursor positions at any time without affecting the displayed waveform. However, if you operate any of the other softkeys, you will erase the previously stored deviations and the waveform will start anew from that point.

Pair 2 to 1 Crosstalk Test

The Crosstalk test is useful for locating resistive crosses between pairs that are typically caused by the breakdown of insulation due to water in a cable. This test is also helpful for determining the location of a pair split and the location of a split repair, when both split pairs are connected.

In this test the CopperPro applies launch pulses on Pair 2, but measures any coupled reflections on Pair 1. The signal level of the resulting single trace is directly proportional to the leakage between the two pairs, and the position of the reflection occurs at the point of the leakage.

Note

The launch pulse does not appear on the Crosstalk test result screen because it is launched on Pair 2. The result screen shows only the signals occurring on Pair 1. However, any resulting influence on Pair 1 from the pulse, which may include slight coupling spikes from the Launch Pulse leading and trailing edge, is displayed.

The TDR softkeys operate in the same manner as those on the Pair 1 test result screen (see “Pair 1 Test” and Table 6-3 for descriptions).

Displaying and Deleting Saved Traces

To display or delete a saved trace, complete the following:

1. From the TDR toolbox (Figure 6-2), select **Recall Trace**.
2. Press ENTER.

   A list of stored TDR trace files is displayed.
3. Press ▲ or ▼ to select the trace file.
4. Do one of the following:
   - To display a file, press ENTER.

     The selected trace is displayed. Note that the waveform is static, which means that it is not continuously updated. Therefore, the real-time **Pulse-width** and **Filter** softkeys are not available for use.

     You can operate the cursor, **VOP**, **Gain**, **Zoom**, **Vertical**, and **Horizontal** softkeys. These keys operate in the same manner as they do on the Pair 1 test result screen (see "Pair 1 Test" and Table 6-3 for descriptions).
   - To delete a file, press **Delete** (see Chapter 7, "Saved Test Results").

Compare Recall and Pair 1 Test

The Compare Recall and Pair 1 test is used to compare a previously stored trace with a "live" trace on Pair 1. The format of the results is like those shown in Figure 6-3, in which two "live" signals are displayed for comparison. In this test, Pair 1 is shown as the lower trace with a solid line, and the previously stored trace is shown as the upper trace with dotted lines.

You cannot operate the real-time **Pulse-width** and **Filter** softkeys on the result screen. The remaining softkeys operate in the same manner as those on the Pair 1 test result screen (see "Pair 1 Test Results" and Table 6-3 for descriptions).

TDR Test Operating Tips

The operating tips in this section are provided to help you in the "real world" of TDR testing.

Determining the VOP

When you select a **Cable Type** and **Gauge** in the setup for the test, the CopperPro automatically uses a standard median VOP value. Several factors, however, can make this value erroneous and cause the tester to incorrectly determine the location of a fault:

- Multiple gauges in the cable makeup
- Cable dielectric differences between manufacturers
- Dielectric variation with temperature (1% per 10°C)
- Water in the cable
- Age of the cable.

The following procedure outlines a reliable method for calibrating the VOP factor to a particular cable type:

1. Locate a known *good* pair in the same binder group as the test pair.
2. Find the pair's *exact* length. There are several ways to do this:
    - Run an Ohms-to-Distance test with the far end shorted and with the gauge configuration known.
    - Run an Opens test, using the proper cable type.
    - "Wheel off" the length with a measuring wheel (taking slack loops or "snaking" into account).

3. Run the TDR Pair 1 test on the known good pair.
4. Align the reflection cursor on the *exact* leading edge of the pair's positive "open" reflection.
5. Adjust the VOP until the "Delta C" distance equals the known length.
6. Use this value of VOP for testing the faulty pairs.

Double-ended Testing

To further minimize errors during TDR testing, it is advisable to test from both ends of the cable. If the sum of the "Delta C" distances to the same fault (from testing from both ends) does not equal the known section length, adjust the VOP factor and re-test from both ends. When the sum of the "Delta C" distances equals the section length, you have found the exact location of the fault.

Another method entails mathematically deriving the exact fault distance (without having to adjust VOP and re-test multiple times). However, this method requires that the exact section length be known. To obtain an exact distance, do the following:

1. Test the faulted pair from both ends and record both "Delta C" distances to the *same* fault (D1 and D2).
2. Calculate the Correlation Factor (CF) by dividing the known section length (L) by the sum of the two distances: CF = L / (D1 + D2)

3. Multiply each of the two distances by the CF to get the corrected distance (CD) to the fault from both ends:

   CD1= CF x D1 and CD2 = CF x D2

   Example: Known section length L =1200 feet

   TDR Measurement D1 = 400 feet

   TDR Measurement D2 = 600 feet

   CF = 1200 / (400 + 600) = 1.20

   CD1 = 1.2 x 400 = 480 feet

   CD2 = 1.2 x 600 = 720 feet

   Section Length = CD1 + CD2 = 1200 feet (sanity check)

Testing for Faults Close to the CopperPro

Reflections that occur before the launch pulse has been completed (due to faults that are very near the CopperPro connection) may be distorted or even completely masked by the launch pulse itself. In these cases, to get a clearer picture of the reflection, attach a *known* length of jumper wire (of the same type and gauge as in the cable, if possible) to the CopperPro test leads to compensate for the pulse's width. An extension of about 10 to 15 feet in length should cover *all* applications, using the CopperPro's shortest pulse-width.

Chapter 7
Saved Test Results

Introduction

This chapter shows you how to save test results in the CopperPro's memory. You will also learn how to view and print saved test results and how to upload them to a PC.

Saving Test Results

The CopperPro saves results in two types of files:

- Text-based files

  Text-based files consist of data that is comprised solely of alphanumeric characters and special symbols. The results of the simpler tests, such as the Voltage, Shorts and Grounds, and Opens tests, are stored as text-based files.

- Graphical files

  Graphical files consist of data that is represented by a waveform (in the case of TDR) or a frequency sweep graph. The results of more complex tests, such as the TDR, Noise, Level, and Loss tests, are stored as graphical files.

Storage Limitations of Saved Result Files

The CopperPro stores text-based test results in a circular buffer, so that as additional files are saved, older files are eventually overwritten. The tester's available storage capacity differs depending on the type of test result. Graphical results require much more storage space than text results. Therefore, there is a limit to the number of graphical files that the tester can store. Graphical files are not automatically overwritten as are the text-based files, but may be manually deleted. Text-based files, on the other hand, take up less space so the tester can store more files of this type. Table 7-1 gives you an indication of the tester's storage space limitations for text-based and the two types of graphical files.

Table 7-1. Storage Limitations of Saved Result Files

Type of File	Space Limitation
Text-based	Approximately 10,000 lines of data
Graphical TDR waveform	Ten files
Graphical frequency sweep	Two files

Result File Header

When the tester stores a result, it saves it under a header. The top portion of Figure 7-3 shows you an example of a header. The result file header automatically provides the following information:

- Wire Center Name

  A user-supplied name that identifies the primary work location. For instructions on how to specify or change the Wire Center name, see "Creating a Custom Header for Test Result Files" in Chapter 3.

- Facility Cable Number

  A user-supplied number that identifies the specific cable on which a test was performed. For instructions on how to supply or change this number, see "Generic and Test-Specific Setup Parameters" in Chapter 3.

- Pair/Terminal Number

  A user-supplied number that identifies the specific single cable pair, cross-box binding post, or inside terminal number on which a test was performed. For instructions on how to supply or change this number, see "Generic and Test-Specific Setup Parameters" in Chapter 3.

- Date/Time Stamp

  A record of the date and time that the test was conducted. The CopperPro automatically supplies this information.

If you do not supply the information in the aforementioned list, the header contains a Date/Time stamp only. Operator Name, Location, and Job Number may optionally be added to the header.

If a group of results shares the same header information (that is, Wire Center name, Facility Cable Number, and Pair/Terminal Number), one header appears immediately before the first saved result in the group and is not repeated for each subsequent result. This convention is used to conserve memory. However, any time you modify the information that is used for the header, the change is reflected in a new header that appears immediately before the group of results it pertains to.

If the elapsed time between tests is greater than ten minutes, the tester places a timestamp before the next test result. If the elapsed time between a group of tests is less than ten minutes, a timestamp is not posted before each result. Again, the purpose of this convention is to conserve memory.

Test results with the same Wire Center name are listed in the order in which the tests were conducted and under the name of the specific test. This grouping of results under a common Wire Center name allows results for multiple tests on the same pair to be easily identified.

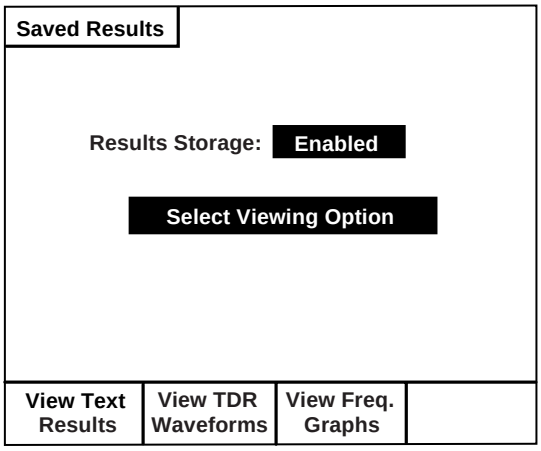
Storing Test Results Automatically

The CopperPro features an automatic test storage option that, when activated, automatically saves the text-based results of non-continuous tests. All relevant test data is saved and any failures (those results that exceed a preset Pass/Fail threshold) are highlighted in reverse video.

Be aware that the automatic test storage option allows you automatically store text-based files only. You must manually save graphical files (see "Saving a Displayed Waveform or Frequency Graph"). The automatic test storage option is enabled when the tester is shipped from the factory. If you want prevent the tester from automatically storing test results, you can turn off the option. To do this, complete the following:

1. On the tester's front panel, press SAVED RESULTS.

   The **Saved Results** selection screen (Figure 7-1) is displayed:



acy91s.eps

Figure 7-1. Saved Results Selection Screen

   The **Results Storage** field shows that automatic test storage is **Enabled**.

2. Press ▲or ▼ to change the automatic test storage setting to **Disabled**.

   The tester no longer automatically stores test results.

Saving a Displayed Waveform or Frequency Graph

To save a TDR waveform or frequency sweep graph, do the following:

1. Make sure that the TDR waveform or frequency sweep graph that you want to save is displayed on the tester's LCD.
2. Press ENTER.

   The list of saved waveforms (see Figure 7-4) or frequency graphs (see Figure 7-5) is displayed.
3. Press ▲ or ▼ move the cursor to the desired storage position (1 through 10 for a TDR waveform and 1 or 2 for a frequency sweep graph).
4. If you want to make some notes about the waveform or graph, press 1(**Edit Remarks)**. Then, type your notes in the space provided.
5. Press 2(**Save**).

   The waveform or graph is saved in the storage position you selected. The tester also saves the associated setup information (for example, Vop, Pulsewidth, Cursor positions, and Filters employed).

Viewing Stored Test Results

To view test results that are stored in the tester's memory, press SAVED RESULTS.

The **Saved Results** screen is displayed (see Figure 7-1). From this screen, you can view the following saved results:

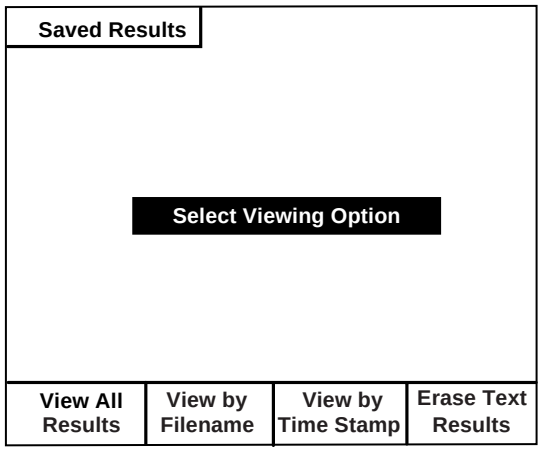
- Text-based results
- TDR waveforms
- Frequency graphs.

The following sections provide instructions for viewing the three types of test results.

Viewing Text-based Results

To view stored text-based results, press 1 (**View Text Results**) on the **Saved Results** screen (Figure 7-1).

The **Select Viewing Option** screen (Figure 7-2) is displayed:



acy92s.eps

Figure 7-2. Saved Results Screen: Viewing Text Results

On this screen, you can select the following options:

- View all results
- View results for a particular Wire Center
- View results for a certain time period
- Erase all results.

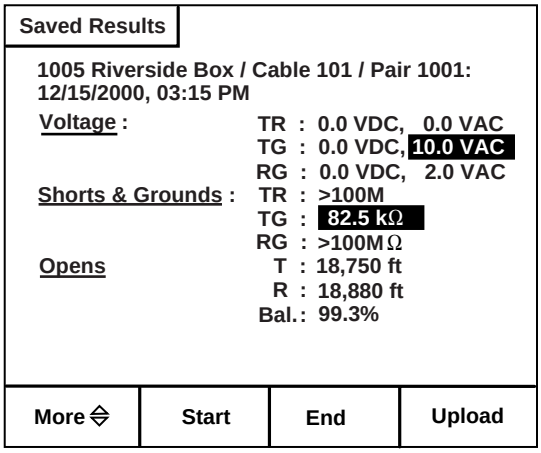
These options are described in the following sections.

Viewing All Results

To view all stored text results, do the following:

1. On the **Saved Results** screen (Figure 7-2), press [1](**View All Results**).

   The tester lists of all the text-based results stored in memory (see Figure 7-3), beginning with the oldest files (those with the earliest time stamp).



acy93s.eps

Figure 7-3. Saved Results: All Text Results

2. Use these softkeys to navigate through the list:
   - Press [1](**More**) then press ⊕ to page forward and ⊖ to page backward.
   - Press [2](**Start**) to display the first screen. The oldest results are on listed this screen.
   - Press [3](**End)** to display the last screen. The most recent results are listed on this screen.

Viewing Results for a Particular Wire Center

The CopperPro groups test results under Wire Center names. If you want to view test results for a particular Wire Center, do the following:

1. On the **Saved Results** screen (Figure 7-2), press [2](**View by Filename**).

   A list of Wire Center names with associated results is displayed.

2. Press [1](**More**) until you display the screen containing the desired Wire Center name.

3. Press ⊕ or ⊖ to move the cursor to the Wire Center name. Then, press [2](**View**).

   The results saved under the Wire Center name you selected are displayed.

Viewing Results for a Particular Period of Time

You can view results of tests conducted during a particular time period. To do this, complete the following:

1. On the **Saved Results** screen (Figure 7-2), press [3](**View by Time Stamp**).

2. When prompted, type both a starting date and time and ending date and time in the space provided.

3. Press 2(**View**).

   Test results for the time period you specified are displayed. The results are listed in chronological order, beginning with the starting date and time that you provided.

Erasing All Results

To erase all saved text results from the tester's memory, do the following:

1. Display the **Saved Results** screen (Figure 7-2).
2. Press 4(**Erase Text Results**).

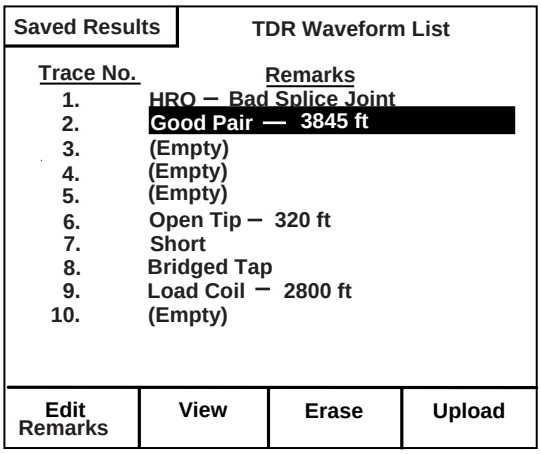
   All saved text results are permanently deleted from the tester's memory.

Viewing TDR Waveforms

To view stored TDR waveforms, do the following:

1. On the **Saved Results** screen (Figure 7-1), press 2(**View TDR Waveforms**).

   The list of TDR waveforms stored in the tester's memory is displayed (Figure 7-4):



acy94s.eps

Figure 7-4. Saved Results: List of TDR Waveforms

2. To view a waveform, press ⊕ or ⊖ to select it. Then, press 2(**View**).
3. If you want to edit the notes you made about the waveform, press 1(**Edit Remarks**). Then, in the space provided type the desired information.

Deleting a Saved Waveform

To delete a saved TDR waveform, do the following:

1. Display the list of TDR Waveforms (see Figure 7-4). Then, press ⊕ or ⊖ to select the desired waveform.
2. Press 3(**Erase**).

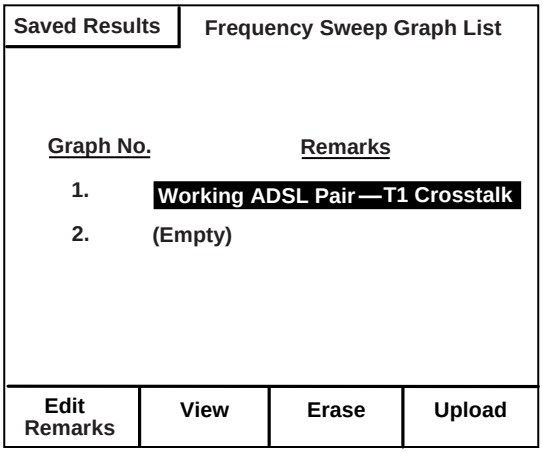
   The selected waveform and associated remarks are permanently deleted from the tester's memory.

Viewing Stored a Frequency Sweep Graph

To view a stored frequency sweep graph, do the following:

1. On the **Saved Results** screen (Figure 7-1), press 3(**View Freq. Graphs**).

   The **Frequency Sweep Graph List** (Figure 7-5) is displayed:



acy95s.eps

Figure 7-5. Saved Results: List of Frequency Sweep Graphs

2. Press ▲ or ▼ to select the graph. Then, press 2 (**View**).

4. If you want to edit the notes you made about the graph, press 1 (**Edit Remarks**). Then, in the space provided type the desired information.

Deleting a Saved Frequency Graph

To delete a saved frequency graph, do the following:

1. Display the list frequency sweep graphs (see Figure 7-5). Then, press ▲ or ▼ to select the graph.

2. Press 3 (**Erase**).

   The selected graph and associated notes are permanently deleted from the tester's memory.

Printing Test Results

To print a saved text result, TDR waveform trace, or a frequency sweep graph, do the following:

1. Connect the CopperPro to a serial graphics printer (see "Connecting to a Printer" in Chapter 2).

   Note

   *If you are printing a saved text file, you do not need a graphics printer because the file is printed in ASCII. However, if you are printing a waveform or frequency sweep graph, you must have a true graphics printe*r.

2. On the tester's LCD, display the results that you want to print.

3. Press ◯, then press SAVED RESULTS.

   The results displayed on the LCD are printed.

Uploading Test Results to a PC

You can upload saved test results (both text-based and graphical) to a PC. To do this, follow these steps:

1. Connect the CopperPro to a PC (see "Connecting to a PC" in Chapter 2).
2. Set the baud rate of the PC communications program to 38.4 kb/s.
3. On the tester's LCD, display one of the following:
   - Text-based results (as shown in Figure 7-3)
   - The list of TDR waveforms with the desired trace selected (as shown in Figure 7-4)
   - The list of frequency sweep graphs with the desired graph selected (as shown in Figure 7-5).
4. Start the PC communications program (such as ProComm or Hyperterm). Then, wait until communication between the tester and the PC is established.
5. After you receive confirmation that the tester and PC are communicating, on the displayed CopperPro screen, press 4 (**Upload**).

   The transfer of files from the tester to the PC begins. Text-based results are transferred to the PC as text files. TDR waveforms and frequency sweep graphs are transferred in X-Modem file transfer protocol.

Chapter 8
Updating the CopperPro with New Software

Introduction

Periodically, Fluke Networks releases software updates for your 990DSL CopperPro Loop Tester. When an update is available, you can download it from the Fluke Networks website at http://www.flukenetworks.com.

The process of updating the CopperPro with new operating software consists of three basic steps:

1. Connect the CopperPro to a personal computer (PC).
2. Put the CopperPro in download mode.
3. Install the software update program on the PC and download the files to the CopperPro.

This chapter provides instructions for each step in this process.

Before You Begin

Before you begin, you must have the following:

- An IBM compatible PC with these minimum features:
  - At least one available RS-232 serial port. The serial port must have a nine-pin interface or an adapter that converts the serial port to a nine-pin interface.
  - Windows 95, 98, 98SE, Me, or NT (Version 4.0 or 2000).
- The serial RS-232 cable that was supplied with the CopperPro.
- The ability to connect to the Internet and access the Fluke Networks web site.

Step One: Connect the Tester to a PC

To connect the CopperPro to a PC, complete the following:

1. Connect one end of the supplied RS-232 cable to the nine-pin RS-232 serial port on the side connector panel (see Figure 2-1) of the CopperPro.
2. Connect the other end of the RS-232 cable to an available serial port on the PC.

Step Two: Put the Tester in Download Mode

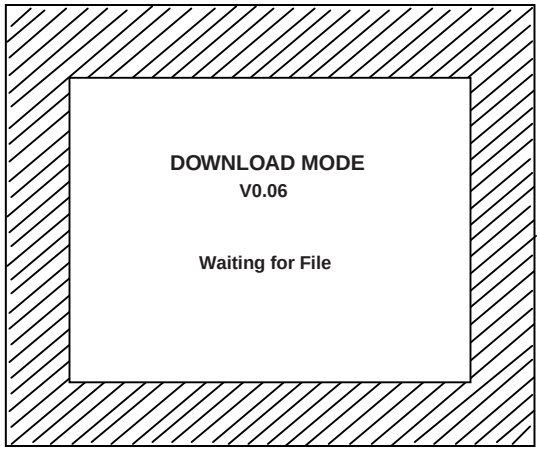
To put the CopperPro in download mode, do the following:

1. Turn on the CopperPro.
2. Press ◯, then [i].

   The **USER OPTIONS** menu is displayed.

3. Select **Program Download**. Then press ENTER

   The CopperPro displays the **DOWNLOAD MODE** screen (Figure 8-1):



acy89s.eps

Figure 8-1. Download Screen: Waiting for File

   The "Waiting for File" message indicates that the CopperPro is in download mode and ready to receive the files to update the software.

Step Three: Updating the Tester's Software

The update software is available from the Fluke Networks website (www.flukenetworks.com). To obtain the software, your PC must have a connection to the Internet and have a web browser installed that is capable of executing programs from the Internet. Microsoft Internet Explorer Version 5.0 (or later) performs this function. The following instructions assume that you are using Microsoft Internet Explorer 5.0 (or later).

1. Start your Internet Web browser and verify that you have a connection to the Internet.

2. Access the following web address (URL):
   http://www.flukenetworks.com/CopperPro/Update/versionxxx/cpflash.exe

   The browser displays the **File Download** window.

3. In the **File Download** window, select **Run this program from its current location**. Then, click **OK**.

   The download process begins. After the program is downloaded, the browser may display a **Security Warning** window.

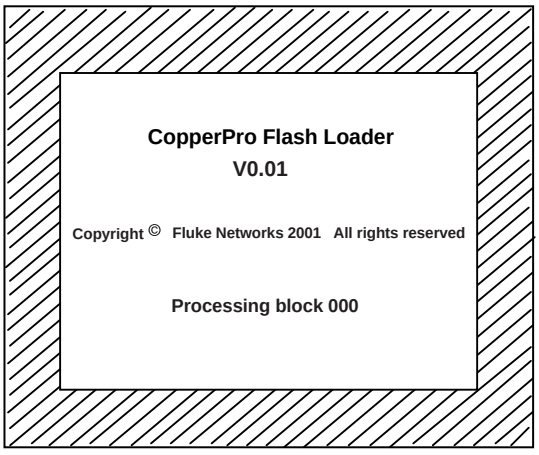
4. Click **Yes** if the Security Warning window is displayed.

   Your PC displays this message: “Searching for CopperPro”.

   After the program detects the CopperPro, it begins updating the tester’s Flash memory. Messages are displayed on the PC to indicate the type of data that is being transferred from the PC to the CopperPro.

Note

If the program does not detect the CopperPro, it prompts you to supply the correct serial port.



acy88s.eps

Figure 8-2. Final Download Screen

The Flash update occurs in blocks of flash data. The update begins with the highest numbered block and works toward zero. The CopperPro displays this progression as a series of "Processing block 0XX" messages. The value XX represents the number of the block that is being transferred. The number of the first block, however, is not determined until the Flash update is created.

After Flash memory block 000) is finished processing (see Figure 8-2), the CopperPro automatically reboots. The start-up screen is momentarily displayed, showing you the new version of software that is installed.

The download process is completed.

5. Disconnect the RS-232 cable from the PC and the tester.

   You can now operate the CopperPro with the new version of software.

Appendices

Appendix	Title	Page
A	Features and Specifications	A-1
B	Replacement Parts and Accessories	B-1

Appendix A
Features and Specifications

Introduction

Appendix A describes the physical and operational characteristics of your 990DSL CopperPro Loop Tester

Physical

Size: (H x W x D): approximately 25 cm x 13.5 cm x 8.1 cm (9.8” x 5.3” x 3.2”)

Weight: 1.8 kg (4.0 lbs.)

Display: 320 x 240 pixel graphic LCD with backlight and adjustable contrast

LED Indicator: charging status indicator (located on the side connector panel)

Communication Port: RS-232 PC and printer port (DB-9)

Power

AC Operation: operates from an external AC adapter/charger

Battery Type: operates from an internal removable NiMH rechargeable battery pack (installed)

Battery Life: a fully charged battery provides approximately 16 hours of normal use

Battery Recharge Time: 2 to 3 hours (in the tester) for a fully discharged battery pack

Environmental

Operating Temperature: -20° C to +60° C (-4° F to +140° F)

Storage Temperature: -40° C to +70° C (-40° F to +158° F)

Humidity Tolerance (operation without condensation): 95 %

Rain Resistance: IEC60529 IP02, International protection water dripping

Vibration: Random, 2 g, 5 Hz to 500 Hz

Shock: 1 Meter Drop Test

Altitude: 4500 m (15,000 ft)

Standards Compliance

Analog Transmission Parameter Measurement: IEEE 743-1995

ADSL Metallic Interface: ANSI T1.413-1998

Regulatory Compliance

Safety: CSA C22.2 No 1010.1

CE:

- EN 61326 Emissions and Immunity CLASS A.
- EN 61010-1 + 2nd amendment

Operational Specifications: Basic 990DSL

Function	Range	Accuracy
AC Voltage	0 V to 250 V	1 % ±0.5 V
DC Voltage (R_{IN} = 100 kΩ or 10 MΩ)	0 V to 150 V 150 V to 300 V	1 % ±0.5 V 2 %
DC Loop Current (430 Ω)	0 mA to 120 ma	2 % ±0.3 mA
Resistance	0 Ω to 100 Ω	0.1 % ±0.10 Ω
(Shorts & Grounds)	100 Ω to 4 kΩ	0.3 % ±0.10 Ω
	4 kΩ to 100 MΩ	3 %
Leakage Stress	2 kΩ to 100 MΩ	3 %
Opens	0 ft to 3000 ft	1 % ±5 ft
	3 kft to 50 kft	3 %
	50 kft to 80 kft	5 %
Splits	0 kft to 50 kft	10 % Distance to End ±50 ft[1]

[1]Distance to Split >50 ft. Split pairs must be the same length ±5 %.

Operational Specifications: Basic 990DSL (continued)

Function	Range	Accuracy
RFL		
Fault Resistance (Rf)	0 MΩ to 30 MΩ	-
Loop resistance	0 Ω to 4000 Ω	-
Resistance to Fault	0 Ω to 100 Ω	0.1 % RTS[1] ±0.10 Ω
(@ Rf = 100 kΩ)	100 Ω to 4 kΩ	0.3 % RTS[1] ±0.10 Ω
Load Coils		
Count	0 to 6	±1
Tracing Tone		
Frequency	577.5 Hz	0.1 %
Level	>3.5 V p-p[2]	10 %
VF Noise		
Impedance	600 Ω, Bridged	1 %
Filters	C, CN, 3 k, 15 k, Psophometric	-
Metallic Noise	0 dBrn to 10 dBrn	±2 dB
	10 dBrn to 100 dBrn	±1 dB
Power Influence	40 dBrn to 120 dBrn	±2 dB
VF Loss		
Signal Level	-40 dBm to +10 dBm	± 0.5 dB (Dry Line) ± 1.0 dB (Dial-up Single Tone) ± 2.0 dB (Dial-up SmartTone)
Frequency	100 Hz to 20 kHz	0.1 % ±2 Hz

[1]RTS = Resistance to Strap

[2]V p-p = Volts Peak to Peak

Operational Specifications: Basic 990DSL (continued)

Function	Range	Accuracy
VF Longitudinal Balance	0 dB to 70 dB	±2 dB
Disturbing Frequency	200 Hz to 2500 Hz	0.1 %
Impedance	600 Ω	1 %
Send VF Tone		
Frequency	100 Hz to 20 kHz	0.1 %
Amplitude (Settable)	-20 dBm to +3 dBm	±0.5 dB (1 dB increment)
Impedance	600 Ω, 900 Ω	1 %

Operational Specifications: 990DSL Wideband Option

Function	Range	Accuracy
WB Noise/Level		
Impedance	100 Ω, 135 Ω, Bridged	1 %
Filters	E, F, G, None	-
Frequency	10 kHz to 1200 kHz	0.1 % ±508 Hz
Amplitude	-50 dBm to +3 dBm	±1 dB @ 135 Ω[3]
	-90 dBm to -50 dBm	±3 dB @ 135 Ω[3]
WB Loss		
Impedance	135 Ω	1 %
Frequency	10 kHz to 1200 kHz	0.1 % ±508 Hz
Magnitude	0 dB to 50 dB	±1 dB[3]
	50 dB to 70 dB	±2 dB[3]

[3] For send frequency, multiples of 508.626 Hz.

Operational Specifications: Wideband Option (continued)

Function	Range	Accuracy
WB Long. Balance	0 dB to 70 dB	±5 dB
Disturbing Frequency	20 kHz to 1104 kHz	0.1 %
Impedance	135 Ω	1 %
Filters	E, F, G, None	-
Send WB Tone		
Frequency	10 kHz to 1200 kHz	0.1 % ±508 Hz
Amplitude (fixed)	0.0 dBm	±0.5 dB
Impedance	100 Ω, 135 Ω	1 %
WB Impulse Noise		
Impedance	100 Ω, 135 Ω, Bridged	1 %
Filters	E, F, G, None	-
Test Time	1 minute to 1440 minutes (24 hours)	1 %
Impulse Counter	0 to 9999	-
Counter Threshold	-40 dBm to 0 dBm	±1 dB
ADSL Auto-Test		
Impedance	100 Ω	
Noise Filter	E, F, G, None	
ADSL Standard	ANSI Full, G. Lite	
Data Rate Prediction:		
Resolution	32 kb/s	
Downstream Rate	0 kb/s to 8192 kb/s	±96 kb/s (3 units resolution)
Upstream Rate	0 kb/s to 1024 kb/s	±64 kb/s (2 units of resolution)

Operational Specifications: 990DSL TDR Option

Function	Range	Accuracy
Launch Pulse		
Impedance	135 Ω	1 %
Pulse-width	20 ns, 100 ns, 500 ns, 1000 ns, 2500 ns, 5000 ns	10 % ±5 ns
VOP Selection	0.300 to 0.999	-
Range (VOP = 0.64)	30,000 ft	-
Range Selection	10 ft to 48 kft (Auto.)	-
Horizontal Resolution	0.5 ft to 156 ft	-
Distance to Reflection	0 ft to 30,000 ft	1 % ±VOP uncertainty
Vertical Gain	80 dB	2 dB
Power Filter	5 kHz Highpass	-
Averaging Filter	4 x waveform average	-
Input Protection	±400 V pk[4]	-

[4]V pk = Voltage peak

Appendix B
Replacement Parts and Accessories

Introduction

Appendix B provides information about the replacement parts and optional accessories that you can obtain for the 990DSL CopperPro Loop Tester. To order accessories, call one of the following numbers:

USA: 1-888-993-5853

Canada: 1-800-363-5853

Europe: +31-402-675-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

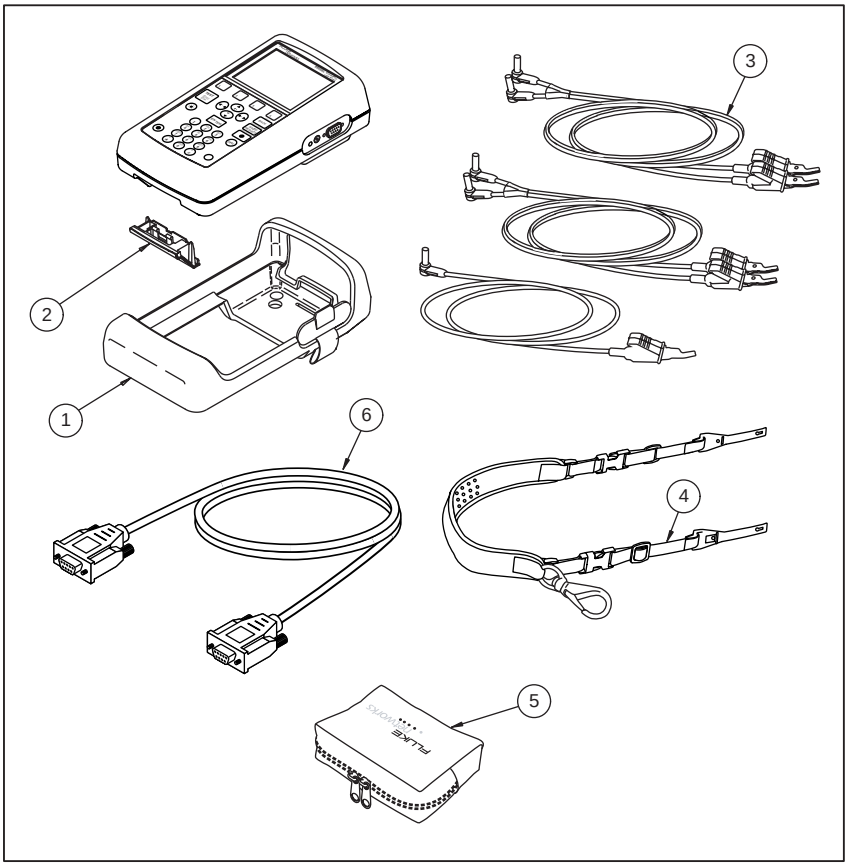
Anywhere in the world: +1-425-446-4519

Replacement Parts

Table B-1 lists replacement parts that you can purchase for the CopperPro. When you place an order, you will need to supply the order number for the item. Refer to Figure B-1 for an illustration of the replacement parts listed in this table. Use the Item Number to locate the part.

Table B-1. Replacement Parts for the CopperPro Loop Tester

Item Number	Description	Order Number
①	Holster	PN 665950
②	Battery Door	PN 938357
③	Test Lead Set	Contact Fluke Networks Customer Service
④	Shoulder Strap	PN 1576950
⑤	Test Lead Bag	PN 1610449
⑥	RS-232 Cable	PN 944806
Not Shown	990DSL CopperPro Users Guide	PN 1554870
Not Shown	990-Printer Cable	PN 943738



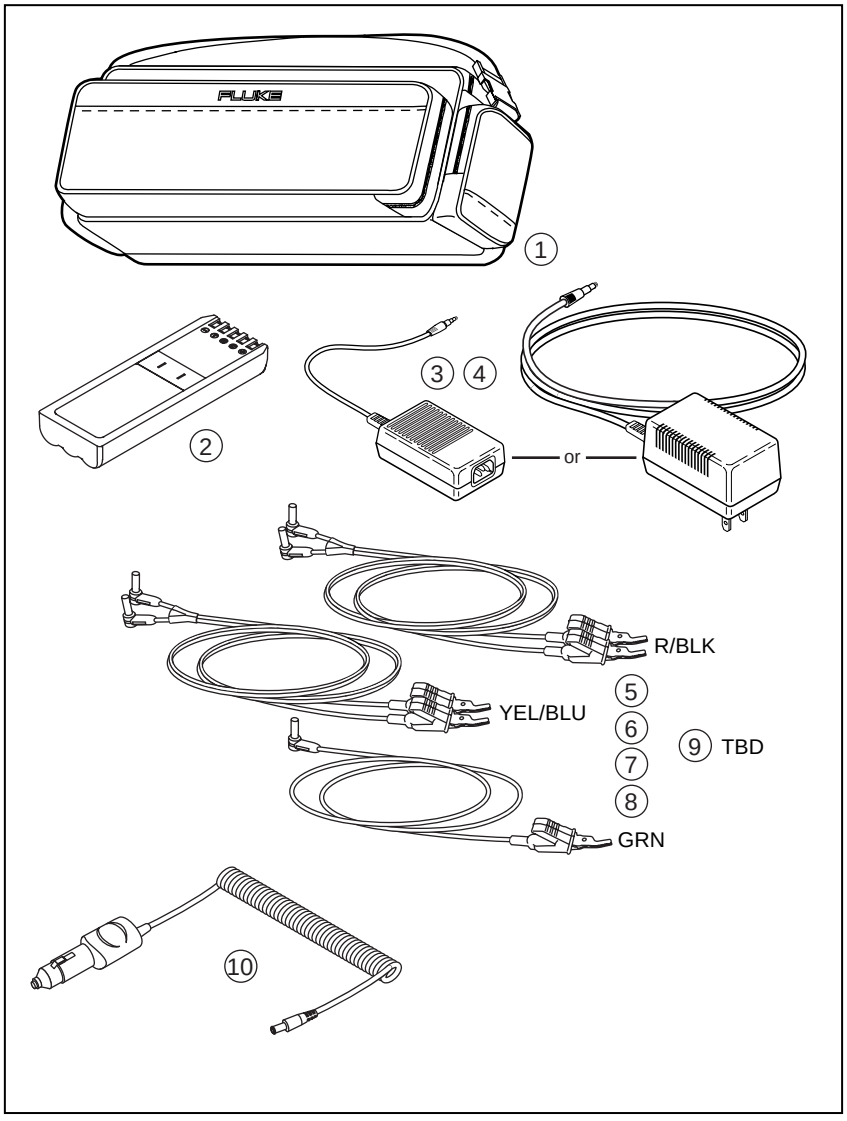
acy76f.eps

Figure B-1. Replacement Parts

Table B-2 lists the optional accessories that are available for the CopperPro. When you place an order, you will need to supply the order number for the item. Use the number in the Item Number column to locate the accessories that are shown in Figure B-2.

Table B-2. Optional Accessories for the CopperPro Loop Tester

Item Number	Description	Order Number
①	Deluxe Soft Case	990-CASE
②	NiMH Extra Battery Pack	BP7235
③	External Battery Charger NiMH INTL with Power Supply	BC7210 INTL
④	External Battery Charger NiMH 120V with Power Supply	BC7210 120
⑤	Test Lead Set, Spike + Bed of Nails Contacts	990TL-SB
⑥	Test Lead Set, Spike + No Bed of Nails Contacts	990TL-S
⑦	Test Lead Set, No Spike + Bed of Nails Contacts	990TL-B
⑧	Test Lead Set, No Spike + No Bed of Nails Contacts	990TL-N
⑨	Test Lead Set (International)	(TBD)
⑩	12V Vehicle Battery Charger/Adapter	BE720
Not Shown	990DSL Serial Graphics Printer	990-PRINTER
Not Shown	990 Serial Printer Cable	PN 943738



acy77f.eps

Figure B-2. Optional Accessories

Index

—A—

AC power, connecting to, 2-8
Adjusted Opens test, 4-18
ADSL testing
  Auto-Test, 5-2
  G-Lite test, 5-7
automobile battery, connecting to, 2-8
Auto-Tests, 3-4, 4-2

—B—

backlight, turning on and off, 3-21
battery, 2-10
  checking capacity, 2-10
  conserving power, 3-12
  deep discharge, 2-13
  discharging, 2-13

—C—

calibrating the CopperPro, 3-20
Call Waiting Caller ID test, 4-64
charging status LED, 2-7
Compare Recall and Pair 1 test, 6-16
comparing traces, 6-16
configuring the CopperPro, 3-10
connector panel, 2-6
conserving battery power, 3-12
Contin. DCV softkey, 4-11
Continuous Voltage test, 4-11
CopperPro
  AC power, connecting to, 2-8
  automobile battery, connecting to, 2-8
  Auto-Tests, 3-4
  backlight, turning on and off, 3-21
  battery, 2-10
  calibrating, 3-20
  configuring the tester, 3-10
  connector panel, 2-6
  date/time, setting, 3-11
  dial set operation, 3-23
  features, A-2
  front panel, 2-2
  individual tests, 3-4
  keys, 2-3
  language of displays, changing, 3-13
  LCD, 2-3
  Main menu, 3-3
  measurement units, changing, 3-13
  menus, 3-3
  PC, connecting to, 2-9
  printer, connecting to, 2-9, 7-12
  printing, 3-24
  RS-232 port, 2-6
  self-tests, running, 3-24
  serial number, storing, 3-16
  serial port, configuring, 3-17
  setup menus, accessing, 3-4
  software version, displaying, 3-2, 3-22
  speaker, adjusting volume of, 3-22
  specifications, A-3
  toolbox tests, 3-4
  turning on, 3-2
crosstalk test, 6-15

—D—

date/time, setting, 3-11
DATU tests, 4-60
DC power jack, 2-6
dial set, 3-23
Dial-Up tests, 4-51
discharging the battery, 2-13

—E—

editing the setup for a test, 3-7

—F—

Facility Cable No., 3-7
factory default values, restoring, 4-3
fault resistances, converting to distance, 4-15
features of CopperPro, A-2
feet, changing to meters, 3-13
function keys, 2-3

—G—

G-Lite test, 5-7
ground test lead, 2-6

—H—

header for reports, creating, 3-17

—I—

Instrument Pair No., 3-7
intermittent faults, finding, 6-14

—K—

keys, descriptions of, 2-3

—L—

language of displays, changing, 3-13
LCD
  backlight, turning on and off, 3-21
  contrast, adjusting, 3-21
  description of, 2-3
Leakage Stress test, 4-37
LED charging status indicator, 2-7, 2-12
length and gauge information, storing, 4-28
Load Coils test, 4-34
Loop Current and Ground Ohms test, 4-62
Loop Current test, 4-62
Loop Devices test, 4-36
low-power mode, 3-12

—M—

Main menu, 3-3
menus, 3-3
meters, changing to feet, 3-13
Milliwatt test, 4-62
Milliwatt VF Loss test, 4-62
Monitor Line test, 4-68

—N—

Number ANI test, 4-63

—O—

On/Off key, 3-2
On-Hook Caller ID test, 4-63
Opens test, 4-16

—P—

Pair 1 Monitor test, 6-14
Pair 1 test, 6-11
Pair 1 to 2 Crosstalk test, 6-15
Pair 1/Pair 2 Compare test, 6-12
Pair 1/Pair 2 Difference test, 6-13
Pair/Terminal No., 3-7
PC, connecting to, 2-9
POTS self-test, running, 3-24
POTS testing
  Adjusted Opens test, 4-18
  Auto-Test, 4-2
  Dial-Up tests, 4-51
  individual tests, 4-7
  Leakage Stress test, 4-37
  Load Coils test, 4-34
  Loop Devices test, 4-36
  Monitor Line test, 4-68
  Opens test, 4-16
  RFL test, 4-23
  Send VF Tone test, 4-48
  Shorts & Grounds test, 4-13
  Smart-Pro tests, 4-55
  Splits test, 4-20
  toolbox tests, 4-7
  Tracing Tone test, 4-39
  VF Longitudinal Balance test, 4-46
  VF Loss test, 4-43
  VF Noise test, 4-40
  Voltage test, 4-9, 4-44
power-down mode, 3-12
printer, connecting to, 2-9, 7-12

printing, 3-24

—Q—

Qualified Services List, 5-12
Quiet Termination test, 4-51, 4-62
Quiet Termination VF Noise test, 4-62

—R—

reflections, 6-4, 6-19
report header, 3-17
Resistance Fault Location (RFL) test, 4-23
RFL test, 4-23
ring test lead, 2-6
RS-232 port, 2-6, 3-17

—S—

SASS tests, 4-51, 4-58, 4-59
self-tests, running, 3-24
Send VF Tone test, 4-48
Send WB Tone test, 5-24
serial number, storing, 3-16
serial port, configuring, 3-17
setup menus, 3-4
Setups softkey, 3-4
Shorts & Grounds test, 4-13
Smart-Pro test, 4-51
Smart-Pro tests, 4-55
softkeys, 2-3
software updates, 8-1
software version, 3-22
sound, adjusting, 3-22
speaker, adjusting volume of, 3-22
specifications, A-3
Splits test, 4-20
system information, displaying, 3-22

—T—

TDR self-test, running, 3-24
TDR testing, 6-3
  Auto-Test, 6-4
  Compare Recall and Pair 1test, 6-16
  displaying and deleting traces, 6-16
  Pair 1 Monitor test, 6-14
  Pair 1 test, 6-11
  Pair 1 to 2 Crosstalk test, 6-15
  Pair 1/Pair 2 Compare test, 6-12
  Pair 1/Pair 2 Difference test, 6-13
  starting and stopping, 6-11
  toolbox tests, 6-10
telephone list, creating, 3-14
Terminated VF tests, 4-65
tests, individual, 3-4
Time Domain Reflectometer. *See* TDR testing
timers, 3-12
tip test lead, 2-6
toolbox tests, 3-4
traces
  comparing, 6-16
  deleting, 6-16
  displaying, 6-16
  saving, 6-11
Tracing Tone test, 4-39
turning on the tester, 3-2

—U—

updating the tester, 8-1
uploading results to a PC, 3-24

—V—

Velocity of propagation. *See* Vop
VF Longitudinal Balance test, 4-46
VF Loss test, 4-43
VF Noise test, 4-40
Voltage test, 4-9, 4-44
Vop, 6-3

—W—

WB Impulse Noise, 5-28
WB Longitudinal Balance test, 5-21
WB Loss test, 5-19
WB Noise/Level test, 5-15
WB self-test, running, 3-24

—X—

XDSL testing
  Auto-Test, 5-7
  WB Impulse Noise test, 5-28
  WB Longitudinal Balance test, 5-21

WB Loss test, 5-19
WB Noise/Level test, 5-15
WB Tone test, 5-24
XDSL toolbox, 5-13

—Z—

Zero Leads utility, 3-20