COPPER TESTING QUICK REFERENCE GUIDE

Testing copper is not an easy task. Knowledge, experience and good analytical skills are required to be able to determine the root cause of complex copper-loop issues. For this reason, EXFO developed a wide range of intelligent copper testing functions to help locate, identify and fix issues affecting telecom network performance. From simple validation tests to advanced fault-finding features, this guide provides an overview of EXFO's copper test functions and their applications.
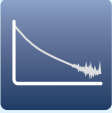
DIGITAL MULTIMETER (DMM)

The purpose of the DMM is to perform basic resistance/voltage measurements in order to determine the physical characteristics of the copper loop and determine if basic copper faults are causing service problems.

FEATURE	APPLICATION	Network Lifecycle Steps				Product compatibility	
		Installation	Qualification	Maintenance/troubleshooting	Advanced troubleshooting	MaxTester 600 series	FTB-600 series
Voltage	To measure the presence of voltage on a copper pair. During qualification and troubleshooting, the pair under test must be disconnected at both ends to make sure there is no voltage present on the line. If there is voltage, then there is a contact (low insulation) with another live pair.	✔	✔	✔		✔	✔
Resistance	To measure the resistance (ohms) of the loop. This test calculates the resistive length of the cable of the line under test and verifies that there are no interruptions by applying a low voltage to the line. It also requires a strap at the far end. For an insulation resistance test, be sure to use an appropriate setup.	✔		✔	✔	✔	✔
Resistance Balance	To measure the difference in resistance (ohms) between the A/Tip and B/Ring of a copper pair. This test checks that no high-resistive fault problems are being generated by corrosion or poor connections. It also requires a strap to ground/earth at the far end of the loop.			✔	✔	✔	✔
Capacitance	To measure the capacitance value (nF or uF) of the loop. This test calculates the cable length of the line under test. It requires an open state at the far end. It also provides a capacitance balance measurement that can yield important information on possible splits, bridge taps and poor grounding impairments.	✔	✔	✔		✔	✔
Insulation Resistance (Stress/ Leakage)	To assess the insulation quality of the copper pair and ensure that there is not any leakage, nor any contact faults with other wires or ground/earth. This test identifies problems in a cable by applying a high voltage to the A/Tip and B/Ring and ground/earth, and observing whether or not the resistive value rises or falls. It also requires an open state at the far end.	✔		✔	✔	✔	✔
Station Ground	To check the earth/ground quality in a specific location in relation to that of the central office. This test uses A/Tip, B/Ring and ground/earth leads to calculate the insulation resistance between the wires and the ground. If the CO is a floating exchange type without a ground reference, the test may provide inaccurate results.			✔	✔	✔	✔

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FREQUENCY TESTING

The purpose of frequency testing is to measure the characteristics of the pair under test in the frequency domain.
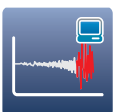
FEATURE	APPLICATION	Network Lifecycle Steps — Installation	Qualification	Maintenance/troubleshooting	Advanced troubleshooting	Product compatibility — MaxTester 600 series	FTB-600 series
Load Coil Detection	To measure the presence of up to five load coils on a copper pair. It is important to note that load coils were once used to extend the reach of normal voice (POTS) lines. This test makes sure that a cable is loaded properly, or when prequalifying DSL loops, it makes sure that all load coils have been removed from service.	✔	✔			✔	✔
Single-Ended Attenuation (SEA)	To measure loss at all frequencies up to VDSL2 (30 MHz) from one end of the circuit without the use of a FED or second technician. This test uses a special signal Tx and an advanced algorithm to determine the attenuation of copper pair over a selected frequency range. The SEA test is complementary to PSD and serves to verify that the line can support DSL services.	✔	✔	✔	✔	✔[a]	✔
VF Longitudinal Balance	To determine how balanced the A/Tip and B/Ring are from each other to the ground/earth. This test applies a common mode signal to both wires of a pair and measures the level of noise rejection between them. This determines the pair quality for the passing service.		✔		✔	✔	✔
WB Longitudinal Balance	To measure the ability of a circuit to reject noise across wideband frequencies. This test is used to evaluate ground conditions, poor splices or insulation breakdown. It can be used for all types of DSL, but because the bandwidth of VDSL2 is so much wider than ADSL, this test must be performed at the maximum frequency of the service being qualified (up to 30 MHz for VDSL2 on the FTB-1; the limit on the MaxTester is 17 MHz).	✔	✔	✔	✔	✔[a]	✔
Tx/Rx Tone	To transmit or receive a tone generated to/from the opposite end. This test uses the Send Tone part (Tx) to transmit a tone over the line and calculate the insertion loss of the pair in dual-end mode using a receiver device at the remote end. It also uses the Receive Tone part (Rx) to calculate the insertion loss of the pair in dual-end mode using a transmitter device at the remote end.	✔	✔	✔		✔	✔
WB Return Loss	WB return loss test measures the mismatching of the line impedance with respect to the ideal impedance across the frequency band. The difference may be created by pair impairment and it can create problems for technologies relying to echo cancellation systems like ISDN or SHDSL.		✔		✔	✔[a]	
RX Tone with FED	Operators' processes may require measurement of the insertion loss of a pair using a dual-end line test (DELT). In this case, it is possible to use this test in conjunction with the TS125 FED.		✔			✔[a]	

Note

a. Applicable only to the MaxTester 610, MaxTester 635 and MaxTester 635G

NOISE TESTING

The purpotse of noise tests is to perform voice frequency (VF)/ wideband (WB) noise and level measurements.

FEATURE	APPLICATION	Network Lifecycle Steps — Installation	Qualification	Maintenance/troubleshooting	Advanced troubleshooting	Product compatibility — MaxTester 600 series	FTB-600 series
VF Noise	To measure the voice-frequency noise on a subscriber's telephone line. The industry standard is less than 70 dBm (20 dBrnC) of noise at the customer's end.	✔	✔	✔		✔	✔
Power Influence	To determine the effect of the main (50/60 Hz) field from power cables on the pair under test. The 50/60 Hz field and its harmonics are measured and compared to the industry standard of −10 dBm (80 dBrnC) (maximum value). This helps calculate the amount of noise that is caused by power generation from the power company.		✔		✔	✔	✔
VF Impulse Noise	To identify noise sources external to the copper pair. This test determines the level and number of impulse noise violations in the voice-frequency band from external sources, like high voltage motors near telephone lines and microwave ovens. This is a single-end measurement.		✔	✔		✔	✔
WB Power Spectral Density (PSD) Noise	To check the ambient noise on a circuit prior to provisioning to ensure it will support the rate requested by the customer. This test helps avoid providing service that will be unreliable and cause further technician visits. It tests the entire VDSL2 bandwidth (30 MHz).	✔	✔	✔	✔	✔[a]	✔
WB Impulse Noise	To measure the number of noise impulses on a line that is caused by sources outside the copper plant. A violation can be plotted in an Impulse Noise Histogram. [b] The histogram attaches a *time* component to the noise measurement, allowing a technician to determine how many violations occurred, and more importantly, when they occurred. This is a single-end measurement.		✔	✔	✔	✔[a]	✔
Impulse Scope	To capture and analyze impulse noises on a line with the option of performing simultaneous frequency and time domain analysis. This test allows a technician to define the signature of the noise and locate the possible source.				✔		✔
Impulse Duration and Disruption (IDD)	To capture and analyze impulse noises on a line with statistical data to help fine-tune the impulse noise protection (INP) level on ADSL2+/ VDSL2. This test creates a histogram of the distribution of fast and slow impulses over time with high-level duration and disruption (IDD) times.				✔		✔
NEXT	To measure the near-end crosstalk attenuation between two pairs. Under good conditions, the crosstalk attenuation of the pairs should be high. However, in the case of unbalance, split pairs or low insulation, there could be strong noise from one pair to the other. With the tester connected to the pairs, this test requires an open state at the far end.	✔	✔	✔		✔	✔

Notes

a. Applicable only to the MaxTester 610, MaxTester 635 and MaxTester 635G
b. Applicable only to the FTB-1, MaxTester 610, MaxTester 635 and MaxTester 635G

FAULT LOCATOR

The purpose of the fault locator is to provide a fault-location toolbox.

FEATURE		APPLICATION	Network Lifecycle Steps	Installation	Qualification	Maintenance/troubleshooting	Advanced troubleshooting	Product compatibility	MaxTester 600 series	FTB-600 series
	Resistive Fault Locator (RFL)	To determine the distance to high-resistance faults that TDRs are not able to find. This test uses the resistive length of copper cables to find faults as high as 20 MΩ. The test modes include 2-Wire, 4-Wire and Küpfmüller (K-Test). K-Test mode will locate faults when both wires of the pair have a contact fault.				✓	✓		✓[a]	✓
	TDR	To find changes in the physical plant. This test will find events such as opens, shorts, bridged taps and water. The test modes include Auto, Auto, Manual[b] and CrossTalk (xTalk)[b]. xTalk mode will locate possible splits and contact points between two pairs.		✓		✓	✓		✓	✓

smart R™

The purpose of EXFO's SmartR™ features, Pair Detective and FaultMapper is to assist field technicians by giving them access to two intelligent tests capable of determining the line condition and identifying common circuit faults.

FEATURE		APPLICATION	Network Lifecycle Steps	Installation	Qualification	Maintenance/troubleshooting	Advanced troubleshooting	Product compatibility	MaxTester 600 series	FTB-600 series
	Pair Detective	To provide optimized fault identification through automated analysis. This application runs multiple, consecutive tests to offer guidance on probable issues resulting in a faster, more comprehensive interpretation of the situation. With the tester connected at the near end, this test requires an open state at the far end.		✓	✓	✓	✓		✓[a]	✓
	FaultMapper	To identify and locate service-affecting line faults. Providing fully automated copper pair analysis, this application generates an intuitive schematic/graphical representation of the copper loop. In single-end test mode, FaultMapper can detect typical copper plant faults (opens, shorts, grounds) as well as critical impairments (bridge taps). With the tester connected to the pair, this test functions with an open or a strap at far end.				✓	✓		✓[a]	✓

Notes

a. Applicable only to the MaxTester 610, MaxTester 635 and MaxTester 635G

b. Applicable only to the FTB-1, MaxTester 610, MaxTester 635 and MaxTester 635G

EXFO COPPER TESTING PORTFOLIO

MaxTester 600 Series

Compact, rugged and user-friendly handheld test solution dedicated to the installation and maintenance of your copper infrastructure.

› MaxTester 610 – Wideband Copper Tester
› MaxTester 635 – Wideband Copper
  and VDSL2/ADSL2+ Tester
› MaxTester 635G – Copper Characterization
  and DSL/G.fast Analysis

FTB-600 Series

Platform-based multitechnology test solution designed for the advanced technician performing expert-level copper troubleshooting.

› FTB-610 – Wideband Copper Test Module
› FTB-635 – Wideband Copper, xDSL and Multiplay
  Test module

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