COPPER, VDSL2, ADSL2+ AND IP TRIPLE-PLAY TEST SET



EXFO AXS-200/635 Network Tester Specs Provided by www.AAATesters.com



<u>o⊚pMapper</u>™



GLOBAL ×DSL TEST EQUIPTMENT GROWTH LEADERSHIP AWARD

The more-in-one 30 MHz copper, DSL and triple-play testing solution

Based on industry-leading Broadcom DSL chipset for proven VDSL2 and ADSL2+ interoperability and support for impulse noise protection (INP) and Broadcom PhyR[™] configurations.

Features/Benefits

- Multilayer copper, DSL and triple-play analysis, for minimized CAPEX and OPEX
- Affordable triple-play testing over VDSL2 and ADSL1/2/2+ including Ethernet in/out operation for FTTx deployments
- 30 MHz spectrum analysis for single-ended VDSL2, for a truck roll reduction
- DSL, IPTV and VoIP service assurance using a comprehensive range of metrics such as DSL link speeds, multilayer fault analysis histogram, MDI as well as IP packet loss and jitter
- VDSL2 and ADSL2+ Annexes A, B, L and M support for ultimate network flexibility

Applications

- Detection of potential bottlenecks on subscriber loops to ensure high-quality, consistent and error-free triple-play services (IPTV, Internet and VoIP)
- 30 MHz spectrum analysis for circuit qualification in any VDSL2 band plan (12, 17, 30 MHz)
- Loop and fault analysis including LoopMapper using proven TDR and FDR techniques for VDSL2 or ADSL2+ prequalification
- Triple-play deployment verification inside the subscriber premises using Ethernet in/out testing



30 MHz Copper and VDSL2 Triple-Play Services Testing

Benefit from optimal performance and flexibility for your FTTx-based triple-play services deployments thanks to EXFO's AXS-200/635 module for the AXS-200 SharpTESTER. This test set provides you with a wide range of measurements so that no matter what stage of VDSL2 or ADSL1/2/2+ deployment you are at-prequalification, installation, troubleshooting or repair-you have all the measurement tools you need to get the job done efficiently and properly. Moreover, by keeping test cycles as short as possible, the AXS-200/635 allows you to save money; thus, positively affecting your bottom line.

The AXS-200/635 combines multilayer 30 MHz copper spectrum, VDSL2 speed verification with backward compatibility to ADSL1/2/2+ and triple-play testing-making it the only test set you need. It also enables field crews to speed up service turn-up, maintenance and troubleshooting operations by assessing the physical medium or triple-play services in a single test sequence.

Part of the SharpTESTER Access Line, the AXS-200/635 integrates the functionalities of the AXS-200/61030 MHz Copper Test Set and the AXS-200/630 VDSL2, ADSL2+ and IP Triple-Play Test Set. This highly intuitive handheld unit allows technicians to qualify and troubleshoot the copper-loop plant and triple-play services from top to bottom with one consolidated test set.

The AXS-200/635's bright color LCD display provides a sharp graphical user interface for showing clear results (including graphs), making it a straightforward, user-friendly test solution, perfect for triple-play services analysis. Designed for real-life testing conditions, the AXS-200/635's display is ideally suited for use in direct sunlight thanks to its transflective color display.



You Need VDSL2 and Ethernet to Deliver HD IPTV

VDSL2's high-speed capability not only breathes new life into your existing copper plant but it allows you to reduce churn and gain market share in delivering triple-play services to your customers. High-definition (HD) IPTV service is the killer application for VDSL2 deployment as it requires the most bandwidth and the best quality of service (QoS) that your customers have come to expect.

EXFO's AXS-200/635 offers a quick, yet thorough method for testing triple-play services–VDSL2 and Ethernet-based data, VoIP and IPTV testing–using pass/fail-driven automated functionalities.

In addition to validating connectivity to the DSLAM, the AXS-200/635 provides upstream and downstream parameters such as actual data rates, attenuation and noise margin. What's more, it delivers advanced IPTV measurements-packet jitter, packet loss, PCR jitter, MDI, PID viewer and IGMP zap time-both in Terminate (stand-alone) and Through mode operation. The AXS-200/635 also monitors residential VoIP call flow and statistics, facilitating VoIP QoS assurance.

Show Details	3	Video Strear	n Detec
Stream IP	Туре	Rates	Usage
192.168.0.159:554	RTSP	3935 kbps	16%
192.168.0.159:6972	Unicast	64 kbps	0%
224.1.1.1:100	Multicast	4443 kbps	18%
Video Stream	P Arrival Jitter	PCR	litter

ine Tests IPTV Analysis 🗱 15:19 🛅 nalyzed Stream: 224.1.1.1 Stream Content PID Rate(kbos) Video 300 3793 Audio 301 187 16 Program Association Table 0 Program Map Table 48 16 Stream Content Save Result

ine Tests IPTV Analysis			🗱 15:19 [
Analyzed Stream:	224.1.1	.1 🔻	🕑 PASS
Stream Rates:		MDI:	70.4:0
IP Packet: 413	L kbps	DF(Ave):	69.0 ms
Transport Rate: 433	7 kbps	DF(Min):	65.8 ms
Null Packet Rate: 0 kb	ps	DF(Max):	72.1 ms
		VB(Min):	-36677
		VB(Max):	1500

Simultaneous detection of multicast (RTP/UDP), unicast (RTP/UDP) and TCP/RTSP VOD streams.

IPTV test results screen showing PID Viewer.

Test results screen showing stream parameters such as MDI.

Single-Ended Video and Data Rate Analysis

The AXS-200/635 single-ended video and data rate analyzer software option allows you to determine the xDSL data rates that a copper loop will support, prior to connecting/provisioning the circuit. With this new feature, you can evaluate a circuit's ability to carry ADSL2+ bit rates at the CO or the customer premises and find out how many IPTV channels can be supported during the pre-deployment stage.

Thanks to this industry-leading option, you can:

- Prequalify and validate circuits without having to install terminal equipment
- Reduce the number of false positives (failed installs)
- Decrease the cost of identifying up-sell opportunities (customers wanting newer/faster video and network applications such as ADSL2+ and IPTV)

Dwn: 24.6	8 Mbps		Up: 109	2 kbps	
Annex	A	Ŧ	Technology	ADSL2+	
Reference Point	CPE	Ŧ	Target SNR	12	1
	Re	ecalcı.	late		

Data Rate Prediction screen showing the forecasted ADSL2+ data rate.

HD Streams	1		0	
SD Streams	2		ø	
Predicted Rate	Dwn:24.68 Mbps		Up: 1092 kbps	
	High Def.		Std. Def.	
No of Streams	1		2	
Stream Rate (Mbps)	12.00		3.00	111
Technology	ADSL2+	Ŧ		
Annex	A	Ŧ	Recalculate	
Target SNR	12			

Run Test screen showing the predicted IPTV channels.

Impulse Noise Protection +

You need to provide your customers with comprehensive assurance against poor tripleplay services. With this in mind, the telecom industry has adopted the DSL-based impulse noise protection (INP) parameter, which is particularly important when deploying IPTV services based on VDSL2 and ADSL2+. For example, the INP helps reduce the amount of macro-blocking in an IPTV stream caused by short duration and intermittent impulse noise spikes. However, the downside of standard INP implementation is that it can limit the speed of VDSL2 (or ADSL2+) offered to customers as well as the addressable service area (distance).

The AXS-200/635 supports the traditional INP parameter as well as Broadcom's innovative approach to INP called PhyR[™]. This technology allows for significantly lower BER, higher DSL rate and longer reach compared to standard INP implementations. As a result, the AXS-200/635 can be used to verify and ensure consistent QoS for DSL-based IPTV deployments without impacting speed or performance of the DSL link.

Parameter	DownStream	UpStream	
SNR Margin:	22.0 dB	0.0 dB	•
Attenuation	0.0 dB	0.0 dB	•
Output Power:	0.0 dBm	-24.0 dBm	
INP:	1.0	1.0	
Interl.Depth:	361	139	
Interl.Delay:	4.0 ms	4.0 ms	
TRELLIS:	ON	OFF	
BITSwap:	Not Active	Not Active	

22: 14:20 📷)

DSL results screen.

True Backward-Compatible and Interoperable Testing

Since the AXS-200/635 is based on the industry-leading Broadcom chipset, you are assured of excellent interoperability for VDSL2 and ADSL2+ when testing against other Broadcom chipset-based devices as well as other manufacturer chipsets.

Thanks to the AXS-200/635's Broadcom chipset, you can use the Broadcom's Nitro mode when testing ADSL2+ to effectively negotiate with DSLAM (also using a Broadcom chipset) in order to achieve data rates as high as 30 Mbit/s (depending on DSLAM setup, loop length, noise influences and circuit quality).

time		
2plus-AnnexM		
1		
FF910C		
Stream U	pStream]
kbps 1	773 kbps	-
kbps 1	773 kbps	0
% 1	00.0 %	
	1 FF910C Stream U 2 kbps 1 7 kbps 1	FF910C Stream UpStream kbps 1773 kbps / kbps 1773 kbps

Multilayer fault analysis histogram

TestSummary	Status DSL Params
ADSL2+ test results scre	en. VDSL2 test results screen.
Key Features	
INP and PhyR™	Supports Broadcom's PhyR [™] functionality and legacy impulse noise protection parameters
User-definable automated test routines	Presents easy-to-interpret pass/fail results
FTTx support	Enables DSL and 10/100 Mbit/s Ethernet assessment of triple-play services in Terminate and Pass Through mode
IPTV analysis	Provides key IPTV qualification parameters with features such as set-top box (STB) emulation, join/leave requests, PCR jitter analysis and PID viewer
MDI reporting	Supports media delivery index (RFC 4445) for evaluating the IPTV quality of experience
VoIP analysis	Ensures VoIP services are not affected by packet loss or jitter
Data analysis	Offers a common set of measures such as ping, traceroute, HTTP speed testing and FTP speed testing to ensure

Visually indicates when and at what layer errors are occurring, helping to identify the source of the problem as well as

reliable and consistent Internet connectivity

facilitating quick and efficient troubleshooting

Line Status: Showtime Operational Mode : VDSL2-17a CO VendorID: BDCM CO Version: 0x910C Parameter DownStream UpStream Max BitRate: 141304 kbps N/A Actual BitRate: 79945 kbps 15148 kbps Ø Capacity: 56.6 % N/A DCI D Line Chabus

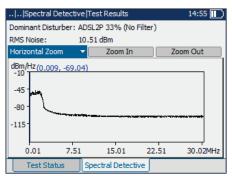
Line Tests CPE Test

30 MHz Testing: Get the Whole Picture

For many telcos, installing ADSL links has gone quite smoothly; however, preparing the copper loop plant for triple-play services is another story. EXFO's AXS-200/635 provides a full VDSL2 spectrum analysis in order to identify and locate disturbances and signal interferers affecting voice and video delivery over the last mile. It also offers an extensive range of single-ended tests that help you quickly locate and repair the faults that affect quality of service (QoS).

Auto Tests Test Results		📰 10:00
DMM Tests:	Completed	PASS
Isolation:	Completed	
Load Coil Detection:	0	
VF Tests:	Completed	PASS
VF Impulse Noise:	Completed	
Receive Tone:	Completed	
WB Longitudinal Balance:	Completed	PASS
PSD Noise:	Completed	
Attenuation:	N/A	
WB Impulse Noise:	Completed	
TDR Length:	N/A	
Test Status	Summary	DMM Results

Test Results screen–Auto tests.



Detecting Excessive Spectral Noise

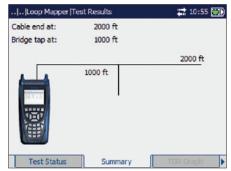
Use the AXS-200/635's 30 MHz Power Spectral Density Noise feature to manage the spectrum in the cable bundle. The unit's graphic display helps to determine which service is deployed on the loop and at what power level. This is the best technique to use in identifying signals that are running too strong for the bundle, and it is essential in unbundled local loop environments for spectral policing.

Test Results screen-PSD noise.

LoopMapper Makes It Simple

The AXS-200/635's convenient and powerful LoopMapper tool simplifies the detection of faults, bridge taps or cable ends. By automatically selecting the time-domain reflectometer (TDR) and/or the frequency-domain reflectometer (FDR), based on the line conditions, Loop Mapper displays a straightforward wiring diagram that includes the loop distances, for easy interpretation.





Test Results screen-Loop Mapper.

Complete Metallic Testing Including Digital Multimeter (DMM) and Voice Frequency (VF)

With the AXS-200/635, AC and DC voltage measurements are automatically performed and documented, without having to press countless buttons or having to move the test leads. The AXS-200/635 also measures AC and DC current to offer a complete picture of the electrical stability on the circuit under test. Additionally, it measures capacitance and resistance, including balance calculations for each. Capacitance and resistance measurements are automatically converted into distance values for loop-length assessment. The AXS-200/635 offers unique tests to detect the presence of corrosion and water in circuits to help technicians achieve faster and easier troubleshooting.

DC Voltage:	0.0 V	-0.5 V	-0.5 V
AC Voltage:	0.0 V	0.0 V	0.0 V
Frequency:	0 Hz	0 Hz	0 Hz
	T-R	🔴 T-G 🛛	🐌 R-G 🛛 👙
	-0.		
AC~ 0.	-0.		

DMM capacitance test screen.

Multiple Applications, One Test Set

EXFO's AXS-200/635 integrates the capabilities of both the AXS-200/610 30 MHz Copper Test Set and the AXS-200/630 VDSL2, ADSL2+ and IP Triple-Play Test Set. It's the all-in-one solution for complete copper/DSL/triple-play assessment on the local loop.

Application	AXS-200/610	AXS-200/630	AXS-200/635
Copper fault location	 		×
Copper troubleshooting	 		
Narrowband testing	 		
ADSL2+/VDSL2 prequalification	 		×
VDSL2 service verification		 	×
ADSL2 service verification		 	×
IPTV analysis (DSL and Ethernet)		 	×
VoIP analysis (DSL and Ethernet)		 	
Data analysis (DSL and Ethernet)		 	
INP and/or PhyR[] support		 	
DSL Annexes A, B and L support		 	
Annex M support		v	v

xDSL/Triple-Play Testing Specifications

VDSL2 VTU-R-MODULE

Chipset	Broadcom
Standard Compliance	
VDSL2	ITU-T G.993.2
ADSL1/2/2+	Annex A option (over POTS): ITU-T G.992.5 (ADSL2+), ITU-T G.992.3 (ADSL2), ITU-T G.992.1 (G.DMT) and ANSI T1.413 Issue 2
	Annex B option (over ISDN): ITU-T G.992.5 (ADSL2+), ITU-T G.992.3 (ADSL2), ITU-T G.992.1 (G.DMT) and UR2 Annex L (RE-ADSL) and Annex M are also supported
DSL measurements (upstream and downstream)	Maximum attainable bit rates
	Actual achieved bit rates
	Latency mode: fast, interleaved
	Capacity
	Signal-to-noise ratio (SNR) margin
	Output power
	Attenuation
	Carrier load (bits/bin)
	Interleave depth
	Interleave delay
	Trellis coding
	Bit swapping
Miscellaneous functions/measurements	PhyR [™] and INP support
	ATM F4 and F5 OAM loopback (ADSL1/2/2+ modes only)
	Link errors FEC, CRC, HEC
	Loss of sync counter
<	VDSL2 per band information

IPTV-OVER-DSL/ETHERNET T	ESTING
Physical-layer support	VDSL2 ADSL1/2/2+ Ethernet 10/100
Supported video compression/standards	MPEG2, MPEG4 part 2 and 10 (H.264/AVC), WM9
Operation	Terminate and Pass Through
IPTV parameters/functionality	Video streaming (channels) detection IGMP join/leave requests with STB emulation Bandwidth usage per channel IGMP packets information Set-top box (STB) traffic/setup information Key IP video CoS parameters: packet loss, packet jitter, zap time, PCR jitter, PID statistics Media delivery index (MDI) showing delay factor, media loss rate and virtual buffer CoS pass/fail indicators
IP connectivity support	Graphic results: bandwidth usage and multilayer fault analysis histogram IP packet and PCR jitter histograms Multicast/unicast RTP/UDP IP stream support TCP/RTSP VOD support Multiple downstream PVC in ATM mode for IPTV DNS, DHCP client/server, NAT, VLAN

VoIP-OVER-DSL/ETHERNE	T TESTING
Physical-layer support	VDSL2
	ADSL1/2/2+
	Ethernet 10/100
Recognized signalling protocol	Session initiation protocol (SIP) v2 (RFC 3261)
Operation	Pass Through
Recognized codecs	G.711, G.729, G.726, G.723
VoIP parameters/functionality	Call monitoring/analysis/statistics
	Call flow
	Key VoIP QoS parameters: packet loss, packet jitter
	QoS pass/fail indicators
	Graphic results: delay distribution, jitter histogram
IP connectivity support	DNS, DHCP client/server, NAT, VLAN

xDSL/Triple-Play Testing Specifications (continued)

DATA ANALYSIS MODE				
Physical-layer support	VDSL2			
	ADSL1/2/2+	ADSL1/2/2+		
	Ethernet 10/100			
Encapsulation methods	PPPoE (RFC 2516), RFC 2684 supporting bridged Ethernet (IPoE), IPoA (RFC 1577), PPPoA/LLC			
	and PPPoA/VC-MUX (RFC 2364)			
Operation	Terminate and Pass			
Login format		word using PAP or CHAP		
IP connectivity support	DNS, DHCP client/s			
Ping	Pings another device	e on the network		
	Ping device:	Gateway, destination IP address or URL		
	Number of pings:	1 to 99		
	Packet size:	32 to 1500 bytes (32 is default)		
	Results:	Indicate packet size, packets sent/received, average round-trip times in milliseconds (ms)		
Traceroute	Determines the path used to reach device on the network			
	Timeout:	In seconds		
	Time to live (TTL):	Default is 100 ms, maximum is 5 s		
	Packet size:	32 bytes		
	Number of hops:	1 to 30 (default is 30)		
	Results:	Indicate IP address of hop and round-trip time in milliseconds (ms)		
HTTP speed test		Downloads a Web page and indicates speed of download		
	Address:	IP or URL		
	Protocol:	HTTP		
	Results:	Time, speed in kbit/s		
FTP speed test		Displays speed to upload and/or download a file		
	Address:	IP or URL		
	Protocol:	FTP		
	Results:	Time, speed in kbit/s		

Copper Testing Specifications ª

ENECUENC CHARACTERISTICS * Beards Inspanse 300 Hz Io 10 Mit, resolution 11 Hz Beards Inspanse 10 Mit Io 20 Mit, resolution 10 Hz Beards Inspanse 0.0 Hz Io 20 Mit, resolution 10 Hz Beards Inspanse 0.0 Hz Io 20 Mit, resolution 10 Hz Beards Inspanse 0.0 Hz Io 20 Mit, resolution 10 Hz Beards Inspanse 0.0 Hz Io 20 Mit, resolution 10 Hz Transmit Registry 100 Hz Io 20 Mit, resolution 10 Hz Transmit Registry 200 Hz Io 20 Hz, resolution 1 Hz Is Eggs Transmit Registry 200 Hz Io 20 Hz, resolution 1 Hz Is Eggs Transmit Registry 200 Hz Io 20 Hz, resolution 1 Hz Is Eggs Transmit Registry 200 Hz Io 20 Hz, resolution 1 Hz Is Eggs Transmit Registry 400 Hz Io 20 Hz, resolution 1 Hz Is Eggs Transmit Registry 400 Hz Io 20 Hz, resolution 1 Hz Is Eggs Transmit Registry 400 Hz Io 20 Hz, resolution 1 Hz Is Eggs Transmit Registry 400 Hz Io 20 Hz, resolution 1 Hz Io 20 Hz, reso		
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Transmit frequency 200 Ht to 20 Hz, resolution 1 Hz steps Transmit frequency 20 Hz to 20 Hz, resolution 1 Hz steps Transmit frequency 20 Hz to 30 Hz, resolution 1 Hz steps Transmit frequency 20 Hz to 20 Hz to 20 Hz to 30 Mz Transmit frequency 20 Hz to 20 Hz to 20 Hz to 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz to 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 100 HZ to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 10 Hz to 20 Hz to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 10 Hz to 20 Hz to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 10 Hz to 20 Hz to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 10 Hz to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz And to 10 Hz to 20 Hz to 20 Hz to 20 Hz 20 Hz to 20 Hz <t< td=""><td>TRANSMITTER CHARACTERIS</td><td>TICS</td></t<>	TRANSMITTER CHARACTERIS	TICS
Transmit Indjurny 20 kHz to 30 MHz, resolution 1 MHz steps Transmit Red (Bm) -20 to +20 to 20 Hz 0.450 Hz Transmit Red (Bm) -20 to +20 at 00 C for 500 Hz 0.350 Hz Transmit Red (Bm) -20 to +20 at 00 C for 500 Hz 0.350 Hz Transmit Red (Bm) ±1.68 C0 C for 500 Hz to 20 MHz Level uncertainty (accurreg) ±1.68 C0 Ftx 10 20 MHz ±2.68 CB 2.2 MHz to 17 MHz Impediance (C) 100, 135 and 600 VF. FOISE MEASUREMENT Range (Bm) Range (Bm) 0 to -00, subject to instrument noise foor Uncertainty (accurreg) (BI) ±1 VF. INPULSE NOISE		
Transmit level (dBm) -20 to 45 at 600 fbr 20 bits to 90 Hz -20 to 45 at 600 fbr 20 bits to 30 Hz -20 to 45 at 600 fbr 20 bits to 30 Hz Financerus uncontributy faccuracy) +50 fbr 20 fbr 20 bits to 30 Hz -10 to +10 at 100 fbr 20 bits 20 bits at 00 dBm +50 fbr 20 bits at 00 dBm -11 dB 20 hHz to 22 Mits -12 dB 10 dB mits -12 dB mits 10 dB mits -12 dB mits 10 dB mits -12 dB mits 11 dB mits		
20 to -10 at 100 / 150 / 150 / 20 Met to 20 Met Frequency uncertainty (accuracy) ±180 ppm + 0.5 He Level uncertainty (accuracy) ±13 dia Impediance (0) 100, 135 and 600 VF NOSE MEASURENT None, 3 He Range (dBm) 0 to -90, subject to instrument noise floor Uncertainty (accuracy) ±1 Hines None, 3 He Filter None, 3 He Mid threshold Low threshold (plus separation High threshold Mid threshold plus separation High threshold Mid threshold plus separation High threshold 100 Danal time (DB) 105 Filter Maximum 209 for each threshold and D filter (IEEE 743-1996) Courter Maximum 209 for each threshold Timet 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) Notes range (dBm) ±10 at -40 dBm UP		
	Transmit level (dBm)	
Frequency uncertainly (accuracy) ±06 dB 200 Ht to 20 Mt at 0 dBm Level uncertainly (accuracy) ±06 dB 200 Ht to 20 Mt at 0 dBm ±1 dB 201 Ht to 20 Mt at 0 dBm Press 200 Ht to 20 Mt at 0 dBm WF NOISE MEASUREMENT Press Participation (0) 0 to -00, subject to instrument noise floor Uncertainly (accuracy) (dB) ±1 Press None, 3 Mt at 1 dB stops Mone Table (dBm) 0 to -40, in 1 dB stops Mid threahold Low threahold gBm separation High threahold Mid threahold gBus separation High threahold I to 40, in 1 dB stops Datal time (ms) To 3, a bits fill, Creassage, peophometric, notohed and D filter (IEEE 743 1995) Counter Mainton 996 for each threahold Time 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOCOUND) Nose arrays (dBm) Nose arrays (dBm) ±10 at -50 dBm Level uncertainty (accuracy) (dB) ±10 at -50 dBm Level uncertainty (accuracy) (dB) ±10 at -50 dBm More arrays (dBm) ±10 at -50 dBm Uncertainty (accuracy) (dB) <td></td> <td></td>		
Level uncertainty (accuracy) ±0.6 dB 200 Hz to 22 MHz to 24 MHz to B 2.2 MHz to 17 MHz to B 100, 135 and 600 VF NOISE MEASUREMENT 100, 135 and 600 Filters 100, 135 and 600 VF NOISE MEASUREMENT 100, 135 and 600 VF INPULSE NOISE 100, 10, 10, 11 dB step Levi Inschuld (BBm) 0.0 -40, in 1 dB step High Inschuld Mthreshold plus asparaton Separation (BD 1.0 6, in 1 dB step Doad time (ine) 1.0 5, in 1 dB step Courter Mainture DA block, default is 10 minutes POWER INFLUENCE (NOISE TO GROUND) 100, in 40 steps Lowardianty Courter) (dB) ±1.0 VF LONGTUDINAL BALANCE 100 a -60 dBm Figure purchariting (accuracy) (dB) ±1.0 VF LONGTUDINAL BALANCE 100 a -60 dBm Figure purchariting (accuracy) (dB) ±1.0 TIME-OOMAIN REFLECTOMETY (TOR) 0000 (25		
ti dB 20 kHz to 22 MHz ± 3dB 12 MHz to 30 MHz Impedance (0) 100, 138 and 600 VF NOISE MEASUREMENT Range (Bm) 0 to -90, subject to instrument noise floor Unortianty (accuracy) (dB) ±1 Filters None, 3 MHz flat, Crimessage, peophemetric, notched and D filter (IEEE 743-1996) VF IMPULSE NOISE Low threshold Low threshold (dBm) 0 to -40, in 1 dB steps Md threshold Low threshold plus separation Fibre None, 3 MHz flat, Crimessage, peophemetric, notched and D filter (IEEE 743-1996) Counter Maximum 969 for each threshold Timer 1 to 1, in 1 dB steps Counter Maximum 969 for each threshold Timer 1 to 1, in 1 dB steps Counter Maximum 969 for each threshold Timer 1 to 1 -0 to 10 Uncertainty (accuracy) (BB) ± 1.0 at -0 dB m Feaguency (Hal) 0 to 40 Uncertainty (accuracy) (BB) ± 1.0 at -0 dB m Feaguency (Hal) 1 to 4 Timer 1 to 4 Level uncertainty (accuracy) (AB) ±		
±2 dB 2.2 MHz to 20 MHz Impediance (0) 100, 135 and 800 VF NOSE MEASUREMENT Range (dBm) 0 to -90, subject to instrument noise floor Honestainty (accuracy) (dB) ±1 Filters None, 3 kHz flat, Crimessage, pacphometric, notched and D filter (IEEE 743-1995) VF IMPULSE NOISE Impediance Low threshold (dBm) 0 to -40, in 1 dB steps Might threshold More hand (B alt, Crimessage, pacphometric, notched and D filter (IEEE 743-1995) VF IMPULSE NOISE Impediance Low threshold (dBm) 0 to -40, in 1 dB steps Separation (dB) 1 to (in 1 dB steps Dead time (ms) 128 Filtes None, skife alls, Crimesage, pacphometric, notched and D filter (IEEE 743-1995) None arrays (dBm) -60 to +10 Uncertainty accuracy) (dB) ±10 Time 1 minute to 24 hours, default is 15 minutes VF LONGITUDINAL BALANCE Frequency (MS) Use arrays (dBm) -60 to +10 Uncertainty accuracy) (dB) ±1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fuly automatic operation with location of most	Level uncertainty (accuracy)	
±3 dB 17 MHz to 30 MHz impedance (IQ) 100. 190 and 600 VF NOISE MEASUREMENT Range (IBR) Range (IBR) 0 to -90, subject to instrument noise floor Uncettainty (accuracy) (IB) ±1 Filters None, 3 kHz flat, Creessage, psephometric, notched and D filter (IEEE 743-1995) VF. IMPULSE NOISE Low threshold (IGBM) 0 to -40, in 1 dB steps Mid threshold Low threshold plus separation High threshold Separation (IB) 1 to 6, in 1 dB steps Mid threshold (IGBM) Counter Maximum 990 (or each threshold) Separation (IB) Counter Maximum 990 (or each threshold) To make threshold Counter Maximum 990 (or each threshold) To make threshold POWER INFLUENCE (NOISE TO GROUND) Nota marge (IBM) -0 to 10 Uncertainty (accuracy) (IB) ±1.0 at -80 dBm -0 to 10 Uncertainty (accuracy) (IB) ±1.0 at -80 dBm -0 to 80 Level uncertainty (accuracy) (IB) ±1.0 at -80 dBm -0 to 80 Level uncertainty (accuracy) (IB) ±1.0 at -80 dD 0.0 fth -0 to 80 Level uncertainty (accuracy)		±1 dB 20 kHz to 2.2 MHz
Impedance (D) 100, 135 and 600 VF NOSE MEASUREMENT 0 to -90, subject to instrument noise floor Increatianty (accuracy) (dB) 1 Filters None, 3 HHz flat, C-message, psophometric, notched and D filter (IEEE 743-1995) VF IMPULSE NOISE Use +40, in 1 dB steps Mid Breshold Low threshold plus separation High threshold Mid threshold plus separation Separation (dB) 1 to 6, in 1 dB steps Doad time (ms) 125 Contrer Maamum 996 for each threshold Timer Immute to 24 hours, defaul in 18 minutes POWER INFLUENCE (NOISE TO GROUND) None, 3 Hz flat, C-message, psophometric, notched and D filter (IEEE 743-1985) Conter Maamum 996 for each threshold Timer Immute to 24 hours, defaul in 18 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±10 at -60 dBm -60 dBm VF LONGITUDINAL BALANCE Frequency (tHz) (accuracy) (ac		±2 dB 2.2 MHz to 17 MHz
VF. NOISE MEASUREMENT 0 b = 40, subject to instrument noise floor Under difficit seconcep) (dB) 11 Filters Nois Ver IMPULSE NOISE 0 to = 40, in 1 dB steps Low threshold (dBm) 0 to = 40, in 1 dB steps Mid threshold Low threshold provide separation Mid threshold Low threshold provide separation Separation (dB) 10 b 5, in 1 dB steps Dead time (imp) 125 Filters None, 3 MtF flat, C-message, psophometric, notched and D filter (IEEE 743-1986) Counter Maintum 999 for cost threshold Timer 1 minute to 24 hours, default to 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise angle (dBm) Noise arrange (dBm) -60 to +10 Lorent intrig cacuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 Level angle (B) 0 to 80 Level angle (B) 0 to 80 Level ancertainty (accuracy) (dB) ±1 TIME-COMAIN REFLECTOMETRY (TDR) Mode Filty automatic operation with location of most significant even		±3 dB 17 MHz to 30 MHz
VF. NOISE MEASUREMENT 0 b = 40, subject to instrument noise floor Under difficit seconcep) (dB) 11 Filters Nois Ver IMPULSE NOISE 0 to = 40, in 1 dB steps Low threshold (dBm) 0 to = 40, in 1 dB steps Mid threshold Low threshold provide separation Mid threshold Low threshold provide separation Separation (dB) 10 b 5, in 1 dB steps Dead time (imp) 125 Filters None, 3 MtF flat, C-message, psophometric, notched and D filter (IEEE 743-1986) Counter Maintum 999 for cost threshold Timer 1 minute to 24 hours, default to 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise angle (dBm) Noise arrange (dBm) -60 to +10 Lorent intrig cacuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 Level angle (B) 0 to 80 Level angle (B) 0 to 80 Level ancertainty (accuracy) (dB) ±1 TIME-COMAIN REFLECTOMETRY (TDR) Mode Filty automatic operation with location of most significant even	Impedance (Ω)	100, 135 and 600
Range (dBm) 0 to -90, subject to instrument noise floor Uncertainty (accuracy) (dB) ±1 Filters None, 3 HHz flat, C-message, psophometric, notched and D filter (IEEE 743-1985) VF IMPULSE NOSE Uncertainty (accuracy) (dB) Low threahold (dBm) 0 to -40, in 1 dB stops Mid Hireshold Mid Hireshold plus separation Separation (dB) 1 to 6, in 1 dB stops Dead time (ms) 125 Filters None, 3 HHz flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter Maximum 999 for each threshold Timer Imitate to 24 hours, default is 1 minutes POWER INFLUENCE (NOISE TO GROUND) Nosa range (dBm) Nosa range (dBm) -60 to +01 Uncertainty faccuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fuly automatic operation with location of most significant		
Uncertainty (accuracy) (dB) +1 Filters None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) VF IMPULSE NOISE Low threshold (dBm) 0 to 0-40, in 1 dB steps Mid threshold (Bm) 1 to 6, in 1 dB steps Separation (dB) 1 to 6, in 1 dB steps Dead time (m0) 125 Filters None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter None, 3 Ht/ flat, C-message, Psophometric, notched and D filter (IEEE 743-1995) Counter ange (IB - 10 Counter ange (IB - 10 Counter ange (IB - 10 Counter ange (ID - 10 Counter ange (ID - 10) Counter ang		
Filters None, 3 kHz flat, C-message, psophometric, notched and D filter (IEEE 743-1996) VF IMPULSE NOISE		
VF IMPULSE NOISE Low threshold (dBm) 0 to ~40, in 1 dB steps Mid threshold Low threshold plus separation Mid threshold Move threshold plus separation Separation (dB) 1 to 6, in 1 dB steps Filters None, 3 kHz flat, Creessage, psophometric, notched and D filter (IEEE 743-1995). Courter Maximum 996 for cach threshold Timer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBn) Noise range (dBn) -60 to +10 Level uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE Frequency uncertainty (accuracy) (pm) Frequency uncertainty (accuracy) (pm) 1004 Frequency uncertainty (accuracy) (pm) 150 Level range (dB, dccuracy) (pm) 150 Level range (dB, dccuracy) (pm) 150 Level range (dC, dccuracy) (pm) 50 Level range (dB, dccuracy) (pm) 150 Level range (dC, dccuracy) (pm)<		
Low threshold (dBm) 0 to -40, in 1 dB steps Mid threshold Low threshold jues separation Separation (dB) 1 to 6, in 1 dB steps Dead time (mg) 125 Filters None, 3 Mz fait, C-message, psophometric, notched and D filter (IEEE 743-1995) Courter Maximum 999 for each threshold Timer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) -60 to +10 Unite to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) -60 to +10 Unevel uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 TIME-DOMAIN REFLECTOMETRY (TPR) Mode Fully automatic operation with location of most significant events Distance range (m) Es to 50.0 Level uncertainty (accuracy) (dB) ±1.0 TIME-DOMAIN REFLECTOMETRY (TPR) Mode Fully automatic operation with location of most significant events Distance range (m) Es to 50.0 Level automatic or 30 (tD 0, h) 20.0 (tD 000 ft) Test signals Sine wave, compensated sine wave, half-sine wave and square wave Anglitude 7.5 V p. p. on cable, 9 V p. p. p. On the Courteautrice of the 18 000 (th) cable, 900 (10 000 th), 6000 (10 000 th), 6000 (10 000 th), 6000 (10 000 th), 6000 (20 000 th), 13 50 (45 000 th and	Filters	None, 3 kHz flat, C-message, psophometric, notched and D filter (IEEE 743-1995)
Low threshold (dBm) 0 to -40, in 1 dB steps Mid threshold Low threshold jues separation Separation (dB) 1 to 6, in 1 dB steps Dead time (mg) 125 Filters None, 3 Mz fait, C-message, psophometric, notched and D filter (IEEE 743-1995) Courter Maximum 999 for each threshold Timer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) -60 to +10 Unite to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) -60 to +10 Unevel uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 TIME-DOMAIN REFLECTOMETRY (TPR) Mode Fully automatic operation with location of most significant events Distance range (m) Es to 50.0 Level uncertainty (accuracy) (dB) ±1.0 TIME-DOMAIN REFLECTOMETRY (TPR) Mode Fully automatic operation with location of most significant events Distance range (m) Es to 50.0 Level automatic or 30 (tD 0, h) 20.0 (tD 000 ft) Test signals Sine wave, compensated sine wave, half-sine wave and square wave Anglitude 7.5 V p. p. on cable, 9 V p. p. p. On the Courteautrice of the 18 000 (th) cable, 900 (10 000 th), 6000 (10 000 th), 6000 (10 000 th), 6000 (10 000 th), 6000 (20 000 th), 13 50 (45 000 th and		
Mid threshold Low threshold plus separation High threshold Mid threshold plus separation Separation (dB) 1 to 6, in 1 dB steps Dead time (ms) 125 Filtera None, 3 kHz flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter Namunn 999 for each threshold Timer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise arrage (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±1 to 4 -60 dBm VF LONGITUDINAL BALANCE Feequency (th) Frequency (th) 1004 Frequency (th) 0 to 80 Level uncertainty (accuracy) (dB) ±1 0 Distance range (m) 5 to 6000 (25 ft up to 20 000 ft) Pulse width 15 ns to 20 µs Time default 5 ns wave, compensated sine wave, half-sine wave and square wave Amplitude 7.3 V pp on cable, 9 V pp op noicuut Mord on pagastion (VOP) 7.3 V pp on cable, 9 V pp op noicuut Horizontal scale (m) 1.5 to 5000 (5 to 10 000, ft; co (2000 ft), 1500 (5000 ft), 3000 (10 000 ft), 6000 (20 000 ft), 13 500 (450 00 ft) and 15 000 (50 00 ft), 1500 (5000 ft), 3000 (10 000 ft), 13 500 (450 00 ft) and 15 000 (50 00 ft), 1500 (5000 ft), 3000 (10 000 ft)		
High threshold Mid threshold julus separation Separation (dB) 10 6, jn 1 dB steps Dead time (ms) 125 Filters None, 3 kHz flat, Creessage, psophometric, notched and D filter (IEEE 743-1995) Courter Maximum 999 for each threshold Timmer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) Noise range (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE Frequency (Hz) Frequency (Hz) 1004 Three_construction (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode File to 20 us Test signals Sine wave, compensated sine wave, natificiant events Distance range (m) 8 to 6000 (25 ft up to 20 000 ft) Pulse width 15 ne to 20 us Test signals Sine wave, compensated sine wave, natificine wave and square wave Amplitude 7.5 V pp on cable, 9 V pp op and iccuit Velocity of propagation (VOP) 0.400 to 0.990 or 120 m/ya to		
Separation (dB) 1 to 6, in 1 dB steps Dead time (ma) 125 Filters None, 3 kHz ftat, C-message, psophometric, notched and D filter (IEEE 743-1995) Counter Mainum 998 for each threshold Timer I minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Note range (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE Frequency (lA) 1004 Frequency (lA) 1004 Freq		
Dead time (ms) 125 Filters None, 3 LHF flat, C-message, psophometric, notched and D filter (IEEE 743-1995) Courter Maximum 999 for each threshold Timmer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) Noise range (dBm) -60 to +10 Uncertainly (accuracy) (dB) ±1.0 Level uncertainly (accuracy) (dB) ±1.0 VF LONGTUDINAL BALANCE Frequency (Hz) Frequency (Hz) 1004 Frequency (Hz) 0 to 80 Level uncertainly (accuracy) (dB) ±1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fully automatic operation with location of most significant events Distance range (m) 8 to 6000 (25 ft up to 20 000 ft) Pulse width 15 ns to 20 µs Test signals Sine wave, compensated sine wave and square wave Anplitude 7.5 V pp on cable, 9 V pp opn circuit Velocity of propagation (VOP) 0.400 to 0.399 or 120 m/µs to 299 m/µs Distance arange (m) £1(4 m + 2 % x distance) or £4(5 ft + 2 % x distance) Units Feet and meters		
Filters None, 3 Hz fiat, C-message, poophometric, notched and D filter (IEEE 743-1995) Counter Maximum 999 for each threshold Timer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOSE TO GROUND) Noise range (dBm) -60 to +10 Uneretiantry (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 Frequency (H2) 1004 Frequency (H2) 0104 Counter (GB) 0 to 80 Level uncertainty (accuracy) (dB) ±1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fulg automatic operation with location of most significant events Distance range (m) ± to 8 to 6000 (25 ft up to 20 000 ft) Pulse width 15 ns to 20 µs Test signals Sine wave, compensated sine wave, half-sine wave and square wave Amplitude 0.420 to 0.099 or 120 m/µs to 299 m/µs Distance uncertainty (accuracy) (m) 1.4 m tr 2.7 w distance or 1.45 ft + 2.7 w distance) Units Feet and metes Velocity of propagation (VOP) 0.400 to 0.999 or 120 m/µs to 299 m/µs Distance uncertainty (accuracy) (m) 1.5 to 5000 (5 ft t		1 to 6, in 1 dB steps
Counter Maximum 999 for each threshold Timer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 VF LONGTUDINAL BALANCE Frequency (hz) Frequency (hz) 1004 Frequency (hz) 0 to 80 Level uncertainty (accuracy) (dB) ±1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fully automatic operation with location of most significant events Distance range (m) 8 to 6000 (25 fully to 20 000 ft) Pulse width 15 ns to 20 µs Test signals Sine wave, compensated sine wave, half-sine wave and square wave Amplitude 7.5 V pp on cable, 9 V pp open circuit Velocity of propagation (VOP) 0.400 to 0.999 or 120 mil µs to 299 mil µs Distance uncertainty * (accuracy) (m) ±1.4 m + 2 % x distance) or ±4.5 ft + 2 % x distance) Units Feet and meters Horizontal scale (m) Automatic or 30 (100 0 ft), 300 (100 0 ft), 500 (200 0 ft), 1500 (5000 ft), 453 (510 0		
Timer 1 minute to 24 hours, default is 15 minutes POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) ~60 to +10 Uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE Frequency (Hz) Frequency (Hz) 1004 Frequency (moditinity (accuracy) (gB) ±10 Level uncertainty (accuracy) (dB) ±1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fully automatic operation with location of most significant events Datance range (m) 8 to 6000 (25 ftu p 12 02 000 ft) Pulse with 15 ns to 20 upen circuit Test signals Sine wave, compensated sine wave, half sine wave and square wave Amplitude 7.5 Vr ps on cable, 9 V pp open circuit Valoity of propagation (VCP) 0.400 to 0.990 or 120 or 14.5 ft + 2 9 to distance) Units Feet and meters Horizontal scale (m) Automatic 30 (100 0ft), 600 (2000 ft), 1500 (5000 ft), 3000 (10 000 ft), 6000 (20 000 ft), 13 500 (1500 tt), 3000 (10 000 ft), 6000 (20 000 ft), 13 500 (1500 tt), 3000 (10 000 ft), 6000 (20 000 ft), 13 500 (1500 tt), 13 500 (1500 tt), 13 500 (1500 tt), 13 500 (1500 tt), 150 (1500 tto 5000) FREQUENCY-DO	Filters	None, 3 kHz flat, C-message, psophometric, notched and D filter (IEEE 743-1995)
POWER INFLUENCE (NOISE TO GROUND) Noise range (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 Frequency (ta) 1004 Frequency (ta) 1004 Frequency (ta) 1004 Frequency (ta) 1004 Frequency (ta) 0.00 Level range (dB) 0.10 60 Level range (dB) 1.1 Mode Fully automatic operation with location of most significant events Distance range (m) 8 to 6000 (25 ft up to 20 000 ft) Test signals Sine wave, componated sine wave, half-sine wave and square wave Amplitude 7.5 V p. po cancicut Velocity of propagation (VOP) 0.400 to 0.999 or 120 m/ys to 299 m/ys Distance uncertainty < (accuracy) (m)	Counter	Maximum 999 for each threshold
Noise range (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE Frequency (H2) 1004 Frequency (H2) 004 Investrainty (accuracy) (gpm) ±50 Level range (dB) 0 to 80 Level investrainty (accuracy) (gpm) ±11 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fully automatic operation with location of most significant events Distance range (m) 8 to 6000 (25 ft up to 20 000 ft) Pulse width 15 ns to 20 µs Test signals Sine wave, compensated sine wave, half-sine wave and square wave Amplitude 7.5 V pp open circuit Velocity of propagation (VOP) 0.400 to 0.999 or 120 m/µs to 299 m/µs Distance uncertainty cf accuracy) (m) 11 (1.4 m + 2 % x distance) Units Feet and meters Horizontal scale (m) 15 to 5000 (5 ft to 18 00 0ft), 300 (10 000 ft), 300 (10 000 ft), 600 (20 000 ft), 1350 (5000 ft), 300 (10 000 ft), 600 (20 000 ft), 1350 (500 to 5000) Distance range (m) 15 to 5000 (5 ft to 18 00 0ft) Velocity of propagation (VOP) 0.400 to 15001, ±50 (1500 to 5000) <	Timer	1 minute to 24 hours, default is 15 minutes
Noise range (dBm) -60 to +10 Uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE Frequency (H2) 1004 Frequency (H2) 004 Investrainty (accuracy) (gpm) ±50 Level range (dB) 0 to 80 Level investrainty (accuracy) (gpm) ±11 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Mode Fully automatic operation with location of most significant events Distance range (m) 8 to 6000 (25 ft up to 20 000 ft) Pulse width 15 ns to 20 µs Test signals Sine wave, compensated sine wave, half-sine wave and square wave Amplitude 7.5 V pp open circuit Velocity of propagation (VOP) 0.400 to 0.999 or 120 m/µs to 299 m/µs Distance uncertainty cf accuracy) (m) 11 (1.4 m + 2 % x distance) Units Feet and meters Horizontal scale (m) 15 to 5000 (5 ft to 18 00 0ft), 300 (10 000 ft), 300 (10 000 ft), 600 (20 000 ft), 1350 (5000 ft), 300 (10 000 ft), 600 (20 000 ft), 1350 (500 to 5000) Distance range (m) 15 to 5000 (5 ft to 18 00 0ft) Velocity of propagation (VOP) 0.400 to 15001, ±50 (1500 to 5000) <		
Uncertainfy faccuracy) (dB) ±1.0 Level uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE 1004 Frequency (Hz) 1004 Frequency (Hz) 0 to 80 Level uncertainty (accuracy) (BP) ±50 Level uncertainty (accuracy) (BP) ±1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Distance range (m) B to 6000 (25 ft up to 20 000 ft) Pulse width 15 ns to 20 µs Test signals Sine wave, compensated sine wave, half-sine wave and square wave Amplitude 7.5 V pp on cable, 9 V pp open circuit Velocity of propagation (VOP) 0.400 to 0.999 or 120 m/µs to 299 m/µs Distance uncertainty ° (accuracy) (m) ±(1.4 m + 2 % x distance) or ±(4.5 ft + 2 % x distance) Units Feet and meters Horizontal scale (m) Automatic or 30 (1000 ft), 600 (2000 ft), 1500 (5000 ft), 3000 (10 000 ft), 6000 (20 000 ft), 13 500 (45 000 ft) and 15 000 (500 0 ft) Peter certainty (accuracy) (m) 1.5 to 5000 (5 ft to 18 000 ft) Preduencertainty (accuracy) (m) 1.5 to 5000 (5 ft to 18 000 ft) Protochits data Feet and meters LoaD COLL DETECTION Count		
Level uncertainty (accuracy) (dB) ±1.0 at -60 dBm VF LONGITUDINAL BALANCE Frequency uncertainty (accuracy) (ppm) ±50 Frequency uncertainty (accuracy) (dB) ±10 1004 Frequency uncertainty (accuracy) (dB) ±1 1 TIME-DOMAIN REFLECTOMETRY (TDR) Mode Fully automatic operation with location of most significant events Distance range (m) 8 to 6000 (25 ftup to 20 000 ft) 15 ns to 20 µs Test signals Sine wave, compensated sine wave, half-sine wave and square wave Amplitude 7.5 V p-p on cable, 9 V p-p open circuit Velocity of propagation (VOP) 0.400 to 0.999 or 12.00 ruly to 12.94 x distance) Distance uncertainty (accuracy) (m) ±1.1 th + 2 % x distance) or ±(4.5 ft + 2.9 % x distance) Units Feet and meters Horizontal scale (m) Automatic or 30 (100 ft), 300 (1000 ft), 600 (2000 ft), 1500 (5000 ft), 3000 (10 000 ft), 6000 (20 000 ft), 13 500 (5000 ft) Pietace uncertainty (accuracy) (m) ±3 (3 to 1000), ±15 (1000 to 1500), ±50 (1500 to 5000) Units Feet and meters LooD COLL DETECTION Five Piot (Hz) Up to 10 Distance range (m) Up to 8000 (up to 27 000 ft) <		
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Distance range (m) 1.5 to 5000 (5 ft to 18 000 ft) Velocity of propagation (VOP) 0.400 to 0.999 or 120 m/µs to 299 m/µs Distance uncertainty (accuracy) (m) ±3 (3 to 1000), ±15 (1000 to 1500), ±50 (1500 to 5000) Units Feet and meters LOAD COIL DETECTION Five Count Five Plot (kHz) Up to 10 Distance range (m) Up to 8000 (up to 27 000 ft) SINGLE-END FREQUENCY RESPONSE (ATTENUATION) Distance range (m) 70 to 5000 (200 ft to 16 000 ft) Frequency range 4.3 kHz to 30 MHz Frequency uncertainty (accuracy) ±50 ppm Level uncertainty (accuracy) ±50 ppm Level uncertainty (accuracy) ±00 pm Level uncertainty (accuracy) ±00 pm Level uncertainty (accuracy) 0.1 Horizontal scale (MHz) ADSL2+ = 2.208, VDSL2-12 = 12, VDSL2-17 = 17.66, VDSL2-30 = 30 Vertical scale (dB) 0 to +100		
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Vertical scale (dB) 0 to +100		
	Vertical scale (dB)	0 to +100
	~	

NOTES a. At 23 °C \pm 1 °C on batteries, unless otherwise specified.

b. Characteristics are subject to instrument noise floor (approx. -70 dBm). Levels below -70 dBm can be measured using the PSD noise test.
 c. Does not include the uncertainty due to VOP.

Copper Testing Specifications (continued)

Test type	Continuous or peak-hold		
Vertical scale	-10 dBm/Hz to -145 dBm/Hz or +20 c		
Horizontal scale	4.3125 kHz to 17 MHz, in 4.3125 kHz s		
Noise filters	None or E, F, G, VDSL2-8, VDSL2-12,	/DSL2-17 and VD	SL2-30
DSL IMPULSE NOISE MEASU	REMENT		
Threshold	-50 dBm (40 dBrn) to 0 dBm (90 dBrn) in 1 dB steps	
Counter	Maximum 65 000		
Test duration	1, 5, 10, 15 and 60 min, 24 h or continu	ious (up to 360 h)	
Histogram plot interval	1, 5, 10, 15 or 60 min		
Uncertainty (accuracy) (dB)	±2		
SWEPT LONGITUDINAL BALA	NCE TEST		
Frequency uncertainty (accuracy) (ppm)	±50		
Level uncertainty (accuracy)(dB)	±2.0		
Vertical scale (dB)	0 to 80.0 up to 2.2 MHz 0 to 60.0 up to 30 MHz		
Horizontal scale	ADSL/2+: 26 kHz to 2.2 MHz		
	SHDSL: 26 kHz to 1 MHz VDSL/VDSL2-12: 26 kHz to 12 MHz VDSL2-17: 26 kHz to 17.66 MHz		
	VDSL2-30: 26 kHz to 30 MHz		
DIGITAL MULTIMETER (DMM) Measurement	Range	Resolution	Uncertainty (accuracy)
DC voltage	0 to 200 V	1 V	the better of ±2 % or ±1 V
AC voltage	0 to 140 Vrms	1 V	the better of ± 2 % or ± 1 V
solation resistance	0 to 999 MΩ	3 digits	
	0 to 999 Ω	o algito	the better of ± 2 % or ± 5 Ω
	1 kΩ to 99 MΩ		$\pm (2 \% + 1 \text{ digit})$
	$100 M\Omega$ to 999 MΩ		$\pm (5 \% + 1 \text{ digit})$
	Distance up to 30 000 m (100 000 ft)		
Resistance	0 to 30 MΩ	3 digits	
	0 to 999 Ω	o aigito	the better of ± 2 % or ± 5 Ω
	1 kΩ to 30 MΩ		$\pm (2 \% + 1 \text{ digit})$
	Distance up to 30 000 m (100 000 ft)		<u>=(</u> 2 ,0 , , , a.g.,
Capacitance	1 nF to 10 µF	3 digits	±(2 % + 1 digit)
Capacitanos	Distance up to 30 000 m (100 000 ft)	o algito	
DC current	0 to 110 mA	1 mA	±(2 % + 1 digit)
AC current	0 to 77 mA	1 mA	$\pm (2 \% + 1 \text{ digit})$
SPECTRAL DETECTIVE			
	pedance) onto a live circuit to display a plot	of transmitted level	s and spectrum (PSD). The Spectral Detective test can
referenced to any user-selected impedance	. The impedance reference setting is required		
Test type	Continuous or peak-hold		
Bridging impedance	15 kΩ		
Vertical scale	-10 to -145 dBm/Hz or +20 to -110 c	IBm	
Horizontal scale	4.3125 kHz to 17 MHz, in 4.3125 kHz s	steps or 8.625 kHz	to 30 MHz, in 8.625 kHz steps
Noise filters	None or E, F, G, VDSL2-8, VDSL2-12, V	/DSL2-17 and VDS	SL2-30
STRESS/LEAKAGE (ISOLATIC	N RESISTANCE)		
		mA	
	100 VDC, current safely limited to < 1.0		
Source	100 VDC, current safely limited to < 1.0 0 to 999 auto-ranging		
Source Range (MΩ) Resolution	0 to 999 auto-ranging 3 significant digits		
Source Range (MΩ) Resolution	0 to 999 auto-ranging		
Source Range (MΩ) Resolution	0 to 999 auto-ranging 3 significant digits		
Source Range (MΩ) Resolution Jncertainty (accuracy)	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω , the better of ±2 % or ±5 Ω		
Source Range (MΩ) Resolution Uncertainty (accuracy)	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 99 MΩ, ±(2 % + 1 digit)		
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s)	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 99 MΩ, ±(2 % + 1 digit) 100 MΩ to 999 MΩ, ±(5 % + 1 digit) 1 to 99		
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s) RESISTIVE FAULT LOCATION	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 99 MΩ, ±(2 % + 1 digit) 100 MΩ to 999 MΩ, ±(5 % + 1 digit) 1 to 99		
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s) RESISTIVE FAULT LOCATION Test type	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 999 MΩ, ±(2 % + 1 digit) 100 MΩ to 999 MΩ, ±(5 % + 1 digit) 1 to 99 (RFL) Single pair and separate good pair		
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s) RESISTIVE FAULT LOCATION Test type Fault detection (MΩ)	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 99 MΩ, ±(2 % + 1 digit) 100 MΩ to 999 MΩ, ±(5 % + 1 digit) 1 to 99 (RFL) Single pair and separate good pair 0 to 20		
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s) RESISTIVE FAULT LOCATION Test type Fault detection (MΩ) Resolution	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 99 MΩ, ±(2 % + 1 digit) 100 MΩ to 999 MΩ, ±(5 % + 1 digit) 1 to 99 (RFL) Single pair and separate good pair 0 to 20 3 digits		
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s) RESISTIVE FAULT LOCATION Test type Fault detection (MΩ) Resolution Loop resistance (kΩ)	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 99 MΩ, ±(2 % + 1 digit) 100 MΩ to 999 MΩ, ±(5 % + 1 digit) 1 to 99 (RFL) Single pair and separate good pair 0 to 20 3 digits 7 maximum		
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s) RESISTIVE FAULT LOCATION Test type Fault detection (MΩ) Resolution Loop resistance (kΩ) Multiple cable sections	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ± 2 % or ± 5 Ω 1 kΩ to 99 MΩ, $\pm (2$ % + 1 digit) 100 MΩ to 999 MΩ, $\pm (5$ % + 1 digit) 1 to 99 (RFL) Single pair and separate good pair 0 to 20 3 digits 7 maximum Five (includes gauge and temperature set)	etting)	resistance (four significant digits)
Source Range (MΩ) Resolution Uncertainty (accuracy) Soak timer (s) RESISTIVE FAULT LOCATION Test type Fault detection (MΩ) Resolution Loop resistance (kΩ) Multiple cable sections Fault location	0 to 999 auto-ranging 3 significant digits 0 to 999 Ω, the better of ±2 % or ±5 Ω 1 kΩ to 99 MΩ, ±(2 % + 1 digit) 100 MΩ to 999 MΩ, ±(5 % + 1 digit) 1 to 99 (RFL) Single pair and separate good pair 0 to 20 3 digits 7 maximum	etting)	

Module size (H x W x D)	283 mm x 125 mm x 92 mm	(11 ¹ / ₈ in x 4 ¹⁵ / ₁₆ in x 3 ⁵ / ₈ in)	
Module weight (with battery)	1.3 kg	(2.8 lb)	
Temperature			
operating	0 °C to 50 °C	(32 °F to 122 °F)	
storage	−20 °C to 60 °C	(-4 °F to 140 °F)	
Humidity	5 % to 95 % relative, non-condens	ng	
Power supply			
input	100-240 VAC at 1.8 A, 50 Hz to 60 Hz		
output	18-24 VDC at 3.33 A to 2.50 A, 60 W		
Battery	Internal rechargeable Li-Ion battery, with battery state indication		
Test connections	Five-color banana connector for T, R, G, T1, R1		
	RJ-45 for ADSL2+ and Ethernet 10/100 WAN		
	RJ-45 for Ethernet 10/100 LAN		
Differential voltage protection	125 VRMS or 400 VDC max		
Common mode voltage protection	1000 VRMS		
Self-test	Routine on power-up		
Voltage detection	> 20 V will trigger alarm message		
Results storage	128 MB		
Languages	English, French, German, Spanish,	Chinese (Simplified)	

STANDARD ACCESSORIES

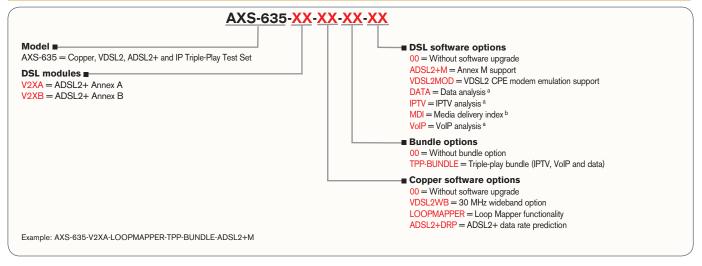
Hand strap, Certificate of Compliance

ACC-RJTC: RJ-45 to telco clip (test cable), or ACC-RJMM: RJ-45 to 4 mm plugs with crocodile clips (test cable)

ACC-RJRJ: RJ-45 Ethernet cable

ACC-5COLR: Five-color 4 mm banana plugs terminated with telco clips, or ACC-5COLR4MM: Five-color 4 mm banana plugs terminated with 4 mm plugs with crocodile clips ACC-STRP: RFL strap

ORDERING INFORMATION



Notes

a. Included with the TPP-BUNDLE option.

b. Requires the IPTV or TPP-BUNDLE option.

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EXFO is certified ISO 9001 and attests to the quality of these products. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. EXFO has made every effort to ensure that the information contained in this specification sheet is accurate. However, we accept no responsibility for any errors or omissions, and we reserve the right to modify design, characteristics and products at any time without obligation. Units of measurement in this document conform to SI standards and practices. In addition, all of EXFO's manufactured products are compliant with the European Union's WEEE directive. For more information, please visit www.EXFO.com/recycle. Contact EXFO for prices and availability or to obtain the phone number of your local EXFO distributor. For the most recent version of this spec sheet, please go to the EXFO website at http://www.EXFO.com/specs

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