/Inritsu

CMA 3000

SPECIFICATIONS

10 G interface option

General description

When equipped with the 10G interface and Ethernet measurement options, the battery-powered, easy-to-use and portable Anritsu CMA 3000 is a comprehensive solution for testing and measuring LAN and WAN communication lines up to 10 Gbps, in addition to the full-featured 2 Mbps transmission testing provided by the CMA 3000 basic instrument. Adding additional CMA 3000 options allows you to also test V-series data interface connections, E3, unframed DS3, E4 and SDH lines.

The 10G interface option comes in two versions: a single port and a dual port version at the 10Gbps rate. Optional optical modules can be inserted in the 10G ports. Both versions include a dual-port Ethernet 1000/100/10 Mbps test interface equipped with electrical and optional optical interface ports.
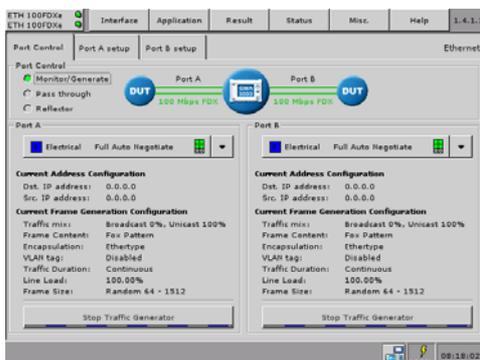

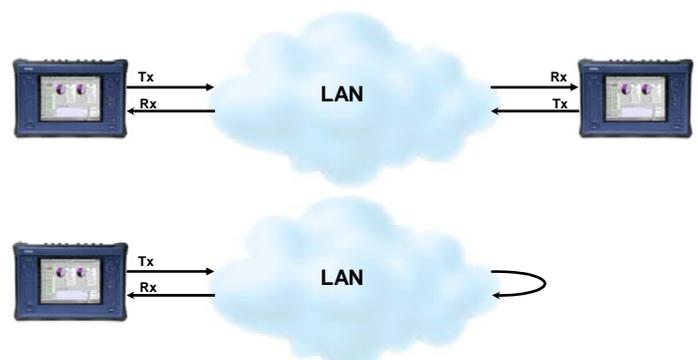Fig. 1 The operation of the CMA 3000 is made easy through an intuitive graphical user interface.

Fig. 2 Out-of-service testing with two instruments or a far-end loop back.

Key Features	Key Applications

• 10G LAN PHY and 10G WAN PHY options
 	
• Single or dual port at the 10G rate
 	
• Dual-port Ethernet 1000/100/100Mbps test interface
 	
• Traffic generation capabilities up to full line rate
 	
• Comprehensive statistics
 	
• Automated RFC 2544 testing of:
 	
   o Throughput
 	
   o Frame loss
 	
   o Latency
 	
   o Packet jitter
 	
   o Burstability
 	
• Simultaneous monitoring of both directions on a line
 	
• IPv4 and IPv6 support
 	
• Multistream, Stacked VLAN, MPLS and VoIP test options
	• Installation and commissioning testing
	
	• QoS verification
	
	• End-to-end testing
	
	• Rapid in-service diagnostics and troubleshooting

The 10G interface option can be equipped with a 10G LAN PHY option. With this the option can test and analyze Ethernet links at rates from 10 Gbps to 10 Mbps. A 10G WAN PHY option can be added to test and analyze Ethernet traffic encapsulated in OC-192/STM-64 frames.

Transmitters and receivers permit out-of-service testing for installation, commissioning and Quality of Service (QoS) verification while a pass-through mode enables in-service monitoring for both fast troubleshooting and detailed analysis of the live traffic on the line. This makes CMA 3000 the ideal instrument for measuring in- and out-of-service transmission quality.

You can easily read and interpret information from the tested lines off the large color display with easy-to-understand colors and graphical symbols. For fast troubleshooting, the CMA 3000 displays alarms and transmission link status on LED indicators. And the graphical user interface makes it a simple task to configure and operate the instrument.

Installation, commissioning and QoS verification

For installation, commissioning and QoS verification CMA 3000 provides powerful and flexible traffic generation capabilities, allowing you to easily test the network under various conditions, including generation of VLAN tagged traffic. Performance and QoS statistics are presented in tables and graphs facilitating results interpretation. Through preprogrammed thresholds, CMA 3000 can isolate abnormal conditions on the tested line.

Fig. 3 Statistics are presented in tables and easy to understand graphs.
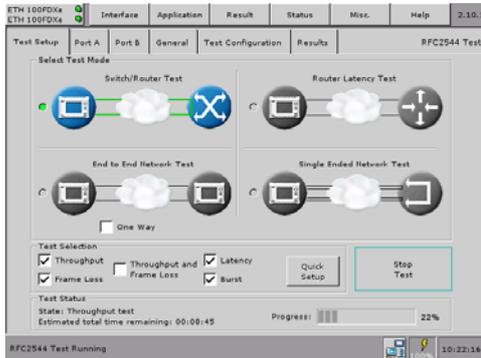
RFC 2544 analysis

Fig. 4 Intuitive configuration of the RFC 2544 tests
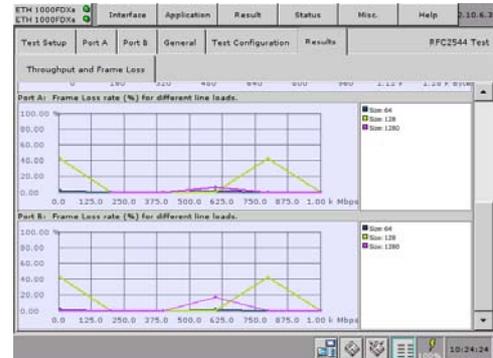

Fig. 5 CMA 3000 presents RFC 2544 results in graphs or tabular format

The IETF RFC 2544 "Benchmarking Methodology for Network Interconnect Devices" defines a number of tests to be used for describing the performance characteristics of these network devices. With the CMA 3000 Ethernet options, testing of performance parameters, such as throughput and frame loss, latency, packet jitter and burstability in compliance with RFC 2544 is straightforward. CMA 3000 automates the testing procedure while still allowing you to configure the test to be as thorough as needed. To get full information on the performance of both sides of a line, the end-to-end test mode allows two CMA 3000 to work together in a master-slave setup whereby the user can control both units and inspect the results of the test from both units on the master instrument.

In-service troubleshooting

For fast troubleshooting the CMA 3000 status monitor is always active, providing essential information on the monitored transmission system, including:

- Line alarms on LED indicators with a trap facility

- Display of current line status

- Optical level indication

- Electrical cable test facility

- Indication of main link quality parameters : Utilization, Throughput and Errored frames
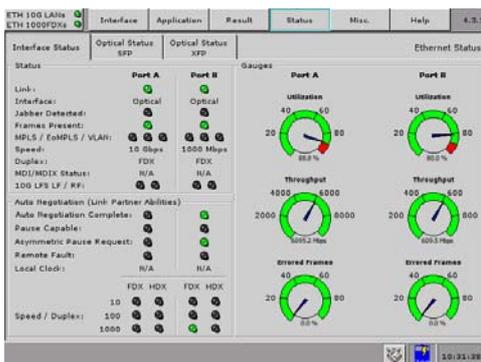

Fig. 6 Interface status indicators for a quick overview of the line's condition.
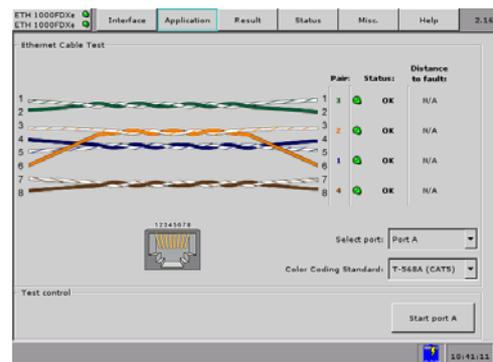

Fig. 7 The CMA 3000s cable test facility makes it easy to identify failures on electrical cables like short circuits or breaks of a wire pair. The cable test facility also indicates the distance from the instrument to the fault.

Detailed in-service analysis

CMA 3000 can analyze live traffic in details by presenting statistics on the main performance indicators for a monitored line. To facilitate the analysis of data it's possible to define threshold values for a number of parameters. CMA 3000 uses the thresholds to color-highlight results outside the acceptable range. This is also indicated on the LEDs of the instrument.
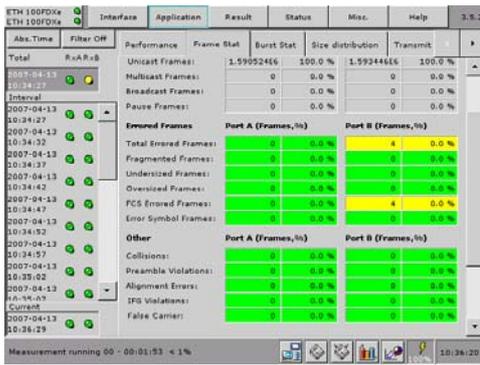
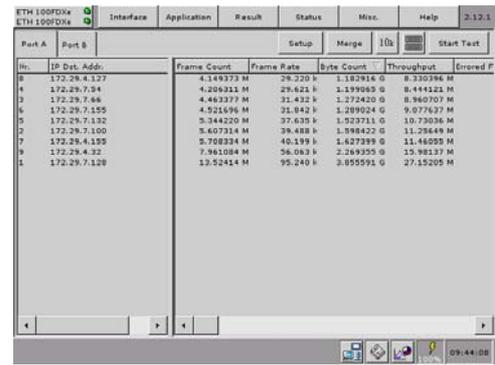Fig. 8 Tabular presentation of performance statistics.

Fig. 9 IP traffic analysis with the IP channel statistics option.

IP channel statistics option

For further analysis of live IP traffic on the Ethernet line CMA 3000 can be equipped with the IP channel statistics option. This option provides detailed information on the traffic on the monitored line for up to 232 individual channels, identified by parameters like Ethernet addresses, IP addresses, VLAN tags or MPLS labels. This allows you to identify whether a channel:

- Loads the line heavily
- Sends many errored frames
- Uses the line in an inefficient way

Ethernet Multistream option

The Ethernet multistream option for the CMA 3000 allows the user to test a congested networks ability to transport high priority traffic rather than lower priority traffic. The user can activate up to 8 streams per port with different priority settings on the Ethernet line and detect how they are affected by frame loss through the network. With the multistream option you also get information on packet jitter and latency per stream, issues that can cause problems for services like VoIP.
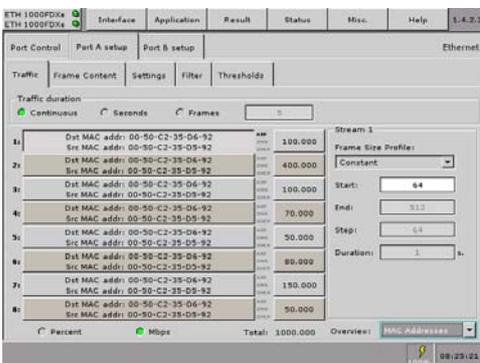

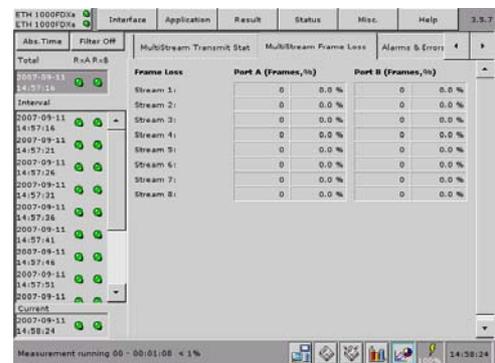Fig. 10 The CMA 3000 gives an easy overview of the up to 8 streams that it can generate.

Fig. 11 Information on frame loss in shown for up to 8 streams in one screen to make it easy to compare how the streams are transported through the network.

Stacked VLAN option

Stacked VLAN (Q-in-Q) is increasingly used in several types of Ethernet based networks. With a CMA 3000 equipped with Ethernet and Stacked VLAN options the user has a powerful tool for testing such networks. The Stacked VLAN option supports up to 8 levels of VLAN tags.

MPLS option

MPLS (Multi Protocol Label Switching) allows efficient routing of traffic in packet based networks. With a CMA 3000 equipped with Ethernet and the MPLS option the user has a powerful tool for testing this type of traffic. Up to 8 levels of MPLS labels can be inserted. The MPLS option also supports EoMPLS (Ethernet over MPLS) also known as PWE3 (Pseudo Wire Emulation Edge-to-Edge), which defines transport of layer 2 protocol across an MPLS network.

VoIP test options

With a CMA 3000 equipped with VoIP and Ethernet options the field technician can use the same instrument for testing VoIP services and the basic Ethernet transport system.
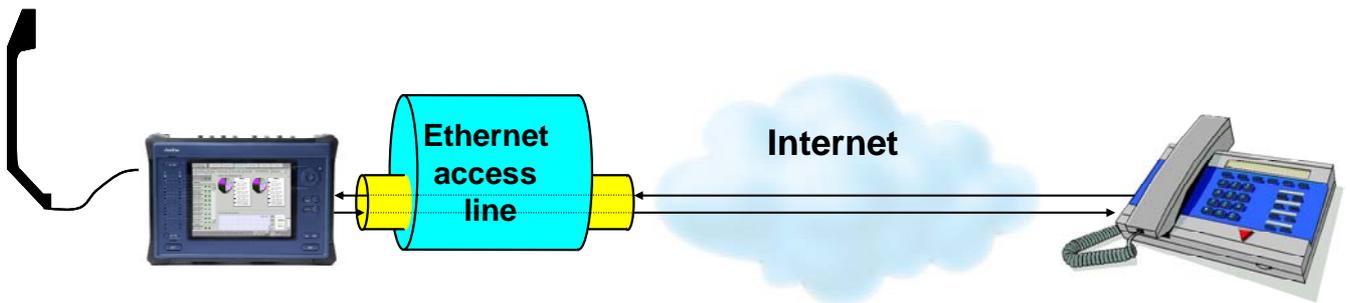

Fig. 12 Basic VoIP connectivity is verified by calling another party using the CMA 3000's VoIP functionality.

For VoIP testing the instrument can establish a call and answer incoming calls. By connecting an analog telephone to the CMA 3000 the user can make a conversation with the called/calling party. Statistics collected during the call will inform the user on the performance of the communication line used for the call. Based on this an add-on option can present voice quality information in terms of Mean Opinion Score (MOS) and R-factor values for one call at the time.

To make a realistic test case the instrument can generate or receive up to 8 calls simultaneously. These calls can be made on one or both test ports in the Ethernet option. If the instrument is also equipped with the Ethernet Multistream option, each of the 8 calls can be assigned to a stream, f.inst. allowing individual configuration of priority for the calls.

Fig. 13 **A total of 8 VoIP calls can be generated through the CMA 3000's two Ethernet test ports**. The voice quality evaluation is presented for one call if the Voice Quality Measurement option is installed.
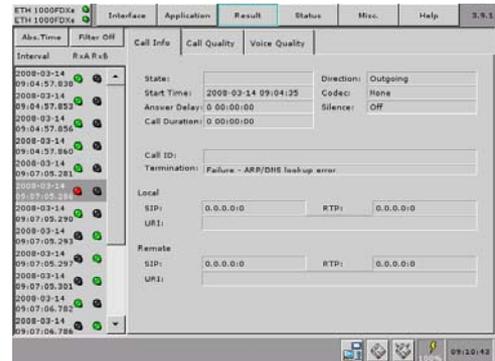
Fig. 14 VoIP call records are stored in memory when a measurement is active. Unsuccessful calls are highlighted with a red indicator in the left column.

10 G WAN PHY option

When the 10G interface is equipped with a 10G WAN PHY option the CMA 3000 can be used for test and analyze of Ethernet traffic encapsulated in OC-192/STM-64 frames. The instrument provides powerful statistics for analysis of the transmission-error performance of a line together with information on pointer operations. G.826, G.828/G.829 or M2101 error-performance parameters are calculated for the measurement. When generating a 10 G WAN PHY the instrument provides you with great flexibility for injecting errors, alarms and overhead byte changes into the transmitted signal.
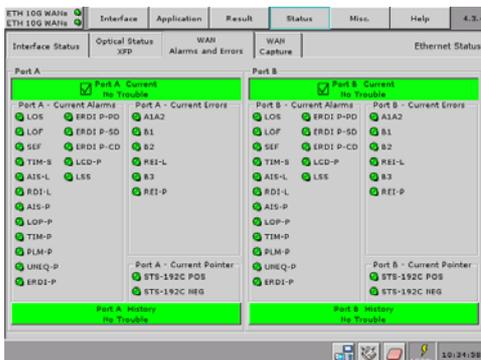
Fig. 15 **A quick overview of the alarm and error status on the line**.

Fig. 16 Statistics for analysis of the transmission-error performance.

Specifications

The specifications below list the functionality for a basic CMA 3000 with 10 G interface option installed. For information on the functionality of the basic configuration please refer to the CMA 3000 basic instrument specifications sheet.

Ethernet test interfaces	
Hardware option attached to basic instrument	• Optical line interfaces 1 or 2 ports 10 Gbps, user-selectable optical modules: 850 nm (SR), 1310 nm (LR) and 1550 nm (ER) *NB: Correct functioning can only be guaranteed with optical modules purchased from Anritsu for the CMA 3000.* • Optical line interfaces 2 ports 1000 Mbps, user-selectable optical modules: 850 nm (SX), 1310 nm (LX) and 1550 nm (ZX) or 100 Mbps 1310 nm (FX or LX) *NB: Correct functioning can only be guaranteed with optical modules purchased from Anritsu for the CMA 3000.* • Electrical line interfaces 2 ports (in addition to the optical ports) 10/100/1000 Mbps RJ45 (unshielded and shielded twisted pair cables, category 5, 5E, and 6) • **Safety measures for laser products:** Optical modules for the CMA 3000 comply with optical safety standards in IEC 60825-1. • Specification of optical modules purchased from Anritsu for the CMA 3000 (each with 1 transmitter and 1 receiver) with LC connectors (specifications may be subject to change without further notice):

Description (approx. distance)	Min. input sensitivity and wavelength		Output power and wavelength	
10GBASE- SR 850 nm Multi mode (0.3 km)	-11.1 dBm	850 nm Center	Between -6.5 dBm and - 1.5 dBm	Between 840 nm and 860 nm
10GBASE - LR 1310 nm Single mode (10 km)	-14 dBm	Min. 1260 nm Max. 1600 nm	Between -6 dBm and -1 dBm	Between 1290 nm and 1330 nm
10GBASE - ER 1550 nm Single mode (40 km)	-16 dBm	Min. 1260 nm Max. 1600 nm	Between -1 dBm and 2 dBm	Between 1530 nm and 1565 nm
10GBASE - ER 1550 nm Single mode (80 km)	-23 dBm	Min. 1260 nm Max. 1575 nm	Between 0 dBm and 4 dBm	Between 1530 nm and 1565 nm
1000BASE-SX 850 nm Multi mode (0.5 km)	-17 dBm	Min. 770 nm Max. 860 nm	Between -9.5 dBm and -3 dBm	Between 830 nm and 860 nm
1000BASE-LX 1310 nm Single mode (10 km)	-20 dBm	Min. 1260 nm Max. 1580 nm	Between -9 dBm and -3 dBm	Between 1285 nm and 1343 nm
1000BASE-ZX 1550 nm Single mode (80 km)	-24 dBm	Min. 1260 nm Max. 1580 nm	Between 0 dBm and 5 dBm	Between 1500 nm and 1580 nm
100BASE-FX 1310 nm Multi mode (2 km)	-31 dBm	Min. 1270 nm Max. 1600 nm	Between -20 dBm and -15 dBm	Between 1280 nm and 1380 nm
100BASE-LX 1310 nm Single mode (10 km)	-31 dBm	Min. 1270 nm Max. 1620 nm	Between -15 dBm and -8 dBm	Between 1261 nm and 1360 nm

Ethernet test configurations (10 G LAN PHY option required)	• Monitor/generate • Pass-through • Reflector

Ethernet measurements (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
Supported encapsulations (frame formats)	• EtherType II (DIX v.2) • IEEE 802.3 with 802.2 (LLC1) • IEEE 802.3 with SNAP
Traffic generation	• Variable line rate traffic generation, up to full line rate • Line load profile: Constant or ramp • Traffic duration: Continuous, programmable number of seconds or frames • Adjustable frame size from 44 bytes to 16000 bytes • Frame sizes may be set to constant, stepped or random length • User-defined traffic mix of unicast and broadcast frames • User-defined VLAN ID and VLAN priority • Fixed or incremented IP identifier • Configurable IP and Ethernet source and destination addresses (supports IPv4 and IPv6 addressing). Fixed, DHCP, DNS. • Generate pause frames

	• Respond to pause frames • Answer incoming ARP and ping requests (On/Off) • User programmable DSCP/TOS byte • User programmable UDP/TCP address • Automatic TCP connect (user selectable) • UDP check sum: automatic or fixed (null). TCP check sum: automatic • Optional Ethernet (MAC) address swapping (reflector mode)
Receiver settings	• User-defined expected preamble length (3 to 15 bytes) • User-defined IFG lower threshold (8 to 15 bytes) for Ethernet 10/100/1000 Mbps • User-defined Jumbo frame size upper limit (1519 to 16000 bytes)
Error generation	• IFG for Ethernet 10/100/1000 Mbps, FCS, Preamble, Error symbol • Wrong IP checksum, fragmented IP, UDP with zero checksum • PRBS bit error, BERT sequence error
Alarm generation	• No link, Remote fault
Cable test	Identifies failures on electrical cables like short circuits or breaks of a wire pair and indicates the distance from the instrument to the fault. • Max distance: 110 m, accuracy: +/- 3 m.
RFC 2544 installation and commissioning	Switch/router test and Single ended network test modes: • Throughput • Frame loss • Latency or packet jitter • Back-to-back frames (burstability) End to end network test mode (two CMA 3000s in a master-slave setup) • Throughput • Frame loss • Back-to-back frames (burstability) Router latency test mode: IP ping based latency test or packet jitter For RFC 2544 throughput measurement the user can choose to make the measurement for: • Utilization layer • Physical layer • Physical layer excl. preamble • Link layer • Network layer • Data layer • Average or maximum values
BER test	Generation and detection of test patterns. Count of errors in received test pattern. Pattern generation: Unframed, framed with IP header or framed with IP header and TCP/UDP header Detection of sequence errors and loss of sequence synchronization. Frame loss count and frame loss seconds Throughput measurement results are calculated for: • Utilization layer • Physical layer • Physical layer excl. preamble • Link layer • Network layer • Data layer • Min, avg. and max. values are presented Test patterns supported: • PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, HF test pattern, CRPAT, JTPAT, SPAT, 55 Hex, Fox, 16 bit user programmable User-defined resolution: 1, 2, 5, 10, 15, 30s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 hour
Service disruption measurement	Service disruption measurement that can be activated as a part of the BER test • Max. and avg. service disruption time, resolution 0.1 µsec • Number of service disruptions

Ping test	For connectivity and configuration check
	• Round Trip Time (RTT)
	• Supports IPv4 and IPv6 addressing
	• Answer incoming Ping requests (On/Off)
Traceroute	Trace the IP route over the IP network
	• User-defined max no. of hops (1 to 255)
	Information per hop: Min/avg/max ping time and no. of ping time outs
Reflector mode	The following parameters are user selectable:
	• Swap all MAC addresses or one specific MAC address
	• Swap IP addresses
	• Swap port numbers on UDP/TCP frames
	• Force ACK on TCP frames
	Maximum internal delay when instrument is in reflector mode:
	0.5 µsec @10Gbps, 2.1 µsec @1Gbps, 12.4 µsec @100 Mbps, 113.1 µsec @10 Mbps

Results (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
Status	• Link status
	• Remote fault
	• Signal present
	• Jabber detected
	• Frames present
	• Speed
	• Full or half duplex
	• Interface type
	• Local clock (Ethernet 1000)
	• Pause capable and Asymmetric pause request (not Ethernet 10Gbps)
	• Link partner capabilities
	• Indicators for Utilization, throughput and errored frames
	CMA 3000 indicates the signal level for optical Ethernet interfaces
Resolution	User-defined resolution for statistical measurements: 1, 2, 5, 10, 15, 30s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 hour
Performance statistics	• Max/min/avg utilization
	• Max/min/avg throughput
	• Max/min/avg frame rate
	• Max/min/avg Latency
	• Max/min/avg Packet jitter
Frame statistics	• Total frames
	• Total valid frames
	• Unicast/multicast/broadcast frames
	• Number of pause frames
	• Total errored frames
	• Fragmented frames
	• Number of oversized and undersized (runts) frames
	• Number of FCS errored frames
	• Error symbol frames (not Ethernet 10Gbps)/Code violation frames (Ethernet 10Gbps)
	• Number of collisions (10/100 Mbps half duplex)
	• Preamble violations
	• IFG violations (Ethernet 10/100/1000 Mbps)
	• False carrier
	• 10G LFS LF (local fault)
	• 10G LFS RF (remote fault)

Burst statistics	• Total frames in bursts • Max/min/avg burst size
Frame distribution statistics	• Total valid/good frames • 64 - 127 byte frames • 128 - 255 byte frames • 256 - 511 byte frames • 512 - 1023 byte frames • 1024 - 1518 byte frames • Total number of jumbo frames • Max/min/avg frame size
Filters	Up to 8 filter conditions can be defined. Each condition can filter on: • IP or MAC source address • IP or MAC destination address • Broadcast address • IEEE OUI value • Encapsulation type • VLAN ID and VLAN tag priority • MPLS • TPC/UDP source and destination port • User-defined pattern at a defined offset
Adjustable thresholds	• Utilization • Throughput • Collision rate • Unicast frames • Multicast frames • Broadcast frames • Pause frames • Errored frames • Undersized frames (runts) • Oversized frames • FCS errored frames • IFG violations (Ethernet 10/100/1000 Mbps) • Preamble violations
DHCP	• Show source IP address assigned by DHCP • Show current lease expire time • Show IP addresses of primary and secondary DNS server when obtained by DHCP

Ethernet Stacked VLAN option (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
Number of VLAN tags	Up to 8 VLAN tags can be set by the user Only 1 level of VLAN is supported in ping, traceroute and RFC2544 router latency tests
Parameters per VLAN tag	• EtherType 0x8100 (802.1Q), 0x88a8 (802.1ad), 0x9100 or 0x9200 • User-defined VLAN ID, CFI and VLAN priority
Status	Indicator for detection of VLAN tagged frames
Statistics	Available information: • Number of VLAN tagged frames • Max. number of VLAN layers detected

Ethernet Multistream option (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
Number of streams	Up to 8 streams per port can be activated
Parameters per stream	• Encapsulation (frame format) • Line rate traffic load, up to full line rate • Configurable IP and Ethernet source and destination addresses (supports IPv4 and IPv6) • User-defined traffic mix of unicast and broadcast frames • Adjustable frame size from 44 bytes to 16,000 bytes • Frame sizes may be set to constant, stepped or random length • User programmable VLAN ID and VLAN priority, DSCP/TOS byte and UDP/TCP address In stream 1 a BER test can be made
Statistics	Available information per stream: • Frame loss count/rate • Throughput • Latency • Packet jitter • Frames and bytes received and transmitted

IP channel statistics option (10 G LAN PHY option required for support of 10 Gbps Ethernet)	

Statistics	The statistics are provided for up to 232 channels, identified by user-defined combinations of:
	• IPv4, IPv6 or MAC address
	• VLAN ID or MPLS label
	• Protocol information
	• IP next header (protocol)
	• TPC/UDP ports
	Traffic Capacity:
	• 10 Mbps line speed, 100 Mbps line speed and 1 Gbps line speed: 100% line load
	• 10 Gbps line speed:
	  o With average frame size 530 bytes (or higher) and the longest burst of short frames (64 bytes) is 84: 100% line load
	  o For all frame sizes: The traffic capacity is up to 2.20 Mframes per second when the longest burst of short frames (64 bytes) is 84.
	  o If the above conditions are not fulfilled, frames will be discarded from the IP Channel statistics. A special counter will show the number of frames discarded from the IP Channel statistics.
	Available information per channel:
	• Frame count/rate
	• Throughput
	• Byte count
	• MPLS frames
	• Jumbo frames
	• Errored frames and errored frame rate
	• Errored throughput
	• Errored byte count
	• Frame/packet size distribution
	• IP header bytes
	• IP fragments
	• TTL threshold violations
	• IP packet count, rate
	• IP bytes
	• IP throughput
	• IP header errors
	• TCP/UDP bytes
	• TCP/UDP packet count, rate, throughput
	• TCP/UDP errored packets

Ethernet MPLS option (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
MPLS supported	MPLS unicast is supported (EtherType 0x8847)
	Support for MPLS in BERT, RFC 2544 (exculding router latency) Tests and general statistics
	MPLS can only transport VLAN and VoIP if EoMPLS is activated
Number of MPLS headers	Up to 8 MPLS headers can be set by the user
Parameters per MPLS headers	User-defined label, Exp and TTL fields in the MPLS header
EoMPLS support	An EoMPLS (Ethernet over MPLS) or PWE3 (Pseudo Wire Emulation Edge-to-Edge) label (the RFC4448 Control word) can be added.
Status	Indicator for detection of MPLS frames and EoMPLS
Statistics	Available information: • Number of MPLS frames and EoMPLS frames • Max. number of MPLS layers detected

VoIP Call emulation options (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
Emulation modes	The instrument supports Client/Terminal emulation.
Supported protocols (options)	• SIP RFC 3261 • RTP/RTCP RFC 3550 and RFC 3551 • ITU-T H.323 Full connect • ITU-T H.323 Fast connect The VoIP call emulation options run on IP v4 only.
Settings	The following settings are user selectable: • Calling alias • IP address DHCP/static and Subnet mask • Gateway address and DNS server • DSCP/TOS byte • MAC address • VLAN ID and VLAN priority • RTCP on/off • Silence ringing signal SIP specific parameters (requires SIP call emulator): • Proxy/registrar address and port, User name, password, Registrar expire time H.323 specific parameters (requires H.323 call emulator): • Gate Keeper Mode (No Gate Keeper, Auto Discover Gate Keeper, Static Gate Keeper • Gate Keeper address and port, User name, password, H.245 tunneling
Supported Voice Coding	The following Voice codings are supported: • µ-law/A-law (G.711) • ACELP 5.3, MPC-MLQ 6.3 kbps (G.723.1) • ADPCM 16/24/32/40 kbps (G.726) (only with SIP call emulator) • LD-CELP 16 kbps (G.728) • CS-ACELP 8 kbps (G.729 a,b) • GSM FR • GSM EFR • Fixed codec preference list User selectable • Silence suppression (depends on selected codec) • Jitter buffer delay • Source: Voice conversation (optional telephone), tone, pre-recorded speech signal
Simultaneous calls	Up to 8 calls can manually be generated at a time
Call generator	Up to 8 simultaneous calls can automatically be generated repeatedly.

Call emulation logs	The following information is provided for each call:
	• IP address/Alias, RTP ports, Answer delay, Duration of call, Encoding (codec), Silence suppression On/Off
	• Call progress and error messages with 1 msec resolution
Call statistics	• Throughput sent/Throughput received as Bytes and Packets
	• Out of sequence packets.
	• Packet loss
	• Packet jitter (msec, (min/cur/max)
	• Packet Round Trip Time (RTT) (msec, (min/cur/max)
DTMF detection	Received in-band DTMF (tone signal in the audio stream) can be recorded for one speech channel. DTMF detection can be enabled and disabled.
Voice quality (optional)	Voice quality measurement on one call at the time:
	• Uses Telchemy's algorithms for achievement of MOS and R-factor values at live traffic end points:
	• MOS: Conversational, Listening, P.862 estimate, Maximum with selected codec
	• R-factor: Conversational, Listening, G.107 estimate, Listening during Burst and Gap periods, Maximum with selected codec
	• Voice quality evaluation summary, based on user defined thresholds
VoIP measurements	When a measurement is running Call emulation logs, call statistics are stored pre call that terminated during the measurement. DTMF information and the optional Voice quality information are stored for calls where they were measured. In addition there is a summary for all calls terminated during the measurement with information on:
	• Total number of calls. Number of Incoming, Outgoing, succeed, failed calls
	• Call duration (min/avg/max). Answer delay (min/avg/max)
	• Throughput sent/Throughput received as Bytes and Packets (min/avg/max/total)
	• Out of sequence packets. (min/avg/max/total)
	• Packet loss (min/avg/max/total)
	• Packet jitter (msec, min/max)
	• Packet Round Trip Time (RTT) (msec, min/max)
Phone Interface	Interface for connection of an analog telephone
	AC impedance: Approx. 600Ω.
	The phone will be supplied with a constant current of approx. 20 mA
	The phone supports receiving and transmitting speech signals.
	Connector: RJ-11 (1x6)

10G WAN PHY option (10 G LAN PHY option required)	
WAN modes	10GigE (normal), WAN-PHY with Mixed-frequency test pattern, Square wave pattern, PRBS 31 pattern
Terminology	SONET or SDH
Error insertion	SONET Terminology:
	• A1A2, B1, B2, REI-L, B3, REI-P
	SDH Terminology:
	• B1, A1/A2, B2, MS-REI, B3, HP-REI
Alarm insertion	SONET Terminology:
	• LOS, LOF, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, TIM-P, PLM-P, UNEQ-P, ERDI P-PD, ERDI P-SD, ERDI P-CD
	SDH Terminology:
	• LOS, LOF, OOF, MS-AIS, MS-RDI, MS-TIM, AU-AIS, AU-LOP, HP-PLM, HP-UNEQ, HP-TIM, HP-RDI, LCD
Error measurement	SONET Terminology:
	• A1A2, B1, B2, REI-L, B3, REI-P
	SDH Terminology:
	• B1, A1/A2, B2, MS-REI, B3, HP-REI
	G.826, G.828+G.829 or M.2101.1(M.2100) error performance parameters are calculated

Alarm detection	SONET Terminology:
	• LOS, LOF, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, TIM-P, PLM-P, UNEQ-P, ERDI P-SD, ERDI P-CD, ERDI P-PD, LCD-P, LSS
	SDH Terminology:
	• LOS, LOF, OOF, MS-AIS, MS-RDI, MS-TIM, AU-AIS, AU-LOP, HP-PLM, HP-UNEQ, HP-TIM, HP-RDI, LCD, LSS
Overhead byte functionality	Generation of overhead bytes, defined by the user
	Capture and display of current overhead bytes
Pointer operation monitor	Positive movements, Negative movements, NDF

Miscellaneous	
Mechanical	The 10G interface option is a module plugged onto the back of the instrument.
	• Dimensions of 10G interface option module: Approx. 10 x 30.7 x 4.3 cm (HxWxD)
	• Weight of 10G interface option module: Approx. 1.1 kg

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