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. The 10G ports can be equipped with 10G LAN PHY, 10G WAN PHY and STM-64 options. 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 ports.

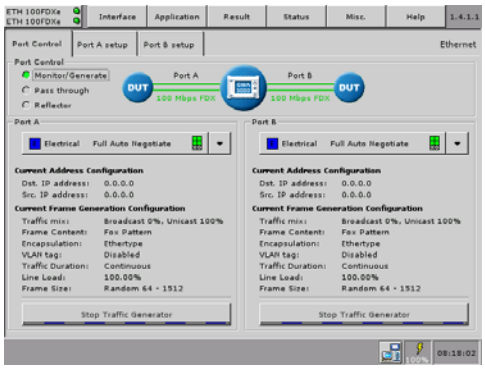

Fig. 1 The operation of the CMA 3000 is made easy through an intuitive graphical user interface.

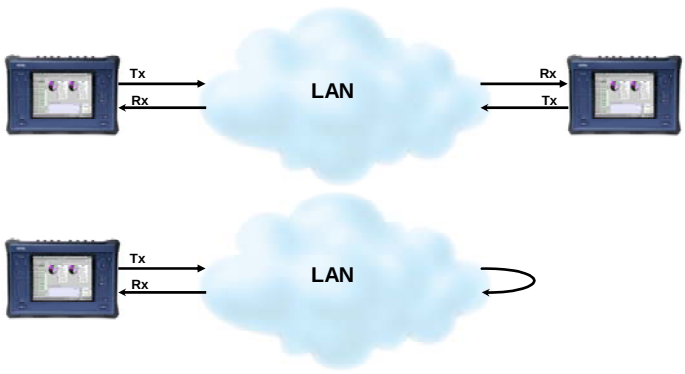

Fig. 2 Out-of-service testing with two instruments or a far-end loop back.

Comprehensive Ethernet testing up to 10 Gbps

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
• Service Activation Test option
  o Service activation in accordance with ITU-T Y.1564
• Multistream, Stacked VLAN, MPLS and VoIP test options
• Synchronous Ethernet test option
• IP channel statistics option
	• Installation and commissioning testing
	• QoS verification
	• End-to-end testing
	• Rapid in-service diagnostics and troubleshooting
	• Throughput
	• Frame loss

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.

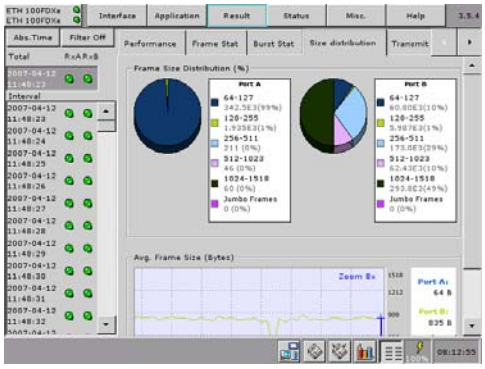

Fig. 3 Statistics are presented in tables and easy to understand graphs.

RFC 2544 analysis

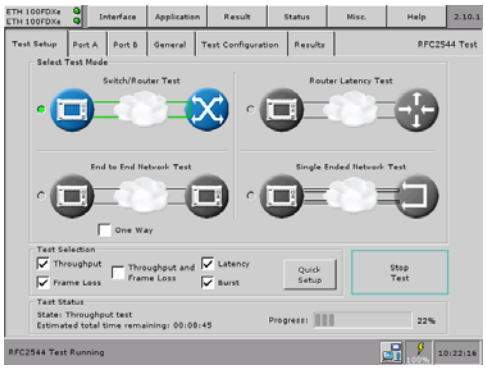

Fig. 4 Intuitive configuration of the RFC 2544 tests

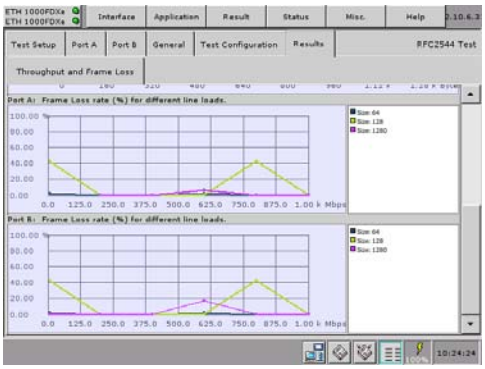

Fig. 5 CMA 3000 presents RFC 2544 results in graphs or tabular format

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

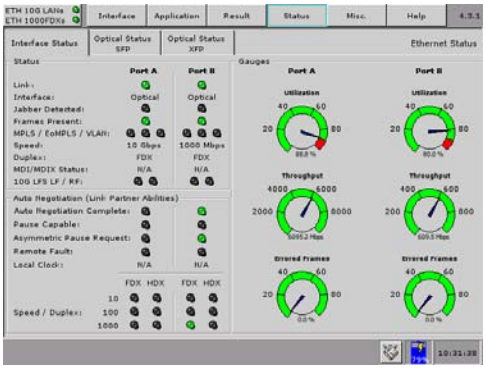

Fig. 6 Interface status indicators for a quick overview of the line’s condition.

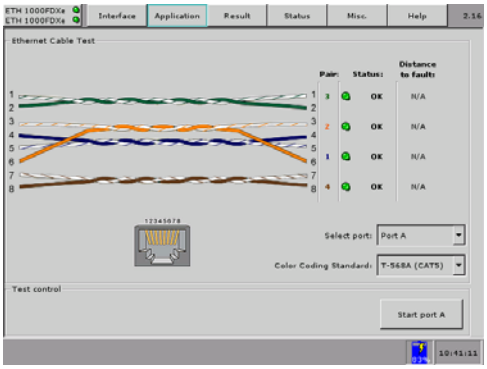

Fig. 7 The CMA 3000s cable test facility makes it easy to identify failures on electrical cables like short circuits or breaks of a wire pair. The cable test facility also indicates the distance from the instrument to the fault.

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.

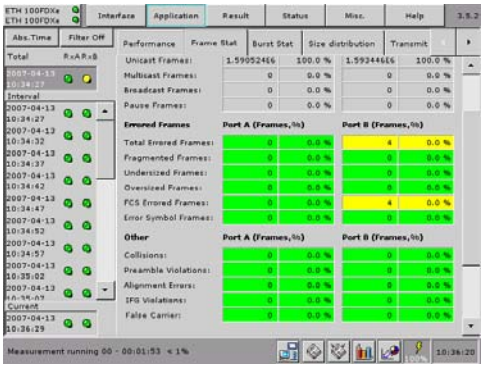

Fig. 8 Tabular presentation of performance statistics.

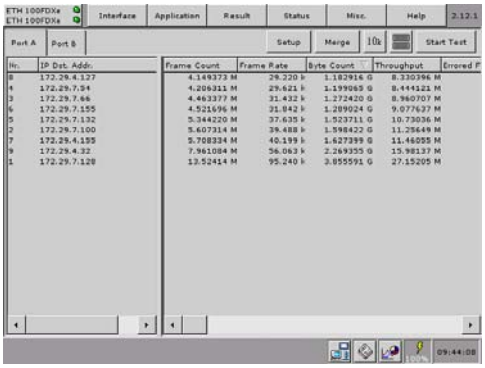

Fig. 9 IP traffic analysis with the IP channel statistics option.

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

Service Activation Test option

The wide deployment of Ethernet technology for many applications in the access and core of telecom networks has caused a need for new testing standards to be developed. Therefore ITU-T has defined a new recommendation Y.1564, which defines a new methodology for testing multiple Ethernet services simultaneously in a network. The recommendation is designed to allow service providers to assess customer end to end network performance. Y.1564 includes the combination of changing end user traffic profiles with multiple frame sizes and streams which require different traffic priorities through the network. The recommendation also defines testing multiple traffic streams (services) simultaneously, confirming the policing per stream, confirming the transfer time and jitter across the network and confirming the network can manage bursts of traffic for short durations.

The Ethernet Service Activation Test option for the CMA 3000 allows the user to conduct tests in accordance with Y.1564 for up to 8 services. The test is typically done with two CMA 3000s performing the Service Activation Test in a Local-Remote setup. It can however also be done with one unit and a far-end loop back device.

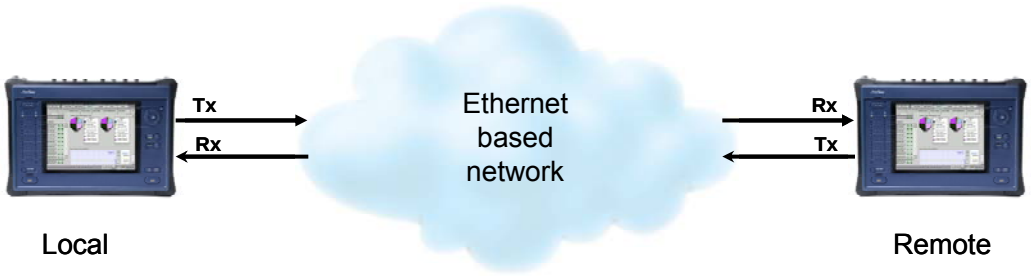

Fig. 10 Two CMA 3000s conducting a Service Activation Test in a Local-Remote setup.

When the service activation test is done in the Local-Remote setup with two CMA 3000s you control the test from the local instrument: It transfers relevant information to the remote unit and after the test is completed you can see results from both units on the local instrument. Easy to understand graphical symbols make it very fast to see if the tests passed. If further analysis is required the information presented can be expanded to show all details of each test.

For measurements of Frame Transfer Delay (FTD) between two CMA 3000s, a GPS add-on option can provide true one-way measurements of Frame Transfer Delay. The GPS option can synchronize the clocks of the two CMA 3000s involved in the measurement, when a GPS signal can be received at the test sites. If GPS synchronization can be achieved prior to moving the

units to the test sites the CMA 3000s will hold the synchronization for a period of time, allowing tests to be made with GPS synchronized instruments.

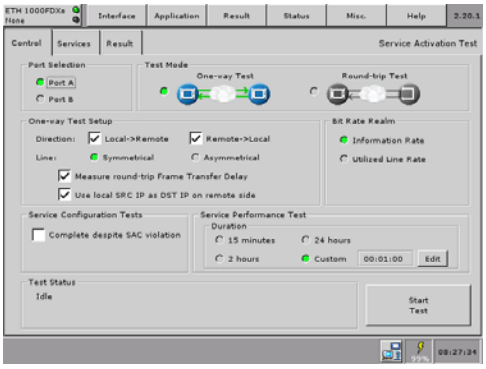

Fig. 11 It is easy to configure the Service Activation Test in the CMA 3000's intuitive User Interface

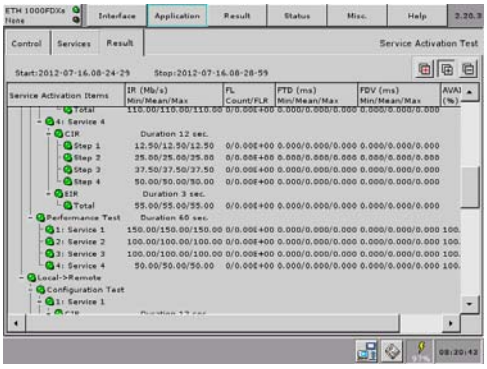

Fig. 12 The Service Activation Test screen gives easy to understand indications on pass/fail of each of the conducted tests.

Synchronous Ethernet Test option

Ethernet is today the dominant technology for data transmission, and legacy networks based on synchronous technology (PDH, SDH/SONET) migrate to packet-switched network based on Ethernet. However, the asynchronous nature of Ethernet provides certain transmission challenges as many existing networks have a strong requirement of frequency synchronization across the entire network. To support this requirement Synchronous Ethernet is introduced.
Two techniques are defined for Synchronous Ethernet:

- Physical synchronization signal forwarding as defined in ITU-T recommendations G.8261, G.8262 and G.8264 (in many cases this is now called SyncE)
- Protocol based synchronization as defined in IEEE1588 v2 (also known as the Precision Time Protocol PTP)

The Synchronous Ethernet Test option for the CMA 3000 allows the user to conduct Test and analysis of both technologies SyncE (ITU-T G.826x) and of IEEE 1588 v2 (PTP) including ITU-T G.8265.1 IEEE 1588 v2 profile for telecommunication.

The SyncE (ITU-T G.826x) functionality includes detection and generation of G.826x Synchronization Status Messages (SSM) for verification of the SyncE network. An alarm will indicate if SSMs are not detected. For detailed analysis the instrument can log SSMs for transfer to a PC via the FrontSim option for decode with Wireshark.

The SyncE (ITU-T G.826x) transmit clock can be synchronized to external clock signal sources to emulate a synchronous Ethernet signal. The transmit clock can be deviated to stress test network devices. Furthermore the CMA 3000 provides an indication of the bit rate of the received Ethernet signal relative to a chosen reference.

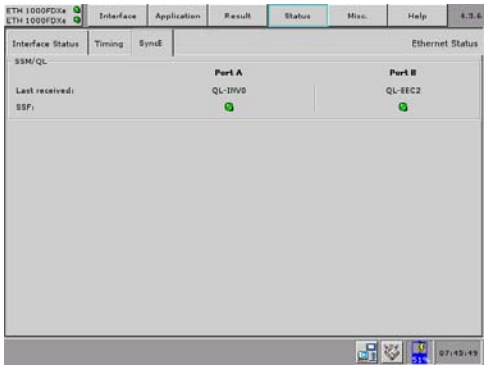

Fig. 13 Read out of the current QL value from the received SSM messages

Fig. 14 Comprehensive statistics on SSM QL messages and values

The IEEE 1588 v2 (PTP) functionality includes the CMA 3000 to act as a master using the internal instrument clock or a GPS signal (when present) as clock source. Alternatively the instrument can act in slave mode, including choosing the best master wall clock and constantly adjusting the clock. During a test the user will get comprehensive statistics on IEEE 1588 v2. An alarm is generated if synchronization messages are not received within a certain time.

Fig. 15 Comprehensive IEEE 1588 v2 statistics on offset and offset variance, path delay variation, messages and clock state transitions.

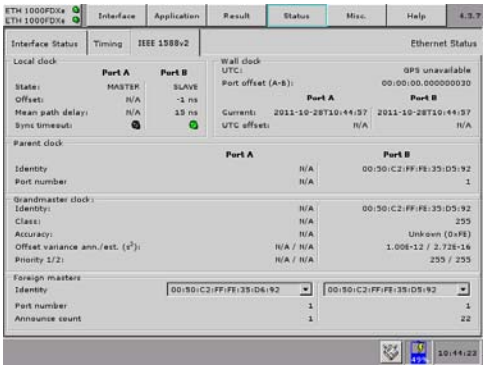

Fig. 16 Detailed information on IEEE 1588 v2 clock status

For quick analysis and troubleshooting of the IEEE 1588 v2 (PTP) signaling the CMA 3000 can log information on the transferred messages and present in on the built-in screen. For detailed analysis the instrument can log PTP message for transfer to a PC via the FrontSim option for decode with Wireshark.

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.

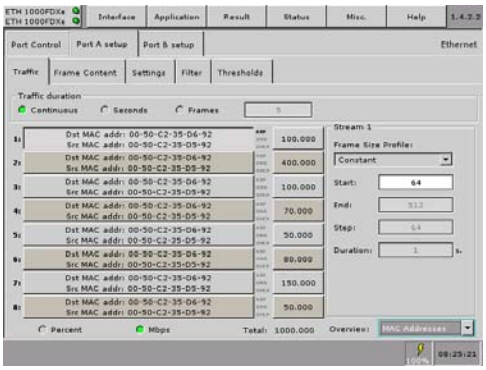

Fig. 17 The CMA 3000 gives an easy overview of the up to 8 streams that it can generate.

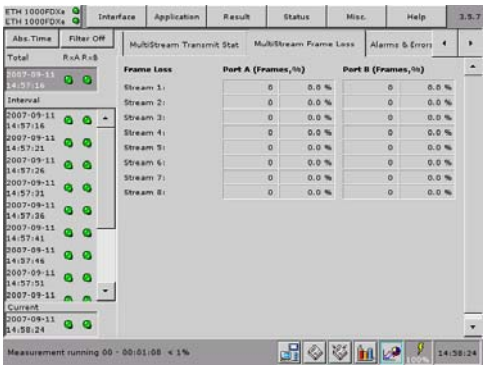

Fig. 18 Information on frame loss in shown for up to 8 streams in one screen to make it easy to compare how the streams are transported through the network.

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.

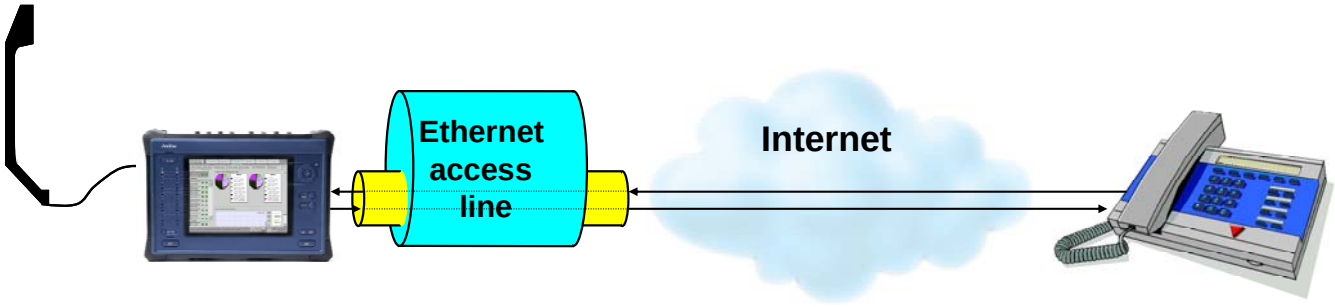

Fig. 19 Basic VoIP connectivity is verified by calling another party using the CMA 3000's VoIP functionality.

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. 20 **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.

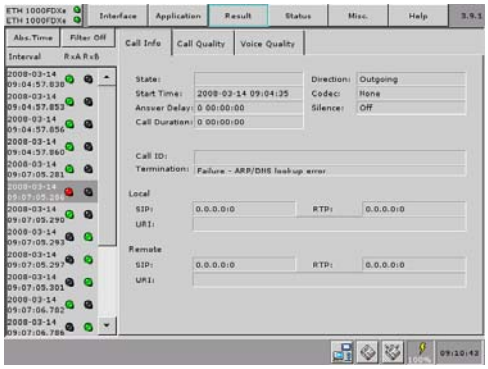

Fig. 21 VoIP call records are stored in memory when a measurement is active. Unsuccessful calls are highlighted with a red indicator in the left column.

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.

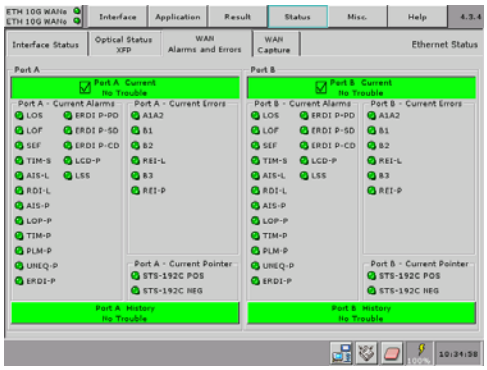

Fig. 22 **A quick overview of the alarm and error status on the line**.

Fig. 23 Statistics for analysis of the transmission-error performance.

Powerful STM-64 testing

Key Features	Key Applications
• Simultaneous bi-directional monitoring of STM-64 lines • Powerful testing of STM-64 systems and embedded PDH systems • Mapping and de-mapping • Comprehensive error and alarm statistics • Overhead byte testing and monitoring • Trouble scan • Pointer event generation and monitoring • APS test facility	• Comprehensive out-of-service testing for: o Installation o Provisioning • Performance analysis • Multiplex testing • Physical line monitoring • In-service monitoring for: o Fast troubleshooting o Overhead byte analysis o Traffic monitoring o In-service error performance measurement

The 10G interface option for the CMA 3000 supports an STM-64 testing option. When equipped with the STM-64 option, the CMA 3000 with 10G interface option is a powerful and easy-to-use tool for testing SDH systems running at the STM-64 rate. Lower SDH rates can be supported with another SDH option installed; E3 testing is supported if the E3 test option is installed while E4 testing is supported with the E4 interface add-on option for the lower rate SDH option. If the STM-64 option is used with the two port version of the 10 G interface option, the instrument supports simultaneous bi-directional monitoring of STM-64. This makes CMA 3000 the ideal instrument for both in- and out-of-service transmission-quality measurements.

The intuitive user interface, with a large color LCD display and easy-to-understand graphical symbols allows you to easily read and interpret important information from the STM-64 signal. For fast troubleshooting, the CMA 3000 displays alarms and transmission link status on LED indicators.

In addition, the trouble scan feature provides a fast approach to examining the STM-64 signal for major problems. Furthermore the user can make the CMA 3000 automatically configure to the received STM-64 signal, eliminating lengthy instrument setup.

The powerful 2 Mbps analysis capabilities of the basic CMA 3000 enables you to analyze a demultiplexed 2 Mbps signal embedded in an STM-64 signal. Additional CMA 3000 options let you carry out signaling analysis of GSM, GPRS/EDGE, SS7 and ISDN protocols and testing of Ethernet 10 Gbps/1 Gbps/100 Mbps/10 Mbps, VoIP, V-series, E4 and E3 interfaces.

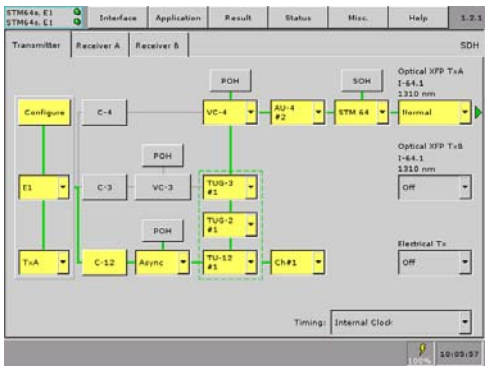

Fig. 24 The intuitive user interface of CMA 3000 facilitates the SDH test setup.

Speeds STM-64 troubleshooting

The CMA 3000 status monitor allows you to speed troubleshooting, as the 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 input frequency and deviation
- Indication of optical input level
- Display of overhead bytes
- Propagation time monitor
- Traffic channel usage in an embedded 2 Mbps signal
- Audio level in a traffic channel in an embedded 2 Mbps signal
- Listen-in on a traffic channel in an embedded 2 Mbps signal

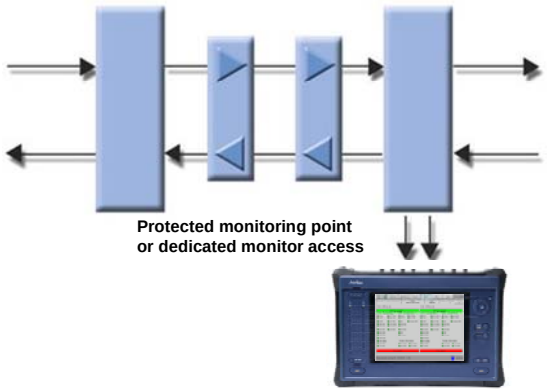

Fig. 25 With the CMA 3000 you are able to perform bi-directional in-service monitoring of STM-64 lines.

Fig. 26 The CMA 3000 gives you a quick overview of errors and alarms of both sides of the STM-64 line.

Further troubleshooting can be done, using the CMA 3000 Trouble Scan feature. It allows you to examine the STM-64 signal for major problems and get them highlighted in an easy-to-understand display. In-depth trouble analysis can be done using the instruments pointer movement graph.

Fig. 27 The trouble scan feature gives you a quick overview of the tributaries of the monitored line.

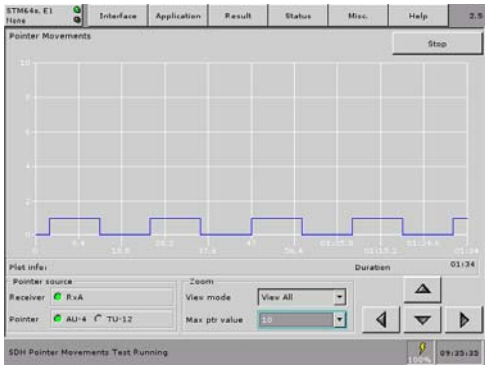

Fig. 28 The pointer graph allows a detailed analysis of pointer movements in the monitored STM-64 signal.

For monitoring purposes you may connect the CMA 3000 using optical splitters or special test interfaces. If neither is available, you can use the CMA 3000 through-mode to access the signal.

Out-of-service or in-service SDH statistics

For installing/commissioning and out-of-service troubleshooting of STM-64 lines the CMA 3000 provides powerful statistical measurements for Bit Error Rate (BER) testing. Statistics are also available for in-service analysis of the transmission-error performance of a line together with information on pointer operations. G.826, G.828, G.829 or M.2100 error-performance parameters are calculated for the measurement. The result is highlighted with easy-to-understand color indications.

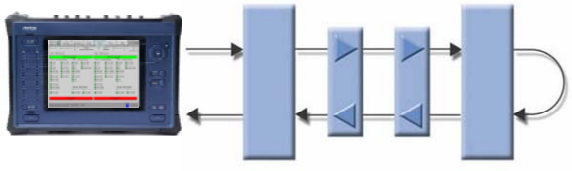

Fig. 29 By looping back a test signal from the CMA 3000 at the far end you can easily test the quality of STM-64 lines.

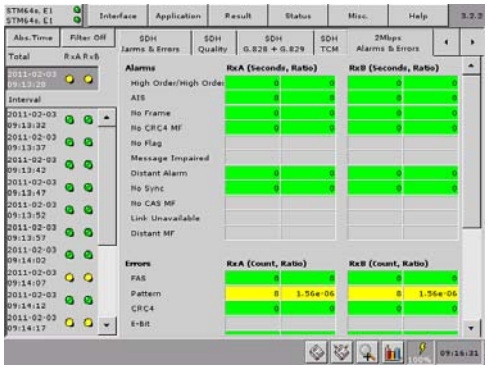

Fig. 30 The intuitive presentation of transmission error statistics.

Out-of-service STM-64 tests

During installation/commissioning and stress testing of network elements you can control the signal transmitted by the CMA 3000. When generating an SDH signal the instrument provides you with great flexibility for injecting errors, alarms, pointer operations and overhead byte changes into the transmitted signal. In addition, you can deviate the frequency of the transmitted signal from nominal to test a receiver's ability to handle signals that are out of specifications.

A special test feature provides easy testing of APS (Automatic Protective Switching) to allow identification of maximum switchover time during the test. Should the result be above the user-defined threshold you will receive an indication of the problem. SDH or 2 Mbps events can be selected to trigger measurement of the switchover time.

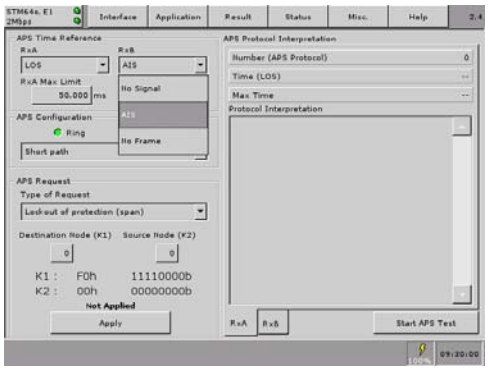

Fig. 31 The dedicated APS test application makes it easy to find the maximum APS switchover time.

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.

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 (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 measurements (10 G LAN PHY option required for support of 10 Gbps Ethernet)

Ethernet test configurations

- Monitor/generate
- Pass-through
- Reflector

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, 2.8 µsec @1Gbps, 20 µsec @100 Mbps, 185 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

Service Activation Test option (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
Service Activation Test	Service Activation Test in accordance with ITU-T recommendation Y.1564 • Test up to 8 services • Color-Aware and Non-Color-Aware in combinations (IP DSCP or VLAN PCP) • Supported Ethernet interfaces: 10 Gbps (requires 10 G LAN option), 1 Gbps, 100/10 Mbps • Test modes: One-way (uni- or bi-directional, symmetrical or asymmetrical), Round-trip • Test port: A or B • Verification against Service Acceptance Criteria: Information Rate, Frame Transfer Delay, Frame Delay Variation, Frame Loss Rate, Availability Optional GPS timing synchronization
Service Configuration Test	• Subtests for: Committed Information Rate, Excess Information Rate, Traffic Policing, Committed Burst Size, Excess Burst Size • Step duration: 1 sec to 60 sec (user programmable) • Number of steps: 1 to 10 (user programmable) • Slope: rising or falling • Results: Pass/Fail indication, IR (Min/Mean/Max), FL (Count/FLR), FTD and FDV (Min/Mean/Max/ Current (during measurement))
Service Performance Test	• All services tested simultaneously at CIR • Duration 15 min, 2 hours, 24 hours or customer programmable • Results: Pass/Fail indication, IR (Min/Mean/Max), FL (Count/FLR), FTD and FDV (Min/Mean/Max/ Current (during measurement)), AVAIL (%), Unavail (sec)

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 header	User-defined label, Exp and TTL fields in each 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

Synchronous Ethernet Test option (10 G LAN PHY option required for support of 10 Gbps Ethernet)	
Timing Functionality	Timing sources (selectable): • Internal, Ethernet port A, Ethernet port B (dual port version required at 10 Gbps) , 2MHz signal, E1 PDH signal, T1 PDH signal (requires unframed T1 option), IEEE 1588 clock A, IEEE 1588 clock B or a signal from an optional GPS receiver. Frequency deviation of +/- 100ppm in 1ppm steps. The frequency deviation of received Ethernet signals can be measured against a chosen reference timing source.
SyncE (G.826x) functionality:	Specify quality level (QL) of the transmitted Ethernet signal. Analysis of QL indicated in received Ethernet signal. An alarm is raised on missing QL indications. SyncE results: SSM Rx count and rate, SSM Tx count, Indicated QL statistics and SSF seconds. ESMC messages can be captured and exported in a Wireshark compatible format with the FrontSim option. In pass-through mode, the quality level indicated in ESMC messages can be changed on the fly to a given value in both directions independently.

IEEE 1588v2 functionality	Each port of the Ethernet interface can act as a timing master or a timing slave independently. Supported modes: Multicast (native PTP) and Unicast (G.8265.1). When acting as master in Unicast (G.8265.1) mode one slave is accepted at a time; other slaves are ignored. If the slave requires 32, 64, or 128 Sync messages per second the IEEE 1588-2008 paragraph 7.7.2.1 concerning 90% confidence interval is not followed. Configurable parameters (per port): Clock identity, Port number, Priority 1. Priority 2, Domain number, Clock class, Slave only mode, Time source, Encapsulation, Announce receipt timeout, Clock accuracy, Clock step mode, Announce interval, Sync interval, Minimum delay request interval and Unicast duration. A UTC time offset to be used when acting as clock master can be specified. For G.8265.1: Support of stacked VLAN and MPLS (other options required). IEEE 1588 clock results: Clock state, Announce count, Sync count, Follow-up count, Delay request count, Delay response count, Delay follow-up count, Peer delay request/response/response-follow-up counters, Min-/max-/average offset, Min-/max-/average offset deviation, Min-/max-/average offset variance, Min-/max-/average mean path delay, Min-/max-/average peer mean path delay, Min-/max-/average path delay variance, Min-/max-/average path delay variation. With a GPS signal present the offset from UTC time is calculated. The offset time between the two clocks is always shown. Parent clock results: Identity and Port number. Grand-master results: Identity, Class, Accuracy, Priority 1, Priority 2, Announced- and observed offset variance. Foreign master clock result (up to five clocks per port): Identity, Port number and Announce count. Logged IEEE 1588 events: Clock state transitions, State transition events, Faults and Changes in grand-master clock. IEEE 1588 messages can be captured and exported in a Wireshark compatible format with the FrontSim option. In pass-through mode the CMA 3000 acts as an end-to-end transparent clock in one-step mode.

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: • A1A2, B1, 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: • A1A2, B1, 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

Specifications (STM-64 test option)	
Test configurations	Tx/Rx, with two optical modules (requires dual port version of the 10 G interface option) also Rx/Rx, Tx/Rx/Rx
Input offset range	± 50 ppm
Transmitter clocks	• Internal clock accuracy: 4.6 ppm. Clock may be deviated up to 50 ppm. • Recovered from STM-64 input • TTL level external 2 MHz clock • Recovered from 2Mbps
Framing	According to ITU-T rec. G.707
Scrambling	According to ITU-T rec. G.707
STM-64 mappings	Support of the following mappings in accordance with the ITU-T rec. G.707: VC-12/2 Mbps structure: • STM-64 ->AU-4 ->VC4->TUG-3 ->TUG-2 ->TU-12 ->VC-12 ->C-12->2 Mbps PDH (async./sync. mapping) VC-3/34/45 Mbps structure: • STM-64->AU-4->VC4->TUG-3->TU-3->VC-3->C-3->34/45 Mbps PDH[2] VC-4/140 Mbps structure: • STM-64->AU-4->VC4-> C-4->140 Mbps PDH[7, 8] VC-4/Bulk test: • STM-64->AU-4->VC-4->Bulk test pattern[1, 8] VC-4-4c/Bulk test: • STM-64->AU-4-4c-> VC4-4c-> C4-4c->Bulk test pattern[3, 8] VC-4-16c/Bulk test: • STM-64 -> AU-4-16c -> VC4-16c -> C4-16c -> Bulk test pattern[6, 8] VC-4-64c/Bulk test: • STM-64 -> AU-4-64c -> VC4-16c -> C4-16c -> Bulk test pattern[6, 8]
Alarms	Alarms can be detected and generated: • LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-PLM, HP-UNEQ, HP-TIM, HP-RDI, TU-LOM, TU-AIS, TU-LOP, LP-PLM, LP-UNEQ, LP-TIM, LP-RDI, LSS For supported 2 Mbps alarms please refer to the CMA 3000 basic instrument spec. sheet
Errors	Errors can be detected and generated: • B1, A1/A2, B2, MS-REI, B3, HP-REI, LP-B3, LP-REI, V5 Error insertion: • Manual: 1-8000 consecutive errors. • Continuous: 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8}, 10^{-9}, 10^{-10} For supported 2 Mbps errors please refer to the CMA 3000 basic instrument specifications sheet

Error performance	• G.826/G.828/G.829/M.2100 analysis of the received signal based on detected errors and alarms: ES, SES, BBE (not M.2100), UAT, EFS, AT
BER test patterns	Pattern generation and detection for O.181 bulk test pattern: • Test patterns supported: PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31. PRBS patterns can be inverted. All 0s, All 1s, Alternating 1/0, 1000 binary, 1010 binary, 2 in 8, 1 in 8, user-defined 2 bytes For supported 2 Mbps test patterns please refer to the CMA 3000 basic instrument spec. sheet
Pointers	• Support pointer events monitoring and generation • Pointer operations in accordance with G.783 • Events for graphical display of pointer movements
Overhead	• Generation of section and path overhead bytes • Display of current section and path overhead bytes
Round trip delay (propagation time) measurement	• Resolution: 0.1 µsec • Range at STM-64: 0 – 0.2 sec with PRBS 31 as test pattern
Tributary signals	For E1 signals (one per active receiver) embedded in a selected VC-12, the CMA 3000 basic instrument E1 functionality is available For E3/DS-3 signals (one per active receiver) embedded in a selected VC-3, the E3/DS-3 functionality is available if the E3 test option is installed. For E4 signals (one per active receiver) embedded in a selected VC-4, the E4 functionality is available if the E4 test option is installed. [8]

Results (STM-64 test option)	
Status	Current information on: • Alarms and errors on the monitored line • Input level indication for optical signals • Input level indication for electrical signals • Actual bit rate • Frequency deviation • Difference between RxA and RxB bit rate (current and accumulated) • Round trip delay
Statistics	User-defined resolution: • 1, 2, 5, 10, 15, 30s, 1, 5, 10, 15, 30 min, 1, 2, 4, 6, 12 hours Information logged: • Alarms • Errors • Pointer operations
APS	APS (Automatic Protection Switching) test and analysis: • APS switching time is measured. Switching time above a user defined threshold is highlighted o Trigger events (user selectable): STM-64 alarms and errors; APS switchover, E1 alarms (LOS, No Frame, AIS). • Number of switchovers indicated by APS protocol • K1/K2 bytes can be set and displayed Resolution of APS switching time measurement: • STM-64 events excl. VC-12 events and LOS (Loss of Signal): 0.125 msec • VC-12 events: 0.5 msec • E1 events: 1 msec • LOS: Undefined

Related options	
Lower order SDH test options[1] **E4 test option**[7] **E3 test option**[2]	Please refer to the spec. sheet on SDH test up to STM-16, E4 test and E3 test options for further information
Tandem connection monitoring[1]	Please refer to the spec. sheet on Tandem Connection Monitoring for further information

Notes

- [1] Requires installation of a CMA 3000 SDH test option module
- [2] Requires installation of the E3 test module
- [3] Requires installation of an STM1/-4 optical module
- [5] Requires installation of the Enhanced SDH test option incl STM-1e
- [6] Requires installation of an STM-1/-4/-16 optical module and the Enhanced SDH test option incl STM-1e
- [7] Requires installation of the E4 test option
- [8] Internal test signal only

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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