ALBEDO Telecom

in Test we Trust

ALBEDO Ether.Genius is a multitechnology Ethernet tester that includes a Rubidium clock. It is ideal to install and measure advanced services based on GbE, SyncE, PTP, T1/E1, 1PPS, ToD, C37.94 and Datacom

Datasheet

Updated on 10/9/21

Ether.Genius all-in-one tester

CONFIDENTIAL

1. General

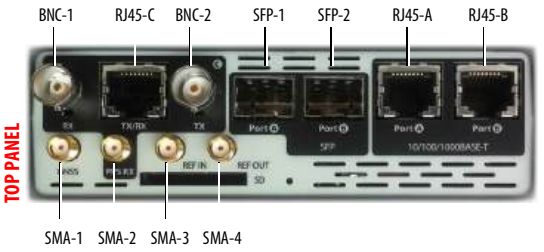
1.1 Operation Modes

- *L1 Endpoint operation:* Generation and analysis of PCS codes or any other pattern, framed or unframed required for BER testing at Layer 1.
- *Ethernet Endpoint operation:* The equipment generates and receives Ethernet PCS codes and Ethernet frames (if required to do so) in port A. It receives PCS codes and Ethernet frames also in port B.
- *IP Endpoint operation:* The equipment generates and receives IPv4 and IPv6 datagrams in port A. It also receives IPv4 and IPv6 datagrams in port B.
- *Through operation:* The equipment does not generate traffic. Traffic received from port A is forwarded to port B. Traffic from port B is forwarded to port A.
- *E1 / T1 Endpoint*: Emulation of a E1 / T1 network termination point including both transmission and reception.
- *E1 / T1 Monitor*: Analysis of E1 / T1 inputs without generating any test signal.
- *E1 / T1 Pass-through*: Transfers E1 or T1 frames between ports in both transmission directions and enables test signal alteration.
- E1 / T1 MUX / DEMUX: Enables E1 / T1 and data communications at the same time to test TDM multiplexers and demultiplexers.
- *Datacom Endpoint*: Emulation of a data communications DTE or DCE.
- *Datacom Monitor*: Transparent, passive monitoring of a DTE to DCE connection.
- *C37.94 Endpoint*: Emulation of a IEEE C37.94 network termination point including both transmission and reception.
- *C37.94 Monitor*: Analysis of IEEE C37.94 inputs without generating any test signal.
- *C37.94 Pass-through*: Transfers IEEE C37.94 frames between ports in both transmission directions and enables test signal alteration.
- *G.703 E0 Endpoint*: Generation and analysis over G.703 co-directional, contra-directional and centralized interfaces.
- *Voice Frequency:* Generation and analysis of analog signals in the telephone band (300 ~ 3400 Hz).
- *Clock Monitor*: Monitors frequency and time clock signals and runs synchronization tests on them.

1.2 Ports

- Port A - B: 2 x SFP, 2 x RJ45 connectors
- Port C: balanced RJ45 120 Ω, unbalanced BNC 75 Ω
- Port D: balanced RJ45 120 Ω (through special adapter)
- Datacom Port: DTE / DCE
- VF Port: analogue voice frequency

1.3 Interfaces, test signals and timing Ports



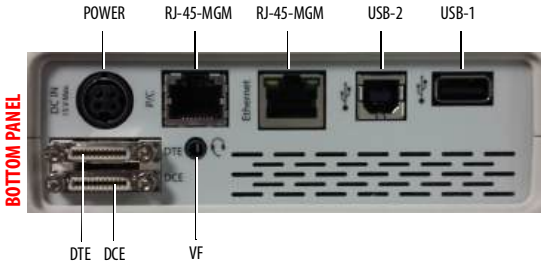


Table 1.
Operation Modes and connection modes

	GbE/IP	Eth L1	E1/T1	Analog	Data	Clock	Cable	C37.94
End-point	YES	YES	YES	YES	YES		YES	YES
Monitor	YES		YES		YES	YES		YES
Through	YES		YES					
Loop	YES		YES					YES
MuxDemux			YES					

Table 2.
Clock Reference Output

		Operation modes							
		GbE/IP	Eth L1	E1/T1	Analog	Data	Clock	Cable	C37.94
Output Interface	*BNC-2*	10 MHz 2.0 MHz	10 MHz 2.0 MHz					10 MHz 2.0 MHz	
	SMA-4	PPS	PPS	PPS	PPS	PPS	PPS	PPS	
	DTE	PPS	PPS	PPS	PPS		PPS	PPS	
	VF				Tone				

Table 3.
Clock Reference Input vs. Test Signal

	Operation modes						
	GbE/IP	E1/T1	Analog	Data	Clock	Cable	C37.94
BNC-1	10 MHz 2.0 MHz 1.5 MHz E1/T1	E1			10 MHz 2.0 MHz 1.5 MHz PPS	10 MHz 2.0 MHz 1.5 MHz E1/T1	
RJ45 -C	E1/T1	E1/T1			10 MHz 2 MHz 1.5 MHz	E1/T1	
BNC-2		E1					
RJ45-A	Ethernet, IP, IEEE 1588, SyncE SyncE					Ethernet	
RJ45-B	Ethernet, IP, IEEE 1588, SyncE SyncE					Ethernet	
SFP-1	Ethernet, IP, IEEE 1588, SyncE SyncE					Ethernet	C37.94
SFP-2	Ethernet, IP, IEEE 1588, SyncE SyncE					Ethernet	C37.94
SMA-1	GNSS	GNSS	GNSS	GNSS	GNSS	GNSS	GNSS
SMA-2					PPS		
SMA-3	PPS	PPS	PPS	PPS	PPS	PPS	PPS
DTE	PPS	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS	V11, V24, V35, V36, EIA530, EIA530A, Codir	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS	PPS	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS
DCE				V11, V24, V35, V36, EIA530, EIA530A			
VF			Analog				

Test signal, Clock reference input

1.4 Operation Modes

2. Clock

- Internal time reference better than ±2.0 ppm.
- Optional OCXO internal reference better than ±0.1 ppm. Optional Rubidium internal reference.
- Holdover operation in units equipped with OCXO and Rubidium references.

2.1 Rubidium Reference

- Free running output freq. accuracy on shipment (25 ºC): ±5e-11
- Aging (1 day, 24 hours warm up): ±4e-11
- Aging (1 year): ±1.5e-9
- Time accuracy to UTC (24 h locked to GNSS, rms value, ±2 ºC): ±20 ns.
- Holdover output time accuracy (2 hours, peak, ±2 ºC): ±100 ns
- Holdover output time accuracy (24 hours, peak, ±2 ºC): ±1.0 µs / 1 day
- Warm-up time (time to <1.5e-9): 15 minutes (typical, 25 ºC)

2.2 GNSS Input Reference

- Compatibility with GPS, GLONASS, BeiDou and Galileo with single or multiple constellation selection.
- Fixed position mode for GNSS references.
- Automatic setting of UTC-to-TAI offset (leap second count) through GNSS.
- 4V - 5V DC output in GNSS port to feed an external antenna.
- Cable delay compensation.

2.3 GNSS Compact Antenna

- SMA male connector
- Polarization: RHCP
- Frequency band: 1573 MHz - 1610 MHz
- Gain: 27 dB
- Noise figure: 1.5 dB
- Voltage: 2.7 V - 5.5 V
- Protection level: IP 67

2.4 Input Clock References

- 1544 kb/s, 2048 kb/s
- 1544 kHz, 2048 kHz, 5 MHz, 10 MHz
- 1 PPS, ToD (NMEA, ITU-T G.8271, China Telecom)
- Synchronous Ethernet

2.5 Output Clock

- 2048 MHz, 5 MHz, 10 MHz
- 1 PPS, ToD (NMEA, ITU-T G.8271)

3. Ethernet Phy

3.1 Interfaces

- SFP ports: 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, 1000BASE-BX, 100BASE-FX, 100BASE-TX, 10BASE-T
- RJ-45 ports: 10BASE-T, 100BASE-TX, 1000BASE-T
- On / Off laser control
- Insertion of code errors

Auto-Negotiation

- Bit rate: 10 Mbit/s, 100 Mbit/s, 1 Gbit/s
- Master and Slave roles in the 1000BASE-T
- Disable auto-negotiation, force line settings

Power over Ethernet (PoE / PoE+)

- Interfaces: 10BASE-T, 100BASE-TX, 1000BASE-T
- PoE pass-through in transparent mode

3.2 Synchronous Ethernet

Interfaces

- SFP ports: 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, 1000BASE-BX, 100BASE-TX
- RJ-45 ports: 100BASE-TX, 1000BASE-T

Timing

- Internal, external or recovered clock in Ethernet interfaces
- Freq offset generation up to ±125 ppm

Synchronization

- Sinusoidal wander generation
- ESMC, SSM, QL: generation, decoding, forwarding

4. Ethernet MAC

- Formats: DIX, IEEE 802.3, IEEE 802.1Q, IEEE 802.1ad
- Jumbo frames up to 10 kB
- Source / Destination MAC address setting
- Type / Length Setting
- Enable / Disable VLAN and Q-in-Q modes
- VLAN VID / User Priority setting
- S-VLAN VID, DEI, PCP, C-VLAN VID, User Priority
- FCS error insertion

5. IP

5.1 IPv4

- Source / Destination IPv4 address setting
- Dest. MAC address by hand or ARP
- DSCP CoS labels, TTL and transport protocol
- IP checksum errors insertion
- Protocols: ARP, DHCP, DNS, Ping, Traceroute

5.2 MPLS

- MPLS generation / analysis
- Double label stack support

- TTL exp, label fields

6. Traffic Generator

- Generation over 8 independent streams

6.1 Bandwidth Profile

Operation Modes

- Continuous
- Periodic
- Ramp
- Random

6.2 Test Patterns and Payloads

- NCITS TR-25-1999 RPAT, JPAT and RPAT for L1 BER tests
- IEEE 802.3, Annex 36A HFPAT, LFPAT, MFPAT, LCRPAT, SCRPAT for L1 BER tests.
- Layer 2-4: PRBS 2^6-1, PRBS 2^7-1, PRBS 2^9-1, PRBS 2^{11}-1, PRBS 2^{15}-1, PRBS 2^{20}-1, PRBS 2^{23}-1, PRBS 2^{31}-1, QRSS along with their inverted versions, user (32 bits), QBF/FOX. These patters apply to stream 1 only
- SLA payload
- All zeros, all ones
- Insertion of TSE: single, rate, random

7. Filters

- Up to 8 simultaneous filters to be applied to the traffic
- Selection by Ethernet, IP, TCP/UDP fields
- Generic filter by using 16 bit mask and arbitrary offset

7.1 Ethernet Selection

- MAC Address: Source and Destination
- Type / Length value with selection mask
- C-VID and S-VID with selection mask
- Service and Customer priority codepoint

7.2 MPLS Selection

- Top and Bottom MPLS headers
- Label value
- Exp field

7.3 IPv4 Selection

- IPv4 Source and Destination address
- IPv4 Protocol
- DSCP fields

7.4 IPv6 Selection

- IPv6 Source and Destination address
- IPv6 flow label
- DSCP
- Next header

7.5 UDP Selection

- Port: single value or ranges of values

7.6 Protocol Selection

- Protocols: IEEE 1588-2008 over Ethernet, IEEE 1588-2008 over IPv4
- Selection by Domain, Port Identity and Message Type (*Sync*, *Delay Request*, *Delay Response*, *Peer Delay Request*, *Peer Delay Response*, *Follow up*, *Peer Delay Follow up*, *Announce*, *Signaling*, *Management*)

8. PHY Results

8.1 Cable Tests

- Optical power (over compatible SFP)
- Inactive links: Open/short, distance to fault
- Active links: *MDI / MDIX*, cable wiring, polarity, skew, crosstalk.

8.2 Auto-Negotiation

- Bit rate and duplex mode
- Master / Slave role indication (1000BASE-T)

8.3 Synchronous Ethernet

- Frequency (MHz), offset (ppm), drift (ppm/s)
- Decoding of the QL transported in SSM
- TIE / MTIE / TDEV verification based on the following masks: EEC ITU-T G.8261 (option 1), EEC ITU-T G.8261 (option 2), EEC ITU-T G.8262 Wander generation, const. temp. (option 1), EEC ITU-T G.8262 Wander generation, temp. effects (option 1), EEC ITU-T G.8262 Wander generation (option 2), EEC ITU-T G.8262 Wander tolerance (option 1), EEC ITU-T G.8262 Wander tolerance (option 2), EEC ITU-T G.8262 Noise transfer (option 2), EEC ITU-T G.8262 Phase discontinuity (option 2)

9. Frame Analysis

- Modes: One-way (port A - A), two-way (port A - B)
- Separate statistics for Port A / B, Tx / Rx, Filter

9.1 Ethernet Statistics

- Counts: Ethernet, VLAN, IEEE 802.1ad frames, Q-in-Q, Control, Pause
- Frames: unicast, multicast, broadcast
- FCS errors, Undersized, Oversized, Fragments, Jabbers
- Size: < 64, 65-127, 128-255, 256-511, 512-1023, 1024-1518, 1519-1522, 1523-1526 and 1527-MTU bytes

9.2 MPLS Statistics

- MPLS stack size: max, min

9.3 IP Statistics

- Packet counts: IPv4 packets, IPv6 packets
- Packet counts: unicast, multicast and broadcast
- UDP packets, ICMP packets
- IPv4 checksum errors, IPv6 checksum errors

9.4 Bandwidth Statistics

- Current, max, min bandwidth received per port and filter
- Unicast, multicast and broadcast counts
- IP and UDP statistics

9.5 SLA Statistics

- Delay (FTD): current, min, max, mean
- Delay variation (FDV or jitter): current, min, max, mean
- Reordering: Out-of-order, Duplicated packets
- Loss (FLR): count, ratio
- Availability: SES count, PEU
- Disruption time statistics

9.6 BER

- Count, seconds, ratio and pattern loss secs at layer 1-4

9.7 Network Exploration

- Top talkers: 16 most popular MAC / IPv4 / IPv6 addresses
- Top C-VID and S-VID: 16+16 most popular tags
- Automatic setup of 8 filtering blocks

10. PTP (IEEE 1588)

10.1 Operation

- Generation / Decoding of PTP - IEEE 1588-2008
- Master / Slave operations, ability to force master or slave roles
- Generation / Analysis up to 128 PTP packet/sec
- 1-step and 2-step mechanism synchronization
- PTP pass-through monitoring
- Encapsulations: PTP over UDP / IPv4, PTP over Ethernet
- Compatible with ITU-T G.8275.1, G.8275.2, G.8265.1 and power profiles

10.2 Protocol state

- Port state, master identity, grandmaster identity, BMC priorities, clock class, accuracy, clock variance, time source, time scale

10.3 Time Error tests

- TE and max |TE| measurement on PTP
- Constant TE (cTE) and dynamic TE (dTE) components

10.4 PTP Wander test

- Measurements: TIE, MTIE, TDEV
- Masks: PEC-S-F ITU-T G.8261.1 (case 3), PEC-S-F ITU-T G.8263 Constant temperature, PEC-S-F ITU-T G.8263 Variable temperature, PRTC ITU-T G.8271 Time error in locked mode, ITU-T G.8271.1 PTP limits at reference point C, PRTC ITU-T G.8272 Locked mode, BC G.8273.2 dTE Constant temperature

10.5 PDV metrics

- Floor delay packet population, ratio/percentage/count
- Count (FPC), Rate (FPR), Percent (FPP)
- Configurable Pass / Fail threshold

10.6 Path Delay Asymmetry

- Between PTP master clock and slave clocks

10.7 Counts & statistics

- PTP message counts: Sync, Delay request, Delay response Peer delay request, Peer delay response, Follow up, Peer delay response follow up, Announce, Signaling, Management
- Sync delay: current, max, min, avg, standard deviation, range
- Sync delay variation: current, max, avg
- Sync inter arrival time: min, max, avg, current
- Delay request: current, max, min, avg, standard deviation, range
- Round trip delay: current, mean
- Correction field: current, max, avg

11. Automatic Tests

- Automatic RFC 2544 / Y.1564 tests in one / two way mode

11.1 Port Loopback

- Layer 1-4 loopback with Filtering conditions
- Loop controls for broadcast and ICMP

11.2 RFC 2544

- Throughput, Frame-loss, Latency, Jitter, Back-to-back, Recovery
- Symmetric and Asymmetric test modes

11.3 eSAM (ITU-T Y.1564)

- Four / eight services (color/not color) defined by CIR, EIR
- FTD, FDV, FLR, availability objectives
- Symmetric and Asymmetric test modes

Test Phases

- Configuration test: CIR test, EIR test, policing test
- Performance test: duration, bandwidth profile (deterministic, random)

12. E1 Generation / Analysis

12.1 Connectors

- Unbalanced (BNC) 75 Ω.
- Dual balanced (RJ-48) 120 Ω.

12.2 Line

- Configurable input impedance: nominal line impedance, PMP 20 dB, PMP 25 dB, PMP 30 dB, high impedance (> 1000 Ω).
- Custom transmission clock: recovered or synthesized
- Configurable output frequency offset within ±25,000 ppm around the nominal frequency.
- Line codes: HDB3, AMI.
- Input Level: From 0 dB to -45 dBm.
- Pulse mask compliance: ITU-T G.703.
- Jitter compliance: ITU-T G.823.

12.3 Frame

- 2 Mb/s unframed, ITU-T G.704, ITU-T G.704 CRC, ITU-T G.704 CAS, ITU-T G.704 CRC + CAS.
- *Nx64* kb/s generation and analysis in contiguous and non-contiguous time slots.
- Generation of custom NFAS spare bits (ITU-T G.704 frame with CRC-4 multi-frame).
- CAS A, B, C, D bit generation for each voice channel. Generation of CAS multi-frame spare bits (ITU-T G.704 frame with CAS multi-frame).
- Custom *Synchronization Status Message* (SSM) generation.

12.4 Line Analysis

- Line attenuation (dB).
- Frequency (Hz), frequency deviation (ppm).
- Custom pass / fail indications

12.5 Frame and Pattern Analysis

- Defects: LOS, LOF, AIS, RDI, CRC-LOM, CAS-LOM, MAIS, MRDI, LSS, All 0, All 1, Slip.
- Anomalies: Code, FAS error, CRC error, REBE, MFAS error, TSE, TSBE.
- ITU-T G.821 performance: ES, SES, UAS, DM. ITU-T G.821 results include pass / fail indications.
- ITU-T G.826 performance: ES, SES, UAS, BBE (near and far end statistics). ITU-T G.826 results include pass / fail indications.
- ITU-T M.2100 performance: ES, SES, UAS, BBE (near and far end statistics). ITU-T M.2100 results include pass / fail indications.
- Channel map and time slot analysis: time slot value in hexadecimal and binary formats, time slot level and frequency computed following the ITU-T G.711 A law.
- FAS / NFAS word analysis.
- CAS A, B, C, D bit analysis.
- Synchronization Status Message (SSM) decoding and analysis.

12.6 Event Insertion

- Physical: Code, AIS, LOS.
- Frame: FAS error, CRC error, MFAS error, REBE, LOF, MAIS, CAS-LOM, RDI, MRDI, CRC-LOM.
- Pattern: TSE, Slip, LSS, All 0, All 1.
- Insertion modes: Single (anomalies), rate (anomalies), continuous (defects), M-single (defects), MN-repetitive (defects).

13. T1 Generation / Analysis

13.1 Connectors

- Dual balanced (RJ-48) 120 Ω.

13.2 Line

- Configurable input impedance: nominal line impedance, PMP 20 dB, PMP 25 dB, PMP 30 dB, high impedance (> 1000 Ω). Cable delay equalization up to a 6 dB attenuation.
- Custom transmission clock: recovered or synthesized
- Configurable output frequency offset within ±25,000 ppm around the nominal frequency.
- Line codes: B8ZS, AMI.
- Input Level: From 0 dB to -45 dB.
- Pulse mask compliance: ANSI T1.102-1999, ITU G.703.
- Jitter compliance: ANSI T1.102-1999, ITU-T G.823.

13.3 Frame

- 1544 kb/s unframed, SF (D4) and ESF in accordance with ANSI T1.403-1999 and ITU-T G.704.
- *Nx64* and *Nx56* kb/s generation and analysis in contiguous and non-contiguous time slots with and without 'robbed bit' signaling.
- CAS A, B, C, D bit generation for each voice channel through the 'robbed bit' mechanism.
- Generation of custom FDL word (ESF frame format).
- Custom *Synchronization Status Message* (SSM) generation.

13.4 Line Analysis

- Line attenuation (dB).
- Frequency (Hz), frequency deviation (ppm).

- Custom pass / fail indications

13.5 Frame and Pattern Analysis

- Defects: LOS, LOF, AIS, RDI, LSS, All 0, All 1, Slip.
- Anomalies: Code, FAS error, CRC error, TSE.
- ITU-T G.821 performance: ES, SES, UAS, DM with pass / fail indications.
- ITU-T G.826 performance: ES, SES, UAS, BBE (near and far end statistics) with pass / fail indications.
- ITU-T M.2100 performance: ES, SES, UAS, BBE (near and far end statistics). with pass / fail indications.
- Channel map and time slot analysis: time slot value in hexadecimal and binary formats, time slot level and frequency computed following the ITU-T G.711 μ law.
- CAS A, B, C, D bit analysis.
- FDL analysis (ESF frame format).
- Synchronization Status Message (SSM) decoding and analysis.

13.6 Event Insertion

- Physical: AIS, LOS.
- Frame: FAS error, CRC error, LOF, RDI.
- Pattern: TSE, Slip, LSS, All 0, All 1.
- Insertion modes: Single (anomalies), rate (anomalies), continuous (defects), burst of M (defects), M out of N (defects).

14. Data Communications

- Operation: DTE emulation, DCE emulation and full duplex monitor.

14.1 Connectors

- Smart Serial universal data communications connector for the DTE and DCE (all interfaces).

14.2 Interfaces

- V.24 / V.28 asynchronous from 50 b/s to 128 kb/s.
- V.24 / V.28 synchronous from 50 b/s to 128 kb/s.
- X.21 / V.11 asynchronous from 50 b/s to 128 kb/s.
- X.21 / V.11 synchronous from 50 b/s to 10 MHz.
- V.35 from 50 b/s to 10 MHz.
- V.36 (RS-449) from 50 b/s to 10 MHz.
- EIA-530 from 50 b/s to 10 MHz.
- EIA-530A from 50 b/s to 10 MHz.

14.3 Line

- Clock circuit selection (TC or TTC) in V.24 / V.28 synchronous, V.35, V.36, EIA-530 and EIA-530a interfaces.
- Configurable output frequency offset within ±25,000 ppm around the nominal frequency.
- Data bits, stop bits, parity and inter-word gap configuration in V.24 and X.21 / V.11 asynchronous interfaces.
- Configuration of input and output data-to-clock phases to 0º, 90º, 180º and 270º.

14.4 Line Analysis

- Frequency (Hz), frequency deviation (ppm).
- Received character count (V.24 asynchronous).
- Logic analyser capability for data, clock and control circuits with custom setting of control circuits.

14.5 Clock and Pattern Analysis

- ITU-T G.821 performance: ES, SES, UAS, DM. ITU-T G.821 results include pass / fail indications.
- Defect insertion and analysis: LOC, AIS, LSS, All 0, All 1.
- Anomaly insertion and analysis: TSE, Slip.

15. IEEE C37.94

15.1 Connectors

- Dual port operation over SMF or MMF with suitable SFP.

15.2 Line

- Transmission clock: Recovered or internally synthesized.
- Laser on and off control.

15.3 Frame

- Unframed or framed operation.
- Frame structure follows IEEE C37.94 section 4.1.
- Configurable bit-rate between 64 kb/s and 768 kb/s in steps of 64 kb/s.

15.4 Line Analysis

- Frequency (Hz), frequency deviation (ppm).
- Transmitted optical power (dBm), received optical power (dBm).
- Received data rate (kb/s).
- SFP information: transceiver, vendor, model and wavelength.

15.5 Frame and Pattern Analysis

- ITU-T G.821 performance: ES, SES, UAS, DM. ITU-T G.821 results include pass / fail indications.
- Event detection and insertion: LOS, AIS, FAS, RDI (yellow), LSS, ALL0, ALL1, Slip, TSE.

16. E0 Generation and analysis

- G.703 co-directional interface operating 48 kb/s, 56 kb/s, 64 kb/s, 72 kb/s, 128 kb/s, 144 kb/s, 192 kb/s, 256 kb/s.
- Custom transmission clock: recovered or synthesized.
- Configurable output frequency offset within ±25,000 ppm around the nominal frequency.

16.1 Line Analysis

- Frequency (Hz), frequency deviation (ppm).

16.2 Pattern Analysis

- ITU-T G.821 performance: ES, SES, UAS, DM. ITU-T G.821 results include pass / fail indications.
- Defect insertion and analysis: LOS, AIS, LSS, 0s, 1s.
- Anomaly insertion and analysis: TSE, Slip.

17. Patterns and Signals

- *PRBS 6*, *PRBS 7*, *PRBS 9* (ITU-T 0.150, 0.153), *PRBS 11* (ITU-T 0.150, 0.152, 0.153), *PRBS 15* (ITU-T 0.150, 0.151), *PRBS 20* (ITU-T 0.150, 0.153), *PRBS 23* (ITU-T 0.150, 0.151), *PRBS 6 inverted*, *PRBS 7 inverted*, *PRBS 9 inverted*, *PRBS 11 inverted*, *PRBS 15 inverted*, *PRBS 20 inverted*, *PRBS 23 inverted*, *QRSS*, *QRSS inverted*, *QBF / FOX*, *all 0*, *all 1*.
- User configurable 32 bit word.
- Tone (from 10 Hz to 4000 Hz, from +6 dBm to -60 dBm) (E1 and T1 interfaces only).

18. Voice Frequency Test

- Tone generation and analysis function. Configurable level between -60 dBm and 0 dBm in steps of 0.1 dB. Configurable frequency between 2 Hz and 4000 Hz in steps of 1 Hz.
- Measurement of *Signal level (dBm)*, *Noise level (dBm)*, *Signal Frequency (Hz)*
- Sensitivity: -60 dBm (signal measurements), -80 dBm (noise measurements).
- ITU-T G.711 analysis: maximum code, minimum code, average code.
- Frequency sweep test with up to 8 user configurable frequencies with custom gain / loss threshold for each of them.

19. Clock Monitor

- Frequency inputs: 2048 kHz, 1544 kHz, 5 MHz, 10 MHz in RJ-48 (120 Ω) or BNC (75 Ω) connectors.
- Time inputs: 1 PPS over SMA (50 Ω) or RJ-48 (120 Ω), ToD (ITU-T G.8271, China Mobile, NMEA) over RJ-48 (120 Ω).
- Configurable input impedance: nominal line impedance, PMP 20 dB, high impedance (> 1000 Ω).

19.1 Line Analysis

- Line attenuation (dB) for frequency inputs.
- Duty cycle for 1PPS.
- Frequency (Hz), frequency deviation (ppm) for frequency inputs.

20. Pulse Mask Analysis

- Interfaces: E1 (primary port), T1 (primary port)
- Operation modes: Eye diagram or continuous run.
- Display of positive, negative and positive / negative pulse.
- Measurement of pulse width, rise time, fall time, level, overshoot and undershoot (positive and negative pulses).
- Pass / fail indication for compliance with ANSI T1.101-1999 and ITU-T G.703 1544 kb/s mask.

21. Jitter and Wander Generation

- Interfaces: E1 (primary port), T1 (primary port), IEEE C37.94.
- Modulation waveform: sinusoidal.
- Modulation frequency range: 1 μHz to 100 kHz.
- Modulation frequency resolution: 0.1 Hz (jitter), 1 μHz (wander).
- Modulation amplitude: 0 ~ 1000 UIpp. Maximum depends on modulation frequency as specified in ITU-T O.171 and O.172.
- Modulation amplitude resolution: 1 mUIpp or $1/10^4$ of the configured value.
- Smooth amplitude changes in jitter range (10 Hz ~ 100 kHz).
- Intrinsic jitter < 10 mUIpp.

22. Jitter Analysis

- Interfaces: E1 (primary port), T1 (primary port), 2048 kHz, 1544 kHz, IEEE C37.94.
- Closed loop phase measurement method.
- Modulation frequency range: 0.1 Hz to 100 kHz (locking time 10 s), 1 Hz to 100 kHz (locking time 1 s), 10 Hz to 100 kHz (locking time < 1 s).
- Modulation amplitude: 0 to 1000 UIpp (single range). Maximum amplitude depends on modulation frequency as specified in ITU-T O.171 and O.172.
- Modulation amplitude resolution: 1 mUIpp.
- Measurement accuracy: better than ITU-T O.172.
- Jitter measurement results: peak to peak jitter, RMS jitter, maximum jitter, hits detection and count (user selectable threshold).
- Jitter measurement observation time: 1 s, 10 s, 60 s.
- E1 / 2048 kHz measurement filters (ITU-T G.703): LP (f < 100 kHz), LP+HP1 (20 Hz < f < 100 kHz), LP+HP2 (18 kHz < f < 100 kHz), LP+RMS (12 kHz < f < 100 kHz).
- T1 / 1544 kHz measurement filters (ANSI T1.102 T1): LP (f < 40 kHz), LP+HP1 (10 Hz < f < 40 kHz), LP+HP2 (8 kHz < f < 100 kHz).

23. Wander Analysis

- Interfaces: E1 (primary port), T1 (primary port), 2048 kHz, 1544 kHz, 5 MHz, 10 MHz, 1 PPS, ToD.
- Open loop measurement method.
- Modulation frequency range: 1 μHz to 10 Hz.
- Wander sampling frequency: 50 Hz.
- Modulation amplitude: 0 to ±2 s (single range).
- Modulation amplitude accuracy: 2 ns.
- Statistics range: 10^2, 10^3, 10^4, 10^5, 10^6 s.
- TIE analysis in E1, T1, 2048 kHz, 1544 kHz, 10 kHz and IEEE C37.94. TE analysis (module 1 second) in 1 PPS interface with minimum and maximum records.
- Frequency offset, frequency drift with maximum records.
- Built in real time TIE, MTIE, TDEV (ITU-T G.810)
- MTIE and TDEV resolution: 100 ps.
- Custom MTIE and TDEV pass / fail indication based on standard masks.

24. Latency

- Interfaces: E1 (primary port), T1 (primary port), IEEE C37.94, data communications, G.703 co-directional, G.703 contra-directional, G.703 centralized, voice frequency.
- One way and two way modes.
- Results: round trip delay, forward path delay, reverse path delay, asymmetry with minimum and maximum records.
- Remote end identification in one way tests.
- Clock sources for one way tests: GNSS and ToD
- Patch cord delay compensation.
- Custom pass / fail indications.

25. Port Loopback

- Interfaces: E1, T1, IEEE C37.94.
- Independent loopback control for each port.

26. Platform

26.1 Ergonomics

- Size: 223 x 144 x 65 mm
- Weight: 1.2 kg (with rubber boot, one battery pack)
- Screen: 4.3 inch, TFT color (480 x 272 pixels)

26.2 Graphical User Interface

- GUI controlled by Touch-screen, Keyboard or Mouse
- Direct configuration and management in graphical mode
- User interface by touch-screen, keyboard and mouse
- Configuration up/down through Internet, USB and SNMP
- Local management with CLI
- Full remote control: SNMP or VNC

26.3 Results

- Local storage in TXT, PDF and CSV files
- File transfer to SD card and USB port
- File management through web interface and SNMP

26.4 Board

- 2 x USB ports
- 1 x RJ45 port
- 2 x LEDs
- Software upgrade through USB port

26.5 Batteries

- Li Ion Polymer
- Up to 24 hours of operation in T1/E1
- Up to 11 hours of operation in Ethernet mode

26.6 Operational Ranges

- IP rating: 54
- Operational range: -10ºC to +50ºC
- Storage range: -20ºC to +70ºC
- Operation humidity: 5% - 95%

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