![ALBEDO Telecom logo - in Test we Trust]

ALBEDO Ether10.Genius is a multitechnology Ethernet tester that includes a Rubidium clock. It is ideal to install / measure advanced telecom services (such as LTE / TDD) at 10GbE, GbE, SyncE, PTP, Jitter/Wander, T1/E1, 1 pps, C37.94, Datacom, OWD.

Datasheet

Updated on 19/6/17

# Ether10.Genius world smallest 10G

## 1. General

### 1.1 Operation Modes

**Table 1.**
Operation Modes and connection modes

|  | 10G/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 |
| Pass | YES |  | YES |  |  |  |  |  |
| Loop | YES |  | YES |  |  |  |  |  |
| MuxDemux |  |  | YES |  |  |  |  |  |

### 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

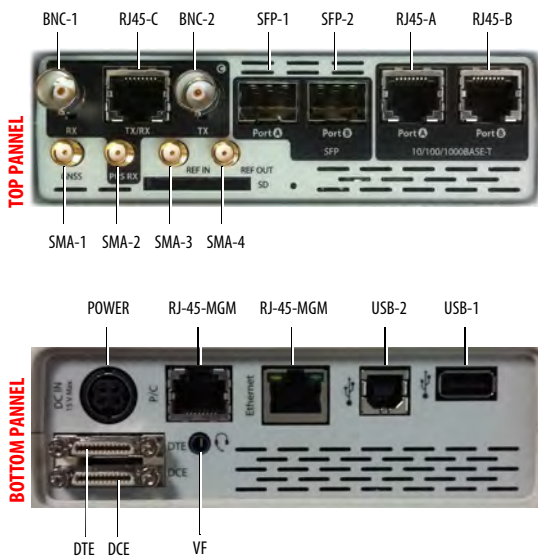### 1.3 Interfaces, test signals and timing Ports



**Table 2.**
Time Reference Input vs. Test Signal

| | | Operation modes | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 10G/IP | E1/T1 | Analog | Data | Clock | Cable | C37.94 |
| **Input Interface** | *Internal Clock* | TCXO OCXO Rubidium | TCXO OCXO Rubidm | TCXO OCXO Rubidm | TCXO OCXO Rubidm | TCXO OCXO Rubidm | TCXO OCXO Rubidm | TCXO OCXO Rubidm |
| | *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 | | | | | Ethernet | |
| | | SyncE | | | | | | |
| | *RJ45-B* | Ethernet, IP, IEEE 1588, SyncE | | | | | Ethernet | |
| | | SyncE | | | | | | |
| | *SFP-1* | Ethernet, IP, IEEE 1588, SyncE | | | | | Ethernet | |
| | | SyncE | | | | | | |
| | *SFP-2* | Ethernet, IP, IEEE 1588, SyncE | | | | | Ethernet | |
| | | SyncE | | | | | | |
| | *SMA-1* | GNSS | GNSS | GNSS | GNSS | GNSS | GNSS | GNSS |
| | *SMA-2* | | | | | PPS | | |
| | *SMA-3* | 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 | C37.94 |
| | *DCE* | | | | V11, V24, V35, V36, EIA530, EIA530A | | | |
| | *VF* | | | Analog | | | | |

🟨 Test signal, ⬜ Clock reference signal

C O N F I D E N T I A L

*This Datasheet that contains a specification which are representative and accurate of the product. However, are subject to change without notice*
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**Table 3.**
Time Reference Output

| Output Interface | Operation modes | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 10G/IP | Eth L1 | E1/T1 | Analog | Data | Clock | Cable | C37.94 |
| | *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 | | | | |

### 1.4 Internal Clock
- Internal time reference better than $\pm2.0$ ppm
- OCXO better than $\pm0.1$ ppm
- Rubidium better than $\pm5.0$e-11

### 1.5 Internal Rubidium Clock
**Freerun (No GPS)**
- Output freq. accuracy (7.5 minutes warm up): $\pm1$e-9
- Output freq. accuracy on shipment (24 h. warm up): $\pm5.0$e-11
- Aging (1 day, 24 hours warm up): $\pm.0.5$e-11
- Aging (1 year): $\pm1$e-9

**GPS Locked**
- Time/Phase Accuracy to UTC: $\pm20$ ns at $1\sigma$ after 24 hours lock
- Frequency Accuracy: 1e-11 (averaged over one week)

**Hold-over**
- Output freq. accuracy (after 24 h. locked): 1.5e-11 / 24h
- Output time accuracy (after 24 h. locked): $\pm100$ ns / 2h, $\pm1.0$μs / 24 h

### 1.6 Built-in GNSS
- GPS/Glonass support
- Onmidirectional magnetic antenna
- SMA connector
- 4V to 5V DC output

### 1.7 Input Clock References
- 1544 kb/s, 2048 kb/s
- 1544 kHz, 2048 kHz, 10 MHz
- 1 pps over SMA

### 1.8 Output Clock
- 2048 MHz, 10 MHz
- 1 pps over SMA

## 2. Ethernet Phy

### 2.1 Interfaces
- SFP / SFP+ ports: 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBA SE-SW, 10GBASE-LW, 10GBASE-EW, 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)**
- Interfaces: 10BASE-T, 100BASE-T, 1000BASE-TX
- PoE pass-through in transparent mode

### 2.2 10G WAN Interfaces Sublayer (WIS)
- According to IEEE 802.3-2012
- Path / Line / Section Overhead, STS Path / Section Trace
- Analysis: LOS, BIP-N(S), SEF / LOF, BIP-N(L), AIS-L, BIP-N(P), LOP-P, AIS-P, REI-L, RDI-L, REI-P, ERDI-P

- Representation of received pointer value

### 2.3 Synchronous Ethernet
**Interfaces**
- SFP / SFP+ ports:10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBASE-SW, 10GBASE-LW, 10GBASE-EW, 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 $\pm125$ ppm (res. 0.001 ppm)
- Line freq (MHz), offset (ppm), drift (ppm/s)

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

## 3. Ethernet MAC
- Formats: DIX, IEEE 802.3, IEEE 802.1Q, IEEE 802.1ad
- Jumbo frames up to 10 kB
- Sour / Dest 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 errors insertion

## 4. IP

### 4.1 IPv4
- Sour / Dest IPv4 address setting
- Dest. MAC address by hand or ARP
- DSCP CoS labels, TTL and transport protocol
- IP checksum errors insertion

### 4.2 Protocols
- ARP
- DHCP
- DNS
- Ping
- Traceroute

### 4.3 MPLS
- MPLS generation / analysis
- Double label stack support
- TTL exp, label fields

## 5. Traffic Generator
Generation over 8 independent streams

### 5.1 Bandwidth Profile
**Operation Modes**
- Continuous
- Periodic
- Ramp
- Random

### 5.2 Test Patterns and Payloads
- Layer 1 BER: HF, LF, MF, Long/Short continuous random, PRBS $2^{31}$-1, A-seed, B-seed, mixed-frequency
- 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.
- PRBS 6, PRBS 7, PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PBRS 6 inv, PRBS 7 inv, PRBS 9 inv., PRBS 11 inv., PRBS 15 inv., PRBS 20 inv., PRBS 23 inv., QRSS, QRSS inv, QBF/FOX, all 0, all 1
- SLA payload
- All zeros
- Insertion of TSE: single, rate, random

## 6. 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

### 6.1 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

### 6.2 MPLS Selection
- Top and Bottom MPLS headers
- Label value
- Exp field

### 6.3 IPv4 Selection
- IPv4 Source and Destination address
- IPv4 Protocol
- DSCP fields

### 6.4 IPv6 Selection
- IPv6 Source and Destination address
- IPv6 flow label
- DSCP
- Next header

### 6.5 UDP Selection
- Port: single value or ranges of values

## 7. PHY Results

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

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

### 7.3 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)
- Resolution of TIE, MTIE and TDEV results: 1 ns
- Simultaneous testing with PTP measurements

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

### 8.1 Ethernet Statistics
- Counts: Ethernet, VLAN, IEEE 802.1ad frames, Q-in-Q, Control, Pause, IEEE 1588-2008
- 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

### 8.2 MPLS Statistics
- MPLS stack size: max, min

### 8.3 IP Statistics
- Packet counts: IPv4 packets, IPv6 packets
- Packet counts: unicast, multicast and broadcast
- UDP packets, ICMP packets
- IPv4 checksum errors, IPv6 checksum errors
- IEEE 1588-2008 packets

### 8.4 Bandwidth Statistics
- Current, max, min, avg (Tx / Rx, Port A / B)
- Unicast, multicast and broadcast counts
- IP and UDP statistics

### 8.5 SLA Statistics
- Delay (FTD): current, min, max, mean
- Delay variation (FDV or jitter): current, min, max, mean
- Reordering: Out-of-order, Duplicated count and ratio
- Loss (FLR): count, ratio
- Availability: SES count, PEU, PEA

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

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

## 9. PTP (IEEE 1588)

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

### 9.2 Protocol state
- Port state, master identity, grandmaster identity, BMC priorities, clock class, accuracy, clock variance, time source

### 9.3 Time Error tests
- TE and max |TE| measurement on PTP
- Constant TE (cTE) and dynamic TE (dTE) components

### 9.4 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.
- Tables and Graphs

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

### 9.6 Path Delay Asymmetry
- Between PTP master clock and client clocks

### 9.7 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
- All results include latency compensation based on PTP correction fields
- PDV metrics (Sync / Delay Request latency statistics) are captured with a resolution of one second

## 10. Automatic Tests
- Automatic RFC 2544 / Y.1564 tests in one/two ways mode

## 10.1 Port Loopback
- Layer 1-4 loopback with Filtering conditions
- MPLS loop control
- Loop controls for broadcast and ICMP

## 10.2 RFC 2544
- Throughput, Frame-loss, Latency, Back-to-back, Recovery
- Symmetric and Asymmetric test modes

## 10.3 eSAM (ITU-T Y.1564)
- Ethernet service activation
- Four / eight services (color/not color) defined by CIR, EIR
- FTD, FDV, FLR, availability objectives
- Symmetric and Asymmetric test modes

**Test Phases**
- Phase 1: steps, step duration
- Phase 2: duration, bandwidth profile (deterministic, random)

## 11. Clock Monitor Mode
- Frequency inputs: 2048, 1544 and 10 kHz
- Time inputs: 1 pps
- TIE, MTIE and TDEV: for all inputs
- TE and max |TE|: for 1 pps
- TE dynamic and constant components
- Jitter and wander generation in 1544 and 2048 kHz interfaces

## 12. ANSI T1.102 / T1 interface

### 12.1 Line
- Configurable impedance: nominal, PMP 20, 25, 30 dB, high (> 1000 Ω)
- Cable delay equalization up to a 6 dB attenuation.
- Configurable output freq. offset ±25,000 ppm
- 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

**Frame**
- 1544 kb/s unframed, SF (D4) and ESF in accordance with ANSI T1.403-1999 and ITU G.704.
- CAS A, B, C, D bit generation for each voice channel
- 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).

### 12.2 Event Insertion
- Physical: AIS, LOS
- Frame: FAS error, CRC error, LOF, RAI
- Pattern: TSE, Slip, LSS, All 0, All 1

**Modes**
- Anomalies: single , rate
- Defects: continuous, burst of M, M out of N

## 13. ITU-T G.703 / E1 Interface

### 13.1 Line
- Configurable impedance: nominal, PMP 20 / 25 / 30dB, high (> 1000 Ω)
- Configurable output freq. offset ±25,000 ppm
- Line codes: HDB3, AMI
- Input Level: From 0 dB to -45 dB
- Pulse mask compliance: ITU-T G.703
- Jitter compliance: ITU-T G.823

### 13.2 Frame
- 2048 kb/s unframed, ITU-T G.704, ITU-T G.704 CRC, ITU-T G.704 CAS, ITU-T G.704 CRC + CAS
- Generation of NFAS spare bits (ITU-T G.704 with CRC-4 multiframe)
- CAS A, B, C, D bit generation for each voice channel.
- Generation of CAS spare bits (ITU-T G.704 with CAS multiframe)

### 13.3 Event Insertion
- Physical: AIS, LOS
- Frame: FAS error, CRC error, MFAS error, REBE, LOF, MAIS, CAS-LOM, RAI, MRAI, CRC-LOM
- Pattern: TSE, Slip, LSS, All 0, All 1

**Modes**
- Anomalies: single , rate
- Defects: continuous, burst of M, M out of N

## 14. T1 / E1 analysis

### 14.1 Test Patterns and Signals
- PRBS 6, PRBS 7, PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PBRS 6 inv, PRBS 7 inv, PRBS 9 inv., PRBS 11 inv., PRBS 15 inv., PRBS 20 inv., PRBS 23 inv., QRSS, QRSS inv, QBF/FOX, all 0, all 1
- User configurable 32 bit word
- Tone (from 10 Hz to 4 kHz, from +6 dBm to -60 dBm)
- External signal insertion: analogue and datacom interfaces

### 14.2 Events Detection and Performance testing
- G.711 occupation and analysis: level, freq
- Data occupation and analysis: Current bit code in each time slot in hexadecimal format
- CAS A, B, C, D bit analysis
- Drop to external output: Analogue, 64 kb/s codir, datacom

**Analogue**
- Line attenuation (dB), freq. (Hz), freq. dev. (ppm)

**Latency**
- Round Trip Delay test (RTD)
- One-Way Delay (OWD) test assisted with GPS / GLONASS

**Defects**
- E1: LOS, LOF, AIS, RAI, CRC-LOM, CAS-LOM, MAIS, MRAI, LSS, All 0, All 1
- T1: LOS, LOF, AIS, RAI, LSS, All 0, All 1

**Anomalies**
- E1: Code, FAS error, CRC error, REBE, MFAS error, TSE, Slip
- T1: Code, FAS error, CRC error, TSE, Slip

**Performance**
- G.821: ES, SES, UAS, DM with pass / fail indications
- G.826: ES, SES, UAS, BBE (near & far-end) with pass / fail
- M.2100: ES, SES, UAS, BBE (near & far-end) with pass / fail

### 14.3 Jitter Analysis
- Closed loop phase measurement method. Reference freq. not required
- Modulation range: .1 to 100 kHz (locking time 10 s), 1 to 100 kHz (locking time 1 s), 10 to 100 kHz (locking time < 1 s)
- Amplitude: 0 to 1000 Ulpp (max. depends on modulation freq.)
- Resolution: 1 mUlpp or 1/10e4
- Accuracy: better than ITU-T 0.172

**Jitter Results**
- Peak to peak, RMS, jitter (reseteable), hits, and count
- Observation time: 1, 10, 60 secs.

**Filters E1**
- 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)

**Filters T1**
- LP (f < 40 kHz)
- LP+HP1 (10 Hz < f < 40 kHz)
- LP+HP2 (8 kHz < f < 100 kHz)

### 14.4 Wander Analysis
- Open loop method
- Range: 1 μHz to 10 Hz
- Sampling: 50 Hz
- Amplitude: 0 to ±2 s (single range)
- Accuracy: 2 ns
- Wander masks: E1 ITU-T G.823, PDH ITU-T G.823 / ETSI EN 300 462-3-1, PDH ITU-T G.8261 CES, PDH ITU-T G.8261 CES (option 2A), PDH ITU-T G.8261 CES, PRC ITU-T G.811, PRC ETSI EN 300 462-3-1, PRC ITU-T G.823,

SSU ITU-T G.823 / ETSI EN 300 462-3-1, SSU ITU-T G.812 Noise genera-tion, constant temperature, SSU ITU-T G.812 Noise tolerance, SSU ITU-T G.812 Noise generation, variable temperature, SSU ITU-T G.812 Noise transfer, SEC ITU-T G.823 / ETSI EN 300 462-3-1, SEC ITU-T G.813 Con-stant temperature (option 1), SEC ITU-T G.813 Constant temperature (option 2), SEC ITU-T G.813 Holdover (option 2), SEC ITU-T G.813 Noise tolerance (option 1), SEC ITU-T G.813 Noise tolerance (option 2), SEC ITU-T G.813 Noise transfer (option 2), SEC ITU-T G.813 Reference switch-ing (option 2), SEC ITU-T G.813 Variable temperature (option 1).

**Results**
- Built-in and real time
- Instantaneous: TIE, freq. offset, freq. drift
- Statistics results: TIE, MTIE, TDEV
- Statistics range: $10^2$, $10^3$, $10^4$, $10^5$, $10^6$ s
- Tables and Graphs

### 14.5 Jitter / Wander Generation
- Waveform: sinusoidal
- Range: 1 µHz to 100 kHz
- Resolution: 0.1 Hz (jitter), 1 µHz (wander)
- Amplitude: 0–1000 Uipp. max depends on modulation freq
- Resolution: 1 mUipp or $1/10^4$ configured value
- Accuracy: better than 0.172
- Intrinsic jitter < 10m Uipp

### 14.6 Pulse Mask Analysis
- Operation modes: Eye diagram or continuous run
- Width, rise / fall time, level, overshoot / undershoot (± pulses)

**Pass / Fail**
- Compliance with ITU-T G.703 E1 mask
- Compliance with ANSI T1.101-1999 T1 mask

## 15. IEEE C37.94

### 15.1 Operation Modes
- Unframed or framed operation
- Clock: Recovered or Internal
- End point or terminal mode
- Results with pass / fail indications

### 15.2 C37.94 Testing
- Bit Rate generation in steps of Nx64 kb/s up to 768 kb/s
- BER, ITU-T G.821 performance test
- Event detection, insertion
- Defects: LOS, AIS, LOF, RDI, LSS, All 0, All 1
- Anomalies: FAS, TSE, Slip
- Round Trip Delay (ms)
- One-way Delay synchronized with GPS
- Frequency (Hz), deviation (ppm), max deviation
- Optical power meter

### 15.3 SFP
- SFP 850 nm, MMF, 2048 kbit/s, 1500 meters
- SFP 1310 nm, SMF, 2048 kbit/s, 10 km

## 16. ITU-T G.703 / E0 (Co-Directional)

### 16.1 Connector
- Balanced (RJ-45) 120 Ω

### 16.2 Features
- Bit rate N x 64 kbit/s (N from 1 to 4)
- Test pattern generation, analysis over co-directional
- Defect insertion, analysis: LOS, AIS, LSS, All 0, All 1
- Anomaly insertion, analysis: TSE, Slip

## 17. Analogue Test
- Tone Generation (from 10 to 4000 Hz, from 0 to -60 dBm)
- Level, frequency
- ITU-T G.711 analysis: max code, min code, avg code

## 18. Data Communications

### 18.1 Connectors
- Smart Serial Universal datacom connector for DTE / DCE

### 18.2 Interfaces
- V.24/V.28 asynchronous (RS-232) from 50 bit/s to 128 kbit/s
- V.24/V.28 synchronous (RS-232) from 50 bit/s to 128 kbit/s
- X.21/V.11 from 50 bit/s to 2048 kbit/s
- V.35 from 50 bit/s to 2048 kbit/s
- V.36 (RS-449) from 50 bit/s to 2048 kbit/s
- EIA-530 from 50 bit/s to 2048 kbit/s

### 18.3 Tests
- Operation: DTE / DCE emulation, FDX monitor
- Test pattern generation, analysis over a datacom
- Logic analyser capability
- Defects: LOC, AIS, LSS, All 0, All 1
- Anomalies: TSE, Slip
- Analogue: Line attenuation (dB), freq (Hz), deviation (ppm)
- One-way Delay synchronized with GPS

## 19. Platform

### 19.1 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)

### 19.2 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
- Web based report and configuration file management
- Local management with CLI
- Full remote control: SNMP or VNC

### 19.3 Results
- Local storage in txt and pdf files
- File transfer to SD card and USB port
- File management through web interface and SNMP

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

### 19.5 Batteries
- Li Ion Polymer
- Up to 24 hours of operation in T1/E1
- Up to 11 hours of operation in GbE
- Up to 6.5 hours of operation in 10GbE

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

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