ALBEDO Telecom
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 11/7/16

Ether10.Genius

Ether10.Genius is a handheld tester 100% suitable for labs or field use because is full equipped (IP/Ethernet/PTP/T1/E1), battery operated (up to 24h of operation), light (1.2kg) and very rugged. The unit is able to test Ethernet/IP networks up to 10Gb/s while supporting master/slave Sync-E/PTP emulation. It also has interfaces for PDH/T1/E1/E0 and IEEE C37.94. Operation modes includes Performance and Quality tests at interfaces and the ability to emulate and analyse PTP/SyncE, while measuring Freq./Phase, PDV metrics, analyse/generate TIE/MTIE/TDEV and TE. A built-in Rubidium clock disciplined with GPS provides an accuracy of a few nsec..

1. General

1.1 Interfaces

- Port A - B: 2 x SFP / SFP+, 2 x RJ45 connectors
- Port C - D: balanced RJ45 120 Ω, unbalanced BNC 75 Ω
- Datacom Port: DTE / DCE
- Analogue voice frequency Port
- RF input over SMA female connector for GPS and GLONASS connections

1.2 Operation Modes

	TCP/IP	Ethernet	E1	C37.94	Datacom
End-point	YES	YES	YES	YES	YES
Monitor	YES	YES	YES		YES
Pass-through	YES	YES	YES		
Loop-back	YES	YES	YES		
Mux-Demux			YES		
Analogue			YES		

2. Timing

2.1 Internal Clock

- Internal time reference better than ±2.0 ppm
- OCXO better than ±0.1 ppm
- Rubidium better than ±5.0e-11

2.2 Internal Rubidium Clock

Freerun (No GPS)

- Output freq. accuracy (7.5 minutes warm up): ±e-9
- Output freq. accuracy on shipment (24 h. warm up): ±5.0e-11
- Aging (1 day, 24 hours warm up): ±.5e-11
- Aging (1 year): ±1e-9

GPS Locked

- Time/Phase Accuracy to UTC: ±20 ns at 1σ 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): ±100 ns / 2h, ±1.0µs / 24 h

2.3 Built-in GNSS

- GPS/Glonass support
- Onmidirectional magnetic antenna
- SMA connector
- 3.3 V DC output

2.4 Input Clock References

- 1544 Mb/s, 2048 Mb/s
- 1544 MHz, 2048 MHz, 10 MHz
- 1 pps

2.5 Output Clock

- 2048 MHz, 10 MHz
- 1 pps

3. Ethernet Phy

3.1 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-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, 10 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

3.2 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

3.3 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

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- Freq offset generation up to ±125 ppm (res. 0.001 ppm)
- Line freq (MHz), offset (ppm), drift (ppm/s)

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
- 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

5. IP

5.1 IPv4

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

5.2 Protocols

- ARP
- DHCP
- DNS
- Ping
- Traceroute

5.3 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

- Layer 1 BER: HF, LF, MF, Long/Short continuous random, PRBS 2^{31}-1, A-seed, B-seed, mixed-frequency
- Layer 2-4: PRBS 2^{11}-1, PRBS 2^{15}-1, PRBS 2^{20}-1, PRBS 2^{23}-1, PRBS 2^{31}-1 along with their inverted versions, user (32 bits). These patters apply to stream 1 only
- SLA payload
- All zeros
- Insertion of TSE: single, rate, random

7. Filters

- Up to 8 simultaneous filters to be 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 Addr: 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 or ranges of values

8. PHY Results

8.1 Frequency / Time Tests

- TIE, MTIE, TDEV on 1544 kHz, 2048 kHz, 10 MHz and 1 pps interfaces
- Includes both numeric and graphical repesentation of wander metrics
- TE and max |TE| measurement (mod. 1 sec) in 1 pps interface

8.2 Cable Tests

- Optical power (over compatible SFP/SFP+)
- Inactive links: Open/short, distance to fault
- 10/100 Mbit/s links: current local port MDI/MDI-X status
- 1000 Mbit/s links: current, polarities, skew

8.3 Auto-Negotiation

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

8.4 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, 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

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
- IEEE 1588-2008 packets

9.4 Bandwidth Statistics

- Current, max, min, avrg (Tx / Rx, Port A / B)
- 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 count and ratio
- Loss (FLR): count, ratio
- Availability: SES count, PEU, PEA

9.6 BER

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

9.7 Network Exploration

- Top talkers: 25 most popular MAC / IPv4 / IPv6 addr
- Top C-VID and S-VID: 25+25 most popular tags
- Atomatic 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 Slave role
- Generation / Analysis of 128 PTP packet/sec
- 1-step and 2-step mechanism synchronization
- Transparent operation in pass-through with Packet delay equalization
- Encapsulations: PTP over UDP / IPv4, PTP over Ethernet
- Unicast/Multicast
- Compatible with TU-T G.8265.1 profiles

10.2 Protocol state

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

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 theshold

10.6 Path Delay Asymmetry

- Between PTP master clock and client clocks

10.7 Counts & statistics

- 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, st-dev, range
- Sync delay variation: current, max, avg
- Sync inter arrival time: min, max, avg, current
- Delay request: current, max, min, avg, st-dev, range
- Round trip delay: current, mean
- Correction field: current, max, avg

11. Automatic Tests

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

11.1 Port Loopback

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

11.2 RFC 2544

- Throughput, Frame-loss, Latency, Back-to-back, Recovery
- Symmetric and Asymmetric RFC based on Ethernet and IP RMP

11.3 Y.1564

- Ethernet service activation
- Eight / four services (colour/not colour) CIR, EIR, max, Througput
- FTD, FDV, FLR, availability objectives
- Symmetric and Asymmetric

Test Phases

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

12. 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

13. ANSI T1.102 / T1 interface

13.1 Line

- Configurable impedance: nominal, PMP 20, 25, 30 dB, high > 1000 W
- 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-T 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).

13.2 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

14. ITU-T G.703 / E1 Interface

14.1 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

14.2 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)

14.3 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

15. T1 / E1 analysis

15.1 Test Patterns and Signals

- PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 9 inv., PRBS 11 inv., PRBS 15 inv., PRBS 20 inv., PRBS 23 inv., 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

15.2 Events Detection and Performance testing

- G.711 occupation and analysis: max/min/avrg code, level, freq.
- 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

15.3 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 UIpp (max. depends on modulation freq.)
- Resolution: 1 mUIpp or 1/10e4
- Accuracy: better than ITU-T O.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)

15.4 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 generation, 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 Constant 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 switching (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

15.5 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

15.6 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

16. IEEE C37.94
16.1 Operation Modes
- Unframed or framed operation
- Clock: Recovered or Internal
- End point or terminal mode
- Results with pass / fail indications

16.2 C37.94 Testing
Follows specifications of IEEE C.37.94 section 7
- Bit Rate generation in steps of nx64 kbs up to 768 kbs
- 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 synchornized with GPS
- Frequency (Hz), deviation (ppm), max deviation
- Optical power meter

16.3 SFP
- SFP 850 nm, Multimode, 2048 kbit/s, 1500 meters
- SFP 1310 nm, Monomode, 2048 kbit/s, 10 km

17. ITU-T G.703 / E0 (Co-Directional)
17.1 Connector
- Balanced (RJ-45) 120 Ω

17.2 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

18. 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

19. Frame Relay Monitoring
19.1 Interfaces
- 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 / EIA-530A from 50 bit/s to 2048 kbit/s

19.2 Settings
- DLCI

19.3 Events
- Long frames, short frames
- Alignment errors
- FCS errors
- Frame abort count

19.4 Statistics
- Bandwidth statistics
- Max, min frame size
- Frames with FECN, BECN, DE
- Active DLCI list
- LMI frame count

20. Data Communications
20.1 Connectors
- Smart Serial Universal datacom connector for DTE / DCE

20.2 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

20.3 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

21. Platform
21.1 Ergonomics
- Size: 223 x 144 x 65 mm
- Weight: 1.2 kg (with rubber boot, one battery pack)

- Screen: 4.3 inch, TFT colour (480 x 272 pixels)

21.2 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, SSH, VNC

21.3 Results

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

21.4 Board

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

21.5 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

21.6 Operational Ranges

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

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