ALBEDO Ether.Genius is a multitechnology Ethernet tester that supports all the functionalities you need to install, commission and troubleshoot telecom services based on GbE, PTP, SyncE, E1, Jitter, Wander, Datacom, C37.94 and VF

Datasheet

ALBEDO Ether.Genius

Ether.Genius is and hybrid TDM and Ethernet / IP generator and analyser. It comes with optional synchronization (jitter and wander) testing capabilities. Ether.Genius is suitable for testing in environments where packet switching has not totally replaced legacy circuit switching technology, like in some cellular networks.

As Gigabit Ethernet tester, Ether.Genius offers multistream Ethernet traffic generation and analysis over dual electrical and optical interfaces up to 1 Gb/s, RFC 2544 and eSAM (ITU-T Y.1564) tests and advanced quality of service testing.

As a TDM tester it includes BER tests, add&drop to datacom interface, extensive error and alarm analysis and jitter/wander testing.

Power companies protect high voltage lines using optical links and the IEEE C37.94 protocol to exchange data between substations.

TEST PLATFORM

1. CONNECTORS

- Operation over two Gigabit Ethernet physical interfaces (Port A, Port B) based either on SFPs or RJ45 connectors
- Port C: Unbalanced (BNC) 75 Ω / balanced (RJ-45) 120 Ω
- Smart Serial universal datacom connector for the DTE and DCE (all datacom interfaces)
- Analogue voice frequency audio port

2. OPERATION MODES

- *Ethernet Endpoint operation*: The equipment generates and receives Ethernet PCS codes and Ethernet frames
- *IP Endpoint operation*: The equipment generates and receives IPv4 datagrams
- *IP / Ethernet Through operation*: Traffic is forwarded between port A and B
- *E1 modes*: E1 monitor, E1 endpoint, E1 mux, E1 demux, E1 through, analogue
- *Datacom modes*: Datacom endpoint, Datacom monitor

ETHERNET

3. ETHERNET PHY

3.1 Interfaces

- *SFP*: 10BASE-T, 100BASE-TX, 100BASE-FX, 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX
- *RJ-45*: 10BASE-T, 100BASE-TX, 1000BASE-T
- On/off laser control for optical interfaces

3.2 Auto-Negotiation

- Rate negotiation, allow 10 / 100 / 1000 Mb/s
- Ability to disable auto-negotiation and force line settings

3.3 Power over Ethernet

- PoE (IEEE 802.3af-2003) and PoE+ (IEEE 802.3at-2009) detection
- PoE interfaces: 10BASE-T, 100BASE-T and 1000BASE-TX through attached RJ-45 ports A and B
- PoE pass-through when the equipment is configured in transparent (through) operation mode

4. SYNCHRONOUS ETHERNET (ITU-T O.174)

4.1 Interfaces

- 100BASE-TX and 1000BASE-T through the attached RJ-45 ports. 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX and 1000BASE-BX through external SFP

4.2 Operation

- Analysis of synchronous Ethernet signal in Ethernet endpoint, IP Endpoint and Through modes, generation of synchronous Ethernet signal in Ethernet endpoint and IP Endpoint modes. Transparent synchronous Ethernet pass-through in Through mode
- Configuration of internal, external or recovered clock in Ethernet interfaces
- Fixed freq. offset generation on transmitted signals with maximum value of ±150 ppm as per ITU-T O.174 (11/2009) 8.2.1
- Sinusoidal wander generation on Ethernet interfaces.
- Generation, decoding and transparent forwarding (Through mode) of the ESMC and the SSM code carried in. Transmission and reception of "hear-beat" and event SSM messages is subject to ITU-T G.8264 clauses 11.3.2.1 and 11.3.2.2.

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- QL to be transported by the SSM is encoded as specified in ITU-T G.781 clauses 5.5.2.1 (Option I), 5.5.2.2 (Option II) and 5.5.2.3 (Option III)

4.3 Analysis

- Measurement of the line frequency (MHz), frequency offset (ppm) and frequency drift (ppm/s) as specified in ITU-T O.174 (11/2009) clause 10
- TIE / MTIE / TDEV measurement on Ethernet interfaces following ITU-T O.172 clause 10
- Decoding of the QL transported in SSM as per ITU-T G.781 clauses 5.5.3.1 (Option I), 5.5.3.2 (Option II) and 5.5.3.3 (Option III)

5. CLOCK REFERENCES

- Internal time reference better than ±3.0 ppm. Optional internal reference better than ±0.1 ppm.
- Ethernet input through Port B (over any valid electrical / optical synchronous Ethernet interface, not available for Port B or when through mode is configured)
- 2048 Mb/s, 2048 MHz, 1544 Mb/s, 1544 MHz input through Port C (balanced or unbalanced)
- 10 MHz, 2048 Mb/s, 2048 MHz, 1544 Mb/s, 1544 MHz input through through DCE datacom port (unbalanced interface, BNC connector adapter).
- One-pulse-per-second (PPS) synchronization input through a RJ-45 interface
- 2048 kHz reference output

6. ETHERNET MAC

- Traffic generation and analysis features up to 1 Gb/s (1.5 millions of frames, if frame size is set to 64 bytes)
- Frame formats: *DIX*, *IEEE 802.1Q*, *IEEE 802.1ad*
- Support for Jumbo frames with MTU up to 10 kB
- Setting of *source* and *destination MAC addresses* as a single value or as a range
- Setting of the *Type / Length* value
- Configuration of *VID* and *priority codepoint* in VLAN modes
- In Q-in-Q / IEEE 802.1ad modes, configuration of the S-VLAN *VID*, *DEI* and *priority codepoint*. Configuration of the C-VLAN *VID* and priority *codepoint*
- Configuration of the *frame size*
- Insertion of FCS errors (both in endpoint and through modes) and undersized frame using the following insertion modes: single, burst, rate and random.

7. MPLS

- MPLS generation and analysis in IP Endpoint mode. Analysis in Ethernet / IP Through mode.
- Support of a single and double label stack. The label is formatted as specified in RFC 3032.
- Configuration of the TTL, exp and label fields for Top and Bottom MPLS headers.

8. IPV4

- Configuration of *source* and *destination IPv4 addresses* as a single value or as a range
- Configuration of *DSCP* CoS labels, *TTL, transport protocol*
- If transport protocol is UDP, support of UDP frame with *source* and *destination port* configuration
- Insertion of IPv4 checksum errors (IP endpoint mode) using the following insertion modes: single, burst, rate and random

9. TRAFFIC GENERATOR

- Generation over 8 independent streams. Each stream has its own specific bandwidth profile,pattern configuration

9.1 Bandwidth Profiles

- Generation modes: *Continuous*, *Periodic burst*, *Ramp* and *Poisson*

9.2 Test Patterns and Payloads

- Layer 2-4 BER test patterns: *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 and user (32 bits). These patters apply to stream 1 only
- Test payload for SLA tests
- User payload: User configurable payload structure specified by means a payload field. Enables transmission of any protocol with a fixed payload, including Ethernet Pause frames, BPDUs or other
- *All zeros* test pattern
- Insertion of TSE (endpoint modes) using the following insertion modes: single, rate and random.

10. FILTER

- Up to 8 simultaneous filters can be applied to the traffic
- The equipment supports a generic filter which can select frames by using a *16 bit mask* and an arbitrary *offset* defined by the user

10.1 Ethernet Selection

- By *source* and *destination MAC addresses*. Selection of MAC address sets with masks
- By *Type / Length* value with selection mask
- By *C-VID* and *S-VID* with selection mask
- By *service* and *customer priority codepoint* value with selection mask

10.2 MPLS Selection

- Separated filters to account for the Top and Bottom MPLS headers.
- By label value. Specific option for selection of label ranges.
- By the value of the Exp field with specific option for selection of ranges.

10.3 IPv4 Selection

- Selection by I*Pv4 source* or *destination* address. It is possible to select address sets by using masks
- Selection by *protocol*
- Selection by *DSCP value*

10.4 IPv6 Selection

- Selection by IPv6 source or destination address (or both at the same time). It is possible to select address sets by using masks
- Selection by IPv6 flow label
- Selection based on the next header field value
- Selection by DSCP value

10.5 UDP Selection

- Selection by *UDP port*. Either as a single value or a ranges

11. PHY RESULTS

11.1 Cable Tests

- Optical power measurement (transmitted and received power) over compatible SFP transceivers

- For inactive links: Open/short fault indication and distance to fault in metres (accuracy: 1 m)
- For 10/100 Mb/s active links, the following results are reported: current local port MDI/MDI-X status
- For 1 Gb/s active links the following results are reported: current local port MDI/MDI-X status, pair polarities (normal/inverted), pair skew (ns)

11.2 Auto-Negotiation
- *Bit rate* and *duplex mode*

11.3 SFP
- *SFP presence*, current *interface*, *vendor*, and *part number*

11.4 Power over Ethernet
- Type of PoE: PoE (IEEE 802.3af), PoE+ (IEEE 802.3at), non-standard, none
- PoE voltage between pairs 1-2 / 3-6 and 4-5 / 7-8 in endpoint test. Voltage and current in pairs 1-2/ 3-6 and 4-5 / 7-8 in through mode

12. FRAME ANALYSIS
- Support of *local one-way* (port A-port B) and *two-way* (port A-port A) test modes
- Separate traffic statistics for Port A and B

12.1 Ethernet Statistics
- Frame counts: *Ethernet*, *VLAN*, *IEEE 802.1ad frames*, *Q-in-Q frames*, *control frames*, *pause frames*
- Frame counts: *unicast*, *multicast* and *broadcast*
- Basic error analysis: *FCS errors*, *undersized frames*, *oversized frames*, *jabbers*
- Frame size counts: *64 or less, 65-127, 128-255, 256-511, 512-1023, 1024-1518, 1519-1522, 1523-1526* and *1527-MTU* bytes

12.2 MPLS Statistics
- MPLS packets (single label).
- MPLS packets (double label).

12.3 IP Statistics
- Packet counts: *IPv4 packets, IPv6 packets*
- Packet counts: *unicast*, *multicast* and *broadcast*
- *UDP packets*, *ICMP packets*
- *IPv4 errors*, *IPv6* errors
- *UDP* errors

12.4 Bandwidth Statistics
- *Current*, *maximum*, *minimum* and *average* (transmitted and received) traffic figures for port A and B
- Ethernet traffic statistics expressed in bits per second, frames per second and a percentage of the nominal channel capacity
- *Unicast*, *multicast* and *broadcast* traffic figures expressed as a percentage of the nominal channel capacity
- IPv4 and IPv6 statistics (bits per second)
- UDP traffic (bits per second)

12.5 SLA Statistics
- Multistream SLA analysis
- Delay statistics: ITU-T Y.1563 *FTD* (current, minimum, maximum, and mean values)
- Delay variation statistics: ITU-T Y.1563 *FTD* (standard deviation), ITU-T Y.1563 *FDV* (peak), RFC1889 / RFC 3393 *jitter* (current, maximum and mean values)
- Duplicated packets, out -of -order packets
- Frame loss: ITU-T Y.1563 *FLR*
- Availability statistics: *SES* and ITU-T Y.1563 *PEU*

12.6 BER
- *Bit error count*, *seconds with errors*, *bit error ratio* (BER)
- *Pattern losses, pattern loss seconds*

12.7 Network Exploration
- *Top talkers* statistics: Displays the 25 most common source MAC / IP addresses
- *Top VID* (IEEE 802.1Q) or *C-VID* (IEEE 802.1ad): Displays the 25 most common VID / C-VID tags
- Top LSPs statistics: Displays the most common MPLS LSPs
- Atomatic setup of the eight available filtering blocks to match the items found in the top talkers list

13. AUTOMATIC TESTS
- The equipment supports automatic normalized tests defined in IETF RFC 2544 and ITU-T Y.1564 (eSAM)
- Support of *local one-way* (port A - port B) and *two-way* (port A - port A) tests
- Support of Ethernet and IP test modes

13.1 IETF RFC 2544 Test
- Support of RFC-2544 *throughput*, *frame-loss*, *latency*, *back-to-back* and *recovery time* tests
- Symmetric (two-way) and asymmetric (one-way) tests when both transmission ends are connected to the same test equipment

13.2 eSAM Test
- Testing of up to eight services (non-color-aware mode) or up to four services (color-aware mode)
- Configuration of the *CIR* and *EIR* for each service
- Configuration tests (CIR, EIR and policing) with *FTD*, *FDV / jitter*, *FLR* results for each service
- Performance test with *FTD*, *FDV / jitter*, *FLR* and *availability* results for all services

14. PORT LOOPBACK
- Layer 1-4 loopback
- Loop frames matching current filtering conditions or loop all frames in layer 2-4 loopbacks
- Loop controls for broadcast and ICMP frames
- MPLS loop control: Replace or preserve labels

15. PING AND TRACE-ROUTE
- Generation of on demand *ICMP echo request* (RFC 792) messages with custom destination IP address, packet length and packet generation interval
- Analysis of *ICMP echo reply* (RFC 792) messages with measurement of round trip time and lost packets
- Analysis of *ICMP Time-To-Live Exceeded* replies received in the trace-route test

16. PROTOCOLS
- *ARP* (IETF RFC 826)
- *DNS* (IETF RFC 1034, RFC 1035)
- *DHCP* (client side) (IETF RFC 2131)
- *Trace-route* application using UDP or ICMP

PTP / IEEE 1588

17. GENERAL
- PTP protocol generation and analysis runs in Port A

- Operation: IEEE 1588-2008 endpoint emulation in Ethernet endpoint, IP Endpoint (Port A). Transparent, non-intrusive IEEE 1588 pass-through monitoring in Through mode
- Support of hardware-assisted generation and decoding of Precision Time Protocol (PTP) as defined in IEEE 1588-2008
- Operation and equipment connection to the network is as any IEEE 1588 Ordinary Clock
- Both Master and Slave operations are supported in endpoint mode. Ability to force Slave role
- Encapsulations: PTP over UDP over IPv4 as defined in IEEE 1588-2008 Annex D, PTP over IEEE 802.3 / Ethernet defined in IEEE 1588-2008 Annex F

18. RESULTS

- Presentation of peer clock details: master identity, peer clock class, peer clock accuracy
- Master clock variance
- TX and RX PTP frame counts classified by frame type
- Sync Inter Packet Gap analysis: average and current
- *Sync delay*: current, min, max, average, st. deviation, range
- *Delay req.*: current, min, max, average, st. deviation, range
- Sync message PDV based on timestamps carried in Sync messages (or the Follow-up messages) and actual receiving times: Maximum, mean and current values.
- Round trip delay computed with the path delay mechanism: Histogram, current, minimum, maximum, mean values and standard deviation
- Wander metrics: TIE, MTIE and TDEV computed over the recovered clock

E1 GENERATION / ANALYSIS

19. LINE

- Configurable input impedance: nominal line impedance, PMP 20 dB, PMP 25 dB, PMP 30 dB, high Z (> 1000 Ω)
- Configurable output frequency offset within ±25,000 ppm around the nominal frequency
- 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

20. 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 custom NFAS spare bits (ITU-T G.704 frame with CRC-4 multiframe)
- CAS A, B, C, D bit generation for each voice channel. Generation of CAS multiframe spare bits (ITU-T G.704 frame with CAS multiframe)

21. TEST PATTERNS AND SIGNALS

- PRBS 9 (ITU-T O.150, O.153), PRBS 11 (ITU-T O.150, O.152, O.153), PRBS 15 (ITU-T O.150, O.151), PRBS 20 (ITU-T O.150, O.153), PRBS 23 (ITU-T O.150, O.151), PRBS 9 inverted, PRBS 11 inverted, PRBS 15 inverted, PRBS 20 inverted, PRBS 23 inverted, all 0, all 1
- User configurable 32 bit word
- Tone (from 10 Hz to 4000 Hz, from +6 dBm to -60 dBm)
- External signal: Analogue, data communications interface

22. ANALYSIS

- Analogue: Line attenuation (dB), frequency (Hz), frequency deviation (ppm), round trip delay (µs). Analogue results include pass / fail indications
- Defects: LOS, LOF, AIS, RAI, CRC-LOM, CAS-LOM, MAIS, MRAI, LSS, All 0, All 1
- Anomalies: Code, FAS error, CRC error, REBE, MFAS error, TSE, Slip
- Live and history LEDs for all Defects and Anomalies
- ITU-T G.821 performance: ES, SES, UAS, DM. ITU-T G.821 results with pass / fail indications
- ITU-T G.826 performance: ES, SES, UAS, BBE (near and far end statistics). ITU-T G.826 results with pass / fail indications
- ITU-T M.2100 performance: ES, SES, UAS, BBE (near/far end statistics). ITU-T M.2100 results with pass / fail
- ITU-T G.711 occupation map and time slot analysis: max-code, min code, average code, time slot level and frequency
- CAS A, B, C, D bit analysis
- Drop to external output: Analogue, Datacomms interface

23. 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
- Insertion modes: Single (anomalies), rate (anomalies), continuous (defects), burst of M (defects), M out of N (defects)

24. JITTER AND WANDER GENERATION FUNCTION

- Modulation waveform: sinusoidal
- Modulation frequency range: 1 µHz to 100 kHz
- Modulation frequency res: 0.1 Hz (jitter), 1 µHz (wander)
- Modulation amplitude: 0 – 1000 Uipp. Maximum depends on modulation frequency
- Modulation amplitude res. 1 mUIpp or $1/10^4$ configured value
- Modulation amplitude accuracy: better than O.172
- Smooth amplitude changes in jitter range (10 Hz – 100 kHz).
- Intrinsic jitter < 10 mUIpp

25. JITTER ANALYSIS FUNCTION

- Closed loop phase measurement method. Reference frequency not required
- 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)
- Modulation amplitude resolution: 1 mUIpp
- Measurement accuracy: better than ITU-T O.172
- Jitter measurement results: peak to peak jitter, RMS jitter, maximum jitter (user reseteable), hits detection and count (user selectable threshold)
- Jitter measurement observation time: 1 s, 10 s, 60 s
- Measurement selectable filters: 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)

26. WANDER ANALYSIS FUNCTION

- Open loop measurement method. Reference freq. required
- Modulation frequency range: 1 µHz to 10 Hz
- Wander sampling frequency: 50 Hz

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- Modulation amplitude: 0 to ±2 s (single range)
- Modulation amplitude accuracy: 2 ns
- Instantaneous: TIE, frequency offset, frequency drift
- Statistics results: TIE, MTIE, TDEV
- Statistics range: 10^2, 10^3, 10^4, 10^5, 10^6 s
- Built in, real time statistics analysis

27. PULSE MASK ANALYSIS

- Operation modes: Eye diagram or continuous run
- Measurement of pulse width, rise time, fall time, level, overshoot and undershoot (positive and negative pulses)
- Pass / fail for compliance with ITU-T G.703 E1 mask

C37.94 SPECIFICATIONS

28. CONNECTORS

- Smart Serial connector to the Ether.Genius hand set
- SFP 850 nm, Multimode, 2048 kbit/s, 1500 meters
- SFP 1310 nm, Monomode, 2048 kbit/s, 10 km

29. C37.94 MEASUREMENT

- Test Rate: N x 64 kbit/s, N = 1 to 12
- Configuration of internal, recovered clock
- Frame/Unframed BER test patterns
- ITU-T G.821 performance: ES, SES, UAS, DM.
- Results with pass / fail indications
- Test pattern generation / analysis
- Frequency (Hz), Deviation (ppm), Max deviation
- Round Trip Delay (ms).
- Defects: LOC, AIS, LOF, RDI, LSS, All 0, All 1
- Anomalies: FAS, TSE, Slip

30. OPERATION MODES

- Endpoint or terminal mode
- Pass/through or Monitor mode

DATA COMMUNICATIONS

31. INTERFACES

- V.24/V.28 asynchronous (RS-232) from 50 b/s to 128 kb/s
- V.24/V.28 synchronous (RS-232) from 50 b/s to 128 kb/s
- X.21/V.11 from 50 b/s to 2048 kb/s
- V.35 from 50 b/s to 2048 kb/s
- V.36 (RS-449) from 50 b/s to 2048 kb/s
- EIA-530 from 50 b/s to 2048 kb/s
- EIA-530A from 50 b/s to 2048 kb/s

32. TESTS

- Operation: DTE/DCE emulation and full duplex monitor
- Test pattern generation / analysis over a datacom interfaces
- Logic analyser capability
- Defects: LOC, AIS, LSS, All 0, All 1
- Anomalies: TSE, Slip
- Analogue: Line attenuation (dB), frequency (Hz), frequency deviation (ppm)

33. FRAME RELAY MONITORING

33.1 Interfaces

- X.21/V.11 from 50 b/s to 2048 kb/s
- V.35 from 50 b/s to 2048 kb/s
- V.36 (RS-449) from 50 b/s to 2048 kb/s
- EIA-530 / EIA-530A from 50 b/s to 2048 kb/s

33.2 Settings

- DLCI

33.3 Events

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

33.4 Statistics

- Bandwidth statistics
- Maximum and minimum frame size
- Frames with FECN, BECN and DE
- Active DLCI list
- LMI frame count

34. ANALOGUE TEST

- Tone Generation (10 Hz to 4000 Hz, 0 dBm to -60 dBm)
- Level and frequency
- ITU-T G.711 analysis: max, min / average code

35. SYNCHRONIZATION

- Internal clock reference
- External ref. clock: 2,048 kb/s (ITU-T G.703), 2,048 kHz
- Configurable input gain: 0 dB, -20 dB

GENERAL

36. USER INTERFACE

- Direct configuration and management in graphical mode using the keyboard and display of the instrument
- Remote access for configuration and management in graphical mode from remote IP site thought the Ethernet interface of the control panel
- File management and download through web interface

37. PLATFORM

- Configuration and report storage and export through attached USB port
- TFT display true Color 4.3" LCD, 480 x 272px
- Dimensions: 223 mm x 144 mm x 65 mm
- Weight: 1.2 kg (with rubber boot)
- AD/DC adapter (220 V AC / 50-60 Hz)
- Li-Po batteries (operation time 10 hs, recharge time 4h)