



ALBEDO xGenius is a multi-technology Transmission / Synchronization 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.

Datasheet

Updated on 4/10/17

xGenius a new dimension

1. General

1.1 Operation Modes

Table 1.
Operation Modes and connection modes

	Operation modes			
	10G/IP	Ethernet L1	E1/T1	Clock
End-point	YES	YES	YES	
Monitor	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

1.3 Interfaces, test signals and timing Ports

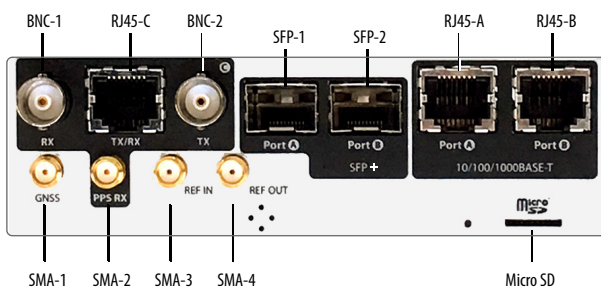


Table 2.
Clock Reference Outputs

Output Interface	Operation modes						
	10G/IP	Ether L1	E1/T1	Analog	Clock	Cable	
BNC-2	10 MHz 2 MHz	10 MHz 2 MHz				10 MHz 2 MHz	
SMA-4	1 PPS	1 PPS	1 PPS	1 PPS	1 PPS	1 PPS	

Table 3.
Clock Reference Inputs / Test Inputs

	Operation modes			
	10G/IP	E1/T1	Clock	Cable
Internal Clock	TCXO OCXO Rb	TCXO OCXO Rb	TCXO OCXO Rb	TCXO OCXO Rb
BNC-1	10 MHz 2 MHz 1.5 MHz E1/T1	E1	10 MHz 2 MHz 1.5 MHz PPS	10 MHz 2 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
RJ45-B	Ethernet, IP, IEEE 1588, SyncE			Ethernet
SFP-1	Ethernet, IP, IEEE 1588, SyncE			Ethernet
SFP-2	Ethernet, IP, IEEE 1588, SyncE			Ethernet
SMA-1	GNSS	GNSS	GNSS	GNSS
SMA-2			1 PPS	
SMA-3	1 PPS	1 PPS	1 PPS	1 PPS

■ Test signal, □ Clock reference

1.4 Internal Clock

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

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1.5 Internal Rubidium Clock

Freerun (No GPS)

- Output freq. accuracy (7.5 minutes warm up): $\pm 1e-9$
- Output freq. accuracy on shipment (24 h. warm up): $\pm 5.0e-11$
- Aging (1 day, 24 hours warm up): $\pm 0.5e-11$
- Aging (1 year): $\pm 1e-9$

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, $\pm 1.0\mu s / 24$ h

1.6 Built-in GNSS

- GPS, Glonass, Beidou, Galileo 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, 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
- 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 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 ± 125 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 802.1Q, 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
- Simultaneous traffic generation over Port A and B

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, PRBS 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: 100 ps
- 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: 16 most popular MAC / IPv4 / IPv6 addresses
- Top C-VID and S-VID: 16+16 most popular tags
- Automatic setup of 8 filtering blocks

8.8 Service Disruption Time

- Service Disruption test based on the analysis of the SLA pattern carried by a synthetic traffic flow.
- Resolution: 1 ms.

- Results: service disruption event count; total disrupted time; average, minimum and maximum time in a service disruption event; last disruption event duration.

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. Port Loopback

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

11. Automatic Tests

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

11.1 RFC 2544

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

11.2 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)

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 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-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 6, PRBS 7, PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 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)

15.2 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

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 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)

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: 10², 10³, 10⁴, 10⁵, 10⁶ s
- Tables and Graphs

15.5 Jitter / Wander Generation

- Waveform: sinusoidal
- Range: 1 μ Hz to 100 kHz
- Resolution: 0.1 Hz (jitter), 1 μ Hz (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 (\pm pulses)

Pass / Fail

- Compliance with ITU-T G.703 E1 mask
- Compliance with ANSI T1.101-1999 T1 mask

16. Platform

16.1 Ergonomics

- Size: 260 x 160 x 63 mm
- Weight: 1.6 kg (with rubber boot, one battery pack)
- Screen: 8 inch, TFT color (800 x 480 pixels)

16.2 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
- Full remote control: SNMP or VNC

16.3 Results

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

16.4 Board

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

16.5 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 10Gb E

16.6 Operational Ranges

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

