



ALBEDO Ether10.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, 1 pps, ToD, C37.94, Datacom, OWD

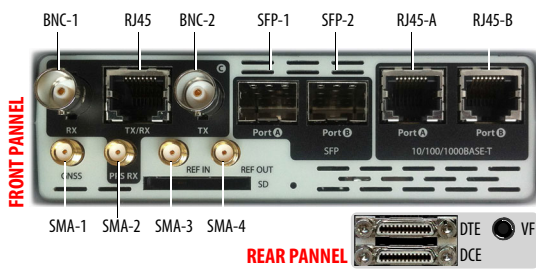
# Datasheet

Updated on 30/9/16

# Ether.Genius all-in-on tester

## 1. General

### 1.1 Interfaces, test signals and timing



**Table 1.** Time Reference Input vs. Test Signal

	Test Signal								
	GbE/IP	E1/T1	Analog	Data	Clock	Cable	L1	C37.94	
<b>Internal Clock</b>	TCXO OCXO Rubidm	TCXO OCXO Rubidm	TCXO OCXO Rubidm	TCXO OCXO Rubidm	TCXO OCXO Rubidm	TCXO OCXO Rubidm	TCXO OCXO Rubidm	TCXO OCXO Rubidm	TCXO OCXO Rubidm
<b>BNC-1</b>	10 MHz 2.0 MHz 1.5 MHz E1/T1	T&M			T&M <sup>i</sup>	10 MHz 2.0 MHz 1.5 MHz E1/T1	10 MHz 2.0 MHz 1.5 MHz E1/T1		
<b>RJ45-C</b>	E1/T1	T&M				E1/T1	E1/T1		
<b>BNC-2</b>		T&M							
<b>RJ45-A</b>	T&M SyncE					T&M	T&M		
<b>RJ45-B</b>	T&M SyncE					T&M	T&M		
<b>SFP-1</b>	T&M SyncE					T&M	T&M	T&M	
<b>SFP-2</b>	T&M SyncE					T&M	T&M	T&M	
<b>SMA-1</b>	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS	
<b>SMA-2</b>					T&M				
<b>SMA-3</b>	PPS	PPS	PPS	PPS	PPS	PPS	PPS		
<b>DTE</b>	PPS-ToD 10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS-ToD	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS-ToD	T&M			PPS-ToD	PPS-ToD	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS-ToD	
<b>DCE</b>			T&M						
<b>VF</b>			T&M						

i. 10, 2.0, 1.5 MHz

**Table 2.** Time Reference Output

Output Interface	Test Signal							
	GbE/IP	E1/T1	Analog	Data	Clock	Cable	L1	C37.94
<b>BNC-2</b>	10 MHz 2.0 MHz					10 MHz 2.0 MHz	10 MHz 2.0 MHz	
<b>SMA-4</b>	PPS	PPS	PPS	PPS	PPS	PPS	PPS	
<b>DTE</b>	PPS-ToD	PPS-ToD	PPS-ToD		PPS-ToD	PPS-ToD	PPS-ToD	
<b>VF</b>			Tone					

### 1.2 Ports

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

### 1.3 Operation Modes

**Table 3.** Operation Modes and connection modes

	GbE/IP	E1/T1	Analog	Data	Clock	Cable	L1	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						

### 1.4 Internal Clock

- TCXO better than ±2.0 ppm
- OCXO better than ±0.1 ppm
- Rubidium better than ±5.0e-11

### 1.5 Internal Rubidium Clock

#### Freerun (No GPS)

- Output freq. accuracy (7.5 minutes warm up): ±1e-9
- Output freq. accuracy on shipment (24 h. warm up): ±5e-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

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1.6 **Built-in GNSS**

- GPS/Glonass support
- Omnidirectional magnetic antenna
- SMA connector
- 4V to 5V DC output

1.7 **Input Clock References**

- 1544 Mb/s, 2048 Mb/s
- 1544 MHz, 2048 MHz, 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 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)**

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

2.2 **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  $\pm 125$  ppm (res. 0.001 ppm)

**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
- 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

4. **IP**

4.1 **IPv4**

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

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
- 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 patterns apply to stream 1 only
- 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 Addr: Source and Destination
- Type / Length value with selection mask
- C-VLAN and S-VLAN 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)
- 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

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)

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

- 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

### 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 packets
- Loss (FLR): count, ratio
- Availability: SES count, PEU

### 8.6 BER

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

### 8.7 Network Exploration

- Top talkers: 25 most popular MAC / IPv4 / IPv6 addr
- Top C-VID and S-VID: 25+25 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

### 9.2 Protocol state

- Port state, best master clock, 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.

### 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

## 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 Y.1564

- Ethernet service activation
- Eight / four services (color/not color) CIR, EIR, max, Throughput
- 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 W
- Cable delay equalization up to a 6 dB attenuation.
- Configurable output freq. offset  $\pm 25,000$  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.824

### 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

### 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  $\Omega$ )
- Configurable output freq. offset  $\pm 25,000$  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, 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, 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: max/min/avg code, level, freq.
- CAS A, B, C, D bit analysis
- Drop to external output: Analogue, 64 kb/s codirectional, 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**

- 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, 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**

- 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<sup>2</sup>, 10<sup>3</sup>, 10<sup>4</sup>, 10<sup>5</sup>, 10<sup>6</sup> 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<sup>4</sup> 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**

- Follows specifications of IEEE C.37.94 section 7
- 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, Multi-mode, 2048 kbit/s, 1500 meters
- SFP 1310 nm, Single-mode, 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 analyzer 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
- Configuration up/down through Internet, USB and SNMP
- Local management with CLI
- Full remote control: SNMP, SSH, 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

### 19.6 Operational Ranges

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