



xGenius is a multi-technology Transmission / Synchronization tester equipped with an atomic Rubidium oscillator making it ideal to maintain Power Substations, 4G/5G Telecom, TV/Radio Broadcast, Finance and Air Traffic Control infrastructures.

Datasheet

Updated on 12/3/19

xGenius a new dimension

1. General

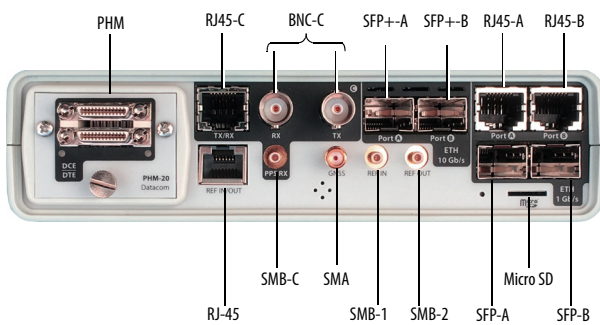
1.1 Operation Modes

Table 1.
Operation modes vs. Connection modes

		Operation modes							
		Eth	Eth L1	T1/E1	Analog	Data	Clock	E0	C37.94
Connection	End-point	YES	YES	YES	YES	YES		YES	YES
	Monitor	YES		YES		YES	YES	YES	YES
	Pass	YES							YES
	Loop	YES	YES	YES		YES		YES	YES
	MuxDmux			YES					

1.2 Ports and Connectors

Front Panel



Back Panel

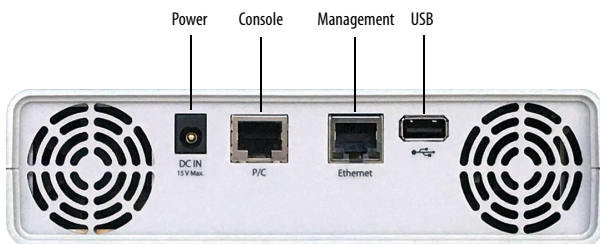


Figure 1. Ports and connectors

1.3 Test Interface and Clock Reference Summary

Table 2. Native Test Interfaces and Clock References

□ Clock references, ■ Test signals

		Operation modes				
		10GE	1GE	T1/E1	Clk Monitor	Cable
RJ45-A			Ethernet, IP PTP, SyncE			Ethernet
			SyncE			SyncE
RJ45-B			Ethernet, IP PTP, SyncE			Ethernet
			SyncE			SyncE
SFP-A			Ethernet, IP PTP, SyncE			
SFP-B			Ethernet, IP PTP, SyncE			
SFP+-A		Ethernet, IP PTP, SyncE				
SFP+-B		Ethernet, IP PTP, SyncE				
BNC-C				E1	5/10 MHz 2448 kHz 1544 kHz	
RJ45-C				T1/E1	5/10 MHz 2048 kHz 1544 kHz 1 PPS/1 PP2S ToD	
SMB-C					1PPS/1PP2S	
SMA		GNSS	GNSS	GNSS	GNSS	GNSS
SMB-1		1PPS/1PP2S	1PPS/1PP2S	1PPS/1PP2S	1PPS/1PP2S	1PPS/1PP2S
SMB-2		1PPS/1PP2S	1PPS/1PP2S	1PPS/1PP2S	1PPS/1PP2S	1PPS/1PP2S
RJ45-1		T1/E1 5/10 MHz 2048 kHz 1544 kHz 1 PPS/1 PP2S ToD	T1/E1 5/10 MHz 2048 kHz 1544 kHz 1 PPS/1 PP2S ToD	T1/E1 5/10 MHz 2048 kHz 1544 kHz 1 PPS/1 PP2S ToD	T1/E1 5/10 MHz 2048 kHz 1544 kHz 1 PPS/1 PP2S ToD	T1/E1 5/10 MHz 2048 kHz 1544 kHz 1 PPS/1 PP2S ToD

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Table 3. PHM Interfaces

	Layout	Modes	Connectors
PHM-20		Datcom endpoint Datcom monitor Datcom loop	SS26 DCE SS26 DTE
PHM-21		IEEE C37.94 endpoint IEEE C37.94 through IEEE C37.94 monitor IEEE C37.94 loop	2 x SFP
PHM-22		G.703/E0 endpoint G.703/E0 monitor G.703/E0 loop	RJ-45
PHM-23		Analog	RJ-45 Headset

1.4 Internal Clock

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

1.5 Rubidium features

GNSS Locked

- Time/Phase Accuracy to UTC: ± 20 ns at 1 σ 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

Freerun

- 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): $\pm 1e-9$

1.6 Built-in GNSS receiver

- SMA connector
- GPS, Glonass, Beidou, Galileo support single / multiple selection
- Onmidirectional magnetic antenna
- Fixed position mode for GNSS references.
- Automatic setting of UTC-to-TAI offset (leap second count)
- 4V - 5V DC output in GNSS port to feed an external antenna
- Cable delay compensation

1.7 Clock reference Inputs

- 10 MHz, 5 MHz, 2048 kb/s, 2048 kHz, 1544 kb/s, 1544 kHz

- 1 PPS, 1PP2S balanced and unbalanced compatible with standard ITU-T G.8271. ToD balanced compatible with ITU-T G.8271, China Mobile and NMEA formats
- Ethernet through Port A and Port B (over any valid electrical / optical synchronous Ethernet interface)
- Custom delay compensation for phase and time inputs

1.8 Clock Reference Outputs

- 2048 kHz and 10 MHz unbalanced.
- 1 PPS, 1 PP2S, balanced and unbalanced compatible with standard ITU-T G.8271. ToD balanced compatible with ITU-T G.8271 and NMEA
- Custom delay compensation for phase and time outputs

2. Ethernet PHY

2.1 Interfaces

SFP / SFP+ ports

- 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBASE-T, 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, 1000BASE-BX, 100BASE-FX, 100BASE-TX, 10GBASE-T

RJ-45 ports

- 10BASE-T, 100BASE-TX, 1000BASE-T
- On / Off laser control
- Insertion of code errors

Auto-Negotiation

- Bit rate: 10 Mb/s, 100 Mb/s, 1 Gb/s
- Master and Slave roles in the 1000BASE-T
- Disable auto-negotiation, force line settings

2.2 Synchronous Ethernet

SFP / SFP+ ports

- 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, 1000BASE-BX, 100BASE-TX

RJ-45 ports

- 100BASE-TX, 1000BASE-T

Timing

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

Synchronization

- ESMC, SSM, QL: generation, decoding, forwarding
- Sinusoidal wander generation on Ethernet interfaces (ITU-T 0.174)

2.3 Power over Ethernet (PoE)

- Interfaces: 10BASE-T, 100BASE-T, 1000BASE-TX
- IEEE 802.3af-2003 and PoE+ (IEEE 802.3at-2009) detection
- PoE pass-through when configured in transparent mode
- Volts in pairs 1-2 / 3-6 and 4-5 / 7-8 in end-point mode
- Voltage / current in 1-2 / 3-6 and 4-5 / 7-8 in transparent mode

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 error insertion

4. MPLS

- MPLS generation / analysis
- Single/Double label stack support
- TTL, Exp, Label fields edition

5. IP

5.1 IPv4

- Sour / Dest edition

- Dest MAC address edition or set up by ARP
- DSCP CoS label edition, TTL and transport protocol
- IP checksum errors insertion
- UDP source and destination port edition

5.2 Protocols

- ARP
- DHCP
- DNS
- Ping
- Traceroute

6. Traffic Generation

- Generation over 8 independent streams
- Two independent traffic generators over A / B ports

6.1 Bandwidth Profile

Generation modes

- Continuous
- Periodic burst
- Ramp
- Random

6.2 Test Patterns and Payloads

Layer 1

- HF, LF, MF, Long/Short continuous random, PRBS 23, A-seed, B-seed

Layer 2-4

- PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 31, all 0, all 1
- SLA payload
- Insertion of TSE: single, rate, random

7. Filters

- Up to 8 simultaneous
- Selection by Ethernet, IP, TCP/UDP fields
- Generic filter by using 16 bit mask and arbitrary offset

7.1 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

7.2 MPLS Selection

- Top and Bottom MPLS headers
- Label value
- Exp field

7.3 IPv4 Selection

- IPv4 sour / dest address
- IPv4 protocol
- DSCP field

7.4 IPv6 Selection

- IPv6 sour / dest address
- IPv6 flow label
- IPv6 "next header"
- DSCP field

7.5 UDP Selection

- Selection by UDP port

8. PHY Results

8.1 Cable Tests

- Inactive links: Open, Short, Distance to fault
- Active links MDI / MDIX Status, Polarities, Pair Skew
- Optical power (over compatible SFP/SFP+)

8.2 Auto-Negotiation

- Bit rate and duplex mode
- 1000BASE-T role indication

8.3 Synchronous Ethernet

- Frequency (MHz), offset (ppm), drift (ppm/s)
- TIE / MTIE / TDEV on Ethernet (ITU-T O.172)
- Decoding of the QL transported in SSM
- Resolution of TIE, MTIE and TDEV results: 100 ps

9. Frame Analysis

9.1 Statistics

Frame Counts

- Ethernet, VLAN, IEEE 802.1ad, Q-in-Q, Control, Pause, PTP
- Unicast, multicast, broadcast
- FCS errors, Undersized, Oversized, Fragments, Jabbers

Frame Sizes

- < 65, 65-127, 128-255, 256-511, 512-1023 1024-1518
- 1519-1522, 1523-1526 and 1527 MTU bytes

9.2 MPLS Statistics

- Single / Double label

9.3 IP Statistics

Packet Counts

- IPv4 / IPv6
- Unicast, Multicast, Broadcast
- TCP, UDP, ICMP
- IPv4 / IPv6 / UDP / TCP checksum errors

9.4 Bandwidth Statistics

- Current, max, min, avg in b/s, f/s, %
- Unicast, multicast, broadcast in %
- IPv4 and IPv6 in b/s, f/s, %
- UDP in b/s, f/s, %

9.5 SLA Statistics

- Simultaneous per stream and port
- 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 Service Disruption Test

- 1 ms resolution
- Total, avg, min, max time
- Time in the last disruption event

9.7 Bit Error

- Count, Errored sec, BER
- Pattern loss secs at layer 1-4

9.8 Network Exploration

- Top MAC / IPv4 / IPv6 talkers
- Top C-VID and S-VID tags
- Automatic 8 filtering blocks

10. PTP (IEEE 1588) testing

10.1 Operation

- Generation / Decoding of PTP - IEEE 1588-2008
- Master / Slave operations, ability to force master or slave roles
- 1-step and 2-step mechanism synchronization
- PTP pass-through monitoring
- Peer-to-peer and end-to-end delay
- Encapsulations: PTP over UDP / IPv4, PTP over Ethernet
- Unicast, multicast and hybrid addressing mechanisms
- Compatible with IEEE 1588-2008 default profiles
- Compatible with ITU-T G.8265.1, G.8275.1, G.8275.2 Telecom profiles
- Compatible with IEEE C37.238 Power profile and IEC 61850-9-3 Utility profile

10.2 Protocol state results

- Port, best master clock, master identity
- Grandmaster identity, BMC priorities, clock class, accuracy, variance, time source, master IP or Ethernet address

10.3 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
- PDV metrics (Sync / Delay Request latency) captures 1s resolution

10.4 Floor Delay metrics

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

10.5 Wander metrics

- TIE (ITU-T G.8260 pktfilteredTIE)
- MTIE (ITU-T G.8260 pktfilteredMTIE)
- TDEV (ITU-T G.8260 pktfilteredTDEV)
- Tables and Graphs

10.6 Time Error (TE) test

- Two-way TE and max |TE|
- Low frequency TE as the cTE + d^LTE components (ITU-T G.8271.1)
- High frequency TE (ITU-T G.8271.1 d^HTE)

10.7 Path Delay Asymmetry

- Between PTP master clock and client clocks

11. Automatic Tests

- Configurable PASS/FAIL objectives
- RFC 2544, ITU-T Y.11564, RFC 6349 and Synchronization tests (SyncE)

11.1 RFC 2544

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

11.2 eSAM (ITU-TY.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)

11.3 TCP test - RFC 6349

- Modes: active (client), passive (server)
- ALBEDO / IPerf3 endpoints in client mode
- Configurable MTU and MSS
- Configurable Bottleneck Bandwidth (BB) in f/s, %
- Round-Trip Time (RTT)
- Window Sweep at 25 / 50 / 75 / 100% of BDP size
- Transfer Time Ratio, TCP Efficiency, Buffer Delay

12. Port Loopback

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

13. ICMP Processor

- Generation of ICMP echo request (RFC 792)
- Analysis of ICMP reply (RFC 792) with Round Trip Time and Lost packets

- Analysis of ICMP Time-To-Live Exceeded and Port unreachable replies received in the traceroute test

14. T1 (ANSI T1.102)**14.1 Connectors**

- Balanced (RJ-48) 120 Ω

14.2 Line

- Configurable impedance: nominal, PMP 20, 25, 30 dB, high (> 1000 Ω)
- Configurable output freq. offset $\pm 25,000$ ppm
- Line codes: B8ZS, AMI
- Input Level: From 0 dB to -45 dB
- Jitter compliance: ANSI T1.102-1999, ITU-T G.823
- Line attenuation (dB)
- Pulse mask compliance (ANSI T1.102-1999, ITU G.703)
- Custom transmission clock: recovered or synthesized

14.3 Frame

- 1544 kb/s unframed, SF (D4) and ESF (ANSI T1.403-1999, ITU-T G.704)
- Nx64 and Nx56 kb/s in contiguous / non-contiguous time slots
- Optional 'robbed bit' signaling
- CAS A, B, C, D bit generation for each voice channel
- Generation of custom FDL word (ESF frame format)
- Custom Synchronization Status Message (SSM) generation

14.4 Patterns

- PRBS 6, PRBS 7, PRBS 9 (ITU-T 0.150, 0.153), PRBS 11 (ITU-T 0.150, 0.152, 0.153), PRBS 15 (ITU-T 0.150, 0.151), PRBS 20 (ITU-T 0.150, 0.153), PRBS 23 (ITU-T 0.150, 0.151), PRBS 6 inverted, PRBS 7 inverted, PRBS 9 inverted, PRBS 11 inverted, PRBS 15 inverted, PRBS 20 inverted, PRBS 23 inverted, QRSS, QRSS inverted, QBF / FOX, all 0, all 1
- User configurable 32 bit word
- Tone (from 10 Hz to 4000 Hz, from +6 dBm to -60 dBm)

14.5 Line Analysis

- Line attenuation (dB).
- Frequency (Hz), frequency deviation (ppm)
- Custom pass / fail indications

14.6 Pulse mask

- Frequency (Hz), frequency deviation (ppm)
- Operation modes: Eye diagram or continuous run
- Display of positive, negative and positive / negative pulse
- Width, rise / fall time, level, overshoot / undershoot ($\pm$ pulses)
- Pass / Fail compliance with ANSI T1.101-1999 T1 mask

14.7 Frame and Pattern Analysis

- Defects: LOS, LOF, AIS, RDI, LSS, All 0, All 1, Slip
- Anomalies: Code, FAS error, CRC error, TSE
- Channel map: time slot in hex/bin, level, freq. (ITU-T G.711 μ law)
- CAS A, B, C, D bit analysis
- FDL analysis (ESF frame format)

14.8 Performance

- Results and PASS/FAIL indication
- G.821: ES, SES, UAS, DM
- G.826: ES, SES, UAS, BBE (near / far-end)
- M.2100: ES, SES, UAS, BBE (near / far-end)

14.9 Event Insertion

- Physical: AIS, LOS
- Frame: FAS error, CRC error, LOF, RDI
- Pattern: TSE, Slip, LSS, All 0, All 1

Modes

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

14.10 Latency**Modes**

- Two way delay

- One way assisted with GNSS or ToD and remote-end identification

Results

- Round Trip Delay (RTD)
- One way Forward / Reverse Path delay
- Asymmetry with min. / max. records
- Patch cord delay compensation
- Pass / Fail indication

14.11 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 < 10 mUipp

14.12 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
- Resolution: 1 mUipp or $1/10^4$
- Accuracy: better than ITU-T 0.172

Jitter Results

- Peak to peak, RMS, jitter, hits detection and count
- Observation time: 1, 10, 60 s

Filters

- LP ($f < 40$ kHz)
- LP+HP1 (10 Hz < $f < 40$ kHz)
- LP+HP2 (8 kHz < $f < 100$ kHz)

14.13 Wander Analysis

- Range: 1 μ Hz to 10 Hz
- Sampling: 50 Hz
- Amplitude: 0 to ± 2 s (single range)
- Accuracy: 2 ns

Results

- Tables and Graphs
- Instantaneous: TIE, freq. offset, freq. drift
- Built in real time TIE, MTIE, TDEV (ITU-T G.810)
- Statistics range: 10^2 , 10^3 , 10^4 , 10^5 , 10^6 s
- Frequency offset, frequency drift with maximum records
- MTIE and TDEV resolution: 100 ps
- Pass / Fail based on standard masks

15. E1 (ITU-T G.703)

15.1 Connectors

- 2 x Unbalanced (BNC) 75 Ω
- Balanced (RJ-48) 120 Ω

15.2 Line

- Configurable impedance: nominal, PMP 20 / 25 / 30dB, high (> 1000 Ω)
- Recovered or synthesized clock
- 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

15.3 Line Analysis

- Line attenuation (dB)
- Frequency (Hz), frequency deviation (ppm)
- Custom pass / fail indications

15.4 Pulse mask

- Frequency (Hz), frequency deviation (ppm)
- Operation modes: Eye diagram or continuous run
- Display of positive, negative and positive / negative pulse
- Width, Rise/Fall time, Level, Overshoot and Undershoot

- Pulse mask compliance ITU G.703

15.5 Frame

- 2048 kb/s unframed (ITU-T G.704, G.704 CRC / CAS / CRC+CAS)
- Nx64 in contiguous / non-contiguous time slots
- Custom NFAS generation (ITU-T G.704 with CRC-4 multi-frame)
- CAS A, B, C, D bit generation for each voice channel

15.6 Patterns and Signals

- PRBS 6, PRBS 7, PRBS 9 (ITU-T 0.150, 0.153), PRBS 11 (ITU-T 0.150, 0.152, 0.153), PRBS 15 (ITU-T 0.150, 0.151), PRBS 20 (ITU-T 0.150, 0.153), PRBS 23 (ITU-T 0.150, 0.151), PRBS 6 inverted, PRBS 7 inverted, PRBS 9 inverted, PRBS 11 inverted, PRBS 15 inverted, PRBS 20 inverted, PRBS 23 inverted, QRSS, QRSS inverted, QBF / FOX, all 0, all 1
- User configurable 32 bit word
- Tone (from 10 Hz to 4000 Hz, from +6 dBm to -60 dBm)

15.7 Frame and Pattern Analysis

- Defects: LOS, LOF, AIS, RDI, CRC-LOM, CAS-LOM, MAIS, MRDI, LSS, All 0, All 1, Slip
- Anomalies: Code, FAS error, CRC error, REBE, MFAS error, TSE, TSBE
- Channel map: time slot in hex/bin, level, freq. (ITU-T G.711 A law)
- CAS A, B, C, D bit analysis
- FAS / NFAS word analysis

15.8 Performance

- Results and PASS/FAIL indication
- G.821: ES, SES, UAS, DM
- G.826: ES, SES, UAS, BBE (near / far-end)
- M.2100: ES, SES, UAS, BBE (near / far-end)

15.9 Event Insertion

- Physical: Code, AIS, LOS
- Frame: FAS/CRC/MFAS error, REBE, LOF, MAIS, CAS-LOM, RDI, MRDI, CRC-LOM
- Pattern: TSE, Slip, LSS, All 0, All 1

Modes

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

15.10 Latency

Modes

- Two way delay
- One way assisted with GNSS or ToD and remote-end identification

Results

- Round Trip Delay (RTD)
- One way Forward / Reverse Path delay
- Asymmetry with min. / max. records
- Patch cord delay compensation
- Pass / Fail indication

15.11 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 < 10 mUipp

15.12 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 $1/10^4$
- Accuracy: better than ITU-T 0.172

Jitter Results

- Peak to peak, RMS, jitter, hits detection and count
- Observation time: 1, 10, 60 s

Filters

- LP ($f < 100$ kHz)
- LP+HP1 ($20 \text{ Hz} < f < 100$ kHz)
- LP+HP2 ($18 \text{ kHz} < f < 100$ kHz)
- LP+RMS ($12 \text{ kHz} < f < 100$ kHz)

15.13 Wander Analysis

- Range: $1 \mu\text{Hz}$ to 10 Hz
- Sampling: 50 Hz
- Amplitude: 0 to $\pm 2 \text{ s}$ (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 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

- Tables and Graphs
- Instantaneous: TIE, freq. offset, freq. drift
- Built in real time TIE, MTIE, TDEV (ITU-T G.810)
- Statistics range: 10^2 , 10^3 , 10^4 , 10^5 , 10^6 s
- Frequency offset, frequency drift with maximum records
- MTIE and TDEV resolution: 100 ps
- Pass / Fail based on standard masks

16. Data Communications

16.1 Connector

- 2 x SS26 (Smart Serial Universal) for DTE / DCE

16.2 Interfaces

- V.24 / V.28 asynchronous from 50 b/s to 128 kb/s
- V.24 / V.28 synchronous from 50 b/s to 128 kb/s
- X.12 / V.11 asynchronous from 50 b/s to 128 kb/s
- X.21 / V.11 synchronous 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

16.3 Line

- Clock selection in V.24 / V.28 synchronous, V.35, V.36, EIA-530/EIA-530a
- Configurable output frequency offset $\pm 25,000 \text{ ppm}$
- Data, Stop, Parity bits and Inter-word gap configuration in asynchronous interfaces

16.4 Operation Modes

- DTE / DCE emulation, Full duplex monitor

16.5 Event Insertion

- Pattern: TSE, Slip, LSS, All 0, All 1
- Asynchronous interfaces: FRM, PRTY

Modes

- Anomalies: single, rate
- Defects: continuous

16.6 Analysis

Line Analysis

- Frequency (Hz), freq. deviation (ppm)
- Received chars

Events detection

- Anomalies: FRM, PRTY, TSE, TSBE
- Defects: LOC, LSS, All 0, All 1, Slips

Performance

- Results and PASS/FAIL indication
- G.821: ES, SES, UAS, DM

16.7 Latency

Modes

- Two way delay
- One way assisted with GNSS or ToD and remote-end identification

Results

- Round Trip Delay (RTD)
- One way Forward / Reverse Path delay
- Asymmetry with min. / max. records
- Patch cord delay compensation
- Pass / Fail indication

17. ITU-T G.703 EO

17.1 Interfaces

- Balanced (RJ-45) 120Ω
- G.703 co-directional, contra-directional and centralized interface
- Bit rates 48, 56, 64, 72, 128, 144, 192, 256 kb/s

17.2 Event Insertion

- Physical: LOS, AIS
- Pattern: TSE, Slip, LSS, All 0, All 1

Modes

- Anomalies: single, rate, burst
- Defects: continuous

17.3 Analysis

Line Analysis

- Frequency (Hz), freq. deviation (ppm)
- Received chars

Events detection

- Anomalies: TSE, TSBE
- Defects: LOS, AIS, LSS, All 0, All 1, Slips

Performance

- Results and PASS/FAIL indication
- G.821: ES, SES, UAS, DM

17.4 Latency

Modes

- Two way delay
- One way assisted with GNSS or ToD and remote-end identification

Results

- Round Trip Delay (RTD)
- One way Forward / Reverse Path delay
- Asymmetry with min. / max. records
- Patch cord delay compensation
- Pass / Fail indication

18. Voice Frequency Test

- Tone generation and analysis function
- Level from -60 dBm to $+3 \text{ dBm}$ in steps of 0.1 dB
- Frequency between 2 Hz and 4000 Hz in steps of 1 Hz

Results

- Signal level (dBm), Noise level (dBm), Signal Frequency (Hz)
- Sensitivity: -60 dBm (signal measurements), -80 dBm (noise measurements)
- ITU-T G.711 analysis: maximum code, minimum code, average code
- Frequency sweep test

18.1 Latency

Modes

- Two way delay
- One way assisted with GNSS or ToD and remote-end identification

Results

- Round Trip Delay (RTD)

- One way Forward / Reverse Path delay
- Asymmetry with min. / max. records
- Patch cord delay compensation
- Pass / Fail indication

19. IEEE C37.94

- Dual port operation over SMF or MMF with suitable SFP
- Endpoint, pass-through and monitor operation modes

19.1 Interfaces

- SFP 850 nm, MMF, 2048 kb/s, 1500 m
- SFP 1310 nm, SMF, 2048 kb/s, 10 km

19.2 Line

- Clock: Recovered or Internal
- Modes: End point, Monitor
- Results: PASS / FAIL
- Laser: ON / OFF control

19.3 Frame

- Unframed / Framed operation
- Configurable bit-rate from 64 to 768 kb/s in 64 kb/s steps

19.4 Event Insertion

- Physical: AIS, LOS
- Frame: FAS, RDI
- Pattern: TSE, Slip, LSS, All 0, All 1

Modes

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

19.5 Analysis

SFP info

- Transceiver, Vendor, Model, Wavelength
- Tx Optical power (dBm)
- Rx Optical power (dBm)

Line Analysis

- Frequency (Hz), freq. deviation (ppm)
- Received data rate (kb/s)

Events detection

- Anomalies: Code, FAS, TSE
- Defects: ACT, LOS, RDI, AIS, LSS, All 0, All 1, Slips

19.6 Performance

- Results and PASS/FAIL indication
- G.821: ES, SES, UAS, DM

19.7 Latency

Modes

- Two way delay
- One way assisted with GNSS or ToD and remote-end identification

Results

- Round Trip Delay (RTD)
- One way Forward / Reverse Path delay
- Asymmetry with min. / max. records
- Patch cord delay compensation
- Pass / Fail indication

19.8 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 detection and count
- Observation time: 1, 10, 60 s

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)

19.9 Wander Analysis

- Range: 1 μ Hz to 10 Hz
- Sampling: 50 Hz
- Amplitude: 0 to ± 2 s (single range)
- Accuracy: 2 ns

Results

- Tables and Graphs
- Instantaneous: TE / TIE, freq. offset, freq. drift
- Built in real time TIE, MTIE, TDEV (ITU-T G.810)
- Statistics range: 10^2 , 10^3 , 10^4 , 10^5 , 10^6 s
- Frequency offset, frequency drift with maximum records
- MTIE and TDEV resolution: 100 ps
- Pass / Fail based on standard masks

20. Clock Monitor Mode

- Frequency inputs: 2048 kHz, 1544 kHz, 5 MHz, 10 MHz in RJ-48 or BNC connectors
- Time inputs: 1 PPS and 1PP2S over SMB or RJ-48 connectors
- ToD (ITU-T G.8271, China Mobile, NMEA) over RJ-48 connectors
- Configurable input impedance: nominal line impedance, PMP 20 dB, high impedance (> 1000 Ω)

20.1 Line Analysis

- Interfaces 2048 kHz, 1544 kHz, 10 MHz
- Line attenuation (dB)
- Frequency (Hz), frequency deviation (ppm)

20.2 Jitter Analysis

- Interfaces: 1544 kHz, 2048kHz
- 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 detection and count
- Observation time: 1, 10, 60 s

Filters (2048 kHz)

- 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 (1544 kHz)

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

20.3 Wander Analysis

- Range: 1 μ Hz to 10 Hz
- Sampling: 50 Hz
- Amplitude: 0 to ± 2 s (single range)
- Accuracy: 2 ns

Results

- Tables and Graphs
- Instantaneous: TE / TIE, freq. offset, freq. drift
- Built in real time TIE, MTIE, TDEV (ITU-T G.810)
- Statistics range: 10^2 , 10^3 , 10^4 , 10^5 , 10^6 s
- Frequency offset, frequency drift with maximum records
- MTIE and TDEV resolution: 100 ps
- Pass / Fail based on standard masks

21. Port Loopback

- Interfaces: E1, T1, IEEE C37.94, data communications, G.703 co-directional, G.703 contra-directional, G.703 centralized

- Independent loopback control for each port
- Custom latency generation up to 50 ms at 2048 kHz

22. Service Disruption Time

- Interfaces: E1/T1, C37.94, Datacom, Co/contra-directional, centralized
- Resolution is 100 μ s or the smaller allowed by the detection rules
- Statistics are service disruption events count.
- Total disrupted time, max, min, avg
- Time in the last disruption event

22.1 Triggers

- In-service: LOS, AIS, LOC, RDI
- Out-of.service: TSE, 1s, 0s

23. Platform

23.1 Ergonomics

- Size: 260 x 160 x 63 mm
- Weight: 1.9 kg (two pack of batteries included)

23.2 Graphical User Interface

- Screen: 8 inch, TFT color (800 x 480 pixels)
- GUI controlled by Touch-screen, Keyboard or Mouse
- One click preconfigured tests
- Advanced navigation
- Web based report and configuration file management
- Full remote control: SNMP and VNC

23.3 Results

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

23.4 Board

- 1 x USB ports
- 1 x RJ45 port
- 2 x application LEDs
- 4 x system LEDs: Run, Event, Power, DC
- Software upgrade through USB

23.5 Batteries

- 2 x Li Ion Polymer
- Duration depends on many factors: application, aging, temp, screen...

23.6 Operational Ranges

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

