

test up to

100G

Next Generation High Speed Networks



Calnex Paragon - **100G**

Calnex Paragon - **✕**

Prove Ethernet Sync to 100GbE

Bringing innovative, new technologies to the marketplace requires tools that are as equally innovative. Without them, you can never be sure whether your devices or systems will meet the required standards. And that risks your, and your company's, reputation — not to mention your return on investment.

Equally, how can you be certain that your vendors are delivering on their performance promises? Do their devices or systems really meet the latest standards? Testing using tools that you can trust is the only way to verify performance and functionality with confidence.

So now that the migration to 100G as the pervasive high-speed interface is truly underway, who do you turn to for innovative test products that you can rely on? Calnex Solutions of course.

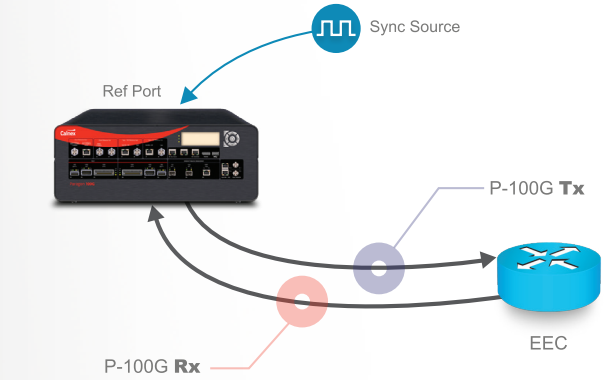
The Calnex Paragon-100G is the industry's first 100GbE SyncE test solution that really is at the leading edge. It is designed to meet the stringent test requirements of NEMs who are designing, verifying and manufacturing 100GbE devices, and for Network Operators who are building 100G networks. It precisely measures frequency and phase synchronization from 100GbE to 100BT in accordance with ITU-T G.8262 (SyncE) and IEEE 1588 (PTP) standards. And supports wander testing of high speed core switches and routers at 40GbE and 100GbE.

High network efficiency and reduced data transmission costs are only possible with highly accurate timing. To make sure your devices and systems deliver the high quality broadband network services of the future, look no further than the Paragon-100G for verifying synchronization accuracy and compliance.

- Prove 100 GbE and 40 GbE SyncE wander performance to ITU-T G.8262
- Evaluate MTIE/TDEV Pass/Fail results to ITU-T G.8262 masks
- Check ESMC (SSM) messaging to ITU-T G.8264
- Test 100GbE and 40GbE jitter to ITU-T G.8262 (optional, later release)
- Prove PTP performance (optional, later release)

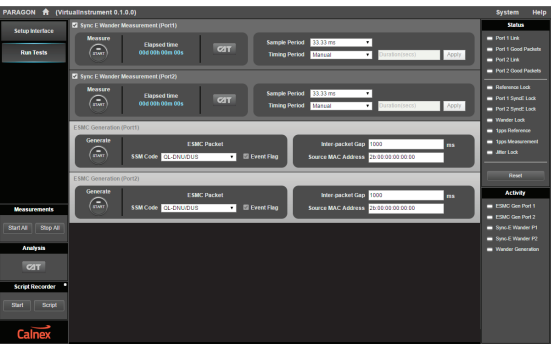
100G/40G SyncE applications – ITU-T G.8262

The Paragon-100G supports full 100GbE and 40GbE SyncE testing to ITU-T G.8262 including Wander Tolerance, Wander Transfer, Wander (Noise) generation, Pull-in, Hold-in and Pull-out ranges, Frequency Accuracy and Phase Transient.



Application	P-100G Tx	P-100G Rx
100G/40G SyncE Wander (noise) Generation	Wander free	Measure Wander
100G/40G SyncE Wander (noise) Tolerance	Apply Wander	Check ESMC
100G/40G SyncE Wander (noise) Transfer	Apply Wander	Measure Wander
100G/40G SyncE Short Term Phase Transient	Break line or set ESMC QL=DNU	SyncE TIE, MTIE

Web-based user-interface



The Paragon-100G user interface offers simple port and interface set up, while its built-in controller lets you operate the tester directly from a tablet.



The Calnex Analyzer Tool (CAT) provides powerful insight into network and device performance. All your measurement results are now in one place, and you can view multiple graphs simultaneously for easier correlation of your results. Plus, with enhanced graphics, it's easy to evaluate ITU-T metrics such as MTIE, TDEV, MAFE, MATIE against ITU-T masks.

Synchronize frequency and phase to a common reference. Clock Reference Inputs (balanced and unbalanced) and 1pps / ToD inputs enable both test and network equipment to be synchronized. Reference Outputs for both frequency and phase are also provided.

High speed interface ports for both 100GbE and 40GbE are supported: Two CFP2 ports for 100GbE LR4/SR4 testing; two CXP ports for 100GbE SR10; QSFP+ ports for 40GbE.



Measure frequency/wander on E1, 2MHz/10MHz unbalanced electrical interfaces and E1/T1 balanced electrical interfaces.*

Measure frequency/wander on 10GbE SFP+, 1GbE SFP and 100BaseT electrical interfaces.*

* Available as future software option

Prove Ethernet Sync to 10GbE

The performance of today’s mobile backhaul depends on proving its overall synchronization quality, and probing its underlying packet-layer and physical-layer mechanisms.

For technologies up to 10 Gb/s, the Calnex Paragon-X offers direct insight to actual device and service behaviour, and the ability to generate a broad range of real-world disruption scenarios to validate the operation of your network devices and systems to industry standards.

It’s the definitive one-box solution to rigorously test SyncE, PTP and NTP synchronization mechanisms, as well as E1/T1/ToD sync interfaces and Ethernet OAM. It brings together all the measurements you need — from jitter and wander through to measuring the accuracy of the recovered Time of Day (ToD), Phase (1pps) and Frequency (MTIE/TDEV) — to ensure your products will work reliably in the complex world of Ethernet switches, routers and gateways.

For design through to evaluation, it’s for good reason the Paragon-X is the industry’s tester of choice for proving Ethernet sync up to 10 Gb/s.

All the measurements you need in one box



1588 and CES

- One-box testing for Master Clock, Slave Clock, Boundary Clock and Transparent Clock devices
- Emulate two PTP masters for BMCA and G.8265 conformance test
- Capture and replay PDV stress profiles
- Run ITU-T and MEF-18 test cases



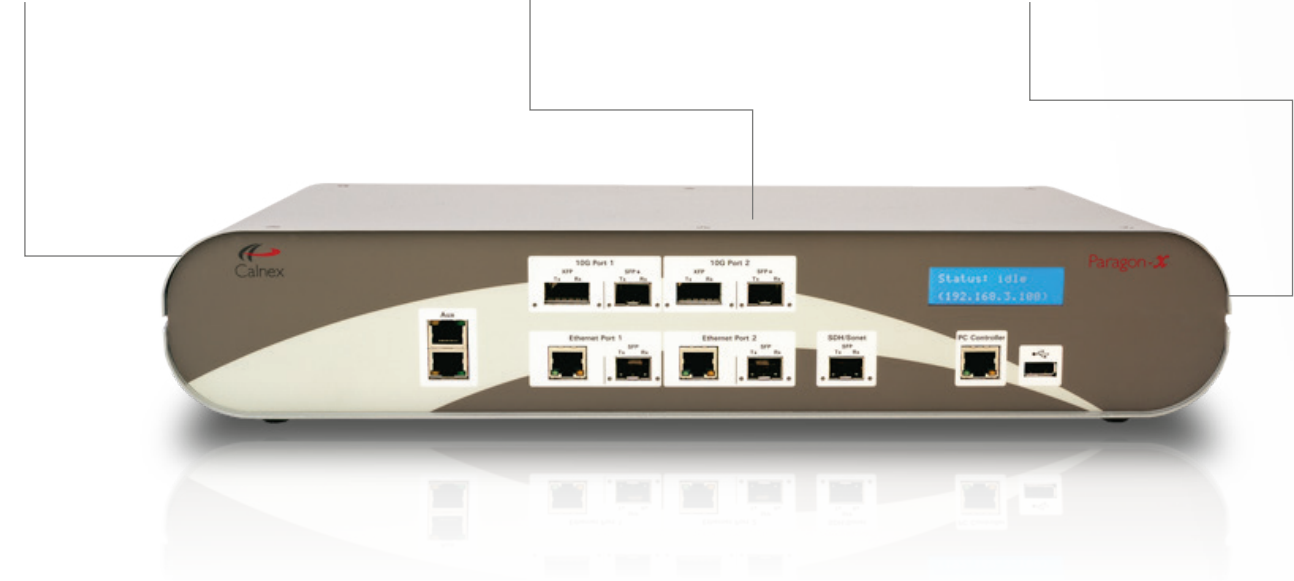
SyncE

- Prove SyncE Jitter and Wander to G.8262
- MTIE/TDEV Pass/Fail evaluation
- 1 nanosecond accuracy
- ESMC (SSM) message testing and proving to G.8264
- Full hybrid SyncE/PTP test suite



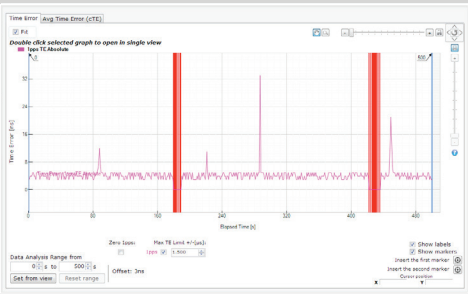
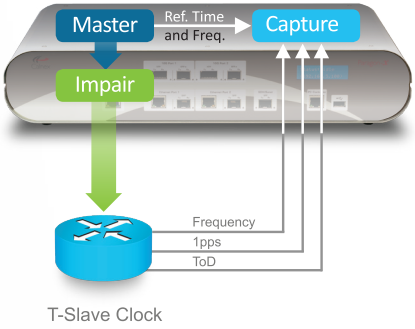
Ethernet OAM

- Prove Connectivity Fault Management (CFM) and Performance Monitoring (PM) for Y.1731, 802.1ag and 802.3ah
- Add latency, jitter, errors, dropped packets to prove OAM implementation
- Prove G.8031/2 protection
- Support for 1000s of MEGs



Hybrid PTP/SyncE 1588

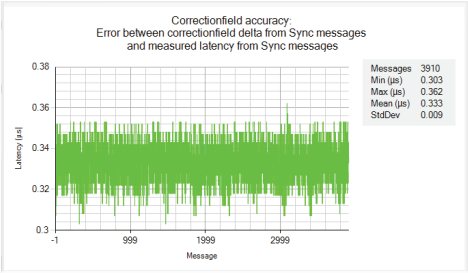
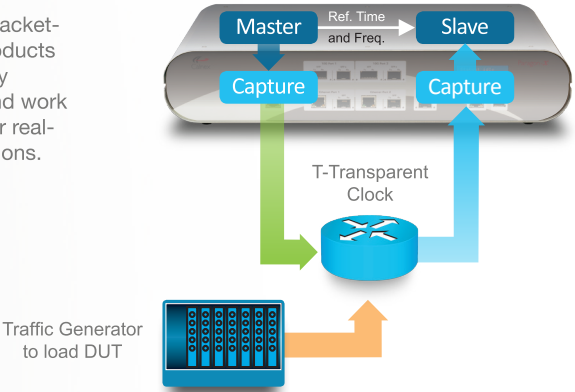
Test hybrid devices simultaneously with 1588 G.8261 PDV profiles and SyncE wander.



Assess T-Slave Clock timing accuracy with 1pps and Time of Day (ToD) measurements.

1588

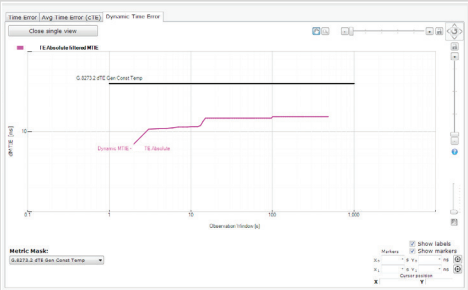
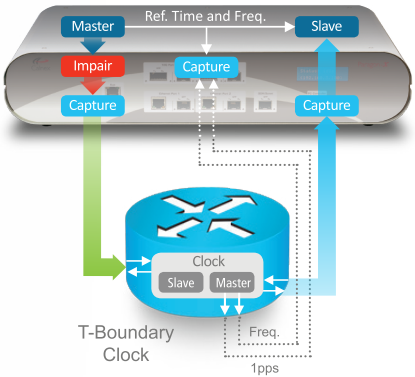
Prove your packet-transport products meet industry standards and work reliably under real-world conditions.



Measure the accuracy of a T-Transparent Clock’s correction field packet-by-packet.

1588

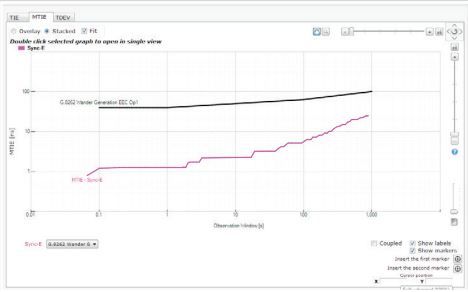
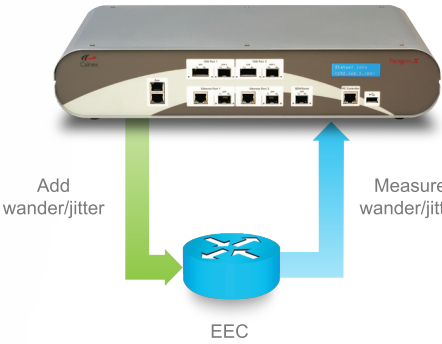
Test hybrid devices simultaneously with 1588 PDV/ SyncE wander and measure output packet timing, recovered clocks and SyncE wander.



Analyze the time error (TE) of T-Boundary Clocks between ingress and egress.

SyncE

Validate Sync-E and ESMC to ITU-T G.8262 and G.8264 standards.



Prove SyncE wander transfer, jitter/wander tolerance and jitter/wander generation to ITU-T G.8262.

Paragon-100G Specifications

	SyncE
Wander Measurement	ITU-T G.8262. Wander Generation, Wander Transfer, Wander Tolerance, Phase Transient, built-in frequency offset plus sinusoidal, MTIE and TDEV wander generation.
Wander Analysis	Built-in (CAT) software including industry standard ITU-T Pass/Fail Masks with clear Pass/Fail indication. ITU-T Masks: G.813, G.823, G.824, G.8261, G.8262, G.8263, G.8261.1, GR.1244 Clock Wander Measurements: TIE, MTIE, TDEV, clock MAFE, clock FFO.
ESMC (SSM) Features	Decode ESMC messages to ITU-T G.8264 and graph/plot Quality Level (QL) changes graphically (bi-directional). QLs: PRS, PRC, INV3, SSU-A/ TNC, INV5, INV6, ST2, SSU-B,INV9, EEC2/ST3, EEC1/SEC, SMC, ST3E, PROV, STU/UKN, DNU/DUS. Overwrite ESMC Message to change QL status. Support for industry standard tool, Wireshark and integrated decode using Tshark.
ESMC Generation	Generate ESMC (SSM) packets per ITU-T G.8264 QLs: PRS, PRC, INV3, SSU-A/ TNC, INV5, INV6, ST2, SSU-B,INV9, EEC2/ST3, EEC1/SEC, SMC, ST3E, PROV, STU/UKN, DNU/DUS. Generate ESMC Messages, change QL value and measure impact on Wander.
SyncE Master	Accuracy traceable to Reference source (refer to Reference Clocks).

	Product
Optical Interfaces	Ethernet (optical CXP, CFP2 and QSFP+ modules not supplied) 100 GbE: CXP (SR10) – 2 slots (optional) 100 GbE: CFP2 (LR4/SR4) – 2 slots (optional) 40 GbE: QSFP+ (LR4/SR4) – 2 slots (optional)
External Reference Clocks	Lock internal timing reference to external reference. Reference Lock soft LED indication. External reference inputs: 64 kHz, 2.048 MHz, 10 MHz, T1 BITS clock (1.544 Mb/s), E1 MTS (2.048 Mb/s), SyncE.
Internal Reference Clock	Frequency Stability over Temp: $\pm 1.5 \times 10^{-7}$
Clock Ref. Output Ports	2 x 10 MHz/2.048 MHz Reference Outputs (BNC).
Clock Measurement¹	1000BT, 100BT Electrical - RJ45, 1 GbE Optical (SFP required). E1 (2.048 Mb/s), 10 MHz, 2.048 MHz – BNC (unbalanced). E1 (2.048 Mb/s), T1 (1.544 Mb/s) – RJ48 (balanced).
Phase Measurement¹	1 pps – BNC (unbalanced). 1 pps – RJ (balanced).
1 pps + ToD Ref. Input¹	1 pps unbalanced Input (BNC), 1 pps balanced Input + ToD (RJ48C). ToD Format: CCSA, CISCO, NTP, NMEA format.
1 pps + ToD Ref. Output¹	1 pps unbalanced Output (BNC), 1 pps balanced Output + ToD (RJ48C).

	General
PC/Mac or Tablet Control Interface	Web-based GUI approach with built-in controller enables use of any PC or Android Tablet with any browser with screen resolution of 1024 x 768 pixels. RJ 45 LAN connection to instrument.
TCP/IP Settings	TCP Port, IP Address and Gateway settable.
Remote Control	Scripting via TCL, Perl and Python. Automatic Script Recorder for TCL, Perl and Python.
Indicator/LEDs	Power On. 40 GbE QSFP+, 100 GbE CXP, 100 GbE CFP2 (if appropriate option fitted) – Integral LEDs.
GPS Rubidium Reference (Option 132)	PRS/Stratum1 (GPS locked): typical 1×10^{-12} Outputs: 10 MHz, 1 pps and NMEA ToD.

¹Optional later release

Paragon-X Specifications

	1588 (option 201) and CES (option 202)	
Packet Sync Rates	1588 Any packet rate.	CES T1, E1, T3, E3 or Any.
Protocols	PTP (1588).	SAToP, CESoPSN, TDMoIP.
Header Capture and Alarms	MessageType, TransportSpecific, VersionPTP, MessageLength, Flags, CorrectionField, SourcePortIdentity, SequenceID (errors highlighted), ControlField, LogMessageInterval, OriginTimestamp.	L, R, M, FRG, Length and Sequence # (errors highlighted). L, R, M Alarm Injection.
Graphs Displayed	Inter-Packet (SYNC, DEL_REQ, DEL_RESP, pDELAY_REQ, pDELAY_RESP, FOLLOW-UP, ALL), Sync PDV (Master-to-Slave PDV), Delay_Req PDV (Slave-to-Master PDV), Slave Clock Wander (T3), Follow-up PDV, Delay_Resp PDV, PDelay_Req PDV, PDelay_Resp PDV, Asymmetry Variation, RTD Variation. (Include or Exclude Correction Factor in PDV Calculation.) Delay Distribution Curve/Histogram.	TIE vs Nominal, TIE vs Measured Average, Delay vs Packet #, Inter-packet Time (vs Time and vs Packet #), Delay Distribution Curve/Histogram.
Standards	G.8261 (Test Cases 1 – 17), G.8273.2 and MEF-18	
PDV Editor Suite	Edit any PDV file from the graphs. Profile Edits: Extract, Repeat, Copy, Paste (Replace or Insert); Modulate, Scale (%), Banding (Deplete or Concentrate); Adjust Delay Floor.	
Measurement Accuracy	5 ns.	
Metrics	ITU-T metrics will be implemented as ratified incl. MTIE, MAFE, ZTIE, PktMTIE, etc.	
Master/Slave Emulation (Option 250)	Emulate up to two 1588 masters with full parametric control and PDV/protocol anomaly addition. Each master can have up to 8 attached slaves. Emulate one 1588 slave. Calculate and display: slave wander, 1 pps/ToD accuracy, TC correction field accuracy, BC time error.	

	SyncE (options 213, 207, 208, 223)
Jitter/Wander Measurement	To ITU-T G.8262 and O.174 - jitter/wander generation, wander transfer, jitter/wander tolerance, phase transient. Built-in frequency offset plus sinusoidal, MTIE and TDEV wander generation.
MTIE/TDEV Analysis	Built-in software with ITU-T masks and Pass/Fail indication.
SyncE Master	Accuracy traceable to Reference source used (refer to Reference Clocks).
Measurement Accuracy	1 ns.
ESMC (SSM) Features to G.8264, G.781, etc	Decode ESMC messages to ITU-T G.8264 and plot Quality Level (QL) changes graphically (bi-directional). QLs: PRS, PRC, INV3, SSU-A/TNC, INV5, INV6, ST2, SSU-B, INV9, EEC2/ST3, EEC1/SEC, SMC, ST3E, PROV, STU/UKN, DNU/DUS. Overwrite ESMC Message to change QL status. Support for ESMC Decode and SyncE in 1588 mode (for concurrent SyncE and 1588 implementations). Integrated decode using industry-standard tool, Wireshark.
ESMC Generation	Generate ESMC (SSM) packets per ITU-T G.8264 QLs: PRS, PRC, INV3, SSU-A/TNC, INV5, INV6, ST2, SSU-B, INV9, EEC2/ST3, EEC1/SEC, SMC, ST3E, PROV, STU/UKN, DNU/DUS. Generate ESMC messages, change QL value and measure impact on wander.

Ethernet OAM (option 301)	
Capture and Decode	Packet Number, Arrival Time, Ethernet Destination Address, Ethernet Source Address, OAM Message Type, MEP ID, RDI, Period fps, TransID, TxFCf, RxFCf, TxFCb, Tx Timestamp(f), Rx Timestamp(f), Tx Timestamp(b), Rx Timestamp(b), Maintenance Domain Length, Maintenance Domain Name, Short MA Name Format, Short MA Name Length, Short MA Name, Time To Live, Origin MAC, Target MAC, Relay Action, OUI, TLV Offset, TLVs.
Round-trip Delay	Based on DMM/DMR messages. Displayed in table and graph. MEF and ITU-T delay methods supported.
View Filtering	MAC addresses and OAM Message types.
Standards Supported	ITU-T Y.1731, IEEE 802.1ag, IEEE 802.3ah, ITU-T G.8031, ITU-T G.8032
Message Filters for Corruption and Delay	CCM, LBM, LBR, LTM, LTR, AIS, LCK, TST, APS, MCC, LMM, LMR, 1DM, DMM, DMR, EXM, EXR, VSM, VSR. Any combination of above messages. CCM at 1 s and 3.33 ms both supported.
Impairments and Delay	Lost, Misordered, Repeated, Errored, AIS/LCK/RDI Generation, Fixed Delay, Variable Delay.
Header Overwrite	Ethernet Header or OAM Header – overwrite any bit (first 128 bytes) with hex or binary value or invert.
Multi-MEG Mode	Capture information for 1000s of MEGs including Eth Dest, Eth Src, SVID, CVID, MEL, MEP ID, OAM Message Count, AIS, RDI, CCM, CCM fps, etc.

	Product
Physical Interfaces	<p>Ethernet</p> <p>100 M Electrical, 100 M Optical (SGMII).*</p> <p>1 G Electrical (optional), 1 G Optical (optional) - SFP.</p> <p>10 G Optical (optional) – XFP or SFP+ (LAN-PHY).</p> <p>*PTP, NTP, CES, Services</p>
Reference Clocks	<p>Lock internal timing reference to external reference. Reference Lock soft LED indication.</p> <p>External reference inputs: 64 kHz, 2.048 MHz, 10 MHz; T1 BITS clock; E1 MTS, SyncE, GPS.</p> <p>Internal reference Stratum-3, + 4.6 ppm.</p>
PC Control Interface	Any standard PC or laptop running Windows XP, Vista or 7. RJ45 LAN connection to instrument.
TCP/IP Settings	TCP Port, IP Address and Gateway settable.

Product (continued)	
Automatic flow-selection in multi-flow environment	Automatic detection of OAM (MEGs), 1588, CES and other flows and filter setup using FlowWizard. Filter: (1 to 64 bytes): Setup messages for capture and replay Select OAM type within a MEG flow Select 1588 Message type(s) or groups Integrated decode using industry-standard tool, Wireshark.
Packet Capture Memory	Capture complete packet and display contents. The filters can specify the packet types to be captured. Internal (2 Gb) or External (via USB).
Graph Manipulation	Zoom in (X and Y), Zoom out (X and Y), Marker 1, Marker 2, Min/Max display in nanoseconds.
Impairments – Delay	
Fixed Delay	6 μ s to 10 s.
Variable Delays	(a) Gaussian, Gamma (b) User Defined – stored PDV profiles or captures from networks (c) G.8261 and MEF-18 Test Cases (d) Sawtooth – Systematic, Beating (F) and Beating (S) (e) Step Function (f) Latency Ramp
1588 Delays applied to:	Packet Sending Time, Correction Field or Both.
Impairments - Corruption	Misordered, Lost, Repeated or Errored Packets.
Control	Single, Burst (1 to 10000), Duration (0.1 s to 10 s), Rate (0.00001% to 99.99999%), Ratio (1×10^{-7} to 9×10^{-1}) or Constant.
Overwrite Header	Any bytes with any value in first 128 bytes.
Switch Simulation	Independently set (a) Latency (b) Buffer Depth (1 byte to 256 kbytes) (c) Bandwidth (0% to 100%)
Timing Measurements (Options 205, 206)	E1/T1 wander – TIE, MTIE, TDEV analysis with ITU-T masks - sample rate 0.1 Hz to 100 Hz. 1 pps accuracy – recovered slave clock 1 pps vs reference.
Simultaneous Measurements	1588/CES PDV and IPG, E1/T1/2.048 MHz TIE/MTIE/TDEV, 1 pps wander/accuracy.
Remote control	Scripting via TCL.
Operation and Regulatory	Temperature 5 - 50°C, Humidity 0 - 95%, CE and EMC (incl. EN-61010, EN-61326, etc.) certified. Voltage 85 - 246 VAC, 100 - 240 VAC (Nominal) @ 50/60 Hz.
GPS Antenna, Receiver and Rubidium Reference (Option 132)	PRS/Stratum 1 (GPS-locked): typical 1×10^{-12} Outputs: 10 MHz, 1 pps.

Specification is subject to change without notice.

Related Products



Calnex Paragon-t

- Speed up test time and reduce test complexity with multi-clock measurements and 4 x wander generators
- Measure multiple outputs; chains of Boundary Clocks, groups of Slave Clocks, SECs and EECs
- 4 x Frequency (SyncE/E1/T1/2.048 M/10 M Wander) measurements plus generators
- 4 x Phase (1 pps accuracy) measurements
- 4 x ToD display measurements

Calnex Sentinel

- PTP, NTP, SyncE and TDM in one portable box
- Measure ALL parameters at the SAME time
- Test networks for Frequency and Phase
- Test networks with Boundary Clocks and Transparent Clocks
- Standard industry masks and packet metrics, with built-in Pass/Fail limits when measuring the network
- Measurement reports in pdf format
- Embedded GPS receiver and Rubidium (Rb)

