Calnex **Tempo**

Calnex
Insight and Innovation

Turn-up and installation sync tester

For 3G/4G/5G Mobile Backhaul,
E911/Critical Infrastructure,
Financial Networks and
Power Comms

Platform Highlights

- Part of the Calnex family of sync testers
- Canned tests for quick turn-up and installation testing
- Embedded GPS/GLONASS/BEDOU receiver and optional mini Rubidium (GNSS disciplined Rb holdover)

Test PTP, SyncE and TDM in one box

- Accurately measures Time Error, PDV and Wander
- Tests both legacy and new networks
- Includes built-in pass/fail limits

Measure TDM (PDH/SDH/Sonet) signals

- Supports TDM network sync testing
- Includes industry-standard masks G.811/G.812/G.813/G.823/G.824

Automatic RFC 2544 and Y.1564 testing

- Verify network performance by testing Throughput, Frame Loss, Latency, Jitter and Burst
- Provides two way measurements for asymmetrical and symmetrical testing

Multistream testing

- Simultaneously test 8 traffic streams configured with CoS/QoS
- Simulate realistic traffic conditions such as Internet, VoIP and IPT

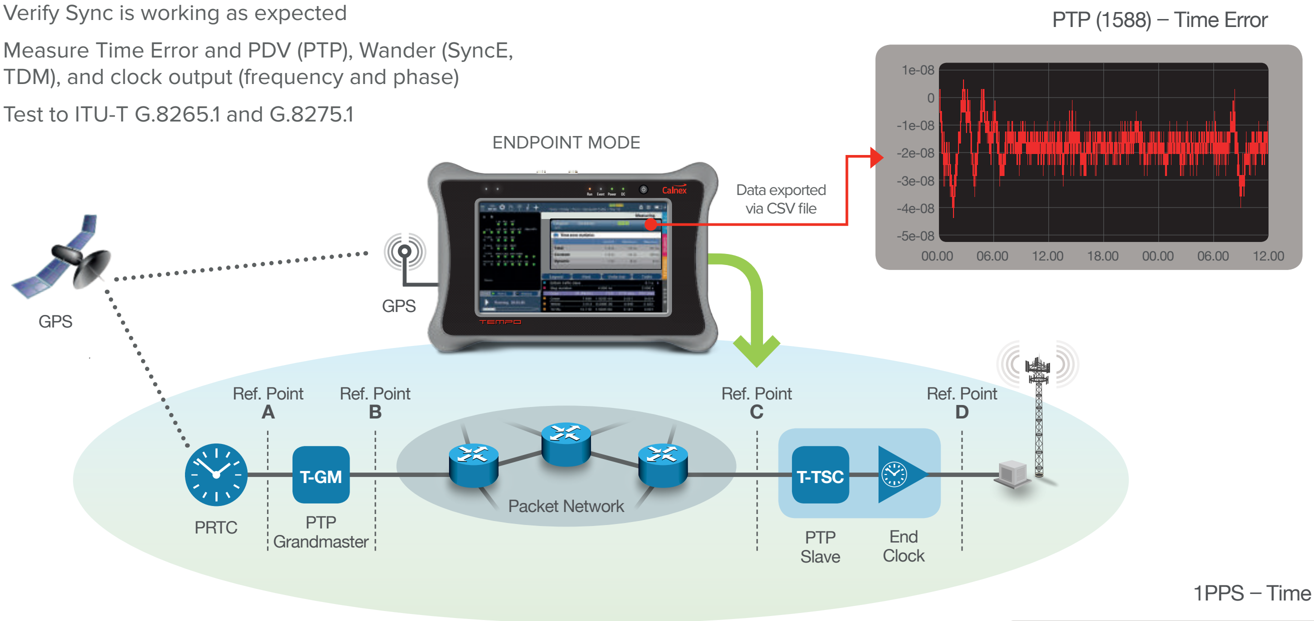
IEC 61850 testing

- GOOSE and SV analytics
- IRIG-B references

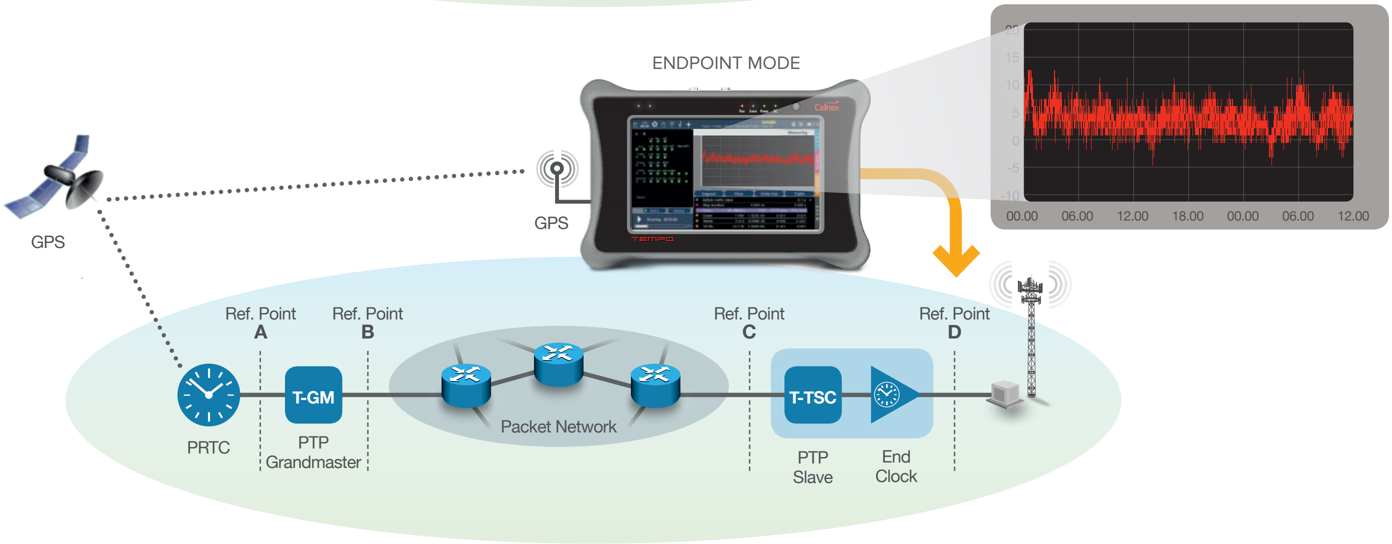
Applications

SYNCHRONIZATION INSTALLATION

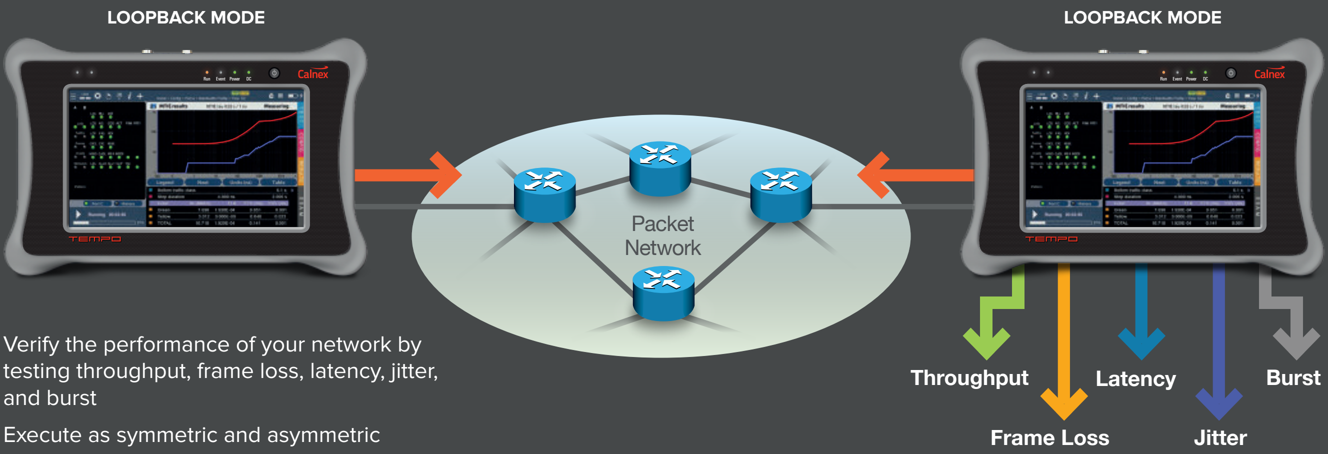
- Verify Sync is working as expected
- Measure Time Error and PDV (PTP), Wander (SyncE, TDM), and clock output (frequency and phase)
- Test to ITU-T G.8265.1 and G.8275.1



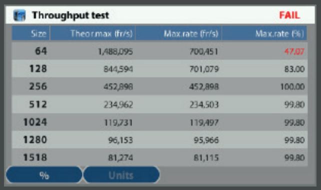
1PPS – Time Error



ETHERNET/DATACOM – RFC2544 TESTING

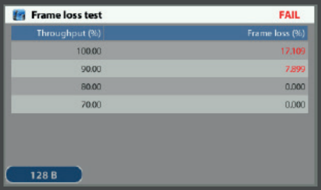


- Verify the performance of your network by testing throughput, frame loss, latency, jitter, and burst
- Execute as symmetric and asymmetric
- Two modes: loopback mode or peer-to-peer mode



Throughput test FAIL

Size	Theor.max (fr/s)	Max.rate (fr/s)	Max.rate (%)
64	1,488,095	700,451	47.07
128	844,594	701,079	83.00
256	452,898	452,898	100.00
512	234,962	234,503	99.80
1024	119,731	119,497	99.80
1280	96,153	95,966	99.80
1518	81,274	81,115	99.80



Frame loss test FAIL

Throughput (%)	Frame loss (%)
100.00	17.109
90.00	7.899
80.00	0.000
70.00	0.000

Specifications

	PTP and SyncE
Synchronous Ethernet	• Clock Ref.: built-in Rubidium and GPS, OCXO, internal (<2.0 ppm), external (10 MHz, 2048/1544 Mb/s, 2048/1544 MHz, 1 PPS) • Line Analysis: frequency (MHz), offset (ppm), drift (ppm/s) [clause 10]; Offset Generation: ±125 ppm (0.001 ppm) as per ITU-T O.174 • Wander Generation [ITU-T O.174 section 8.4] and MTIE / TDEV Measurement [ITU-T O.172 clause 10] • SyncE Generation/Decoding ESMC and SSM [ITU-T G.8264]
PTP / IEEE 1588(v2)	• Precision Time Protocol (PTP): Master and Grandmaster id., Priority 1-2, Class, Accuracy, Variance, Time source • PTP over UDP encapsulation, PTP generation/analysis/emulation; Hardware-assisted Decoding; End-point and Through modes • Counts: Sync Inter Arrival Delay (IAD) Avg/Curr; Packet Total Delay (PTD): Std Dev/Range; Packet Delay Variation (PDV): Cur/Max/Avg • TE and max|TE| measurement on PTP constant and dynamic TE components. Frequency and phase offset master vs. local clock (ppm) • Wander analysis – Real time MTIE and TDEV results (pktfiltered TDEV/MTIE) • ITU-T Telecom profiles – G.8265.1, G.8275.1, G.8275.2
Internal Rubidium Clock	• Freerun (no GPS): Output freq. accuracy (7.5 mins warm up): ±1e-9; Output freq. accuracy on shipment (24 hr warm up): ±5.0e-11 Aging (1 day, 24 hrs warm up): ±0.5e-11; Aging (1 year): ±1e-9 • GPS Locked: Time/Phase accuracy to UTC: ±20 ns at 1σ after 24 hrs lock; Frequency accuracy: 1e-11 (averaged over one week) • Hold-over: Output freq. accuracy (after 24 hr locked): 1.5e-11/24 hr; Output time accuracy (after 24 hr locked): ±100 ns/2 hr, ±1.0 µs/24 hr

	Ethernet Testing
Interfaces	• 2 x SFP / SFP+ : 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, 1000BASE-BX, 100BASE-FX, 100BASE-TX • 2 x RJ45: 1000BASE-T, 100BASE-T, 10BASE-T • Auto-negotiation: Bit rate at 10, 100, 1000 and 10000Mb/s, disable auto-negotiation and direct set up • EtherType II (DIX v.2), IEEE 802.3, IEEE 802.1Q, IEEE 802.1ad; IEEE 802.2–LLC1, IEEE 802.3–SNAP; IPv4 (RFC791), IPv6 RFC2460)
Generation (8 streams)	• Traffic generation and analysis features up to 10 Gb/s, equivalent to 15 million frames, if frame size is set to 64 bytes • MAC address: Source/Destination, Default/User defined, Single/Range • VLAN: Single VLAN support, Q-in-Q stacking, VID, DEI, S-VLAN, C-VLAN, and Priority codepoint • Type/Length: Generation/Analysis, Jumbo frames with MTU up to 10 kB • Bandwidth Profile: Constant, in bit/s and frames/s, Periodic Burst, in high/low traffic, Ramp, in high/low traffic, Poisson • Loopback: L1 to L4 layers, filtering conditions, broadcast and ICMP frames control • Layer 1 BER: HF, LF, MF, long/short continuous random, PRBS 231-1, A-seed, B-seed, mixed-frequency • Layer 2−4: PRBS 211-1, PRBS 215-1, PRBS 220-1, PRBS 223-1, PRBS 231-1 along with their inverted versions, user (32 bits) • SLA payload; All zeros; Insertion of TSE: single, rate, random • RTD and VF tone generation
Filters for Statistics (up to 8 simultaneously)	• Ethernet Selection: MAC address, Type/Length, C-VID, S-VID, CoS and Priority with selection mask • IPv4 and IPv6 Selection: address, protocol, DSCP, Flow (v6): single value or range. UDP Selection: port: single value or range
Traffic Statistics	• Top 16 talkers: Source/Destination MAC/IPv4/IPv6 addresses, VID (VLAN), C-VID (Q_in_Q), S-VID (MPLS) • Ethernet Frame Counts (RFC 2819): VLAN, Q-in-Q, Priority, Control, Pause, BPDUs • Tx/Rx Uni-Multi-Broadcast, Errors, Undersized, Oversized, Fragments, Jabbers, Runts, (Late) Collisions, Sizes, MPLS stack length • Bandwidth Statistics: (in bit/s, frame/s, %) Rate, Max, Min, Aver, Occupancy, Unicast, Multicast, Broadcast • IPv4 and IPv6 Counts: (in bit/s, frame/s, %) Unicast, Multicast, Broadcast, Errors, TCP, UDP, ICMP
Results	• Twisted Cable: MDI/MDI-X status, Open, Cable Length Test, Short, Polarities, Pair Skew. PoE: voltage and current • SFP: Presence current interface, Vendor, Part number, Optical power (over compatible SFP) • Frame Delay (FTD) Y.1563: Min/Max/Med/Mean; Delay Variation (FDV) RFC1889: Peak; Jitter Curr/Max/Min/Mean • Frame Loss (FLR) Y.1563, Duplicated: Out-of-Order packets (RFC 5236) • Availability: SES and Y.1563 PEU; BER: Count, seconds with errors, Pattern losses, pattern loss seconds
RFC-2544 and Y.1564	• RFC 2544: Throughput, Latency, Frame Loss, Back-to-back, Recovery • eSAM: test up to 8 non-color or 4 color aware services. Configuration: CIR, EIR, max. throughput for each service • Tests (CIR, EIR and policing) with FTD, FDV, FLR and availability • Performance test with FTD, FDV, FLR and availability results for all services
ICMP	• RFC 792: IP Ping/Traceroute, Generation of ICMP echo request: Destination IP address, Packet length, Generation interval • Analysis of ICMP echo reply: Round trip time, Lost packets, Time-To-Live exceeded, Port unreachable

	E1 and T1 Testing
Interfaces	• 2 x Unbalanced (BNC) 75 Ω • Balanced (RJ-45) 120 Ω • Additional balanced secondary T1, E1 port 0 to −6 dB, nominal and PMP −20 dB • Bit Rate: 1.544/2.048 Mb/s ± 3 ppm. Codes: HDB3/AMI • 3 x SMB: Clock Source; Internal Timing: 1.544 MHz, 2.048 MHz ± 25000 ppm; Recovery from Rx Timing (Loop Timing) • SMA: External timing (GNSS)
BERT	• Unframed: FAS/FAS+CRC4; PCM30: FAS+CAS/FAS+CRC • Standard, non-standard PRBS, and user patterns. Transmit Error Rate • Force Single Error: Bit, Frame, CRC, and BPV (Bipolar Violation); Alarms, Errors Count; G.826, G.821, and M.2100
Jitter and Wander	• Overpass O.172: Jitter level, tolerance, transfer and Event detection. 100% digital-based generation and analysis • Wander Generation and Measurements (TIE, MTIE, TDEV). Wander results from 20 secs to 100,000 secs
Pulse Mask	• Pulse mask compliance: ANSI T1.102-1999, ITU-T G.703; PASS/FAIL function with Persistent Graphic Display scope • Nominal 2.37 V for Coaxial Pair 75 Ω, Nominal 3.00 V for Symmetrical Pair 120 Ω

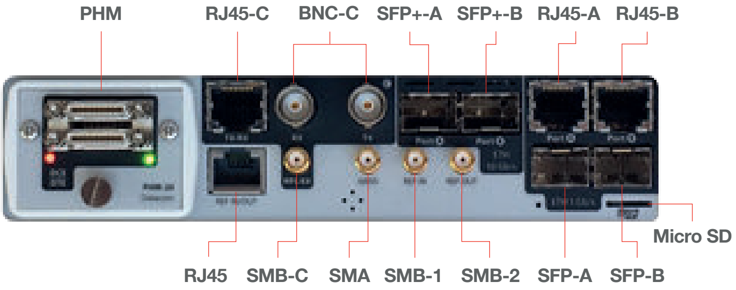
	Power Utility Testing
Clock References Inputs	• IRIG-B00X, B15X, B22X unbalanced (REF IN port). 50 Ω or high impedance modes. Up to 25Vpp. AC or DC coupling • IRIG-B00X, B22X balanced (REF IN/OUT port). ITU-T V.11 electrical characteristics
Clock reference outputs	• IRIG-B00X, B12X, B13X, B14X, B15X, B22X unbalanced (REF OUT port). 50 Ω or high impedance modes. 5 Vpp. AC or DC coupling • IRIG-B00X, B22X balanced (REF IN/OUT port). ITU-T V.11 electrical characteristics • Decodes and analyzes GOOSE frames encoded as specified in IEC 61850-7-2 and 61850-8-1
IEC 61850 GOOSE	• GOOSE protocol scan with GoCBName, GoID, DatSet • GOOSE frame count for the active flow and all flows • Latency analysis: current, average, minimum, maximum, range and standard deviation computed over the active flow
IEC 61850 SV	• Decodes and analyzes SV frames encoded as specified in IEC 61850-7-2 and 61850-9-2 • SV protocol scan with svID population and selection of the active flow • SV frame count for the active flow and all flows • Sample count and sampling rate measurement for the active flow • Latency analysis: current, average, minimum, maximum, range and standard deviation computed over the active flow
IEEE C37.94	
Connectors	• Dual port operation over SMF or MMF with suitable SFP
Line	• Transmission clock: Recovered or internally synthesized • Laser on and off control
Frame	• Unframed or framed operation • Frame structure follows IEEE C37.94 section 4.1 • Configurable bit-rate between 64 kb/s and 768 kb/s in steps of 64 kb/s
Line Analysis	• Frequency (Hz), frequency deviation (ppm) • Transmitted optical power (dBm), received optical power (dBm) • Received data rate (kb/s) • SFP information: transceiver, vendor, model and wavelength
Frame and Pattern Analysis	• ITU-T G.821 performance: ES, SES, UAS, DM. ITU-T G.821 results include pass/fail indications • Event detection and insertion: LOS, AIS, FAS, RDI (yellow), LSS, ALL0, ALL1, Slip, TSE

	Product Ergonomics
Dimensions (w x h x d)	260 x 160 x 63 mm (10.2” x 6.3” x 2.5”)
Weight	1.6 kg (3.5 lbs) with rubber boot and one battery pack
Screen	8 inch, TFT color (800 x 480 pixels)

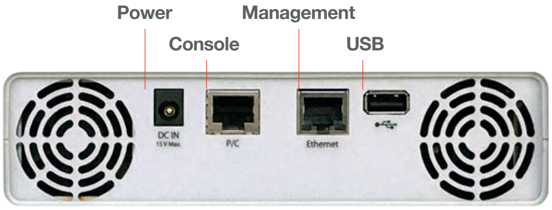
Specification is subject to change without notice.

Ports and Connectors

Front Panel



Rear Panel



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

Test Interface and Clock Reference Summary

	Operating Modes				
Input Interface	10GbE	1GbE	E1/T1	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			
		SyncE			
SFP-B		Ethernet, IP, PTP, SyncE			
		SyncE			
SFP+-A	Ethernet, IP, PTP, SyncE				
	SyncE				
SFP+-B	Ethernet, IP, PTP, SyncE				
	SyncE				
BNC-C			E1	5/10 MHz 2448 kHz 1544 kHz	
RJ45-C			E1/T1	5/10 MHz 2448 kHz 1544 kHz 1PPS/1PP2S ToD	
SMB-C				1PPS/1PP2S	
SMA	GNSS	GNSS	GNSS	GNSS	GNSS
SMB-1	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B
SMB-2	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B	1PPS/1PP2S IRIG-B
RJ45-1	E1/T1 5/10 MHz 2448 kHz 1544 kHz 1PPS/1PP2S ToD IRIG-B	E1/T1 5/10 MHz 2448 kHz 1544 kHz 1PPS/1PP2S ToD IRIG-B	E1/T1 5/10 MHz 2448 kHz 1544 kHz 1PPS/1PP2S ToD IRIG-B	E1/T1 5/10 MHz 2448 kHz 1544 kHz 1PPS/1PP2S ToD IRIG-B	E1/T1 5/10 MHz 2448 kHz 1544 kHz 1PPS/1PP2S ToD IRIG-B

🟩 Test Signal ☐ Clk Ref. Signal

Operating Modes *vs* Connection Modes

	Operating Modes							
Connection	Eth	Eth L1	E1/T1	Analog	Data	Clock	E0	C37.94
End-point	●	●	●	●	●		●	●
Monitor	●		●		●	●	●	●
Pass	●							●
Loop	●	●	●		●		●	●
Mux Demux			●					

Related Products

Calnex Sentinel

- Tests PTP, NTP, SyncE and TDM in one portable box
- Measure ALL parameters at the SAME time
- Over-the-Air Time Error analysis
- For LTE-A, TDD LTE and small cell deployment – test network phase accuracy and validate network performance to ITU-T limits
- Measure and analyze metrics: PDV, FPP, TE/max|TE|/dTE, MTIE/TDEV
- Best-in-class internal Rubidium and measurement accuracy

Calnex Paragon-X

- Test PTP, SyncE, NTP, CES and OAM up to 10G
- Stress-test equipment with real network profiles from field-tests to debug network issues
- Prove PTP, SyncE, CES, Pseudowire, NTP, etc. implementations to ITU-T G.8261 etc.
- Test PTP Ordinary Clocks, Boundary Clocks and Transparent Clocks
- Measure Time of Day (ToD), Phase and Frequency

For more information on Calnex test equipment, and to take advantage of Calnex's extensive experience in Packet Sync and OAM testing technologies, contact Calnex Solutions today:

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calnexsol.com

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