

# Turn-up and Installation Sync Testers

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



Calnex Tempo-c



Calnex Tempo

## Platform Highlights

- Part of the Calnex family of sync testers
- Provides 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

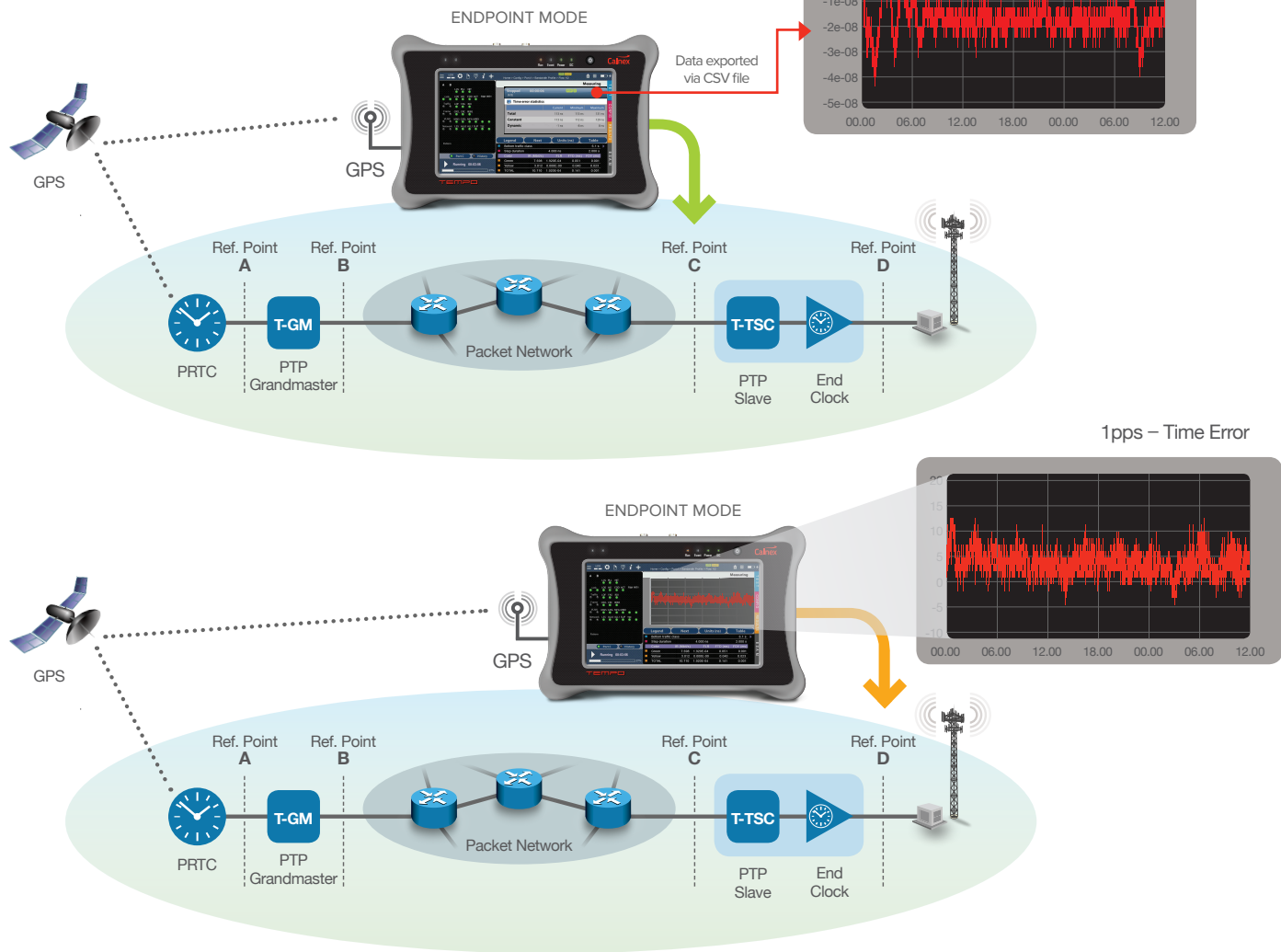
## Multistream

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

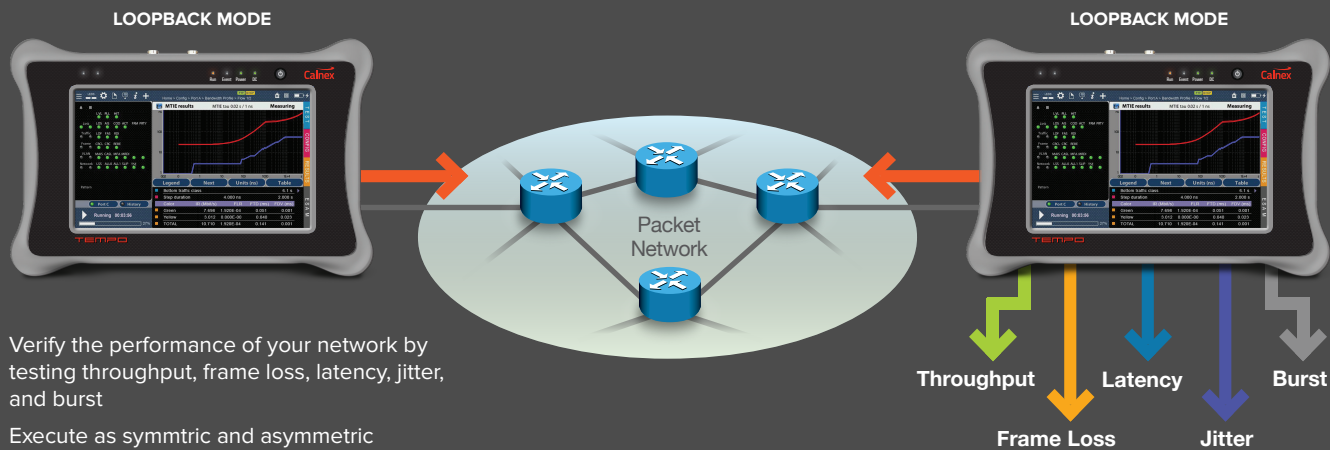
## Applications

### 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



### 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: Loop-back mode or peer-to-peer mode

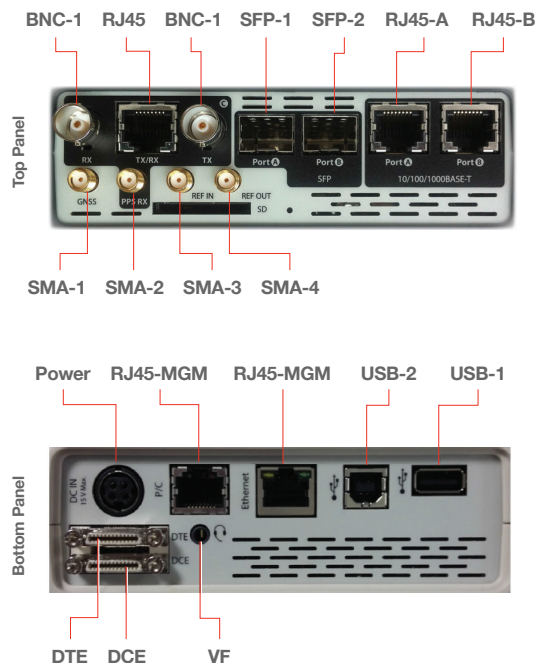
Throughput test				FAIL
Size	Theor.max (fr/s)	Maxrate (fr/s)	Maxrate (%)	
64	1,488,095	700,451	47.07	
128	844,594	701,079	83.00	
256	452,898	452,898	100.00	
512	234,962	234,503	99.80	
1024	119,731	119,497	99.80	
1280	96,153	95,966	99.80	
1518	81,274	81,115	99.80	
%				Units

Frame loss test		FAIL
Throughput (%)	Frame loss (%)	
100.00	17.109	
90.00	7.899	
80.00	0.000	
70.00	0.000	
128 B		

Specifications

PTP and SyncE	
Synchronous Ethernet	<ul style="list-style-type: none"><li>Clock Ref.: built-in Rubidium and GPS, OCXO, internal (&lt;2.0 ppm), external (10MHz, 2048/1544Mb/s, 2048/1544MHz, 1 pps)</li><li>Line Analysis: frequency (MHz), offset (ppm), drift (ppm/s) [clause 10]; Offset Generation: ±125 ppm (0.001 ppm) as per ITU-T O.174</li><li>Wander Generation [ITU-T O.174 section 8.4] and MTIE / TDEV Measurement [ITU-T O.172 clause 10]</li><li>SyncE Generation/Decoding ESMC and SSM [ITU-T G.8264]</li></ul>
PTP / IEEE 1588(v2)	<ul style="list-style-type: none"><li>Precision Time Protocol (PTP): Master and Grandmaster id., Priority 1-2, Class, Accuracy, Variance, Time source</li><li>PTP over UDP encapsulation, PTP generation/analysis/emulation; Hardware-assisted Decoding; End-point and Through modes</li><li>Counts: Sync Inter Arrival Delay (IAD) Avg/Curr; Packet Total Delay (PTD): Std Dev/Range; Packet Delay Variation (PDV): Cur/Max/Avg</li><li>TE and maxTEI measurement on PTP constant and dynamic TE components. Frequency offset master vs. local clock (ppm)</li></ul>
Internal Rubidium Clock	<ul style="list-style-type: none"><li>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</li><li>GPS Locked: Time/Phase accuracy to UTC: ±20ns at 1σ after 24 hrs lock; Frequency accuracy: 1e-11 (averaged over one week)</li><li>Hold-over: Output freq. accuracy (after 24 hr locked): 1.5e-11/24 hr; Output time accuracy (after 24 hr locked): ±100ns/2 hr, ±1.0μs/24 hr</li></ul>
Ethernet Testing	
Interfaces	<ul style="list-style-type: none"><li>2 x SFP / SFP+ : 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBA SE-SW, 10GBASE-LW, 10GBASE-EW, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, 1000BASE-BX, 100BASE-FX, 100BASE-TX, WAN Interface Sublayer (WIS)</li><li>2 x RJ45: 1000BASE-T, 100BASE-T, 10BASE-T, PoE detection/transparency</li><li>Auto-negotiation: Bit rate at 10, 100, 1000 and 10000Mb/s, disable auto-negotiation and direct set up</li><li>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)</li></ul>
Generation (8 streams)	<ul style="list-style-type: none"><li>Traffic generation and analysis features up to 10Gb/s, equivalent to 15 million frames, if frame size is set to 64 bytes</li><li>MAC address: Source/Destination, Default/User defined, Single/Range</li><li>VLAN: Single VLAN support, Q-in-Q stacking, VID, DEI, S-VLAN, C-VLAN, and Priority codepoint</li><li>Type/Length: Generation/Analysis, Jumbo frames with MTU up to 10kB</li><li>Bandwidth Profile: Constant, in bit/s and frames/s, Periodic Burst, in high/low traffic, Ramp, in high/low traffic, Poisson</li><li>Loopback: L1 to L4 layers, filtering conditions, broadcast and ICMP frames control</li><li>Layer 1 BER: HF, LF, MF, long/short continuous random, PRBS 231-1, A-seed, B-seed, mixed-frequency</li><li>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)</li><li>SLA payload; All zeros; Insertion of TSE: single, rate, random</li><li>RTD and VF tone generation</li></ul>
Filters for Statistics (up to 8 simultaneously)	<ul style="list-style-type: none"><li>Ethernet Selection: MAC address, Type/Length, C-VID, S-VID, CoS and Priority with selection mask</li><li>IPv4 and IPv6 Selection: address, protocol, DSCP, Flow (v6): single value or range. UDP Selection: port: single value or range</li></ul>
Traffic Statistics	<ul style="list-style-type: none"><li>Top 16 talkers: Source/Destination MAC/IPv4/IPv6 addresses, VID (VLAN), C-VID (Q_in_Q), S-VID (MPLS)</li><li>Ethernet Frame Counts (RFC 2819): VLAN, Q-in-Q, Priority, Control, Pause, BPDUs</li><li>Tx/Rx Uni-Multi-Broadcast, Errors, Undersized, Oversized, Fragments, Jabbers, Runts, (Late) Collisions, Sizes, MPLS stack length</li><li>Bandwidth Statistics: (in bit/s, frame/s, %) Rate, Max, Min, Aver, Occupancy, Unicast, Multicast, Broadcast</li><li>IPv4 and IPv6 Counts: (in bit/s, frame/s, %) Unicast, Multicast, Broadcast, Errors, TCP, UDP, ICMP</li></ul>
Results	<ul style="list-style-type: none"><li>Twisted Cable: MDI/MDI-X status, Open, Cable Length Test, Short, Polarities, Pair Skew. PoE: voltage and current</li><li>SFP: Presence current interface, Vendor, Part number, Optical power (over compatible SFP)</li><li>Frame Delay (FTD) Y.1563: Min/Max/Med/Mean; Delay Variation (FDV) RFC1889: Peak; Jitter Curr/Max/Min/Mean</li><li>Frame Loss (FLR) Y.1563, Duplicated: Out-of-Order packets (RFC 5236)</li><li>Availability: SES and Y.1563 PEU; BER: Count, seconds with errors, Pattern losses, pattern loss seconds</li></ul>
RFC-2544 and Y.1564	<ul style="list-style-type: none"><li>RFC 2544: Throughput, Latency, Frame Loss, Back-to-back, Recovery</li><li>eSAM: test up to 8 non-color or 4 color aware services. Configuration: CIR, EIR, max. throughput for each service</li><li>Tests (CIR, EIR and policing) with FTD, FDV, FLR and availability</li><li>Performance test with FTD, FDV, FLR and availability results for all services</li></ul>
ICMP	<ul style="list-style-type: none"><li>RFC 792: IP Ping/Traceroute, Generation of ICMP echo request: Destination IP address, Packet length, Generation interval</li><li>Analysis of ICMP echo reply: Round trip time, Lost packets, Time-To-Live exceeded, Port unreachable</li></ul>
E1 and T1 Testing	
Interfaces	<ul style="list-style-type: none"><li>Port A: Unbalanced (BNC) 75Ω and balanced (RJ-45) 120Ω; Balanced (Bantam) 100Ω and balanced (RJ-48) 100Ω</li><li>Port B: Balanced (RJ-45) 120Ω Balanced (Bantam) 100Ω (AT-1544 only) and balanced (RJ-48) 100Ω</li><li>Port C: Unbalanced (BNC) 75Ω analogue voice frequency audio port</li><li>Additional balanced secondary T1, E1 port 0 to –6dB, nominal and PMP –20dB</li><li>Bit Rate: 1.544/2.048Mb/s ± 3ppm. Codes: HDB3/AMI</li><li>4 x SMA: Clock Source: Internal Timing: 1.544MHz, 2.048MHz ± 25000 ppm; External Timing: Recovery from Rx Timing (Loop Timing)</li></ul>
BERT	<ul style="list-style-type: none"><li>Unframed: FAS/FAS+CRC4; PCM30: FAS+CAS/FAS+CRC</li><li>Standard, non-standard PRBS, and user patterns. Transmit Error Rate</li><li>Force Single Error: Bit, Frame, CRC, and BPV (Bipolar Violation); Alarms, Errors Count; G.826, G.821, and M.2100</li></ul>
Jitter and Wander	<ul style="list-style-type: none"><li>Overpass O.172: Jitter level, tolerance, transfer and Event detection. 100% digital-based generation and analysis</li><li>Wander Generation and Measurements (TIE, MTIE, TDEV). Wander results from 20 secs to 100,000 secs</li></ul>
Pulse Mask	<ul style="list-style-type: none"><li>Pulse mask compliance: ANSI T1.102-1999, ITU-T G.703; PASS/FAIL function with Persistent Graphic Display scope</li><li>Nominal 2.37V for Coaxial Pair 75Ω, Nominal 3.00V for Symmetrical Pair 120Ω</li></ul>

## Interfaces, Test Signals and Timing



### Ports

- Port A - B: 2 x SFP, 2 x RJ45 connectors
- Port C: balanced RJ45 120  $\Omega$ , unbalanced BNC 75  $\Omega$
- Port D: balanced RJ45 120  $\Omega$  (through special adapter)
- GNSS Port: SMA female
- PPS Ports: 3 x SMA female (i/o)
- Datacom Ports: DTE / DCE
- VF Port: analogue voice frequency

### Product Ergonomics

- Tempo: 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)
- Tempo-c: 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)

## Related Products

### 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 T-BCs and T-TCs
- Standard industry masks and packet metrics, with built-in Pass/Fail limits when measuring the network
- Embedded GPS receiver and Rubidium (Rb)
- Measurement reports in pdf format



### 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:

tel: +44 (0) 1506 671 416  
email: info@calnexsol.com

**calnexsol.com**

© Calnex Solutions Ltd, Jan 2018.  
CX2013 v1.0

Time Reference Input vs. Test Signal

	Test Signal							
	10G/ GbE/IP	E1/T1	Analog	Data	Clock	Cable	Eth L1	C37.94
Internal Clock	TCX0 OCX0 Rubidium	TCX0 OCX0 Rubidium	TCX0 OCX0 Rubidium	TCX0 OCX0 Rubidium	TCX0 OCX0 Rubidium	TCX0 OCX0 Rubidium	TCX0 OCX0 Rubidium	TCX0 OCX0 Rubidium
BNC-1	10 MHz 2.0 MHz 1.5 MHz E1/T1	E1			10 MHz 2.0 MHz 1.5 MHz E1/T1	10 MHz 2.0 MHz 1.5 MHz PPS	10 MHz 2.0 MHz 1.5 MHz E1/T1	
RJ45-C	E1/T1	E1/T1			10 MHz 2.0 MHz 1.5 MHz	E1/T1	E1/T1	
BNC-2		E1						
RJ45-A	Eth, IP, 1588, SyncE					Ethernet		
RJ45-B	Eth, IP, 1588, SyncE					Ethernet		
SFP-1	Eth, IP, 1588, SyncE					Ethernet		
SFP-2	Eth, IP, 1588, SyncE					Ethernet		
SMA-1	GNSS	GNSS	GNSS	GNSS	GNSS	GNSS	GNSS	GNSS
SMA-2							PPS	
SMA-3	PPS	PPS	PPS	PPS	PPS	PPS	PPS	
DTE	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	V11,V24, V35, V36, EIA530, EIA530A, Codir	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS	PPS-ToD	PPS-ToD	10 MHz 2.0 MHz 1.5 MHz E1/T1 PPS-ToD
DCE				V11,V24, V35, V36, EIA530, EIA530A				
VF			Analog					

Test Signal Clk Ref. Signal

### Time Reference Output

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

### Operation Modes and Connection Modes

	10G/ GbE/IP	E1/T1	Analog	Data	Clock	Cable	Eth L1	C37.94
End-point	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Monitor	Yes	Yes		Yes	Yes			Yes
Pass	Yes	Yes						
Loop	Yes	Yes						
Mux Demux		Yes						