Digital Instruments

SYNC-SWITCH
Gigabit Ethernet
Synchronous Switch

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*Gigabit Ethernet Synchronous Switch*

The device is an IEEE 1588-2008 compliant 10-port Gigabit switch capable of acting as a Transparent Clock and, with aid of the Synchronous Ethernet protocol, to achieve synchronization in the nanosecond range. It is equipped with the latest technology and may be operated via a comfortable web interface. It may be used as an industrial Ethernet switch for rough environments requiring carrier grade switching.

The job of a Transparent Clock (also referred to as TC) switch is very simple to understand.

It just modifies PTP messages as they pass through the device. Timestamps in the messages are corrected for time spent traversing the network equipment. This approach improves distribution accuracy by compensating for delivery variability across the network (called Packet Delay Variation - PDV). The device does not alter any other message other than Sync and Delay_Req packets and is completely transparent both to the PTP Master and to the PTP slaves.
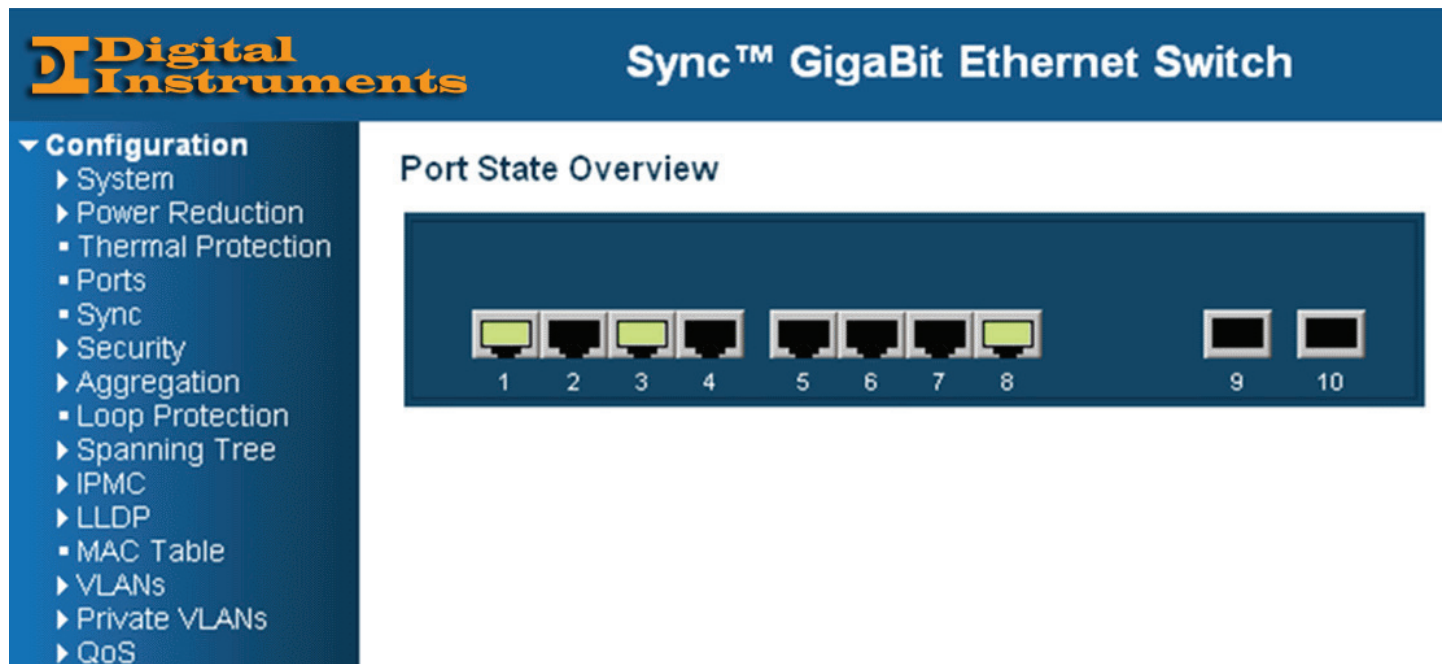
SYNC-SWITCH Web GUI

No Traffic	
Mean:	16.8 µs
Peak to Peak:	310.0 ns
Standard Deviation:	70.1 ns
10% Load	
Mean:	17.9 µs
Peak to Peak:	121.4 µs
Standard Deviation:	11.5 µs
25% Load	
Mean:	19.6 µs
Peak to Peak:	122.6 µs
Standard Deviation:	17.6 µs
50% Load	
Mean:	48.0 µs
Peak to Peak:	122.8 µs
Standard Deviation:	50.9 µs

*Packet delay based on network load*

This approach is particularly needed because the time it takes for a network switch to process a packet greatly varies depending on network load.

```
⊞ Frame 20: 86 bytes on wire (688 bits), 86 bytes captured (688 bits)
⊞ Ethernet II, Src: 00:0a:35:00:23:0f (00:0a:35:00:23:0f), Dst: 01:00:5e:0
⊞ Internet Protocol Version 4, Src: 192.168.200.15 (192.168.200.15), Dst:
⊞ User Datagram Protocol, Src Port: ptp-event (319), Dst Port: ptp-event (
⊟ Precision Time Protocol (IEEE1588)
  ⊞ 0000 .... = transportSpecific: 0x00
     .... 0000 = messageId: Sync Message (0x00)
     .... 0010 = versionPTP: 2
     messageLength: 44
     subdomainNumber: 0
  ⊞ flags: 0x0004
  ⊞ correction: 8244,000000 nanoseconds
     ClockIdentity: 0x000ac0fffea8c80f
     SourcePortID: 1
     sequenceId: 2456
     control: Sync Message (0)
     logMessagePeriod: 0
     originTimestamp (seconds): 1347872672
     originTimestamp (nanoseconds): 430404507
```

Sync message modified by a Transparent Clock

The following graphs show how a PTP Transparent Clock may help improving the overall precision of the PPS reconstruction. They have been taken by just enabling or disabling the Transparent Clock feature and by letting the devices run with an infinite persistence for a few minutes.

TC feature disabled

TC feature enabled

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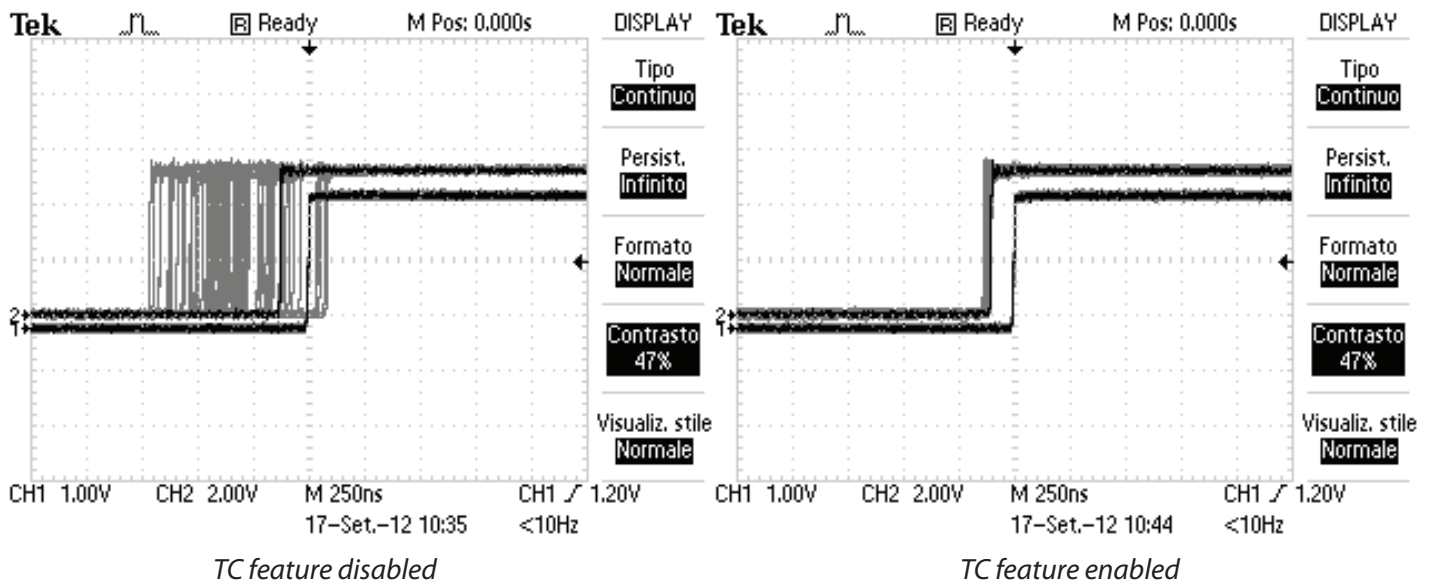
Connectivity
· 8 x Gigabit ports (1 Gbps),
· 2 x SFP ports (2.5 Gbps),
· 1 x 10 MHz Low Phase Noise output,
· 1 x PPS output.

Synchronization
· IEEE 1588-2008 (PTPv2) compliant,
· End-to-End Transparent Clock (UDP/IPv4 and Layer 2),
· Synchronous Ethernet (copper and fiber),
· Internal High-Stability OCXO,
· Internal GPS Radio Receiver for Grandmaster role (optional).

Management
· Web GUI,
· In field upgradability.

Switching features
· Carrier grade switching capabilities,
· Multiple spanning tree for efficient load sharing and redundancy,
· Strong security features for authentication, authorization, and accounting,
· QOS, Link aggregation, Loop protection, VLAN.

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Frequency reference
    Signal: 10 MHz sine wave
    Spectral purity: -70 dBc at full output power. (harmonics), -75 dBc at full output power (non-harmonics)
    Phase noise: -125 dBc at 1 kHz
    Outputs: 1
    Output level: 13 dBm each output
    Output impedance: 50 Ohm
    Output connectors: BNC
    Stability: 1e-12 daily average OCXO locked at GPS in SA.
          OCXO Standard: 1e-10 daily average OCXO in free run,
          OCXO SC: 2e-11 daily average OCXO on free run.

Time reference
    Signal: 1 PPS, 100 μs Duty, Rising Edge
    Output: 1
    Output level: TTL 5 Vpp, Square wave
    Output impedance: 50 Ω
    Output Connectors: BNC.

GPS section
    Receiver: 12 Channels L1 1575.42 MHz
    Tracking: correlation over 12 satellites
    PPS precision: < 50 ns on SA
    Antenna connector: TNC
    Capture time: < 4 min.

PTP section
    Network connection : 8x Ethernet 10/100/1000 interfaces, 2x 1/2.5 Gbps SFP interfaces
    Protocol: IEEE 1588-2008 (PTPv2)
    Role: Transparent Clock
    Time stamping: Hardware
    Precision: 8 ns
    Options: UDP/IPv4 / Layer 2, SyncE.

Supply
    Network: 95 Vac – 240 Vac, Plug IEC320 integrated, filter EMI/RFI.

Size
    Width: 1 Unity 19"
    Depth: 300 mm connectors excluded
    Weight: 1.5 Kg.

Accessories
    Power cord,
    English Handbook.