

The device is an IEEE 1588-2008 (PTP v2) and SyncE compliant 8-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 (TC from now) 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). **SWITCH-EVO** 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.



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

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

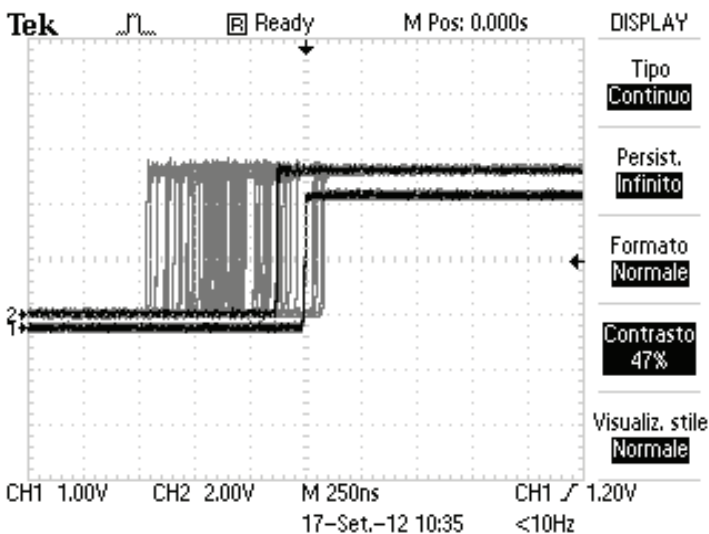
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+ Frame 20: 86 bytes on wire (688 bits), 86 bytes captured (688 bits)
+ Ethernet II, Src: 00:0a:35:00:23:0f (00:0a:35:00:23:0f), Dst: 01:00:5e:
+ Internet Protocol Version 4, Src: 192.168.200.15 (192.168.200.15), Dst:
+ User Datagram Protocol, Src 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
    
```

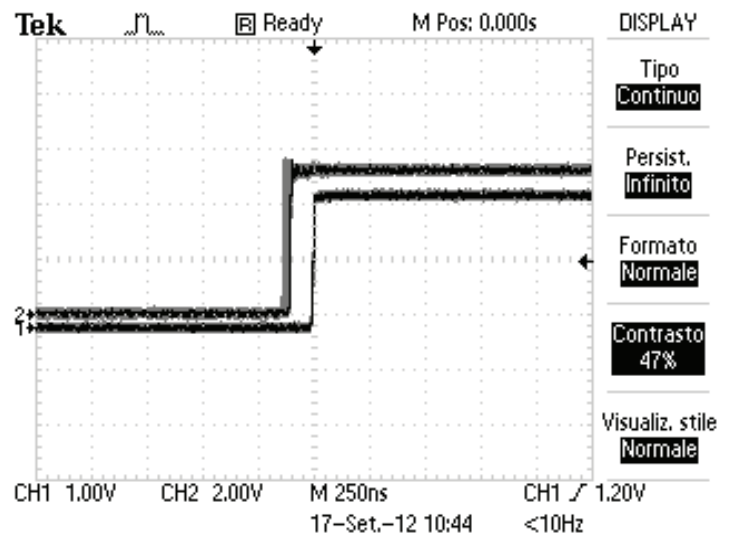
Packet delay based on network load

Sync message modified by a TC

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



TC feature disabled



TC feature enabled

Key Features

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- IEEE 1588 v2 Precision Time Protocol Grandmaster (when equipped with GNSS receiver)
- 8 x Gigabit ports (1 Gbps)
- 2 x SFP ports (2.5 Gbps)
- 1 x 10MHz Low Phase Noise output
- 1 x PPS I/O
- External Frequency input
- End-to-End Transparent Clock (UDP/IPv4 and Layer 2)
- Synchronous Ethernet (SyncE) over copper and fiber
- Internal High-Stability OCXO (or Rubidium as option)
- Internal GPS Radio Receiver for Grandmaster role (optional)

Digital Instruments Sync™ Gigabit Ethernet Switch

Configuration
Monitor
System
Green Ethernet
Thermal Protection
Ports
State
Traffic Overview
QoS Statistics
QCL Status
Detailed Statistics
Sync
Security
LACP
Loop Protection
Spanning Tree
IPMC
LLDP
MAC Table
VLANs
Diagnostics
Maintenance

Port State Overview

Auto-refresh Refresh

2	4	6	8	10
[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
1	3	5	7	9

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.

Interfaces

SNMP protocol and integrated Web Server
GbE - PTP/SyncE I/O combo port
 8x shielded RJ45, 10/100/1000 BaseT Ethernet (also used for management)
 2x SFP 1000 BaseX (also used for management)
 each port is configured as either as an input port (client) or an output port (master)
1 Time of Day (ToD) output via RS232 (optional)
1 PPS I/O via BNC connector
1 10MHz I/O via BNC connector
1 IRIG-B output (00x) via BNC connector

NTP

Protocol: NTPv4
Role: Master Clock Stratum 1 (with GPS) – slave clock Stratum 2
Packet rate: 20.000 transactions per second

IEEE 1588 v2 PTP Input

Boundary Clock function (optional)
Multi-sync function uses PTP or frequency input (SyncE)
IPV4 / UDP, Layer 2, Multicast, Unicast
1-step and 2-step
PTP Profiles
 - ITU-T G.8265.1 Frequency Profile (IPV4)
 - Telecom Profile (ITU-T G.8265.1)
 - Power Profile (IEC C37.238)
 - Default Profile (IEEE 1588 v2)
VLAN (802.1Q, 802.1p)
Best Master Clock Algorithm (BMCA), with Default Profile

IEEE 1588 v2 PTP Output

PTP output client capacity: up to 500 clients
Up to 128 messages per second per client
IPV4 / UDP, Layer 2, Multicast, Unicast
1-step
PTP Profiles
 - ITU-T G.8265.1 Frequency Profile (IPV4)
 - Telecom Profile (ITU-T G.8265.1)
 - Power Profile (IEC C37.238)
 - Default Profile (IEEE 1588 v2)
VLAN (802.1Q, 802.1p)

GPS (optional)

Receiver:	1,575.42 MHz – 12 Channels
Tracking:	12 satellite correlation
PPS Accuracy:	< 50 nsec
Acquisition time:	4 minutes
Stability when locked:	$\pm 1e-12$ after 24 hours
Antenna connector:	TNC
Optional:	GLONASS

Local Oscillator

OCXO (ageing in holdover $\pm 5e-11$ / sec) ¹
Optional: Rubidium (ageing in holdover $\pm 1e-11$ / sec) ¹

Synchronous Ethernet

SyncE can be used as a frequency input and can be generated as an output (as Master)
Conforms to relevant sections: ITU-T G.8261, G.8262 and G.8264 ESMC

Power

AC Power option, 110-220 VAC (IEC 60320 C14 socket)
DC Power option, 36-72 VDC (terminal block)

Network Support

DHCP (RFC2131)	IPV4
DSCP	NTP
HTTP	SNMP
ICMP (RFC 792)	SYSLOG
IEEE 802.1Q, 802.1p VLAN	TIME
IEEE 1588 v2 PTP	

Status Info

15 status LEDs, RS232, SNMP, Web interface

Mechanical

Size:	Height:	44 mm
	Width:	438 mm
	Depth:	295 mm
Rack mounts:	19"/1U.	

¹ Holdover values are approximated and assume operation at constant temperature, no initial frequency or phase offset, and that the unit has been powered for two weeks and locked to GNSS for three consecutive days.