SyncServer® S650 Options and Upgrades

Maximize Performance and Flexibility

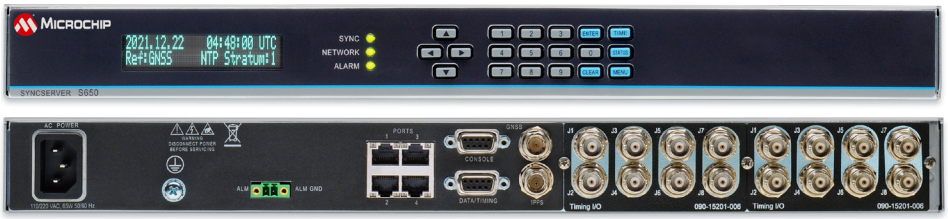
Options and Upgrades

- Rubidium atomic oscillator upgrade
- OCXO oscillator upgrade
- Dual power supplies
- PTP grandmaster license
- PTP input license
- 10 GbE ports
- Security protocol license
- Galileo/GLONASS/BeiDou/SBAS/QZSS license
- BlueSky™ GPS Jamming and Spoofing Detection, Protection, Analysis
- Timing I/O modules
- FlexPort™ license for timing I/O modules
- 10 MHz low phase noise modules
- 1PPS time interval measurements
- Event time capture
- Time-triggered programmable pulse

Microchip makes it easy to configure the SyncServer® S650 to meet specific application needs and requirements with a variety of hardware and software options. Whether the application requires specific Network Time Protocol (NTP) stratum behaviors, Precision Time Protocol (PTP) accuracy, sustained signal quality controllable with oscillator upgrades, more flexibility in signal outputs, or just redundancy features like dual power supplies or multiple constellation GNSS support, Microchip has excellent solutions for all use cases. If the user is not sure how to achieve what they want in terms of configuring choices, they can contact Microchip's timing experts for advice and guidance for customized solutions that meet their needs.

DISA APPROVED Approved Product for DoD Networks

Note: The SyncServer S650 are on the DISA/DoDIN Approved Products List



Option Availability Matrix

Order Time	Option/Upgrade	S600	S650	S650i
Only At initial time of purchase**	Rubidium upgrade	•	•	•
	OCXO upgrade	•	•	•
	Dual AC power supplies	•	•	•
	Dual DC power supplies	•	•	•
	10 GbE SFP+ ports	•	•	•
	Timing I/O Module Standard		•	•
	Timing I/O Module + T1/E1 I/O		•	•
	Timing I/O Module + Fiber Outputs		•	•
	Timing I/O Module + Fiber Input		•	•
	Timing I/O Module + HaveQuick/PTTI		•	•
	10 MHz low phase noise module(s)		•	•
Anytime	Security Protocol license	•	•	•
	PTP Output license (grandmaster option)	•	•	•
	PTP Input license	•	•	•
	FlexPort license*		•	•
	1PPS time interval and event time capture measurements*		•	•
	GNSS license (add Galileo/GLONASS/SBAS/QZSS/BeiDou to the standard GPS***)	•	•	
	BlueSky™ GPS Jamming/Spoofing Detection, Protection(1)	•	•	
	Time-Triggered Programmable Pulse License****		•	•

*Only applicable if one or two timing I/O modules are installed in the SyncServer S650/S650i.
**Return-to-factory hardware retrofit option available. Contact Microchip for full details.
***SyncServers shipping approximately from the start of 2019 are capable of tracking Galileo satellites if version 3.0 software is loaded and the Multi-GNSS Constellation option is installed.
****Requires a Standard Timing I/O Module or the Timing I/O Modules with the fiber connectors be installed in the SyncServer S650/S650i.
(1) See BlueSky Software option data sheet for specifications and SyncServer requirements.

Rubidium Atomic Oscillator



The rubidium atomic clock oscillator upgrade improves not only the stability and ongoing accuracy of the SyncServer, but also its holdover accuracy, saving valuable time for the user. The standard SyncServer is equipped with a crystal oscillator that keeps the clock accurate to specifications while tracking GNSS. However, if the GNSS signal is lost, thereby placing the unit in holdover, the standard oscillator soon drifts away from perfect. Upgrading the oscillator significantly improves the clock accuracy during holdover.

Rubidium holdover accuracy is <1 µs for the first 24 hours and <3 µs after the first three days. The advantage of the rubidium oscillator is that if the GNSS signal is lost, the SyncServer continues to serve accurate time and maintain a high level of clock stability. This allows support personnel plenty of time to correct the GNSS signal problem with little degradation or disruption in time synchronization accuracy.

Oven-Controlled Crystal Oscillator (OCXO)

Similar in application to the rubidium oscillator upgrade, the oven-controlled crystal oscillator (OCXO) upgrade improves the holdover accuracy beyond the standard oscillator, though not nearly as much as the rubidium oscillator. OCXO holdover accuracy is 25 µs for the first day. Depending on the level and duration of accuracy needed, the OCXO is a compromise between the standard oscillator and the rubidium oscillator.

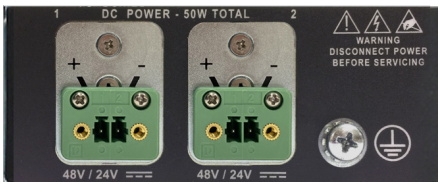
Oscillator	Holdover Drift (1st 24 hours)
Standard	400 microseconds
OCXO	25 microseconds
Rubidium	<1 microsecond

Dual AC Power Supplies



The dual-corded, dual-power supply option provides several levels of time service protection. The power supplies load share equally, and there is an active power management system constantly monitoring the operation. If the power to one cord/circuit is lost or if one power supply fails, the entire load is instantly picked up by the remaining energized power supply with no interruption in time services to the network. Connecting both power supplies to the same circuit provides protection against a single power supply failure. In the event of a power supply failure, notification is instantly provided to the network operator through SNMP trap or email. For extra level of assurance, the power cord(s) supplied with the SyncServers have locking rear IEC 60320 connectors to avoid accidental decoupling.

Dual DC Power Supplies



The dual-corded, dual DC power supply option provides several levels of time service protection. The DC power supplies load share equally and there is an active power management system constantly monitoring the operation. If the power to one cord/circuit is lost or if one power supply fails, the entire load is instantly picked up by the remaining energized power supply with no interruption in time services to the network. Connecting both power supplies to the same circuit provides protection against a single power supply failure. In the event of a power supply failure, notification is instantly provided to the network operator through SNMP trap or email. The option includes two locking connectors to allow the user to make a power cable.

Technical

Specification	Value
Nominal input	24 VDC to 48 VDC
Rated input	20 VDC to 75 VDC

Multi-Port/Profile IEEE 1588 PTP Output License

The IEEE 1588 PTP output license enables PTP grandmaster operations leveraging the built-in hardware timestamping in all SyncServers. LAN 2, 3, and 4 as well as the optional 10 GbE LAN 5 and 6 can each be uniquely configured as PTP grandmasters with this single-option license. This is a very cost-effective way to scale PTP grandmaster operations and increase configuration flexibility.

PTP profiles supported include the popular ITU-T profiles, Enterprise Profile, default profile, Power Profiles, Datacenter profile, SMPTE and Telecom Profile. These profiles can be configured in any combination, the limitation being one profile per port. The Enterprise Profile in a grandmaster is an official recognition of the default multicast profile and the use of unicast delay_request messages (often referred to as hybrid mode). PTP multicast client capacity ranges from 360,000 clients at 1 delay_request/second rate down to 2,800 clients at 128 delay_request/second rate. PTP ITU G.8265.1, G.8275.2 and telecom profile client capacity is up to 800 clients at 128 packets per second. Overall capacity of the Syncserver is 360,000 time stamps/second allocated by the configuration of the protocol and profile on each port.

Compliance

- IEEE1588 2019 version 2.1
- ITU-T G.8265.1/G.8275.1/G.8275.2 Grandmaster Profiles
- Telecom Profile 2008
- Default profile
- Enterprise Profile (default profile with hybrid support)
- Datacenter profile
- Power Profile IEEE C37.238-2011/C37.238-2017
- Power Utility Profile IEC/IEEE 61850-9-3:2016
- Parallel Redundancy Protocol (PRP) IEC 62439-3
- SMPTE Profile ST-2059-2
- One-step or two-step clock operation, IPv4/IPv6

PTP Performance

- PTP message capacity: 360,000 messages per second
- Time stamp accuracy: 30 ns relative to timebase in SyncServer with GbE links
- Time stamp resolution: 1 ns

Configurable PTP Parameters

- Transport protocol: UDP over IPv4/IPv6, or layer 2 over Ethernet
- Delay mechanisms: End-to-End (E2E), Peer-to-Peer (P2P)
- Sync and delay intervals: 128 packets/second to 1 packet/128 seconds for Enterprise/default/Power profiles
- Configurable Packet TTL, Priority, Domain number, Announce receipt timeout, Diffserv code point
- Mean announce message transmit interval: 1 second per Enterprise Profile specification, 8 packets/second to 1 packet/8 seconds for default profile, 16 packets/second to 1 packet/16 seconds for power profiles.

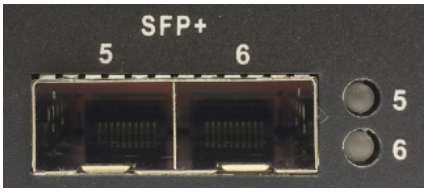
IEEE 1588 PTP Input License

PTP as a timing input is useful for several different application scenarios of which one is tunneling time through PTP over the network to an S650 with no GNSS connection. PTP input can also be used as a backup time reference in the event of the loss of the GNSS signal. When used as a back up to GNSS, the S650 is equipped with Automatic Asymmetry Compensation that automatically measures, calibrates, and stores up to 32 different network path delay asymmetries observed between the PTP client S650 and the PTP grandmaster. In the event of the loss of the GNSS signal, the S650 recognizes the current network path and automatically applies the correct asymmetric path compensation to keep the S600 tightly synchronized to the remote PTP grandmaster. If the network path between the S600 client and the grandmaster changes, the applied compensation will also change.

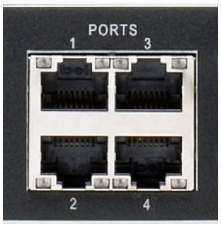
Compliance

- IEEE 1588 2008 version 2
- ITU-T G.8265.1/G.8275.1/G.8275.2 Client Profiles
- Telecom Profile 2008
- Default profile
- Enterprise Profile
- SMPTE Profile ST-2059-2
- PTP gateway/boundary clock if used with PTP output license
- One-step or two-step clock operation
- Up to 128 packets per second
- IPv4/IPv6

10 GbE Network Interface



The S650 10 GbE option adds two SFP+ ports equipped with hardware timestamping that supports NTP, PTP, and NTP Reflector operations. The 10 GbE ports are in addition to the standard four 1 GbE ports for a total of 6 ports. These ports are ideal for interoperability with 10 GbE switches. SFP modules supported are limited to 10 GbE speeds only, and overall system time stamping capacity remains as specified. The 10 GbE SFP+ ports do not use an option module slot on the S650 model.



SyncServer S650 Series LAN Ports have hardware timestamping capability built in ready to support PTP operations

Security Protocol License with Security-Hardened NTP Reflector™/Firewall

Some applications require security enhancements above and beyond what might otherwise be acceptable. For this reason, the SyncServer S650 can be seriously hardened from both the NTP operational perspective and the authentication perspective.

Operational Hardening

The security protocol license includes the security-hardened NTP Reflector with hardware firewall functionality. The GbE line speed NTP Reflector with 100% hardware-based NTP packet processing can handle in excess of 360,000 NTP requests per second (mode three NTP client packets only). This same hardware also acts as a CPU-protecting firewall by bandwidth limiting all non-NTP traffic. In addition to the NTP Reflector, there are denial-of-service (DoS) functions monitoring the packet flow. Abnormally high NTP or non-NTP traffic initiates an SNMP trap. In a DoS attack, the S650 remains impervious to the level of network traffic that could be delivered as all packets are processed in hardware at line speed, though legitimate NTP client requests for time may be blocked elsewhere in the network due to the increased DoS flow.

User and Secure Syslog Authentication Hardening

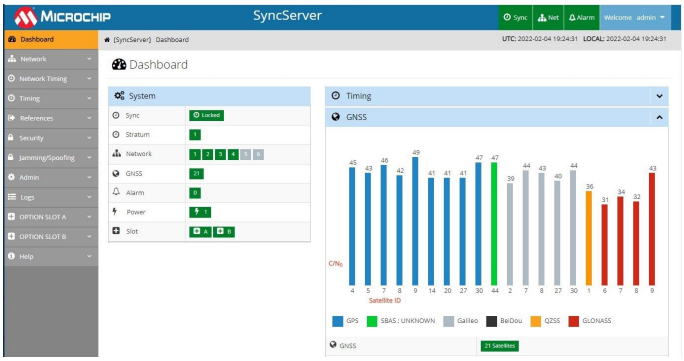
Authentication—whether client, server, secure syslog, or user access—is the next level in security hardening. The NTP Autokey functionality is a step up from MD5 when it is required to have the next level of NTP client-to-server authentication.

For user authentication/permission to access the web interface, TACACS+, RADIUS, LDAP, and CA-signed X.509 certificates are also included in the security protocol license.

Authentication is also available for secure Syslog operations and communication with services such Security Incident Event Management systems (SIEMs). An exhaustive list of X.509 Certificate Authority certificates is maintained, and customizable, to enable the SyncServer to operate as a TLS client to authenticate a certificate sent by a TLS server. X.509 certificates are mapped to the HTTPS and Syslog services.

Multi-GNSS Constellation License

Timing integrity, continuity, and reliability can be improved with the multi-GNSS constellation license that adds support for Galileo, GLONASS, BeiDou, QZSS and SBAS constellations in addition to the standard GPS constellation. With more satellites in view, timing performance can be improved in challenging environments such as urban canyons.



Track GPS/SBAS/QZSS, Galileo, GLONASS and/or BeiDou Satellite Constellations for improved integrity and satellite visibility in urban canyons.

All SyncServer S650 series are equipped with a GNSS receiver capable of simultaneously tracking more than one GNSS constellation. The global constellations include GPS, Galileo, GLONASS, and BeiDou. The regional Satellite Based Augmentation Satellites (QZSS, WAAS, EGNOS, and MSAS) are also used. Users select one or two of the three available constellation frequency plans. If GPS is one of the selected constellations, then the SBAS satellites are automatically included in the tracking. GPS must be selected in order to use QZSS.

Frequency Plan	Constellations
L1/E1	GPS/Galileo/QZSS
L10F	GLONASS
B1	BeiDou

BlueSky™ GPS Jamming and Spoofing Detection, Protection, Analysis

Detect and Protect

The SyncServer BlueSky™ option detects GPS jamming and spoofing related anomalies in real-time to protect essential time and frequency outputs. This software option incorporates intelligent GPS jamming and spoofing detectors that continuously monitor the health of the local live sky GPS constellation. When unexpected changes are detected, and trust is compromised, alarms are sent and the BlueSky detectors respond to protect the integrity of the SyncServer time and frequency outputs.

Jamming Protection

Subtle jamming detection techniques monitored by BlueSky require awareness of RF interference as well as establishing thresholds to detect GPS jamming anomalies in the local area. This includes the minimum number of satellites expected in view, typical carrier to noise levels, and RF interference information provided by the GPS receiver circuits.

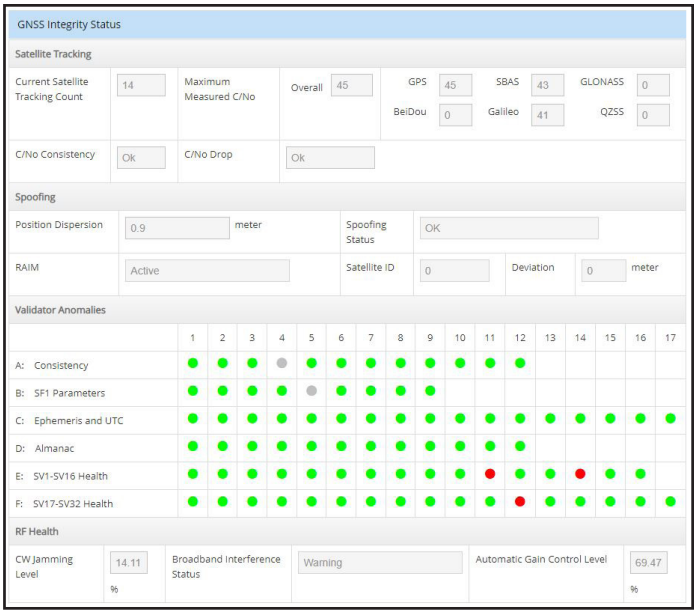
Spoofing Protection

GPS spoofing detection combines monitoring GPS receiver outputs, RAIM, and GPS data validation. The BlueSky data validator continuously checks the data and presents any anomalies in a graphical display. If anomalies that could be associated with a spoofing event are detected, automatic disqualification of GPS as a time source is a user option.

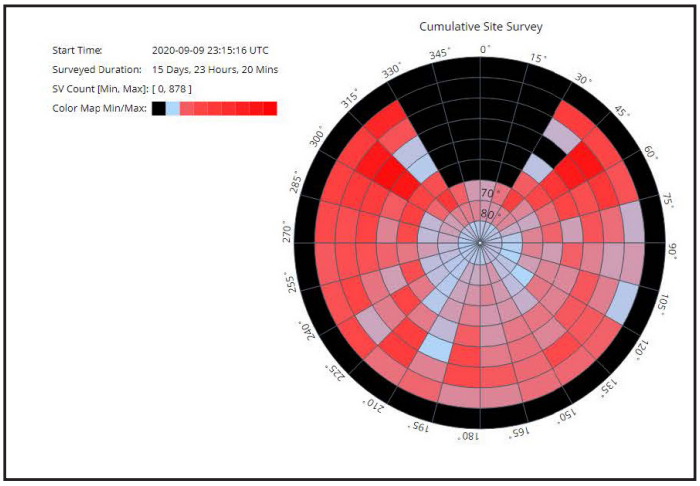
Graphical Live Sky Measurements

The BlueSky option provides the graphical tools to easily characterize the local GPS environment to set meaningful alarm thresholds and subsequent SyncServer behaviors. The charts and graphs provide insights into satellite availability based on antenna location, as well as a historical lookback of data useful to fine tune alarm thresholds. The historical data is also valuable to identify when a jamming or spoofing event occurred and possibly correlate it to known changes in the local RF environment.

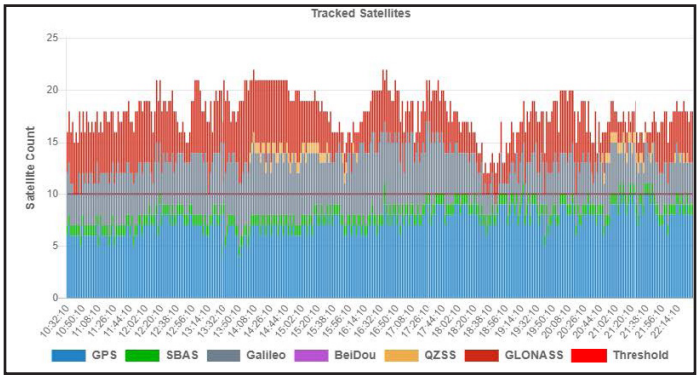
Note: See BlueSky Software option data sheet for specifications and SyncServer requirements. Not available on all SyncServers.



GNSS Integrity Status page including at-a-glance data validator status LEDs for GPS satellite health.

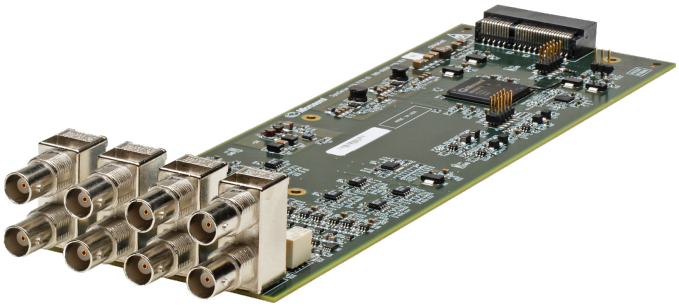


View which segments of the sky most frequently have useable satellite signals. Red = frequent satellites, blue = occasional satellites, black = no satellites ever tracked.



Tracked satellites over time to help identify minimum satellite coverage and verify continuous coverage.

S650 Timing I/O Module



The Timing I/O module is an exceedingly versatile time and frequency input and output option. In the standard configuration, it supports the most popular input and output time codes, sine waves, and rates. The following illustration shows the standard configuration and the configuration with the FlexPort option.

The standard configuration offers a broad yet fixed selection of signal I/O. J1 is dedicated to time code and rate inputs, J2 to sine wave inputs, and J3-J8 to mixed signal outputs. The standard Timing I/O module configuration is 1PPS or IRIG B AM-In, 10 MHz-In, IRIG AM and IRIG DCLS-Out, 1PPS-Out, and 10 MHz-Out. (See the following page for Timing I/O Module specifications.)

FlexPort License for Timing I/O Modules

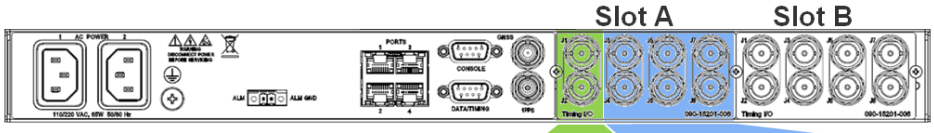
Microchip's unique FlexPort technology efficiently and cost-effectively adds innovative "any signal, any connector" technology, eliminating the wasted space inherent with legacy-style, fixed-signal modules/BNCs.

The FlexPort technology option enables the six output BNCs (J3–J8) to output any supported signal (time codes, sine waves, programmable rates, and so on) all configurable in real time through the secure web interface. Similarly, the two input BNCs (J1–J2) can support a wide variety of input signal types. This uniquely flexible BNC-by-BNC configuration makes efficient and cost-effective use of the 1U space available.

Two Timing I/O modules double the number of supported input and output signals. Unlike legacy modules with fixed count BNCs outputting fixed signal types per module, with FlexPort technology the user can have up to 12 BNCs (two Timing I/O modules) outputting any combination of supported signal types. Fine tuning of rate and time code signal outputs is possible as each output BNC can be individually phase adjusted to the nanosecond level to accommodate different output cable lengths.

This level of timing signal flexibility is unprecedented and can even eliminate the need for additional signal distribution chassis as there is no degradation in the precise quality of the coherent output signals.

FlexPort vs. Standard Configuration



→ BNC Connectors		Input		Output					
↓ Signals		J1	J2	J3	J4	J5	J6	J7	J8
Standard	1PPS	●					●	off	off
	IRIG B AM	●		●				off	off
	IRIG B DCLS					●		off	off
	10 MHz		●		●			off	off
FlexPort	IRIG A/B/C37/E/G NASA/2137/XR3 AM/DCLS	■		■	■	■	■	■	■
	Selectable/Programmable Rates	■		■	■	■	■	■	■
	1/5/10 MHz Sine Waves		■	■	■	■	■	■	■

● = Fixed specific signal type
■ = User configurable Time Codes, Selectable/Programmable Rates or Sine Waves

A single FlexPort license enables configuration flexibility on all installed Timing I/O modules.

Note: All Timing I/O modules are factory installed and must be ordered at the time of initial purchase. The FlexPort license can be added at any time.

Timing I/O Module Signal Characteristics

	Input BNCs		Output BNCs					
Configuration	J1	J2	J3	J4	J5	J6	J7	J8
Standard	IRIG B AM 124 or 1PPS	10 MHz	IRIG B AM 124	10 MHz	IRIG B B004 DCLS	1PPS	off	off

FlexPort™ Options	IRIG:
	A000/A004/A130/A134
	B000/B001/B002/B003
	B004/B005/B006/B007
	B120/B121/B122/B123
	B124/B125/B126/B127
	E115/E125
	C37.118.1a-2014
	IEEE-1344
	
	Rates:
	1 PPS
	10 MPPS
		1 MHz
		5 MHz
		10 MHz
			FlexPort J3–J8 software-selectable outputs per BNC (configured through the web interface):
			• Pulse:
			  • Fixed rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM, 1PPS falling edge
			  • Programmable period: 100 ns to 86400 s, step size of 10 ns
			• Timecode:
			  • IRIG A 004/134
			  • IRIG B 000/001/002/003/004/005/006/007/C37.118.1a-2014/1344 DCLS
			  • IRIG B 120/122/123/124/125/126/127/1344 AM
			  • IRIG E 115/125
			  • IRIG G 005/145
			  • NASA 36 AM/DCLS, 2137 AM/DCLS, XR3
			• Sine: 1/5/10 MHz
			• BNC-by-BNC output phase adjustment for timecodes and pulses					

Signal Levels

Output Signal	Specification
IRIG-In	AM: Ratio 2:1 to 3.5:1 Amp: 1.4 V to 8 V p-p, into 50 Ω DCLS: <0.8 V for logic 0, >2 V for logic 1
IRIG-Out	AM: Ratio 10:3, Amp: 3.5 ± 0.5 Vpp, Zout 50 Ω DCLS: <0.8 V for logic 0, >2.4 V for logic 1, Zout 50 Ω
1PPS-In	Rising edge active, TTL into 50 Ω
Rate/Pulse Out	Rising edge on-time, TTL into 50 Ω
1,5,10 MHz-In	Sine wave, 1 Vpp to 8 Vpp, into 50 Ω
1/5/10 MHz-Out	Sine wave 2 Vpp-3 Vpp into 50 Ω
10 MPPS In	<0.8 V for logic 0, >2 V for logic 1, into 50 Ω

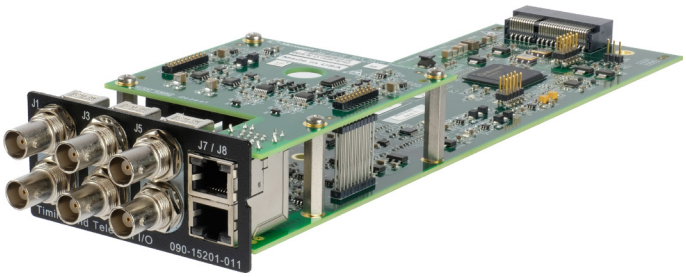
Output Stability

Oscillator	1 s	10 s	100 s	1 ks	10 ks
Standard	$<1\times10^{-9}$	$<2\times10^{-10}$	$<1\times10^{-10}$	$<1\times10^{-11}$	$<1\times10^{-12}$
OCXO	$<1\times10^{-9}$	$<5\times10^{-11}$	$<5\times10^{-11}$	$<7\times10^{-12}$	$<7\times10^{-13}$
Rubidium	$<2\times10^{-10}$	$<3\times10^{-11}$	$<3\times10^{-11}$	$<5\times10^{-12}$	$<5\times10^{-13}$

Note: Measured on any 10 MHz output.

Note: For applications sensitive to 10 MHz phase noise, Microchip recommends the Low Phase Noise modules. The Timing I/O Module 10 MHz outputs are not meant for low phase noise applications.

S650 Timing I/O Module + T1/E1 I/O



The Standard S650 Timing I/O module is outfitted with two RJ48 connectors to support T1/E1 and other supporting timing only signals common to telecommunications applications. Connectors J1-J6 retain the same functionality as the standard Timing I/O module, the J7 and J8 RJ48 connectors support the telecommunications timing signals. These telecommunications timing signals are electrical waveforms used for timing synchronization only, and are not capable of carrying any data other than a fixed set of industry standardized Synchronization Status Messages (SSM) regarding the frequency quality of the signal.

Signal Characteristics

	Input BNCs		Output BNCs					
Configuration	J1	J2	J3	J4	J5	J6	J7	J8
Standard	IRIG B AM 124 or 1PPS	10 MHz	IRIG B AM 124	10 MHz	IRIG B B004 DCLS	1PPS	T1	E1

FlexPort™ Options	IRIG:
	A000/A004/A130/A134
	B000/B001/B002/B003
	B004/B005/B006/B007
	B120/B121/B122/B123
	B124/B125/B126/B127
	E115/E125
	C37.118.1a-2014
	IEEE-1344
	
	Rates:
	1 PPS
	10 MPPS
		1 MHz
		5 MHz
		10 MHz
			FlexPort J3–J8 software-selectable outputs per BNC (configured through the web interface):
			• Pulse:
			  • Fixed rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM, 1PPS falling edge
			  • Programmable period: 100 ns to 86400 s, step size of 10 ns
			• Timecode:
			  • IRIG A 004/134
			  • IRIG B 000/001/002/003/004/005/006/007/ C37.118.1a-2014/1344 DCLS
			  • IRIG B 120/122/123/124/125/126/127/1344 AM
			  • IRIG E 115/125
			  • IRIG G 005/145
			  • NASA 36 AM/DCLS, 2137 AM/DCLS, XR3
			• Sine: 1/5/10 MHz
			• BNC-by-BNC output phase adjustment for timecodes and pulses
							Output: T1, E1, Composite Clock, Japanese Composite Clock, JSW, 1.544 MHz or 2.048 MHz Square Wave
							Input: T1 or E1
							
							ITU-T G.703 & G.704 Compliant
								Output: T1, E1, Composite Clock, Japanese Composite Clock, JSW, 1.544 MHz or 2.048 MHz Square Wave
								
								ITU-T G.703 & G.704 Compliant

Signal Levels

Output Signal	Specification
IRIG-In	AM: Ratio 2:1 to 3.5:1 Amp: 1.4 V to 8 V p-p, into 50 Ω DCLS: <0.8 V for logic 0, >2 V for logic 1
IRIG-Out	AM: Ratio 10:3, Amp: 3.5 ± 0.5 Vpp, Zout 50 Ω DCLS: <0.8 V for logic 0, >2.4 V for logic 1, Zout 50 Ω
1PPS-In	Rising edge active, TTL into 50 Ω
Rate/Pulse Out	Rising edge on-time, TTL into 50 Ω
1,5,10 MHz-In	Sine wave, 1 Vpp to 8 Vpp, into 50 Ω
1/5/10 MHz-Out	Sine wave 2 Vpp-3 Vpp into 50 Ω
10 MPPS In	<0.8 V for logic 0, >2 V for logic 1, into 50 Ω
T1-Out	2.4 V to 3.6 V peak, 100 Ω
E1/T1-In	0.2 Vpp to 6.5 Vpp
E1-Out	3 V ± 0.3 V, 120 Ω
Composite Clock-Out	3 Vpeak ± 0.5 V
JCC-Out	1 Vpeak ± 0.1 V, nominal
JSW-Out	0 dBm ±3 dB, 120 Ω
1.544 or 2.048 MHz Square-Out	3 Vpp ± 0.3 V

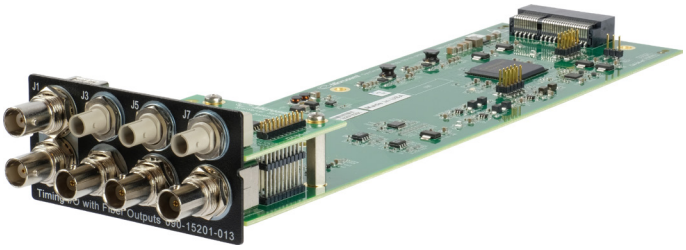
Output Stability

Oscillator	1 s	10 s	100 s	1 ks	10 ks
Standard	$<1\times10^{-9}$	$<2\times10^{-10}$	$<1\times10^{-10}$	$<1\times10^{-11}$	$<1\times10^{-12}$
OCXO	$<1\times10^{-9}$	$<5\times10^{-11}$	$<5\times10^{-11}$	$<7\times10^{-12}$	$<7\times10^{-13}$
Rubidium	$<2\times10^{-10}$	$<3\times10^{-11}$	$<3\times10^{-11}$	$<5\times10^{-12}$	$<5\times10^{-13}$

Note: Measured on any 10 MHz output.

Note: For applications sensitive to 10 MHz phase noise, Microchip recommends the Low Phase Noise modules. The Tiiming I/O Module 10 MHz outputs are not meant for low phase noise applications.

S650 Timing I/O Module + Fiber Outputs



The Standard S650 Timing I/O module is outfitted with three ST fiber connectors (replacing the J3, J5 and J7 BNCs) to support output of the pulse and DCLS signals over multimode fiber. BNC connectors J1, J2, J4, J6 and J8 retain the same functionality as the standard Timing I/O module. The ideal application is slaving an S650 with a Timing I/O fiber input via the fiber connection. The FlexPort license is required with this module as only DCLS signals are supported on the J3, J5 and J7 fiber outputs.

Signal Characteristics

	Input BNCs		Output Fiber ST			Output BNCs		
Configuration	J1	J2	J3	J5	J7	J4	J6	J8
Standard	Module REQUIRES the FlexPort Option		Module REQUIRES the FlexPort Option			Module REQUIRES the FlexPort Option		

FlexPort™ Options	IRIG:
	A000/A004/A130/A134
	B000/B001/B002/B003
	B004/B005/B006/B007
	B120/B121/B122/B123
	B124/B125/B126/B127
	E115/E125
	C37.118.1a-2014
	IEEE-1344
	
	Rates:
	1 PPS
	10 MPPS
		1 MHz
		5 MHz
		10 MHz
			FlexPort J3, J5, J7 software-selectable DCLS outputs per Fiber ST connector (configured through the web interface):
			• Pulse:
			  • Fixed rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM, 1PPS falling edge
			  • Programmable period: 100 ns to 86400 s, step size of 10 ns
			• Timecode:
			  • IRIG A 004
			  • IRIG B 000/001/002/003/004/005/006/007/ C37.118.1a-2014/1344 DCLS
			  • IRIG G 005
			  • NASA 36 DCLS, 2137 DCLS
			• Connector by connector output phase adjustment for timecodes and pulses
						FlexPort J4, J6, J8 software-selectable outputs per BNC (configured through the web interface):
						• Pulse:
						  • Fixed rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM, 1PPS falling edge
						  • Programmable period: 100 ns to 86400 s, step size of 10 ns
						• Timecode:
						  • IRIG A 004/134
						  • IRIG B 000/001/002/003/004/005/006/007/ C37.118.1a-2014/1344 DCLS
						  • IRIG B 120/122/123/124/125/126/127/134 4 AM
						  • IRIG E 115/125
						  • IRIG G 005/145
						  • NASA 36 AM/DCLS, 2137 AM/DCLS, XR3
						• Sine: 1/5/10 MHz
						• BNC-by-BNC output phase adjustment for timecodes and pulses		

Signal Levels

Output Signal	Specification
IRIG-In	AM: Ratio 2:1 to 3.5:1 Amp: 1.4 V to 8 V p-p, into 50 Ω DCLS: <0.8 V for logic 0, >2 V for logic 1
IRIG-Out	AM: Ratio 10:3, Amp: 3.5 ± 0.5 Vpp, Zout 50 Ω DCLS: <0.8 V for logic 0, >2.4 V for logic 1, Zout 50 Ω
1PPS-In	Rising edge active, TTL into 50 Ω
Rate/Pulse Out	Rising edge on-time, TTL into 50 Ω
1,5,10 MHz-In	Sine wave, 1 Vpp to 8 Vpp, into 50 Ω
1/5/10 MHz-Out	Sine wave 2 Vpp-3 Vpp into 50 Ω
10 MPPS In	<0.8 V for logic 0, >2 V for logic 1, into 50 Ω

Output Signal	Specification
Fiber Output	Connector: ST Fiber: Multi-Mode Wavelength: 820 nm Max cable length: 1 km, using 62.5/125 µm fiber

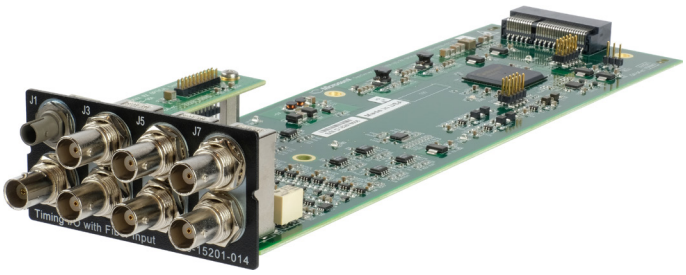
Output Stability

Oscillator	1 s	10 s	100 s	1 ks	10 ks
Standard	$<1\times10^{-9}$	$<2\times10^{-10}$	$<1\times10^{-10}$	$<1\times10^{-11}$	$<1\times10^{-12}$
OCXO	$<1\times10^{-9}$	$<5\times10^{-11}$	$<5\times10^{-11}$	$<7\times10^{-12}$	$<7\times10^{-13}$
Rubidium	$<2\times10^{-10}$	$<3\times10^{-11}$	$<3\times10^{-11}$	$<5\times10^{-12}$	$<5\times10^{-13}$

Note: Measured on any 10 MHz output.

Note: For applications sensitive to 10 MHz phase noise, Microchip recommends the Low Phase Noise modules. The Tiiming I/O Module 10 MHz outputs are not meant for low phase noise applications.

S650 Timing I/O Module + Fiber Input



The Standard S650 Timing I/O module is outfitted with an ST fiber connector, replacing the J1 BNC to support input of a DCLS signal over multimode fiber. BNC connectors J2-J8 retain the same functionality as the standard Timing I/O module. The ideal application is slaving an S650 with a Timing I/O Fiber input via the fiber connection to an S650 with a fiber output. The FlexPort license is required with this module as only DCLS signals are supported on the J1 fiber input.

Signal Characteristics

	Input BNCs		Output BNCs					
Configuration	J1	J2	J3	J4	J5	J6	J7	J8
Standard	Module REQUIRES the FlexPort Option		Module REQUIRES the FlexPort Option					

FlexPort™ Options	IRIG:
	A000/A004
	B000/B001/B002/B003
	B004/B005/B006/B007
	C37.118.1a-2014 DCLS
	IEEE-1344 DCLS
	
	Rates:
	1 PPS
	10 MPPS
		1 MHz
		5 MHz
		10 MHz
			FlexPort J3–J8 software-selectable outputs per BNC (configured through the web interface):
			• Pulse:
			  • Fixed rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM, 1PPS falling edge
			  • Programmable period: 100 ns to 86400 s, step size of 10 ns
			• Timecode:
			  • IRIG A 004/134
			  • IRIG B 000/001/002/003/004/005/006/007/C37.118.1a-2014/1344 DCLS
			  • IRIG B 120/122/123/124/125/126/127/1344 AM
			  • IRIG E 115/125
			  • IRIG G 005/145
			  • NASA 36 AM/DCLS, 2137 AM/DCLS, XR3
			• Sine: 1/5/10 MHz
			• BNC-by-BNC output phase adjustment for timecodes and pulses					

Signal Levels

Output Signal	Specification
Fiber Input	Connector: ST Fiber: Multi-Mode Wavelength: 820 nm Max cable length: 1 km, using 62.5/125 µm fiber
IRIG-Out	AM: Ratio 10:3, Amp: 3.5 ± 0.5 Vpp, Zout 50 Ω DCLS: <0.8 for logic 0, >2.4 V for logic 1, Zout 50 Ω
Rate/Pulse Out	Rising edge on-time, TTL into 50 Ω
1,5,10 MHz-In	Sine wave, 1 Vpp to 8 Vpp, into 50 Ω
1/5/10 MHz-Out	Sine wave 2 Vpp-3 Vpp into 50 Ω

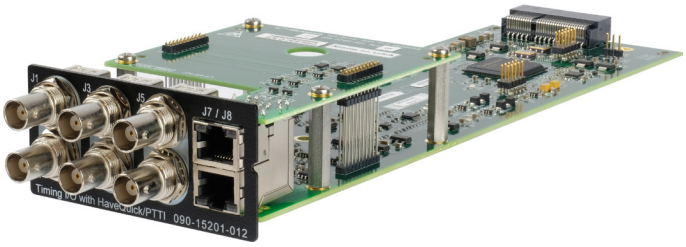
Output Stability

Oscillator	1 s	10 s	100 s	1 ks	10 ks
Standard	$<1\times10^{-9}$	$<2\times10^{-10}$	$<1\times10^{-10}$	$<1\times10^{-11}$	$<1\times10^{-12}$
OCXO	$<1\times10^{-9}$	$<5\times10^{-11}$	$<5\times10^{-11}$	$<7\times10^{-12}$	$<7\times10^{-13}$
Rubidium	$<2\times10^{-10}$	$<3\times10^{-11}$	$<3\times10^{-11}$	$<5\times10^{-12}$	$<5\times10^{-13}$

Note: Measured on any 10 MHz output.

Note: For applications sensitive to 10 MHz phase noise, Microchip recommends the Low Phase Noise modules. The Tiiming I/O Module 10 MHz outputs are not meant for low phase noise applications.

S650 Timing I/O Module + HaveQuick/PTTI



The Standard S650 Timing I/O module is outfitted with two RJ48 connectors to support RS422 PTTI Outputs. Additionally, HaveQuick timecodes are supported as inputs and outputs. All circuitry on the module has been upgraded to support 5V and 10V input and output pulses common to HaveQuick and PTTI signals. Due the tremendous range of signaling options for this module, the FlexPort license is required.

Timing I/O Module Signal Characteristics

	Input BNCs		Output BNCs				RJ48s	
Configuration	J1	J2	J3	J4	J5	J6	J7	J8
Standard	Module REQUIRES the FlexPort Option		Module REQUIRES the FlexPort Option				Module REQUIRES the FlexPort Option	

FlexPort™ Options	IRIG:
	A000/A004/A130/A134
	B000/B001/B002/B003
	B004/B005/B006/B007
	B120/B121/B122/B123
	B124/B125/B126/B127
	E115/E125
	C37.118.1a-2014
	IEEE-1344
	HaveQuick STANAG 4246 I/II, 4430, ICD-GPS-060A BCD
	
	Rates:
	1 PPS
	10 MPPS
		1 MHz
		5 MHz
		10 MHz
		HaveQuick 1PPS
			FlexPort J3–J8 software-selectable outputs per BNC (configured through the web interface):
			• Pulse:
			  • Fixed rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM, 1PPS falling edge
			  • Programmable period: 100 ns to 86400 s, step size of 10 ns
			  • 5V PPS, 5V PPM, 10V PPS, 10V PPM
			• Timecode:
			  • IRIG A 004/134
			  • IRIG B 000/001/002/003/004/005/006/007/ C37.118.1a-2014/1344 DCLS
			  • IRIG B 120/122/123/124/125/126/127/1344 AM
			  • IRIG E 115/125
			  • IRIG G 005/145
			  • NASA 36 AM/DCLS, 2137 AM/DCLS, XR3
			  • HaveQuick
			• Sine: 1/5/10 MHz
			• BNC-by-BNC output phase adjustment for timecodes and pulses
							RS422 PTTI Out	RS422 PTTI Out

Signal Levels

Output Signal	Specification
IRIG-In	AM: Ratio 2:1 to 3.5:1 Amp: 1.4 V to 8 V p-p, into 50 Ω DCLS: <0.8 V for logic 0, >2 V for logic 1
HaveQuick In	TTL, 15 VDC maximum
HaveQuick 1 PPS In	2 V to 10 V
IRIG-Out	AM: Ratio 10:3, Amp: 3.5 ± 0.5 Vpp, Zout 50 Ω DCLS: <0.8 V for logic 0, >2.4 V for logic 1, Zout 50 Ω
1PPS-In	Rising edge active, TTL into 50 Ω
Rate/Pulse Out	Rising edge on-time, TTL into 50 Ω
1,5,10 MHz-In	Sine wave, 1 Vpp to 8 Vpp, into 50 Ω
1/5/10 MHz-Out	Sine wave 2 Vpp-3 Vpp into 50 Ω
10 MPPS In	<0.8 V for logic 0, >2 V for logic 1, into 50 Ω
RS422 Output	± 2 V min to 100 Ω, +3 V typical
5V PPS/PPM	5 V ± 0.5 V
10V PPS/PPM	10 V ± 1 V

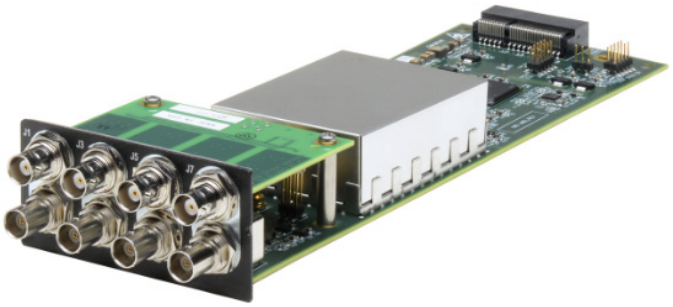
Output Stability

Oscillator	1 s	10 s	100 s	1 ks	10 ks
Standard	$<1\times10^{-9}$	$<2\times10^{-10}$	$<1\times10^{-10}$	$<1\times10^{-11}$	$<1\times10^{-12}$
OCXO	$<1\times10^{-9}$	$<5\times10^{-11}$	$<5\times10^{-11}$	$<7\times10^{-12}$	$<7\times10^{-13}$
Rubidium	$<2\times10^{-10}$	$<3\times10^{-11}$	$<3\times10^{-11}$	$<5\times10^{-12}$	$<5\times10^{-13}$

Note: Measured on any 10 MHz output.

Note: For applications sensitive to 10 MHz phase noise, Microchip recommends the Low Phase Noise modules. The Tiiming I/O Module 10 MHz outputs are not meant for low phase noise applications.

10 MHz Low Phase Noise Modules



For applications requiring superior low phase noise (LPN) 10 MHz signals, two different LPN modules are available. Each module has eight extremely isolated, phase-coherent 10 MHz LPN outputs, with each module offering excellent levels of LPN or Ultra LPN performance and exhibiting low spurious noise characteristics.

Though not a requirement, Microchip highly recommends upgrading the main SyncServer S650 oscillator to the OCXO or Rubidium Atomic clock options for improved coupling between the LPN oscillator and the primary S650 oscillator. This helps ensure phase noise performance and avoid possible LPN unlock alarms in degraded GNSS signal tracking conditions.

- Output level (ULPN): 13 dBm ±1 dB
- Output level: (LPN): 13 dBm ±1.5 dB
- Channel-to-channel isolation: 100 dB at 10 MHz
- Output impedence: 50 Ω
- Connectors: 8x BNC
- Modules/S650 chassis: 1

Note: Phase coherence between the 10 MHz output and 1PPS output requires the OCXO or Rubidium oscillator option.

Standard LPN Module

Offset Frequency (Hz)	Specification (dBc/Hz)	Typical* (dBc/Hz)
1	–95	–100
10	–125	–132
100	–145	–150
1,000	–150	–155
10,000	–155	–158
100,000	–155	–160

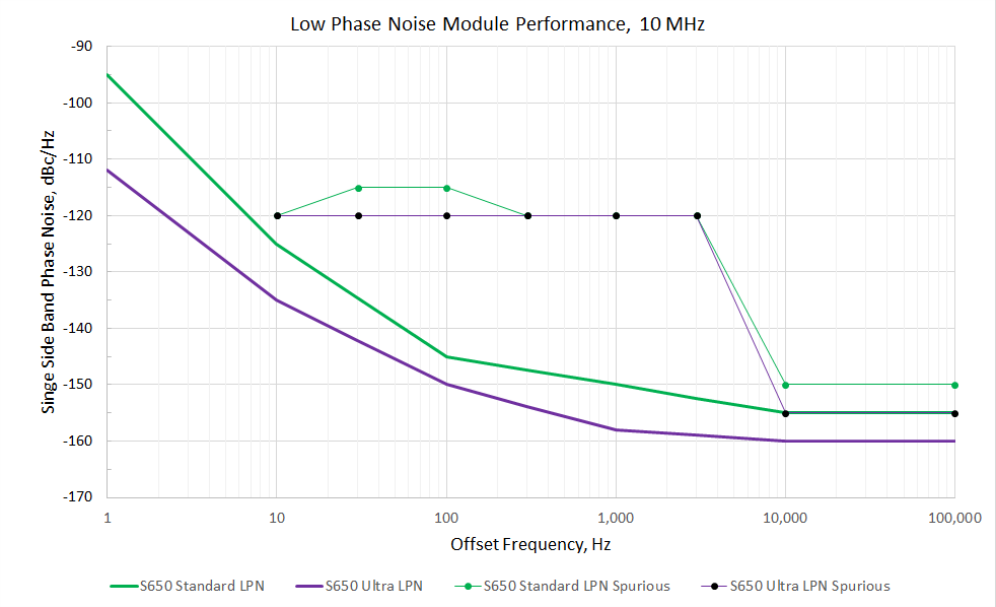
Ultra LPN Module

Offset Frequency (Hz)	Specification (dBc/Hz)	Typical* (dBc/Hz)
1	–112	–115
10	–135	–140
100	–150	–155
1,000	–158	–160
10,000	–160	–162
100,000	–160	–162

*All modules meet the Specification; however, Typical values represent observed medians. Typical values are listed for informational purposes only.

Allan Deviation for LPN and ULPN Modules

Tau	LPN	ULPN
1 s	$<3.0 \times 10^{-12}$	$<4.5 \times 10^{-13}$
10 s	$<4.5 \times 10^{-12}$	$<2.0 \times 10^{-12}$



Time Interval/Event Timing Measurement License

1PPS Time Interval Measurement

Using the S650 Timing I/O module with the 1PPS Time Interval Measurement can be very useful to compare the time between the S650 and another device that outputs a 1PPS signal. Typical application is to measure how accurate a device can synchronize to the S650 such as a PTP client device over a network. This measurement is essential in understanding the detrimental effects of switches and network traffic on the PTP client's ability to accurately synchronize to the S650.

Measurements are easy to perform. Merely connect the 1PPS output from the external device to the S650 Timing I/O module J1 BNC and press the start button on the web interface. The external 1PPS accuracy statistics relative to the S650 are computed and displayed in real-time through the web interface. The current interval, sample count, max, min, mean, standard deviation, median, and RMS of the measurement set are continuously updated on the web interface throughout the duration of the test. Measurement resolution is 10 nanoseconds. Tests have durations from 10 minutes to 1 day with results saved locally and can be exported in text formats easily imported into analysis programs. Measurements can also be sent continuously to a user-defined IP address and UDP port number, or to the DATA/TIMING serial port.

Event Timing

Event timing is the time tagging of an external pulse(s) received on the J1 input connector of the Timing I/O module. This time tag can be displayed, stored or sent out the serial port or network port. The S650 can time tag bursts of up to 100 events per second, and can store up to 86400 event time stamps before overwriting the oldest measurements. Operation can be for a fixed test period or as a continuous output. The web interface acts as a measurement interface displaying the number of measurements and the time tag of the 3 most recent events measured. Data can be exported in TAI or UTC format. The Event Timing uses the same J1 connector as the 1PPS Time Interval measurement, therefore both types of measurements cannot be made concurrently.

- Minimum pulse width: 20 ns
- Minimum interval between pulses: 100 ns
- Input signal amplitude: 2V to 8V

Time-Triggered Programmable Pulse License

The Time-Triggered Programmable Pulse Output option is a software option that provides a user configurable TTL level pulse output that can be used to supply a precisely synchronized "trigger" pulse at specific times or provide periodic pulse outputs. The rising edge of the trigger output may be programmed with 10 nanosecond resolution for fine control. The periodic pulse rates support several popular frequencies such as 1 PPS, 1 PP 10 SEC, 1 PPM, 1 PP 10 MIN, 1 PPH, 1 PP 10 HR, 1 PPD, 1 PP 10 DAYS or 1 PP 100 DAYS. The pulse width is also programmable.

Compatibility

Requires a Timing I/O module be installed as the output is relegated to the J7 BNC or J7 fiber ST connector. FlexPort License is not required, however only the Standard Timing I/O module or the Timing I/O Modules with the fiber connectors are capable of supporting this option.

The technique for creating the output signals of this option are similar to the XLi Programmable Pulse Output, though all configuration is via the SyncServer web GUI and not an XLi F111 PPO CLI command.

Specifications

- Range: 10 MHz to 1 pulse/year
- Pulse width: Configurable by setting pulse stop time
- Start Stop Time Resolution: 10 ns
- On time edge: Rising
- Amplitude: TTL Levels into 50Ω
- Accuracy: ± 5 ns to system clock accuracy, for electrical BNC

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