INDUSTRIAL COMMS

atop Technologies

NTS7500 Series

Power-Grade Industrial NTP Server - PTP Grandmaster Clock

FEATURED HIGHLIGHTS

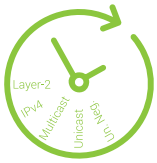
- High precision GNSS module
- Stratum 1 NTP Server, with Optional PTP hardware-support
- PTP Version supports IEEE61850-9-3 and IEEEC37.238 Power Profiles
- Holdover <30 ns/second time-drift when disconnected from GNSS
- IEC62439-3 Clause 5 Parallel Redundancy Protocol (PRP)
- Industrial fanless design for -40~85°C operation; IEC61850-3 protection
- Flexible modular configuration; 2 dedicated Output Module slots
- 2 x 10/100/1000 Mbps RJ45 and 2 x 100/1000 Mbps Combo SFP slots
- Embedded NTP/SNTP client and NTP server
- Support for Legacy Protocols: IRIG-B, BJT, BCD, ST, ST with checksum
- Redundant power input; low-Voltage DC or high-Voltage AC/DC

PRODUCT DESCRIPTION

A Powerful base for NTP and PTP

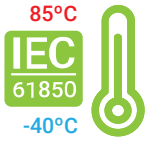
The NTS7500 1U 19" Rack-mount Modular NTP Server with additional Grandmaster Clock feature is a high-powered rugged device that offers good precision and reliability. Suitable for almost any environment and complying with the harshest Industrial EMC conditions, ATOP's device satisfies all industry requirements for Industrial-grade networking timing applications. Its modular architecture provides power-input redundancy and up to 16 different outputs for legacy time Protocols – such as IRIG-B, BCD, ST, ST with checksum.

Stratum 1 NTP Server: NTS7500 embeds a high precision, multi-system GNSS module that supports GPS, GLONASS, BEIDOU and GALILEO GNSS Systems for redundancy. When disconnected from a GNSS time source, its integrated TCXO Oscillator, ensures time drift (1PPS output) does not exceed 30 ppb matching and exceeding the requirements for Power Substations. NTS7500 supports NTPv1/v2/v3/v4 Server and NTP/SNTP Client.



Optional PTP Standard Support: On NTS7500-CPU-NTP, the possible PTP configurations are endless. NTS7500 supports Layer-2 and Layer-3 over IPv4 transport; VLAN Tagging; and Multicast, Unicast and Unicast Negotiation in both End-to-End and Peer-to-Peer delay calculation modes. NTS7500 fully supports IEEE C37.238-2017 and IEEE/IEC 61850-9-3 – 2016 Power Profiles.

Industrial and Substation Hardware : Designed to satisfy EMC requirements for Substation-Grade equipment, NTS7500 has a minimum EMC Level 4 rating and is designed to function between -40°C and 85°C with passive cooling only, allowing it to avoid the risk of having moving parts breakdown from constant operations. Also, its powerful CPU supports up to 2,000 packets per second, allowing endless applications and a large number of slaves to be supported simultaneously. Redundancy through IEC62439-3 Clause 5 PRP.



Proven design: No standardized testing procedure for PTP devices exists. So ATOP tests its products yearly in ISPCS Plugfests to demonstrate their reliability. NTS7500 was successfully tested in Stockholm 2016, Monterey 2017, Geneva 2018 and Portland 2019. More information available on www.ispcs.org.

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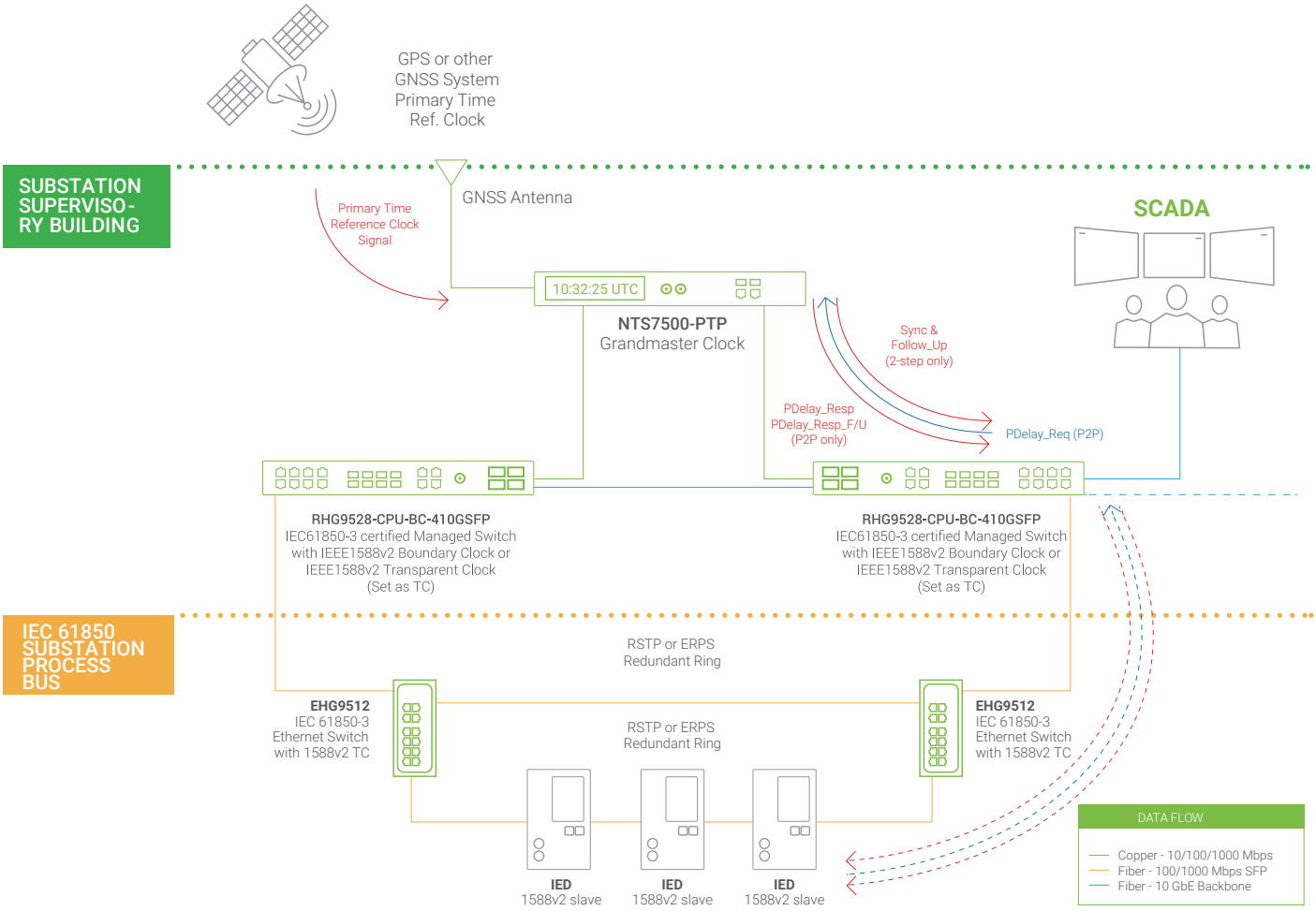
v: 1.4

APPLICATION CASE

IEEE1588v2 Precision Time Protocol

PTP is the only protocol that allows network time synchronization in the nanosecond-range. Current networking protocols nor legacy protocols allow such a timestamp resolution. IEEE1588-2008 (v2) derives from an earlier version issued by IEEE in 2002 that is not backward compatible. Being so exact about timestamp resolution and timekeeping, IEEE1588v2 timestamps are required to be hardware-generated, since no software could keep up with some stringent requirements, no matter the processing power. PTP is a hierarchical protocol, in which Grandmaster Clocks are directly synchronized with reference clocks such as GNSS or Atomic Clocks, with subsequent layers reaching slaves devices. PTP packets are timestamped with a nanosecond resolution.

To achieve such accuracy, PTP works best on Local Area Networks without passing through the internet: latencies and paths would introduce variables latencies that couldn't be accommodated for in the accumulated delay calculations. PTP packets should always travel the same path during each synchronization phase to preserve such high accuracy. PTP is designed to work on Ethernet transport, Layer-2 (Data-link Layer) or Layer-3 IPv4. And there are two methods to calculate link delay: in End-to-End mode, link delay is calculated from the source of the PTP packet until its destination, while in Peer-to-Peer mode, link delay is calculated as between each network node. In addition, PTP is Internet-capable, with IPv4 in unicast and unicast negotiation modes.



Application example

This network diagram shows the use of ATOP's NTS7500 in a substation environment. The GMC is usually located in the office building adjacent to the substation. On one side, it is connected to the GNSS Antenna, with the other side being the Substation backbone connection. Every switch connected to the Grandmaster should be able to handle all Precision time Protocols by hardware, in order not to affect the synchronization quality. Packets are delivered downstream through Boundary or Transparent clocks, where they'll reach PTP slaves – such as substation IEDs.

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CONFIGURATION EXAMPLE

How It Works

Configuring the NTS7500 is as easy and quick. Simply start from the core unit. Then choose a power supply option (obtaining up to 2 redundant power supplies). Then use the expansion module slots as you please for customizing the device with the number of IRIG-B, serial, and Pulse outputs you need. Plug in and connect to a power supply. Then just jump to Web to configure.

The example below shows a configuration scenario.

NTS7500-CPU-NTP
Stratum 1 NTP Server core unit

NTS7X00-AC Power Module
Redundant power module with two relay output and 110~240 AC/120~240 VDC input

NTS7X00-DC Power Module
Redundant power module with two relay output and 24~60VDC input

8-port IRIG-B - Serial Expansion module, with 2x12-pin terminal block

Power-redundant Substation Grade Stratum 1 NTP Server with 8 x IRIG-B serial outputs and 3 x BNC outputs

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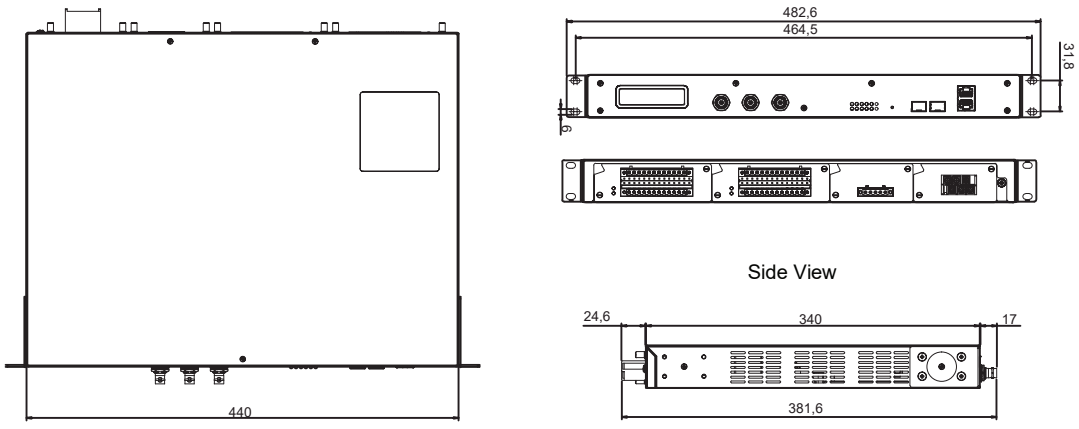
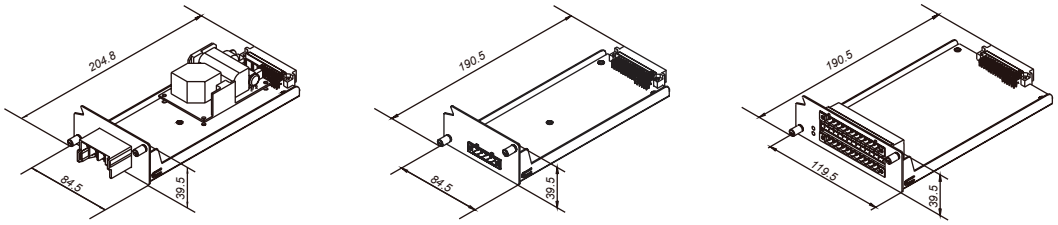
DIMENSIONS & LAYOUT

Grandmaster core module



Modules



SPECIFICATIONS

Grandmaster core

Technical Specifications

Model Name	NTS7500-CPU-NTP (NTP only) or NTS7500-CPU-PTP (NTP Server + PTP GM)
Network Interface	
Standards	IEEE 802.3 10BaseT IEEE 802.3u 100BaseT(X) IEEE 802.3ab for 1000BaseT(X) IEEE 802.3u for 100Base-FX IEEE 802.3z for 1000Base-X ITU-T G.8261 Synchronous Ethernet (NTS7500-CPU-PTP only)
Ports	2x 10/100/1000BASE-T(X) RJ45 combo ports 2x 100/1000 Base-X SFP Slots combo ports
LAN Mode	Dual Subnet or PRP (Parallel Redundancy Protocol)

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GNSS/Clock Specifications		
GNSS Input ports	1x GNSS Input; 1 x BNC (F)	
GNSS Module specific Information	GNSS Supported GNSS Module latency Leap Second Channels	GPS; GLONASS, BEIDOU, Galileo <15ns GNSS/PPS output latency Supported L1
1PPS Output	1x PPS Output, Square Wave, 1000ms pulse width, coaxial BNC (F) connector	
10MHz Reference Output	1x 10MHz Reference Output, Sine Wave, coaxial BNC (F) connector	
Oscillator	Entry-level OCXO	
Software		
Protocols	Network Synchronization	RFC 868 (Time Protocol) RFC 867 (Daytime Protocol) RFC 1119 (NTPv2) Server/ Client RFC 1305 (NTPv3) Server/ Client RFC 5905 (NTPv4) Server/ Client RFC 1769 (SNTPv3) Server/ Client RFC 2030 (SNTPv4) Server/ Client
	Redundancy	IEC62439-3 clause 5 (PRP)
	Configuration and monitoring	RFC 2616 (HTTP/ HTTPS) RFC 1157 (SNMPv1) RFC 1901-1908 (SNMPv2c) RFC 3411-3418 (SNMPv3)
Supported MIBs	MIB II, IF-MIB, SNMPv2 MIB, BRIDGE-MIB, RMON MIB Group 1,2,3,9, RFC RFC 1157, RFC 1213, RFC 1215, RFC 1493, RFC 1643, RFC 1757, RFC 2011, RFC 2012, RFC 2013, RFC 2233, RFC 2571, RFC 2742, RFC 2819, RFC 2863, RFC 3411, RFC 3412, RFC 3413, RFC 3414, RFC 3415, RFC 2674	
Precision Time Protocol NTS7500-CPU-PTP only	Operation Mode	Grandmaster Clock (NTS7500-CPU-PTP only)
	Supported PTP modes	L2 : Multicast L2 VLAN Tagging: Supported L3 IPv4: Multicast, Unicast, Unicast Negotiation One or two-step clock modes supported End-to-End or Peer-to-Peer supported
	Holdover Performance	< 30 ns/second drift when not locked to GNSS, after 24 hours operation total ~1 us/24 hrs drift after locked to GNSS after 24 hours (0.052 us/hr)
	PPS Stability	70 ns when locked to GNSS
	PTP Precision	+/- 50 ns error, as per test with third party slave
	Supported PTP Profiles	PTP default profile, VLAN support C37.238 -2017 Power Profile IEC/ IEEE61850-9-3 Power Profile(2016) User can modify the detailed PTP settings
	Maximum number of Slaves	NTS7500-CPU-PTP can support maximum 2,000 PTPpps (PTP packets per seconds).
Physical Characteristics		
Housing Dimension (W x H x D) Weight Installeation Power inputs Output modules	SPCC IP30 Metal Housing 440 x 44 x 340 mm (not including screws and rack-mount kit) 5.6 Kg (not including module but module cover only) 1U Rack-mount, Rack-mount kit included Dedicated 2 Power module slots (for redundancy) Dedicated 2 Output module slots (IRIG-B and Serial freely exchangeable)	

Environmental Limits	
Operating Temperature Storage Temperature Ambient Relative Humidity	-40°C~85°C (-40°F~185°F) / LCM display maximum 0~70 °C -40°C~85°C (-40°F~185°F) / LCM display maximum -30~80 °C 5%~95% (Non-condensing)

Power Modules

Technical Specifications		
Model name	NTS7X00-AC Power Module	NTS7X00-DC Power Module
Power		
Input Voltage	110-240 AC / 120~240 VDC	24-60 VDC
Input Current (Max)	110-240 VAC, 0.2 A Max 120-240 VDC, 0.2 A Max	24-60 VDC , 0.8 A Max
Input Power (Max)	Approx. 20W Max	Approx. 20W Max
Relay outputs	1 Relay (normal open)	1 Relay (normal open)
Physical Characteristics		
Dimension (W x H x D) Weight Installation	84.5 x 39.5 x 204.8 mm 500 g Cold plug-in (screws provided)	84.5 x 39.5 x 190.5 mm 200 g Cold plug-in (screws provided)

IRIG-B and Serial Output Expansion Modules

Technical Specifications	
Model name	NTS7X00-S1
Interface	
Connector	2 x 12-pin terminal block
Ports	8 x RS-485
Protocols supported	IRIG-B, BCD BJT, ST, ST with Checksum
Configuration	Software-selectable by port, through web interface
Physical Characteristics	
Dimension (W x H x D) Weight Installation	119.5 x 39.5 x 190.5 mm 350 g Cold plug-in (screws provided)

REGULATORY APPROVALS

Regulatory Approvals				
Safety	CB(IEC)/EN 60950-1 & CB(IEC)/EN 62368-1			
EMC	FCC Part 15, Subpart B, Class A, EN 55032:2012, EN61000-6-4, EN 61000-3-2, EN 61000-3-3, EN 55024, EN 55035, EN61000-6-2			
Test	**Item**		**Value**	**Level**
IEC 61000-4-2_2008	ESD	Contact Discharge Air Discharge	±4KV ±8KV	2 3
IEC 61000-4-3_2010	RS	Enclosure Port	10(V/m) , 80-1000MHz 3(V/m), 1.4~6GHz	3
IEC 61000-4-4_2012	EFT	AC Power Port DC Power Port Signal Port	±2.0KV @ 5.0KHz ±1.0KV@ 5.0KHz ±1.0KV @ 5.0KHz	3 2 3
IEC 61000-4-5_2017	Surge	AC Power Port (Waveform: 8/20μs) DC Power Port (Waveform: 8/20μs) Signal Port	Line-to Line±1KV Line-to Earth±2KV Line-to Line±0.5KV Line-to Earth±1KV Line-to Earth±1.0KV Line-to Earth±4.0KV	3 3 2 2 3 4
IEC 61000-4-6_2013	CS	AC Power Port DC Power Port Signal Port	10V, 150KHz~80MHz, 80%AM 10V, 150KHz~80MHz, 80%AM 10V, 150KHz~80MHz, 80%AM	3 3 3
IEC 61000-4-8_2009	PFMF	(Enclosure)	30A/m (r.m.s), 50Hz or 60Hz	4
IEC 61000-4-11_2017	DIP	AC Power Port	30% Reduction (Voltage Dips), 25/30 Cycle 60% Reduction (Voltage Dips) : 10/12 Cycle 100% Reduction (Voltage Dips) : 1 Cycle 100% Reduction (Voltage Interruption) : 250/300 Cycle	3 3 3 3
IEC 61000-4-16	Main Frequency	DC input or output Signal Port Telecommunication Port	30 V continuous / 300V 1	4 4 4
IEC 61000-4-17	Ripple	DC input or output	15% of unit (10% Level 3)	4
IEC 61000-4-18	Damped Oscillatory	AC Power Port DC Power Port	2.5KV common, 1KV differential mode @ 1MHz	4
		Signal Port Telecommunication Port	2.5KV common, 2.5KV differential mode @ 1MHz	4
Shock Drop Vibration	MIL-STD-810G Method 516.5 MIL-STD-810F Method 516.5 MIL-STD-810F Method 514.5 C-1 & C-2			
RoHS2	Yes			
MTBF	9.20 Years			
Warranty	5 years			

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ORDERING INFORMATION

Main core and Modules		
Model Name	**Part Number**	**Description**
NTS7500-CPU-PTP	1P1NTS75000001G	IEEE1588v2 PTP Grandmaster and NTP Server core
NTS7500-CPU-NTP	1P1NTS75000002G	NTP Server core-unit
NTS7X00 SERIAL MODULE	1P1NTS7X000001G	IRIG-B and Serial Output module for NTS7500 - 16-pin Terminal Block
NTS7X00-AC POWER MODULE	1P1NTS7X000002G	T;110~240 VAC;120-240 VDC,0.2A;G
NTS7X00-DC POWER MODULE	1P1NTS7X000003G	T;24-60 VDC;0.8A Max;G

Optional Accessories		
Model name	**Part Number**	**Description**
SDR-75-24	50500752240001G	DIN RAIL POWER SUPPLY / T;AC 88~264V to 24VDC 3.2A;75W
LM38-A3S-TI-N	50708051G	SFP Transceiver, 155Mbps, 1310nmFP, Multi-mode, 2km, 3.3V, -40~85°C
LS38-A3S-TI-N	50709431G	SFP Transceiver, 155Mbps, 1310nmFP, Single-mode, 30km, 3.3V, -40~85°C
LM28-C3S-TI-N	50708031G	SFP Transceiver, 1250Mbps, 850nmVCSEL, Multi-mode, 550m, 3.3V, -20~85°C
LM38-C3S-TI-N	50709411G	SFP Transceiver, 1250Mbps, 1310nmFP, Multi-mode, 2km, 3.3V, -40~85°C
LS38-C3S-TI-N	50709391G	SFP Transceiver, 1250Mbps, 1310nmFP, Single-mode, 10km, 3.3V, -40~85°C
LS38-C3L-TI-N	50709441G	SFP Transceiver, 1250Mbps, 1310nmDFB, Single-mode, 30km, 3.3V, -40~85°C
High-Accuracy GNSS Active Antenna	59901591G	Outdoor Antenna - GL-111
RHG9528-BS	See datasheet	IEC61850-3 Rack-mount Modular Managed Switch & 1588v2 BC/TC
EHG9508/12	See datasheet	IEC61850-3 DIN-Rail Managed Switch & 1588v2 TC

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