



## FEATURED HIGHLIGHTS

- High precision Multi-GNSS module (supports GPS, GLONASS, Galileo,...)
- Wide support for PTP Telecom and Power Profiles (over L2 and IPv4)
- Holdover <1.5us/day time-drift when disconnected from GNSS
- 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 Grandmaster

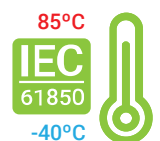
The NTS7700 1U 19" Rack-mount Modular Grandmaster Clock is a high-powered, rugged IEEE1588v2 PTP device that offers high industrial precision and reliability. Suitable for almost any environment and complying with the harshest Industrial EMC conditions, ATOP's GMC satisfies all stringent industry requirements for Substation, Telecom and 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 CRC.

**Highly Accurate Time Precision:** NTS7700 satisfies the requirements specified by ITU for Telecom Grandmasters. For instance, when disconnected from a GNSS time source, its high-precision Oven-controlled Oscillator (OCXO), combined with hardware timestamping, ensures time drift (1PPS output) does not exceed 1.5  $\mu$ s per day (less than 62ns/hour). So in the event of an Antenna or a GPS System failure, it will guarantee time and frequency to be accurate and precise as demanded by LTE network requirements for proper operation.



**Wide PTP Standard Support:** The possible PTP configurations are endless. NTS7700 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. NTS7700 fully supports IEEE C37.238-2017 and IEEE/IEC 61850-9-3 – 2016 Power Profiles; and ITU-T G.8265.1 and ITU-T G.8275.1 G.8275.2 Telecom Profiles for Frequency, Time and Phase Synchronization.

**Industrial and Substation Hardware :** Designed to satisfy EMC requirements for Substation-Grade equipment, NTS7700 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.



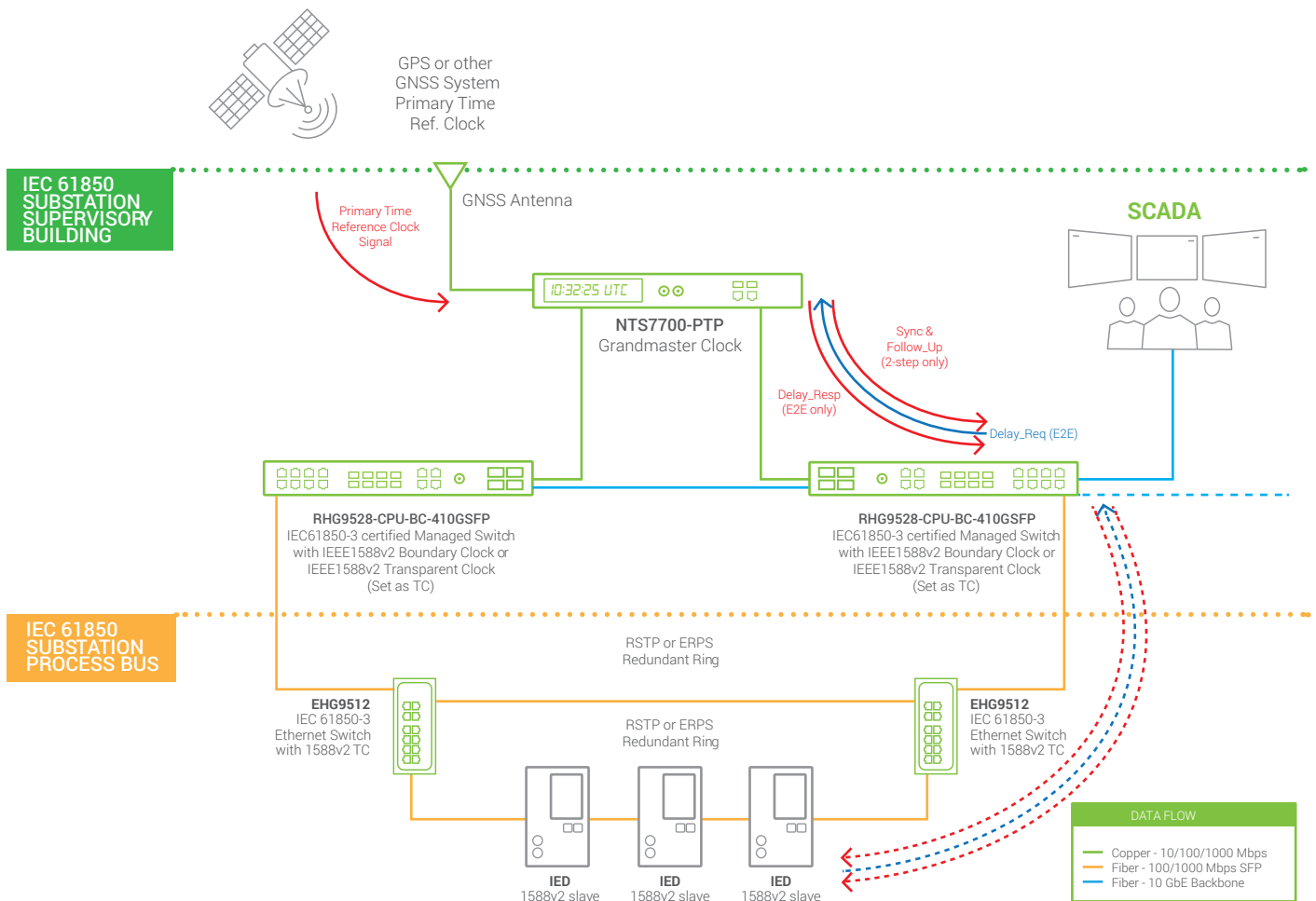
**Proven design:** No standardized testing procedure for PTP devices exists. So ATOP tests its products yearly in ISPCS Plugfests to demonstrate their reliability. NTS7700 was successfully tested in Stockholm in 2016, in Monterey in 2017 and in Geneva in 2018. More information available on [www.ispcs.org](http://www.ispcs.org).

# 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 (Stratum 1 Clocks) are directly synchronized with reference clocks (Stratum 0 Clock) 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

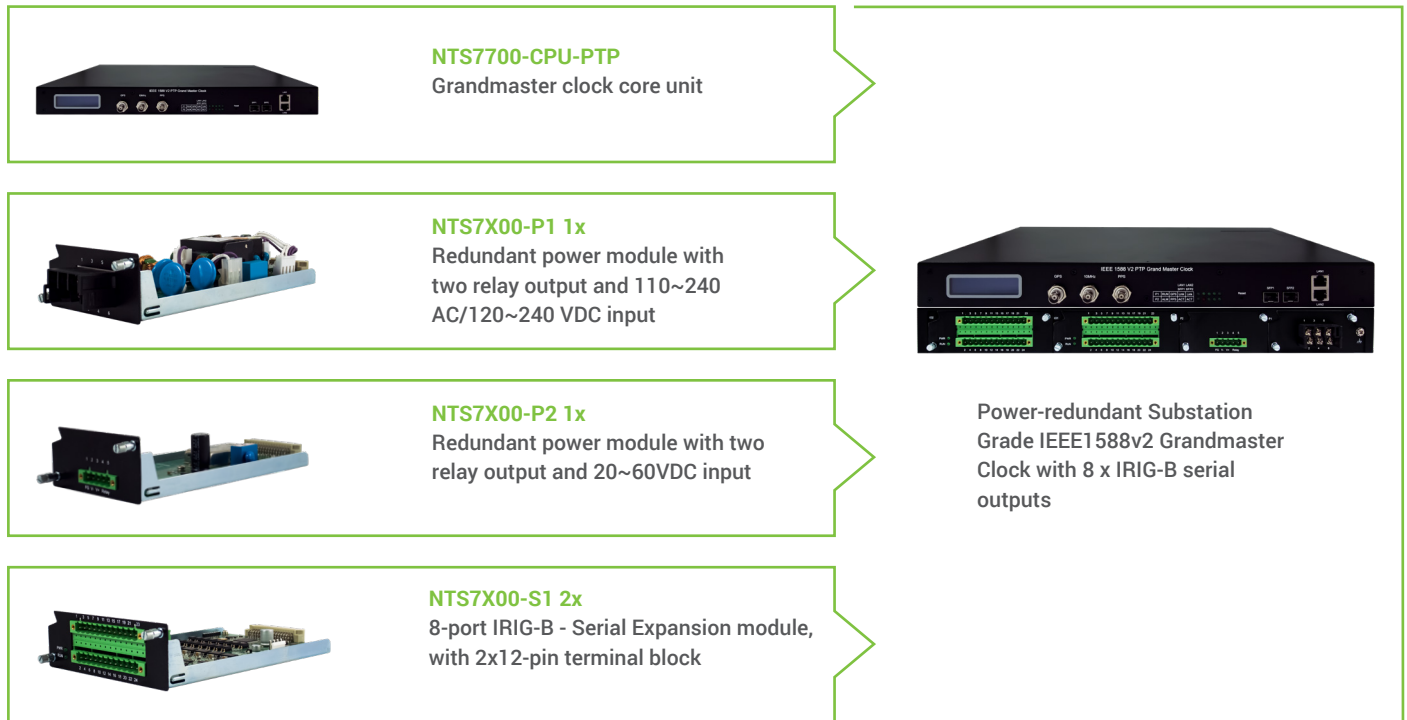
This network diagram shows the use of ATOP's NTS7700 in a substation environment. The GMC is usually located in the office building adjacent to the substation. On one side, it is connected to the GNSS Antenna, with the other side being the Substation backbone connection. IEC61850 substations require all hardware to be comply with stringent EMC compatibility and wide temperature requirements. 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.

## CONFIGURATION EXAMPLE

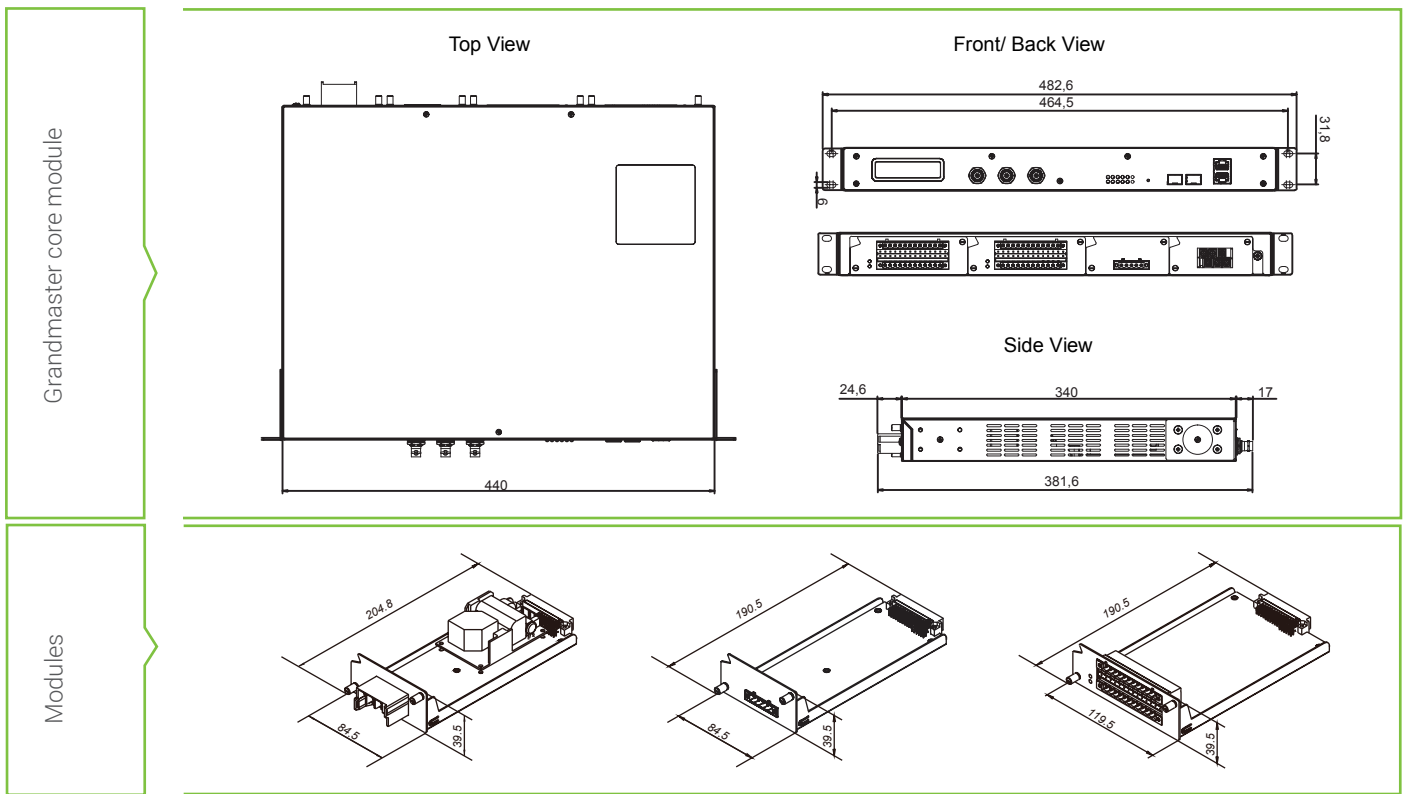
### How It Works

Configuring the NTS7700 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 you need. Plug in and connect to a power supply. Then just jump to Web to configure.

The example below shows a configuration scenario.



## DIMENSIONS & LAYOUT



## SPECIFICATIONS

### Grandmaster core



### Technical Specifications

Model Name	NTS7700-CPU-PTP
<b>Network Interface</b>	
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
Ports	2x 10/100/1000BASE-T(X) RJ45 combo ports 2x 100/1000 Base-X SFP Slots combo ports
LAN Mode	Dual Subnet

GNSS/Clock Specifications		
GNSS Input ports	1x GNSS Input; 1 x BNC (F) - active Antenna	
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	Advanced managed OCXO, with temperature drifting compensation	
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
	Configuration and monitoring	RFC 2616 (HTTP/ HTTPS) RFC 1157 (SNMPv1) RFC 1901-1908 (SNMPv2c)
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	Operation Mode	Grandmaster Clock
	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	< 60 ns/hour drift when not locked to GNSS, after 24 hours operation
	PTP Precision	< 50 ns error
	Supported PTP Profiles	PTP default profile C37.238 -2017 Power Profile IEC/ IEEE61850-9-3 Power Profile(2016) VLAN setting for Power Profile ITU-T G.8265.1 Telecom Profile (Frequency) ITU-T G.8275.1 Telecom Profile (Phase/Time) ITU-T G.8275.2 Telecom Profile (Phase/Time) User can modify the detailed PTP settings
	Maximum number of Slaves	NTS7700 can support maximum 2,000 PTPpps (PTP packets per seconds).
Physical Characteristics		
Housing Dimension (W x H x D) Weight Installation 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	-40°C~85°C (-40°F~185°F) / LCM display maximum 0~70 °C
Storage Temperature	-40°C~85°C (-40°F~185°F) / LCM display maximum -30~80 °C
Ambient Relative Humidity	5%~95% (Non-condensing)

### Power Modules



### Technical Specifications

Model name	NTS7X00-P1	NTS7X00-P2
<b>Power</b>		
Input Voltage	110-240 AC / 120~240 VDC	20-60 VDC
Input Current (Max)	110-240 VAC, 0.2 A Max 120-240 VDC, 0.2 A Max	20-60 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)	84.5 x 39.5 x 204.8 mm	84.5 x 39.5 x 190.5 mm
Weight	500 g	200 g
Installation	Cold plug-in (screws provided)	Cold plug-in (screws provided)

### IRIG-B and Serial Output Expansion Modules



### Technical Specifications

Model name	NTS7X00-S1	NTS7X00-S2
<b>Interface</b>		
Connector	2 x 12-pin terminal block	BNC(F) connector
Ports	8 x RS-485	3 x RS-485
Protocols supported	IRIG-B, BCD BJT, ST, ST with Checksum	IRIG-B, BCD BJT, ST, ST with Checksum
Configuration	Software-selectable by port, through web interface	Software-selectable by port, through web interface

### Physical Characteristics

Dimension (W x H x D)	119.5 x 39.5 x 190.5 mm	119.5 x 39.5 x 190.5 mm
Weight	350 g	350 g
Installation	Cold plug-in (screws provided)	Cold plug-in (screws provided)

## REGULATORY APPROVALS

Regulatory Approvals				
Safety	EN/IEC(CB) 60950/62368			
EMC	FCC Part 15, Subpart B, Class A, EN 55032, EN 55024, EN 61000-6-4:2007+A1 2011, EN 61000-3-2, EN 61000-3-3, EN 61000-6-2:2005			
Power Automation	IEC61850-3 (pending), IEEE 1613 (pending)			
Test	Item	Value	Level	
IEC 61000-4-2	ESD	Contact Discharge	±8KV	4
		Air Discharge	±15KV	4
IEC 61000-4-3	RS	Enclosure Port	30(V/m), 80-1000MHz, 80% AM, 1~3GHz	3
IEC 61000-4-4	EFT	AC Power Port	±4.0KV @ 5~100kHz	4
		DC Power Port	±4.0KV @ 5~100kHz	4
		Signal Port	±2.0KV @ 5~100kHz	4
IEC 61000-4-5	Surge	AC Power Port	Line-to Line±2.0kV	4
		AC Power Port	Line-to Earth±4.0kV	4
		DC Power Port	Line-to Line±2.0kV	4
		DC Power Port	Line-to Earth±4.0kV	4
		Signal Port	Line-to Earth±4.0kV	4
IEC 61000-4-6	CS	0.15-80MHz	30V rms	4
IEC 61000-4-8	PFMF	(Enclosure)	100A/m continuous, 1000A/m (3s)	5
IEC 61000-4-11	DIP	AC Power Port	Drop 70% 3 times/s (1period) Drop 40% 3 times/1ms (50 period) Drop 100% 3 times/50m(5-50per.)	-
IEC 61000-4-16	Main Frequency	DC input or output	30 V continuous / 300V 1	4
		Signal Port		4
		Telecommunication Port		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	2.5KV common, 1KV differential mode @ 1MHz	4
		DC Power Port		4
		Signal Port	2.5KV common, 2.5KV differential mode @ 1MHz	4
		Telecommunication Port		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	TBD			
Warranty	5 years			

## ORDERING INFORMATION

### Main core and Modules

Model Name	Part Number	Description
NTS7700-CPU-PTP	1P1NTS77000001G	IEEE1588v2 Grandmaster clock core-unit, IEC61850-3 certified
NTS7X00-P1	1P1NTS7X00P101G	20~60 VDC / one Relay output power module for NTS7700
NTS7X00-P2	1P1NTS7X00P201G	110~240VAC or 120~240VDC /one Relay output power module for NTS7700
NTS7X00-S1	1P1NTS7X00S101G	IRIG-B and Serial Output module for NTS7700 - 16-pin Terminal Block
NTS7X00-S2	1P1NTS7X00S201G	IRIG-B and Serial Output module for NTS7700 - 8x BNC (F) connectors

### 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
TBD	Ask for more info	Antenna Cable, 10 m
TBD	Ask for more info	Outdoor Antenna
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