

Industry 4.0 Telecom-5G IEC61850 SmartGrids MiFID-II

NTS-5000 Rb+ocxo

NTP/PTP IEEE1588 Modular Time Server

● PTP IEEE1588 Grand Master

● NTP STRATUM-1 Time Server



● CLOCK* ePRTC* PRTC-A PRC

● LAN 10GbE* 1GbE 100Mbps

● IEEE1588 hardware stamping

● SECURITY private PTP-stacks

● PROFILES all PTP IEEE1588

● HOLDOVER Rubidium/OCXO

● IRIG-B DCLS fiber/TTL/rs422

● IRIG-B AM analog modulation

● SMART 700m NTS-antenna

● SNMP v3 v2 MIB2 RADIUS

● CRYPTO MD5 RSA DSA SSL

● REMOTE HTTP HTTPS SSH

● OUTPUT PPS PPM PPH 10MHz

● REDUNDANT power supply

● MiFID II Financial Markets

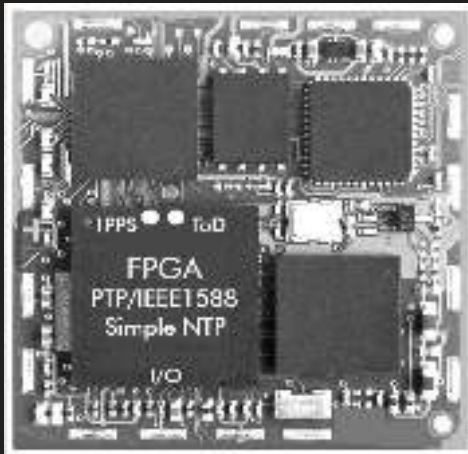
● IEC61850 Smart Grids

● TELECOM 5G ePRTC ready*

 ELPROMA

www.elpromatime.com

* extra feature requiring additional hardware and/or software firmware upgrade



FPGA supports hardware timestamping

Each NIC card is equipped with local FPGA & private PTP-stack



All NIC cards are 100% isolated from each other using analog PPS & internal communication (no TCP/IP)



4x NIC (EXPANDER 1-4) are 100% isolated from each other. There is analog communication between NIC and NTS-5000 (no TCP/IP)

NTS-5000 is Rubidium and **NTS-5000LITE** is OCXO holdover class network appliance. It delivers **Time/Date** and **Frequency** using PTP IEEE1588, NTP and IRIG-B protocols. It can stabilize the frequency of end-device clock using SyncE*, PPS, 10MHz signals. The std. configuration includes **LAN1 - LAN2 100/10Mbps** upgradable to **10GbE** each. Another **8x 1GbE** (grouped pairs: LAN3-4, LAN5-6, LAN7-8, LAN9-10) are optional. The 8x 1GbE are very special interfaces. They are located in isolated **EXPANDER1-4*** Network Interface Cards (NIC) supporting PHY **hardware time-stamping** with profiles. Built-in oscillators **Rubidium** or **OCXO** ensures holdover when missing GNSS signals.

NTS-5000 changes the paradigm of cyber security

Comparing to other products, the NTS-5000 is the only device on a market today supporting **private PTP-stack** and exclusive FPGA (with Real Time Firmware) for each EXPANDER1-4 network card NIC individually. It makes each EXPANDER NIC operating autonomous GRANDMASTER and 100% isolated from others. Internal synchronization is supported by NTS-5000 using **analog signal PPS/ToD** (no TCP/IP communication).

In practice, these seemingly ordinary feature is not obvious, but it is the critical factor for ensuring modern **cyber security** of IT/IoT and future IIoT/Industry 4.0.

It ensures the hackers can not break into NTS-5000 server taking any control over it. Hackers can not move between networks supported by different EXPANDERS either. It successfully helps prevent „**Time Synchronization attack**“, a situation where hacked network device can interfere others synchronization by introducing a network traffic. The random network traffics are especially a dangerous one for destabilizing IT/IoT. Above argues make NTS-5000 most popular at DATACOM, TELECOM, SMART-GRIDS.

Simultaneous PTP-profiles

The typical PTP/NTP network devices have a single FPGA chip and PTP-stack inside. This is a cost effective solution, but it has a serious limitations too. It lets support only a single PTP-profile at the time and for all LAN outputs.

The NTS-5000 is different. The nature of autonomous grandmasters enables simultaneous support of different HW PTP-profiles, each set individually for specific EXPANDER1-4 network card.

It lets single NTS5000 server synchronize several IT/IoT infrastructures at the time using different IEEE1588 PTP-profiles:

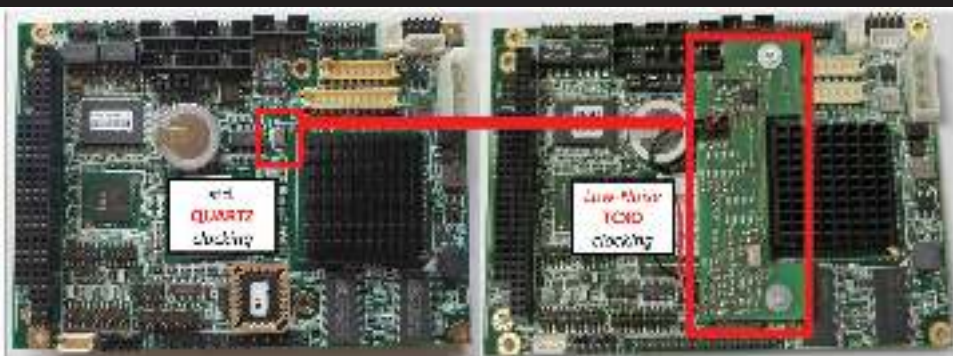
DATACOM (Default Profile, HA*)
 TELECOM ITU-T G.8275.1 Freq
 TELECOM ITU-T G.8275.2 T&F
 POWER IEEE C37.238/IEC 61850-9-3

Performance Confirmed by Professional Metrology Market (NMI)

The autonomous grandmaster technology ensures synchronization performance too. The 2017 MiFID-II NPL tests for London Stock Exchange confirmed accuracy of 50ns. Synchronizing NTS-5000 **MASTER-2-SLAVE**, the PTP accuracy improves up to 25ns. Using **White Rabbit** IEEE1588 v2.1 protocol the accuracy can reach a level below 1ns.

HOLDOVER vs. LOW NOISE

The std. NTS-5000 is equipped with Rubidium or OCXO holdover oscillator ensuring UTC stability when missing GNSS signals. Extra ordinary **LOW-NOISE TCXO** clocking is available too. It replaces std. QUARTZ clocking by TCXO clock (see picture below). The **LOW-NOISE** has impact on NTP/PTPd accuracy, precision, stability and holdover.



STD HOLDOVER

GNSS less time	max. TIME ERROR	
	Rubidium (Rb)	OCXO
1s	0.1[ns]	5 [ns]
1minute	10 [ns]	300 [ns]
1hour	30 [ns]	560 [ns]
1day	0.8[us]	47 [us]
1week	11 [us]	2.2 [ms]
1month	0.2[ms]	40 [ms]
1year	16 [ms]	1.6 [s]

LOW-NOISE HOLDOVER

GNSS less time	max. TIME ERROR	
	Rubidium (Rb)+TCXO	OCXO+TCXO
1s	0.1[ns]	3 [ns]
1minute	9 [ns]	140 [ns]
1hour	25 [ns]	250 [ns]
1day	0.7[us]	22 [us]
1week	9 [us]	1.2 [ms]
1month	0.2[ms]	22 [ms]
1year	12 [ms]	0.9 [s]

Standard GNSS Receiver and Antenna

Std. product includes smart NTS-antenna (pcs. 1). Optionally 2x smart NTS-antennas are supported. Server antenna input PPS accuracy better than 5ns. Final accuracy depends on selected GNSS receiver. The multi-path mitigation* GNSS-rcv is available. The anti-jamming/spoofing is available as option* Supported single band L1 GNSS systems are:

GPS	L1 (1575,42MHz)
GLONASS	L1 (1598,06-1605,38MHz)
GALILEO*	E1 (1575,42MHz)
BEIDOU*	L1 (1561,09-1575,42MHz)

Dual band frequency options: L1+L2 or L1+L5
The replaceable GNSS modules is extra pay service.

Network Time Protocol NTP v2, v3, v4 LAN1-2:

RFC1305
RFC1119
RFC5905
RFC5906
RFC5907
RFC4330
RFC2030

Performance

GNSS synchronization precision /1PPS-in stability @ 1-sigma/ < 5ns
ELPROMA PTP master2slave synchronization accuracy at LAN < 25ns
Network performance at full load (All std. LAN interfaces) 9000 req/s
Max. concurrent NTP clients served at 1024 polling rate 9.2 mln

Precision Time Protocol PTP IEEE1588 LAN3-10:

Profiles:
Default
Telecom ITU-I G.8265.1
ITU-I G.8275.1
ITU-I G.8275.2
Power IEEE C37.238
IEC 61850-9-3*
Audio** AES67**
Finance** HA White Rabbit**

Standard I/O

Factory defaults	ANT	LAN	PPS	10Mhz	IRIG-B AM	IRIG-B DCLS
Sync INPUT	2x RJ45	2x RJ45	2x BNC	1x BNC	2x BNC	2x DSUB-9 (TTL)
OUTPUT	2	2	1	0	1	1
	(NMEA183)	(see above)	1	1	1	1
	(RJ45)	(RJ45 & SFP)	(BNC 50 Ohm)	(BNC 50 Ohm)	(BNS 50 Ohm)	(DSUB-9 pin)

Special I/O

2x USB 2.0 (for firmware upload) 1x DSUB-9 TTY (RS232) 2x ANT1-2 OUTPUT (NMEA183 EMULATION)

Network Interfaces

Expander #No	LAN1-2	LAN3-4*	LAN5-6*	LAN7-8*	LAN9-10*
Network speed	MAIN UNIT	#1	#2	#3	#4
Network speed update to 10Gb (SFP)	100/10Mbps	1GbE	1GbE	1GbE	1GbE
Network Interface Connector Ended	<YES>	<NO>	<NO>	<NO>	<NO>
Timestamping	LAN1: RJ45	LAN3: SFP	LAN5: SFP	LAN7: SFP	LAN9: SFP
Precision Time Protocol IEEE1588	LAN2: RJ45	LAN4: RJ45	LAN6: RJ45	LAN8: RJ45	LAN10: RJ45
	SOFTWARE	HARDWARE	HARDWARE	HARDWARE	HARDWARE
	PTPd	PTPv2:2008	PTPv2:2008	PTPv2:2008	PTPv2:2008
PTP mode (clock)	MASTER	MASTER	MASTER	MASTER	MASTER
IEEE1588 Profiles	SLAVE	SLAVE	SLAVE	only	only
TELECOM ITU-T	<NO>	Default	Default	Default	Default
	<NO>	G.8265.1	G.8265.1	G.8265.1	G.8265.1
	<NO>	G.8275.1	G.8275.1	G.8275.1	G.8275.1
	<NO>	G.8275.2	G.8275.2	G.8275.2	G.8275.2
POWER IEEE C37	<NO>	IEEE C37.238	IEEE C37.238	IEEE C37.238	IEEE C37.238
UTILITY IEC61850-3-9	<NO>	(via C37.238)	(via C37.238)	(via C37.238)	(via C37.238)
PTP max. #SLAVE support	UNLIMITED	32 (default)	32 (default)	32 (default)	32 (default)
PTP max. #SLAVE support hardware*		128/256/450*	128/256/450*	128/256/450*	128/256/450*
max. Network Performance REQ/s	100,000/s				
NTP max. #CLIENTS concurrent/1024pool	9 mln				
NTP Network Time Protocol support	NTP/SNTP	SNTP	SNTP	SNTP	SNTP
NTP client compatybility	NTP/SNTP	NTP/SNTP	NTP/SNTP	NTP/SNTP	NTP/SNTP
	CHRONY	CHRONY	CHRONY	CHRONY	CHRONY
Synchronous Ethernet (ITU-T G.8261.1)	<NO>	SyncE	SyncE	SyncE	SyncE
		Master & Slave	Master & Slave	Master & Slave	Master & Slave

EXPANDER 1-5

Factory defaults	EXP #1	EXP #2	EXP #3	EXP #4	EXP #5
10GbE support (software time-stamping)	<NO>	<NO>	<NO>	<NO>	<NO>
1 GbE support (hardware time-stamping)	1x10GbE	1x10GbE	<NO>	<NO>	<NO>
IRIG-B DCLS	2x 1GbE	2x 1GbE	2x 1GbE	2x 1GbE	1x 10GbE
	<NO>	<NO>	<NO>	4x RS422+	2x TTL 5V
				+PPS MOSFET	2x FIBER
IRIG-B AM	<NO>	<NO>	<NO>	<NO>	2x TTL 5V
RELAY (PWR-A, B, SYNC, GNSS)	<NO>	<NO>	4x ALARM	<NO>	<NO>

Remote Configuration •SNMP v2, v3 •MIB 2 •RADIUS •HTTP •HTTPS •SSH •TELNET •NTPQ/NTPDC •MODBUS**

Mechanical/Environmental

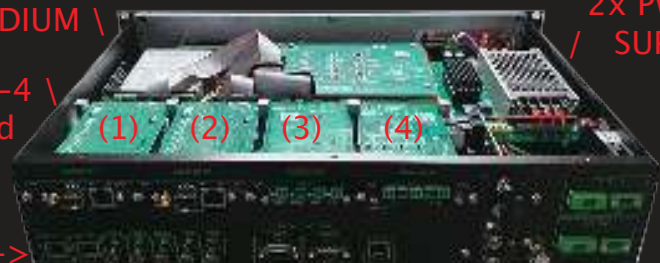
Size: •484 x 300 x 88,8 mm (rack'19 2U)
Power: •110-230 VA/120-370VDC (max. 1A)
•20-70 VDC (max. 2A)
Max. power: 80W w/Rb; LITE w/o Rb 60W
Oper. temp: -55°C +80°C (antenna) 0°C +60°C (server)
Storage temperature: -55°C +80°C (set)
Humidity: up to 95% MTBF 391000 hours

RUBIDIUM \

EXPANDER1-4 \
100% isolated

STD.

INTERFACES ->



2x PWR
/ SUPPLY

DATACOM & FINANCIAL Popular Configurations

DATACOM1: 2x100/10Mbps (Software Time-Stamping) LAN1&LAN2



DATACOM2: 1x10GbE(LAN1) + 1x100/10Mbps LAN2 (Software Time-Stamping)



DATACOM4: 2x1GbE LAN3-4 (Hardware Time-Stamping) + DATACOM1 config



DATACOM5: 4x1GbE LAN3-6 (Hardware Time-Stamping) + DATACOM1 config



DATACOM7: 8x1GbE LAN3-LAN10 (Hardware Time-Stamping) + DATACOM1



DATACOM9: 6x1GbE LAN3-8 (Hardware Time-Stamping) + DATACOM2”(LAN2)



SMART GRIDS & INDUSTRY 4.0 Selected Configurations

SMART-GRIDS1 4xIRIG-B DCLS rs422 (Expander #4) basis on DATACOM-5 conf.



SMART-GRIDS2 2xDCLS Fiber 2xDCLS TTL (Exp. #5) basis on DATACOM-5 conf.



SMART-GRIDS3 is a summary of 2x& 3 item above



SMART-GRIDS4 is like SMART-GRIDS3 with extra 4x ALARM RELAY



SMART-GRIDS CUSTOM1 - This is PTP SLAVE generating IRIG like SMARTGRIDS4



SMART-GRIDS CUSTOM2 - This is PTP SLAVE + CUSTOMS1 (above) + 10GbE out



TELECOM Lte/5G Selected Popular Configurations

TELECOM-1 PRTC-A 2x100/10Mbps, 48VDC

NTP-Server w/ PTPd support



TELECOM-3 PRTC-A 2x10GbE, 48VDC SW-stamping NTP-Server w/ PTPd support



TELECOM-5 PRTC-A 4x1GbE HW-stamping Autonomous NTP/PTP GrandMasters



TELECOM-7 PRTC-A 8xGbE HW-stamping Autonomous NTP/PTP GrandMasters



TELECOM-8 PRTC-A 2x10GbE, 4xGbE HW-stamping Autonomous GrandMasters



TELECOM-9 ePRTC 1x10GbE, 4xGbE HW-stamping Autonomous GrandMasters

