

NTS-pico3

Miniature NTP Time Server for Small Networks



User Manual

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Release notes

Firmware 200130

- + accuracy improvements
- + update nvram-rtc to initialize RTC time when it is too old
- + gpsd enabled and monitored by monit
- + RTC as time source as option in web interface

Firmware 191204

- + /etc/ptp4l.cfg

Firmware 191128

- + enable ntpd to synchronize from RTC as backup time source
- + noselect option disables synchronization to RTC but allows to monitor corrected RTC time vs system time
- + simplified web interface (without advanced tab)
- + PTP configuration via web interface

Firmware 190724

- + PPS OUT
- + ptp4L instead of ptpd2
- + nvram-rtc
- + memtester tool

Introduction

Safety instructions

Except external power supply (230VAC), this equipment contains DC (9-30VDC) voltages. Do not handle any metallic part until the 230VAC power supply has been disconnected! Do not assemble, disassemble set when the power reminds switched ON. Making wiring and touching cables is strongly prohibited when power is ON. Never work alone under hazardous voltage conditions. Always check that the power cord(s), plug(s), and sockets are in good conditions. Always use qualified service personnel to install permanently wired equipment and surge antenna arrestors.

What is NTS-pico3?

NTS-pico3 is next generation ultra miniature time server. It delivers time directly to network using NTP and PTP/IEEE1588 protocols. It is equipped with single 100/10Mbps Ethernet port working with IPv4/IPv6*. Unit is very small and natural air cooling. It has been designed for small industrial networks and it can operate 24/7. It is powered in range 9-30VDC. It is equipped with GNSS antenna and 30 meter coax cable (SMA ended). Marine antenna has built-in GPS signal amplifier (38dB gain) and TCXO holdover oscillator for GNSS less operations.

With hardware timestamping **NTS-pico3** can achieve accuracy $< 200\text{ns}$. Server has multi-satellites receiver simultaneously supporting: GPS, GLONASS. It is GALIELO*, BEIDOU* ready. Server has very fast (less than $0.5\text{ms} \pm 1\text{ppm}$) Time To First Fix TTFF synchronization startup. The GNSS receiver accuracy is better than 15ns (at 2 sigma). Server supports cryptographic authentication for NTP. Holdover mode ensure synchronization accuracy to be better than 4ms in first hour. After 24h the max. holdover error is not bigger than 100ms on server output.



NTS-pico3 id dedicated for up 10 pcs networks

The **NTS-pico3** GNSS receiver is designed for automatic operation without the need for user intervention. It can however, be accessed via a serial port (RS232 or USB) for configuration and debug purposes. Following synchronization Ethernet protocols are supported:

- **NTP Network Time Protocol (rfc5905)**

- **SNTP Simple NTP (rfc 4330)**
- **PTP Precision Time Protocol IEEE1588:2008**

Referential UTC is drawn from GPS & Glonass via built-in GNSS receiver, using NMEA183 frame. NTS-pico3 can also act as an 1PPS frequency reference clock. It can distribute 1PPS using NTP or PTP IEEE1588 protocol. It has also 1 SMA 1PPS output. 1PPS specification:

PPS- out 3.3 VDC (50Ohm)

Pulsewidth: 1ms (pulsewidth)

The PPS-out signal goes directly from GNSS receiver.

Note: In new version of NTS-pico3 there are more options to choose and PPS-output can be set to baseline of NTP or PTP internal clocks of NTS-pico3.

The old version NTS-pico (manufactured 2016-2019) does not support above. This version of product cannot be hardware & software update to new NTS-pico3 and it is required to purchase new one.

For those customers who wants to move from NTS-pico to new NTS-pico3 the Elproma sales offers special discounted price.

Installation

Hardware

The **NTS-pico3** box on arrive includes:

1. **NTS-pico3** miniature time server (pcs 1)
2. **Power supply 12VDC/230VAC** (pcs 1)
3. **Outdoor active GNSS antenna w/ 30m coax H-155 and accessories** (pcs 1)

Options (not included in standard set):

4. **Ethernet cable 1m RJ45/RJ45** (pcs 1)
5. **RS232 cable 1m DB-9/RJ45** (pcs 1)

Note! Set does not include antenna mast, but antenna can be mounted directly using attached accessories: claps, bracket, nuts etc. - they are included.

General presentation

NTS-pico3 includes:

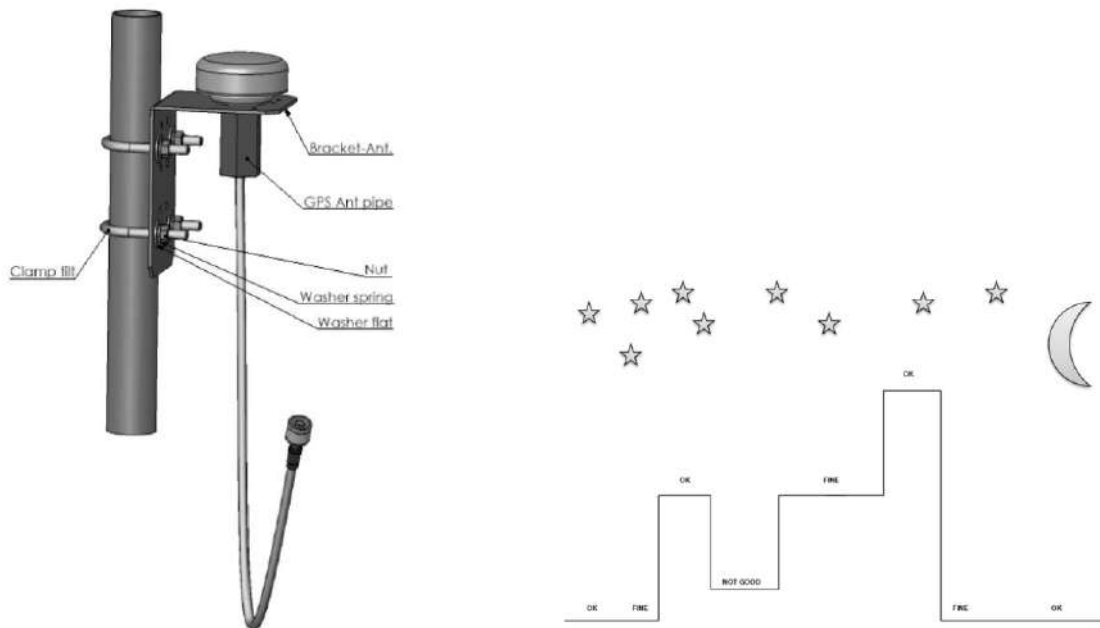
- 1x GNSS (SMA)
- 1x PWR (VDC)
- 1x 1PPS (SMA)



NTS-pico3 picture view

Antenna Mounting

Installing a basic system will require the following (a) **mounting of the antenna** (b) optionally **mounting 1 or 2 lightning arrestors** (not included to product set). The antenna supplied is of the active type, and is suitable for almost all applications. It is supplied with a pre-attached, 30-meter H-155 coax cable, terminated with a male SMA connector. Before commencing installation, check that all the items detailed in the contents list have been supplied. The antenna is supplied with mounting clamps for attachment to a mounting pole, included too. Mast antenna suspension (H=0.5m) is not included but it is available as separate products from Elpoma. Following figure shows an example of how mounting antenna might be achieved.



Mounting GNSS antenna

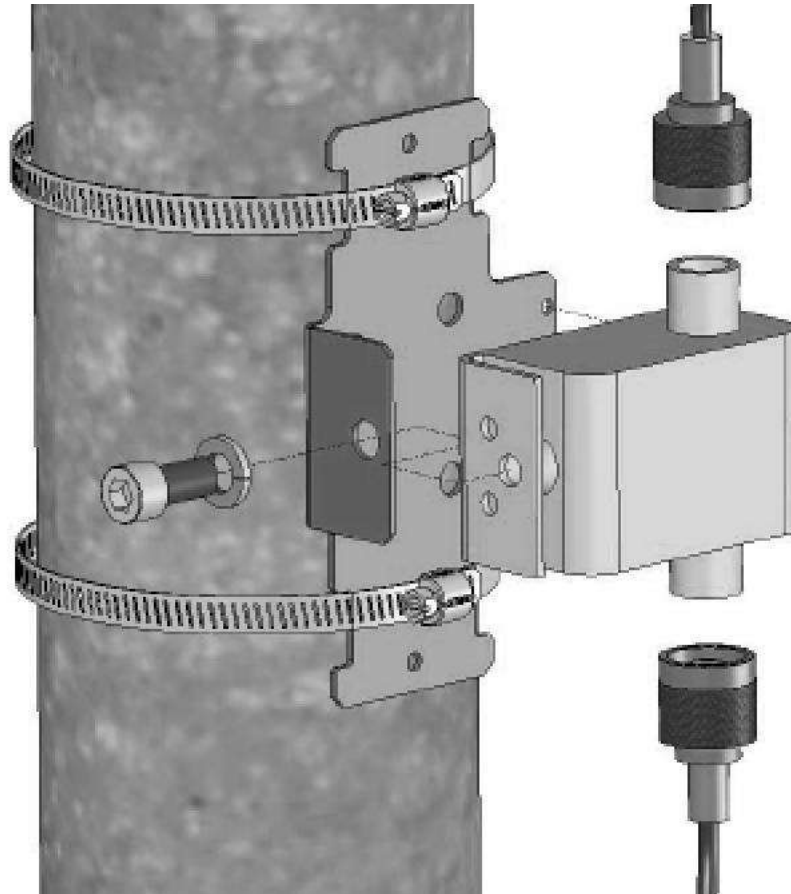
Note! The most important consideration in selecting a position for the antenna is the presence of objects which obscure the sky or horizon. Where possible, there should be no obstruction to a full view of the sky.

Overhead wires and other very narrow obstructions may be considered as invisible to the signals, provided that they are a few meters away. Large flat surfaces can decrease performance of the receiver. Be especially wary about mounting the antenna directly onto the fascia of a flat roof. To overcome this situation, elevate the pole about 1 meter above the flat surface. A satellite prediction mobile phone program may usefully be employed to check a potential installation, and also to identify directions in which obstructions may be a particular source of problems.

Note! When the **NTS-pico3** is operational, the GNSS antenna assembly may be disconnected for short periods (e.g. maintenance or repair) without interruption to the unit synchronization LAN output.

Additional lightning protection considerations

As the antenna is roof mounted (to have a clear view of the sky) it is likely to be exposed to lightning strikes.



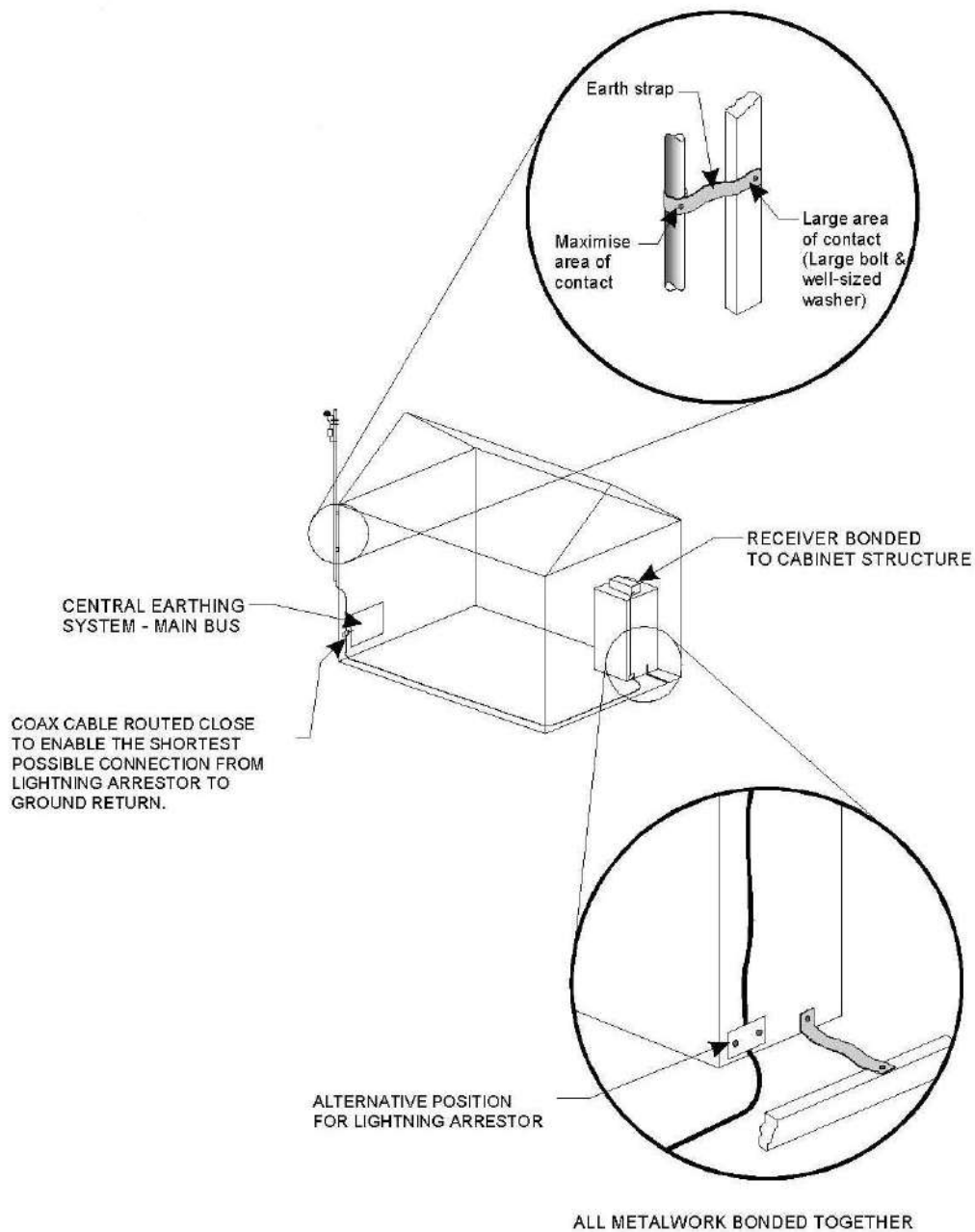
Protection against this is afforded by ensuring adequate grounding of the mountings as described below. There is no way to provide 100% protection for electronic equipment from direct strike damage. It is possible however, to reduce the likelihood of damage from near strike induced fields by ensuring the installation obeys some fundamental rules.

A proprietary lightning arrestor should be installed, of a type which does not reduce GNSS signal transfer. Install the lightning arrestor near to the antenna (e.g. on the mounting pole), ensuring all connections maintain electrical and environmental protection.

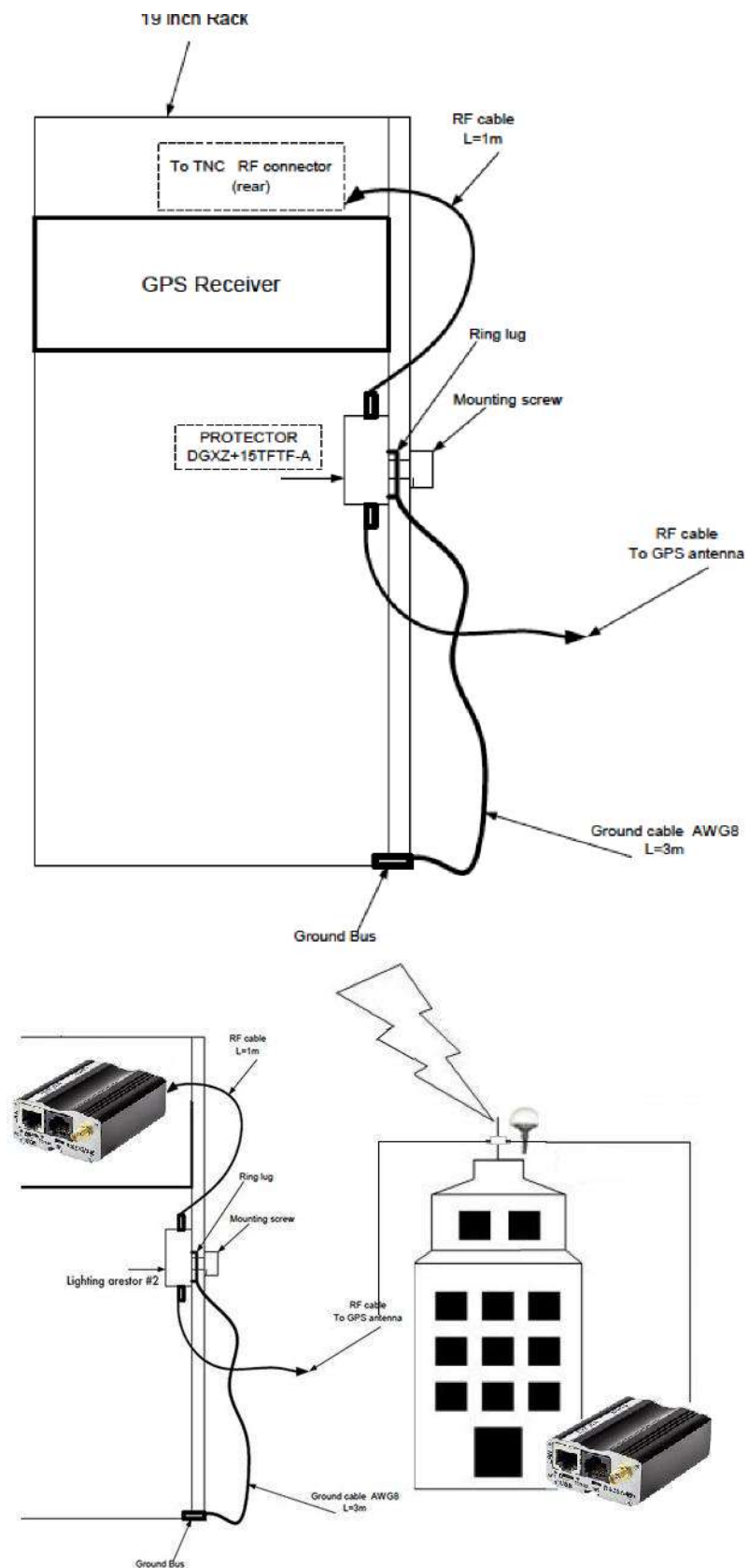
After taking the precautions described previously in the antenna installation, it should be understood that a destructive residual current may still be present in the cable coming down from the antenna to the **NTS-pico3** unit.

A second lightning arrestor should be installed near to the **NTS-pico3** to further dissipate any remaining lightning energy. At the earth end please use multiple connection points if at all possible.

All connections should incorporate as large an area of contact as possible, which is made more probable by the use of large bolts, and substantial washers. Where there is no access to the metal framework of the building, it is absolutely imperative to erect a suitable lightning conductor. Failure to do so is almost certain to result in destruction of **NTS-pico3** and connected into it equipment in the event of the antenna receiving a near lightning strike.



Grounding system



NTS-pico3 surge protection

Serial port, either RS232/RS485

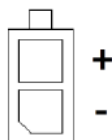
Serial RS232/RS485 (RJ-45 connector marked as “RS232/485”) is placed on front panel of router. Serial connector pinout is described in a tables below.

RS232 RS485 signal	NTS- pico3 RJ-45
A	1
5V	2
B	3
GND	4
TX	5
RX	6
RTS	7
CTS	8

	NTS-pico3 RJ45	RS232 DB9F	RS485 DB9F
A	1	nc	1
5V	2	2	2
B	3	3	nc
GND	4	nc	nc
TX	5	5	5
RX	6	ns	6
RTS	7	7	nc
CTS	8	8	nc

Powering up

1. Connect GNSS antenna to SMA connector at NTS-pico3
2. Connect Ethernet LAN cable to RJ45 connector
3. Plug-in DC power supply to power input and turn power ON. Power supply connector pinout:



Power consumption

- * Typical: 1.2-1.6W
- * Max. peak when active GNSS antenna is not shorted and USB not connected: <2W
- * Max. possible: <8W (info for safety, when short-circuit on internal 5V)

LED operation

Device has four LED indicating its operation. The diode description is presented in the table below.

Diode	Color	Description
U1	Red	GNSS fix indication

U2	Blue	Heartbeat
S	Yellow	GNSS active antenna power supply
PWR	Green	Power supply


Basic SETUP

Go to your web browser and put IP address 192.168.1.234/255.255.255.0.
You will be asked for username and password. By defaults are:

Username: **admin**

Password: **12345**

IP addressing



NTS-Pico3 Time Server Configuration

firmware: 190724

ELPROMA

www.teleorigin.com

Networking

LAN configuration

IP configuration	Configuration	IP Address	Mask
	Static	192.168.1.234	255.255.255.0
DHCP Server	Enabled	Range Start	Range End
	<input type="checkbox"/>	192.168.1.100	192.168.1.200
Defined DNS servers for DHCP clients	Enabled	Master	Slave
	<input type="checkbox"/>		
MAC address	Set	Enter MAC Address	
	<input type="checkbox"/>		

DHCP server: Bind MAC to IP

Binds list

New Delete

Please choose DHCP bind you would like to edit. Please note that after editing DHCP binds you have to save global settings.

Identifier	MAC	IP

Save Settings

Minimum configuration requires setup IPv4

On LAN configuration page you can find essential parameters needed for LAN connection. Here you can set IPv4 address, mask, default gateway.

IMPORTANT NOTE!

For time synchronization purpose please do not use DHCP/DNS.
You will need to keep SSH communication ON for GNSS signals tracing.

TELEORIGIN

UNIQUE TECHNOLOGY FOR TELEMETRY

Device status

Basic

Time

Local network

Wan config

PTP

Ports configuration

Administration

Access control

Registration

Syslog

User files

Configuration

Backup and restore

Discard changes

Save Settings

NTS-Pico3 Time Server Configuration

ELPROMA

firmware: 190724

www.teleorigin.com

Access control

SSH configuration

SSH enabled☒ Enabled
Set this option to enable SSH service

SSH login as root☒ Enabled, Port: 65535
Set this option to enable logon via SSH as root

SSH root password

SSH root key

GenerateGet private keyGet publickeyPaste public keys of authorized users here
You can also generate the public key and download its private key by clicking Generate button
Generating key may take up to 3 minutes, please be patient

WWW config access configuration

Access protocols☒ HTTP☐ HTTPS

HTTP port

HTTPS port

WWW config authorization

Authorization type for admin
Select authentication type for account/interface admin

SSH enable (ON) and password is necessary for tracing on-line GNSS signals

Monitoring GNSS satellite signals ON-LINE

You SSH communication must be switched on first. Please execute from window terminal following commands:

```
ssh root@192.168.1.234 -p 65535
root@192.168.1.139's password: 12345
[root@rbmtx ~]# TERM=vt220
[root@rbmtx ~]# gpsmon
```

```
/dev/ttymx4 NMEA0183>
Time: 2019-08-07T09:01:36.000Z Lat: 52 20' 47.112" N Lon: 20 53' 32.226" E
Cooked TPV
GPGLGA GPRMC GPGLSV GLGLSV GNGSA PORZD GNGBS
Sentences
Ch PRN Az El S/N Time: 090136.00 Time: 090136.00
0 5 36 15 39 Latitude: 5220.7852 N Latitude: 5220.7852
1 16 297 50 35 Longitude: 02053.5371 E Longitude: 02053.5371
2 20 166 24 0 Speed: 00.00 Altitude: 084.2
3 21 189 79 32 Course: 181.7 Quality: 1 Sats: 11
4 26 245 65 30 Status: A FAA: A HDOP: 01.4
5 27 282 17 0 MagVar: RMC Geoid: 38.7
6 29 93 36 39
7 31 216 8 0
8 120 222 21 0
9 124 179 30 0
10 125 223 21 0
11 126 174 30 0
GSV
(68) $GPGLSV,4,1,14,05,15,036,39,16,50,297,35,20,24,166,,21,79,189,31*75
(66) $GPGLSV,4,2,14,26,65,245,30,27,17,282,,29,36,093,39,31,08,216,*77
(62) $GPGLSV,4,3,14,33,21,222,,37,30,179,,38,21,223,,39,30,174,*72
(40) $GPGLSV,4,4,14,40,22,139,,41,08,112,*7C
(66) $GLGLSV,3,1,09,69,09,006,33,70,30,061,34,71,18,115,,76,36,211,*66
(70) $GLGLSV,3,2,09,77,49,292,24,78,13,337,27,85,20,066,36,86,71,015,39*6C
(31) $GLGLSV,3,3,09,87,34,267,31*55
(52) $GNGSA,A,3,21,16,26,05,29,,,,,,02.3,01.4,01.8*1F
(54) $GNGSA,A,3,70,77,69,86,87,85,,,,,,02.3,01.4,01.8*15
(19) $PORZD,A,006.7*3D
PPS offset: 0.000000085
```

GPSmon tool let you trace satellite signals on-line

This screen is the tool to monitor GNSS (GPS & Glonass) satellite signal performance. You should be able to receive signals from at least not less than 4 satellites. Well done installation mostly let view 10-20 GNSS satellites in view. It takes approx. 5-10 minutes since power on to get minimum #sats in view.

Recommendation!

For Linux/Unix and Mac OSX please use BASH std. terminal.
For Microsoft Windows there are various of 3rd party SSH software suppliers. One of the most popular one is free available *putty.exe*

Running NTP (Network Time Protocol)

Configuring NTP

NTS-pico3 firmware starts NTP server and synchronizes to UTC time received from GPS by default. You can add backup NTP servers in NTP Peer 1...3 fields.

TELEORIGIN
UNIQUE TECHNOLOGY FOR TELEMETRY

Device status
Basic
Time
Local network
Wan config
PTP
Ports configuration
Administration
Access control
Registration
Syslog
User files
Configuration
Backup and restore
Discard changes

Save Settings

NTS-Pico3 Time Server Configuration
firmware: 190724
ELPROMA
www.teleorigin.com

NTP

1PPS Output
NONE

RTC time (UTC)
2019-08-07 08:03:40

NTP Peer 1
preferred server

☐ Enabled
0.europe.pool.ntp.org
Enter IP address NTP server

☒ Enter NTP Server as domain name

NTP Peer 2
server

☐ Enabled
Enter IP address NTP server

☐ Enter NTP Server as domain name

NTP Peer 3
server

☐ Enabled
Enter IP address NTP server

☐ Enter NTP Server as domain name

Set Date(V/M/D)
and Time(h:m:s)

2019 8 8 3
7 17

Set
Please enter date/time below and press
Set button

NTP Status

s	remote	refid	st	t	when	pool	reach	delay	offset	jitter
*	SHN(2)	.GPS.	0	1		8	377	0.000	-0.002	0.002
	SHN(3)	.RTC.	0	1		8	0	0.000	0.000	0.000

Monitoring NTP on-line

You SSH communication must be switched on first. Please execute from window terminal following commands:

```
ssh root@192.168.1.234 -p 65535
root@192.168.1.139's password: 12345
[root@rbmtx ~]# ntpq
```

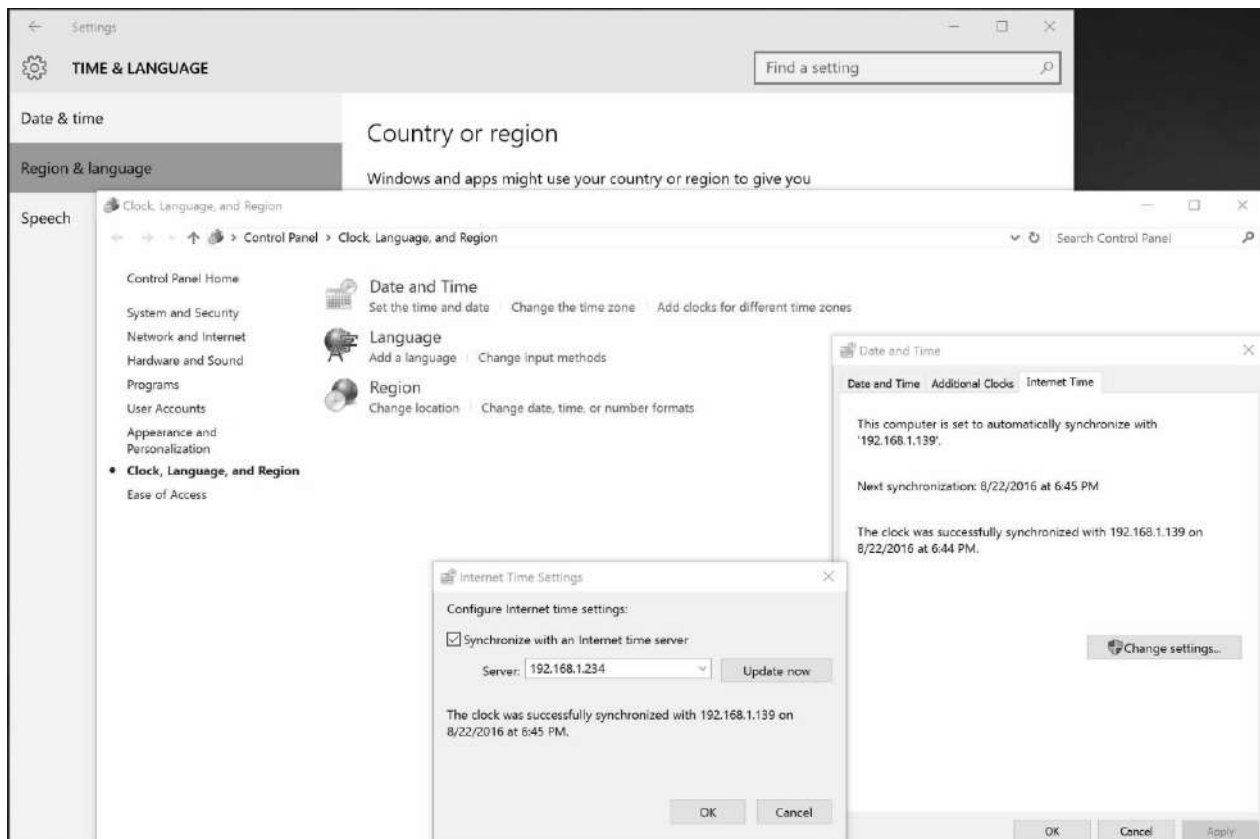
You can use full spectrum of std. NTP monitoring tools incl. **ntpq** and **ntpd** to trace and monitor Network Time Protocol. For more information please ref. to www.ntp.org

```
[root@pico3 ~]# ntpq
ntpq> pe
      remote           refid       st t when poll reach   delay   offset  jitter
=====
*SHM(2)          .GPS.          0 l  6   8  377    0.000   -0.002   0.002
  SHM(3)          .RTC.          0 l  -   8   0    0.000    0.000   0.000
ntpq> rv
associd=0 status=0415 leap_none, sync_uhf_radio, 1 event, clock_sync,
version="ntpd 4.2.8p8@1.3265-o Thu Jul  4 13:56:37 UTC 2019 (1)",
processor="armv7l", system="Linux/3.14.52+", leap=00, stratum=1,
precision=-19, rootdelay=0.000, rootdisp=1.015, refid=GPS,
reftime=e0f504b3.8a8cd3f3 Wed, Aug  7 2019  8:05:07.541,
clock=e0f504b4.b9da49b0 Wed, Aug  7 2019  8:05:08.725, peer=2944, tc=3,
mintc=3, offset=-0.001697, frequency=0.187, sys_jitter=0.001907,
clk_jitter=0.002, clk_wander=0.001, tai=37, leapsec=201701010000,
expire=201912280000
ntpq> 
```

ntpq debugging tool for NTP

Synchronizing Microsoft Windows clock

You simply synchronize any version of Microsoft Windows by simple selecting “Time from Internet” and providing **NTS-pico3** IPv4 . Below there is example for Windows 10.



Using NTS-pico3 as primary source of NTP time for Microsoft Windows

Synchronizing Linux & Mac OSX clock

Both Linux and OSX included built-in NTP protocol. You can simple manually modify ntp.conf file by providing your **NTS-pico3** IPv4 address, however we recommend to use similar Microsoft Windows high level OS Time & Date operations.

Running PTP (Precision Time Protocol)

Switching on PTP enables PTP grandmaster daemon.

The screenshot shows the 'NTS-Pico3 Time Server Configuration' web interface. The top header is red with the 'TELEORIGIN' logo on the left, 'firmware: 190724' in the center, and 'ELPROMA' and 'www.teleorigin.com' on the right. A left sidebar contains a menu with items like 'Device status', 'Basic', 'Time', 'Local network', 'Wan config', 'PTP' (highlighted in red), 'Ports configuration', 'Administration', 'Access control', 'Registration', 'Syslog', 'User files', 'Configuration', 'Backup and restore', and 'Discard changes'. At the bottom of the sidebar is a red 'Save Settings' button. The main content area is titled 'PTP settings' and contains a toggle for 'PTP' which is checked and labeled 'Enabled' with the note 'Set this option to enable PTP service.' Below this is a section titled 'PTP options' with four rows: 'Transport layer' set to 'L2 (Ethernet)', 'IP mode' set to 'multicast', 'Delay mechanism' set to 'E2E', and 'SYNC interval' set to '0' with the note 'You can change sync interval here'.

PTP options:

Transport layer

L2 (Ethernet): PTP packets are encapsulated directly in Ethernet frames (IEEE 802.3 network transport)

L4 (UDP): PTP packets are exchanged over UDP/IPv4

IP mode

The option available for L4 (UDP) transport layer only.

- multicast (default)
- unicast
- hybrid mode

Multicast for SYNC and announce packets, unicast for delay request and response packets.

Delay mechanism

E2E (default)

Delay is measured end-to-end. Delay is calculated for the whole path: grandmaster/master/boundary clock - transparent clocks - slave ordinary clock (GM/MC/BC - TC - OC/SC).

P2P

Delay is measured peer-to-peer. If transparent clocks are present in a network they need to support peer-delay mechanism (and be configured to enable it).

SYNC interval (default 1)

SYNC packet interval value must be in range -7....7 (recommended limits are -3...3).

-4: 62.5ms (1/16 s)
-3: 125ms (1/8 s)
-2: 250ms (1/4 s)
-1: 0.5s (1/2 s)
0: 1 second (typical interval)
1: 2 seconds (default)
2: 4 seconds
3: 8 seconds
4: 16 seconds

PTP client implementation on Windows 10 and Server 2019:

Requirements

PTP client is supported on Windows 10 and Windows Server 2019. At least 1809 update version must be installed on the system

Implementation procedure

First add the *PtPClient* registry key to your Windows register. Already prepared file can be downloaded from below link:

<https://cloud.elpromaelectronics.com/index.php/s/kLnpCMmzR6CGJ5s>

Change the registry keys to configure PTP and disable other client providers (NTP, VMIC etc.). Please modify the below root keys manually:

HKLM\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\NtpClient

Name	Value
PtPMasters	IP of NTS-pico3, default: 192.168.1.234
EnableMulticastRx	0

HKLM\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\NtpClient

Name	Value
Enabled	0

HKLM\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\VMICTimeProvider

Name	Value
Enabled	0

Then restart the Windows Time Service. You can do this by pressing Win + R keys, type *services.msc* and right click on W32tm (Windows Time) service -> Restart.

After W32tm restarting, create the rules in firewall to allow the PTP Client to communicate with the time server (UDP protocol):

Name	Direction	Port
PTP Event In	In	319
PTP Event Out	Out	319
PTP General In	In	320
PTP General Out	Out	320

Verify if PTP Time Provider is enabled using **w32tm /query /configuration** command. Then verify that the system is synchronizing with PTP Source Server using **w32tm /query /status /verbose** command. The output should be as below:

```
C:\WINDOWS\system32>w32tm /query /status /verbose
Leap Indicator: 0(no warning)
Stratum: 3 (secondary reference - syncd by (S)NTP)
Precision: -23 (119.209ns per tick)
Root Delay: 0.0004981s
Root Dispersion: 0.0100020s
ReferenceId: 0x4D505450 (source IP: 77.80.84.80)
Last Successful Sync Time: 08.06.2020 12:30:58
Source: 192.168.0.247
Poll Interval: 10 (1024s)

Phase Offset: 0.0076158s
ClockRate: 0.0156250s
State Machine: 2 (Sync)
Time Source Flags: 0 (None)
Server Role: 0 (None)
Last Sync Error: 0 (The command completed successfully.)
Time since Last Good Sync Time: 2.9138212s
```

ReferenceId: 0x4D505450 indicates that the PTP provider is in use.

Troubleshooting

To troubleshoot **NTS-pico3** you need first to log into device console using serial cable or SSH.

How to check if PTP is working?

From **NTS-pico3** console you can check if ptp process is running. If everything is fine, you shall get 1 in return:

```
[root@pico3 ~]# ps aux | grep '[p]tp4l' -c
1
[root@pico3 ~]#
```

If there is no ptp process you will get 0 (make sure, that you have enabled PTP in web panel):

```
[root@pico3 ~]# ps aux | grep '[p]tp4l' -c
0
[root@pico3 ~]#
```

How to check if NTS-pico3 sends PTP messages?

To check if **NTS-pico3** is actually sending PTP IEEE1588 messages over your LAN network you use *tcpdump* utility and see if PTP frames are going out of device:

1) PTP L2 (Ethernet)

To see only PTP (0x88F7) Ethernet packets:

```
[root@pico3 ~]# tcpdump ether proto 0x88F7 -c 3 -q
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on lan1, link-type EN10MB (Ethernet), capture size 262144 bytes
08:42:38.291470 36:07:13:13:5e:2e (oui Unknown) > 01:1b:19:00:00:00 (oui Unknown), Unknown Ethertype (0x88f7), length 58:
08:42:38.291984 36:07:13:13:5e:2e (oui Unknown) > 01:1b:19:00:00:00 (oui Unknown), Unknown Ethertype (0x88f7), length 58:
08:42:39.211428 36:07:13:13:5e:2e (oui Unknown) > 01:1b:19:00:00:00 (oui Unknown), Unknown Ethertype (0x88f7), length 78:
3 packets captured
3 packets received by filter
0 packets dropped by kernel
[root@pico3 ~]#
```

2) PTP L4 (UDP)

To capture PTP UDP transmission we need to dump tcp packets going to ports 319 and 320:

```
[root@pico3 ~]# tcpdump udp portrange 319-320 -c 3
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on lan1, link-type EN10MB (Ethernet), capture size 262144 bytes
08:46:59.042733 IP 192.168.1.234.319 > 224.0.1.129.319: UDP, length 44
08:46:59.043326 IP 192.168.1.234.320 > 224.0.1.129.320: UDP, length 44
08:47:00.042823 IP 192.168.1.234.319 > 224.0.1.129.319: UDP, length 44
3 packets captured
5 packets received by filter
0 packets dropped by kernel
[root@pico3 ~]#
```

APPENDIX

Technical Specification

model NTS-pico3	Miniature Time Server	Antenna interface	1x SMA
holdover OSC	TCXO	std. GNSS	GPS , GLONASS
sync PROTOCOL	NTP, PTP IEEE1588	extra* GNSS	GALILEO* , BEIDOU*
NTP	RFC5905 , RFC1305 , RFC5906 , RFC5907 , RFC5908 , RFC5909	#SBAS	EGNOS , WAAS , GAGAN
SNTP	RFC4330 , RFC2030 , RFC1769	FREQ #1	1575.42MHz (L1 GPS)
PTP	IEEE1588: 2008	FREQ #2	1598.06-1605.38MHz GLONASS
1pps OUTPUT	1x SMA*	#CHANNELS	32
Time/DAYTIME	RFC(867-8)*	antenna DISTANCE	30m coax H155
#LAN	1	interface RS232	1x RJ45
speed LAN	100/10Mbps (RJ45)	interface USB 2.0	1x Micro-USB
TCP/IP	IPv4, IPv6*, TCP, UDP	weight NETTO	0.3kG (3kG BRUTTO)
MANAGEMENT	HTTP, HTTPS, SSH, TELNET	operating TEMP	-20C+70C
SECURITY	Autokey, DSA, SSL, MD5, RSA	storage TEMP	-40C+85C

SYSLOG	yes	%HUMIDITY	up to 95%
hardware STAMPING*	accuracy < 200ns	POWER	9-30VDC
software STAMPING	accuracy < 800us		* extra feature

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