M B Control & Systems Pvt. Ltd.
Innovative Electronics For You

EKOS GROUP

EKOSync 1588B

PTP / NTP TIME SERVER

USER MANUAL

Document Revision No: 1.1

Safety

For your safety, the following general safety precautions must be observed during all phases of operation of this instrument.

⚠CAUTION WARNING! THIS DEVICE MUST BE EARTHED

Do not use this equipment in a manner not specified by the manufacturer. The protective features of this product may be impaired. It could cause unavoidable damage to the equipment, personal injury and/or death.

Reviewing the complete documentation before installing or operating the instrument is important.

WARNING! HAZARDOUS VOLTAGES CAN CAUSE SHOCK, BURNS AND DEATH.

The power plug shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided and, if unavoidable, shall be carried out only by a qualified person who is aware of the general device test practices.

All recommended equipments that should be earthed. Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous.

Do not install substitute parts or perform any unauthorized modification to the product.

Unless otherwise specified in the documentation, there are no user-serviceable parts inside this instrument.

Instruments that appear damaged or defective should be secured against unintended operation until they can be repaired by qualified service personnel.

This instrument is intended for use in dry, indoor locations only.

Do not wet the instrument when cleaning it.

Safety Symbols

These symbols, which have these meanings, may be marked on this instrument.

 EARTH (GROUND) TERMINAL

Table of Contents

I. FEATURES & SPECIFICATIONS....4

1 Description....4

2 Features....4

3 Specifications....4

Electrical....4

Networking....5

Environmental Specifications....6

Mechanical Specifications....6

Antenna Port Specifications....6

II. OPERATION DESCRIPTIONS.....7

1 Precise Time Synchronization.....7

The IRIG-B Time Code Standard.....7

Network Time Protocol / Simple Network Time Protocol.....8

SNTP.....8

NTP / SNTP in the EKOSync 1588B.....9

FREQ.....9

ALARM RELAY.....9

2 IEEE 1588 / PTP / C37.238.....10

III. INSTALLATION.....12

Device Hardware.....12

Hardware Installation.....14

IV. CONFIGURATION & SETTINGS.....15

1 Front Panel Overview.....15

2 Accessing the PTP/NTP TIME SERVER.....18

EKOSync 1588B PTP TIME SERVER

I. FEATURES & SPECIFICATIONS

1 Description

EKOSync 1588B PTP Time Server provides sub-microsecond accuracy time information for synchronizing energy distribution subsystem intelligent electronic devices, and proceeding according to IEEE 1588 v2 time protocol. Product includes adjustable hold-over times for discontinuities with GPS communication, and compensation for antenna reception distortions.

2 Features

- DC IRIG-B (Unmodulated, DCLS - C37.118.1)
- TCP/IP remote M&C management option
- Synchronized TOD (Time of Day) and PPS (Pulse per second) outputs
- User defined 10MHz/5MHz frequency output
- TCP/IP configuration option
- NTP/ SNTP (IEC 61850)
- SNMP v1, v2c & v3
- IEEE 1588 PTP Server
- 90-265V DC Isolated power supply
- Password protection and user authentication

3 Specifications

Electrical:

Input

Power Supply

Voltage:	**90 to 265 V DC**
Power consumption:	**40W max**
Ethernet (RJ45 UTP)	**10/100/1000Mbps**
Ethernet (SFP)	**1Gbps**

Isolation

Power to GPS input	**3 kV**
Power to I/O	**3 kV**

Outputs

Relay output	**250V 2A**

8 TTL outputs	**Time codes or pulses or user defined** **Electrical specification:** **TTL/CMOS compatible 0-5 V, 2 mA sink/source** **Timing accuracy: ≤50 ns to UTC**

Networking:

GENERAL

DHCP:	**Auto-configuration with fall back to ARP tested link-local address**
VLAN:	**Packet tagging**

PTP (IEEE 1588 V2)

General:	**One-step or two-step operation** **End-to-end or peer-to-peer delay calculations** **Layer 2 (Ethernet) or Layer 3 (UDP) transport** **Slave only mode** **Default Profile support**
Power Profile support:	**C37.238**
TLV support:	**C37.238 offset from TAI time base used by PTP**

Alternate Time Offset TLV support: **with automatic or manual offset**

SNMP MIB support:	**C37.238**

NTP

General:	**Stratum-1 NTP & SNTP time server** **Multicast & Broadcast server capability** **Optional MD5 authentication**

SNMP

General:	**V1, V2C, and V3 support, independently enabled** **Configurable V1 and V2C community names and security groups** **Fully configurable via SNMP** **V3 User-based Security Module (USM) support** **USM MIB support**
USM authentication methods:	**MD5, SHA**
USM privacy methods:	**DES, AES**

NOTIFICATIONS

General:	**SNMP trap generation V1, V2C, and V3** **SNMPv3 traps authenticated and privatized via USM** **Syslog (RFC-3164 and 5424 verities)**

Environmental Specifications:

Operating and Storage conditions

Operating Temperature	**-40° to 70°C (-40 to 158°F) according to IEC 60065**
Storage Temperature	**-40° to 80°C (-40 to 176°F)**
Operating Ambient Humidity	**3% to 97% (non-condensing conditions)**
Altitude	**3000m (9842 ft)**

Mechanical Specifications:

Dimensions (H x W x D)	**47 x 442 x 292 mm**
Weight	**3.920 kg**

Antenna Port Specifications:

Voltage	**3.3 VDC**
Current	**100 mA (max)**
Impedance	**50 Ω**

II. OPERATION DESCRIPTIONS

1 Precise Time Synchronization

Precision Time Protocol (PTP), included in IEEE standard 1588 was originally designed to provide timing for critical industrial automation. PTP identifies two types of clocks, masters and slaves. A clock in a terminating device is known as an ordinary clock, a clock in a transmission component like an Ethernet Switch as a boundary clock. A master which is controlled ideally by a radio clock or a GPS receiver, synchronizes the slaves connected to it respectively.

PTP time server, namely GPS Clock, which provides synchronization in PTP (IEEE 1588) protocol on Ethernet network by using time from GNSS satellites utilizes existing data network so that an installation of a separate timing network is eliminated. Its 25ns accuracy and redundancy mechanisms are also advantages of new generation synchronization system.

Control, protection and measurement devices in modern electric grids need correct time for synchronous operation. To identify the sequence of events in case of unexpected outage, to manage the grid synchronously and to be able to make the measurements in the required accuracy a modern synchronization protocol is needed.

The IRIG-B Time Code Standard

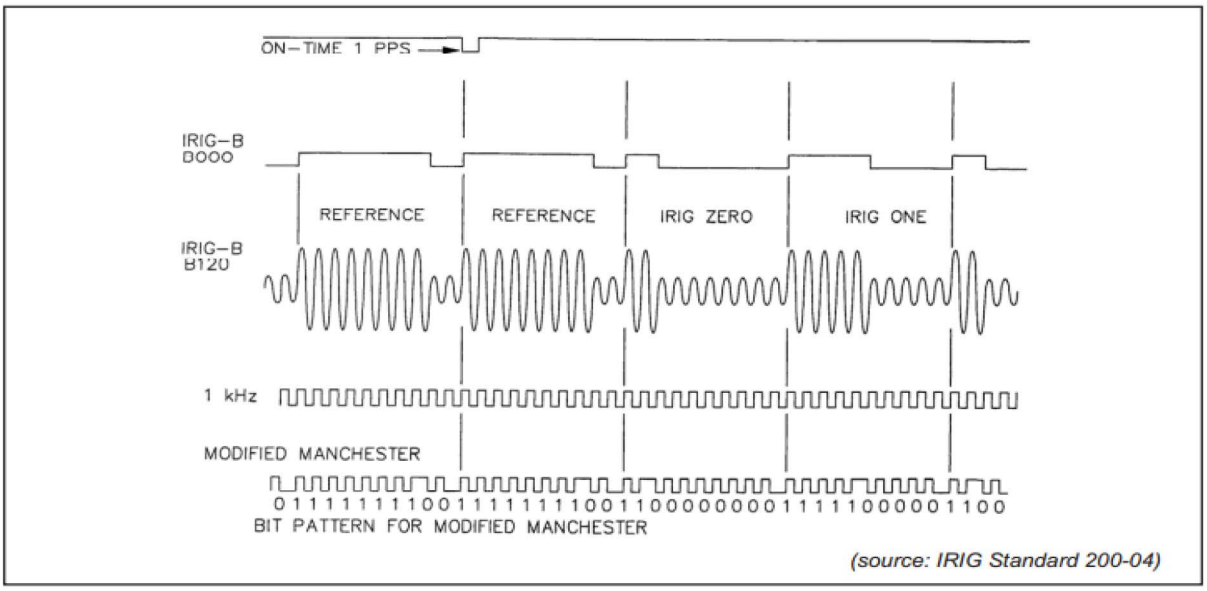
IRIG-B is the industry standard for GPS time synchronization. The IRIG time codes were originally developed by the Inter-Range Instrumentation Group (IRIG), part of the Range Commanders Council (RCC) of the US Army. IRIG time code B is widely used in the electrical power industry.
IRIG-B refers to a serial time code format. The IRIG-B time code consists of 100 bits produced every second, 74 bits of which contain various time, date, time changes and time quality information of the time signal. IRIG-B sends Day of Year, Hour, Minute and Second data on a 1KHz carrier, with an update rate of one second. IRIG-B DCLS (DC level shift) is IRIG-B without the 1KHz carrier.

There are three methods of communicating analogue pulses in the IRIG Standard:
- **Modulated** : amplitude-modulated, sine wave carrier
- **Unmodulated** :DC level shift, no carrier signal
- **Modified Manchester :** amplitude-modulated, square wave carrier

Three types of coded expressions are used in the IRIG standard:

- **Binary Coded Decimal** time-of-year (BCDTOY) and year (BCDYEAR)
- **Control Functions (CF),** set of bits reserved for user applications
- **Straight Binary Seconds (SBS)** time-of-day (0 to 86400 seconds)

A comparison of IRIG-B coding methods is given in the figure below.



Network Time Protocol / Simple Network Time Protocol

Network Time Protocol (NTP) has been the traditional way to synchronization time over Ethernet networks. NTP allows time synchronization up to 100 milliseconds. The IEEE 1588 PTP is required to achieve tighter synchronization.

There is NTP led on front panel. When the NTP is enable, the led is ON. To enable the NTP server of the PTP/NTP Time Server check the Enable checkbox in the NTP configuration page.

PTP is basically a faster version of NTP. IEEE 1588 is designed for local systems requiring very high accuracies beyond those attainable using NTP, which is sufficient to transfer data across networks at speeds of up to 10 Mbps. As data rates have increased, the need for synchronised transmission and reception have increased with it. At speeds of 1 Gbps and above, PTP is necessary.

SNTP

A less complex implementation of NTP, using the same protocol but without requiring the storage of state over extended periods of time, is known as the Simple Network Time Protocol (SNTP). It is used in some embedded devices and in applications where high accuracy timing is not required.

NTP / SNTP in the EKOSync 1588B

The EKOSync 1588B can act as an NTP or SNTP server, and is intended to be an NTP time server. The EKOSync 1588B synchronizes to GPS to provide accurate timing signals, and NTP time signals are published through the clock Ethernet port.

FREQ

The EKOSync 1588B has one Frequency out port which produces 5-10-20-25MHz.

ALARM RELAY

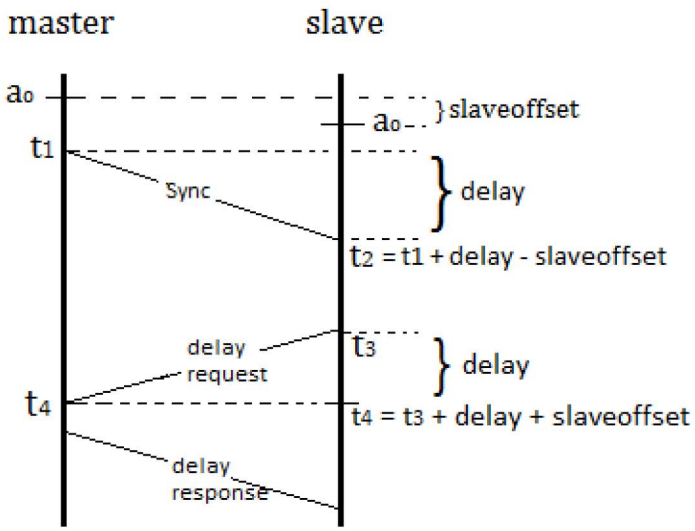
Connect the Sync indication relay to the alarm circuit if required.

(CM = Common, NO = Normally Open, NC = Normally Closed)

Example;

The relay alarms when the antenna problems, poor sky view or power supply fails.

The IEEE 1588 precision time protocol (PTP) provides a standard method to synchronize devices with sub microsecond precision over a local area network (LAN) [6]. The protocol synchronizes slave clocks to a master clock ensuring that events and timestamps in all devices use the same time base. IEEE 1588 protocol uses the Best Master Clock algorithm to automatically determine which clock in the network is the most precise. It becomes the master clock that is a GPS disciplined time reference. All other clocks become slaves (e.g. a IEDs) and synchronize their clocks with the master. IEEE 1588 defines one-step and two-step clock operations. One-step clock updates accurate timestamp in synch message but two-step clock sends accurate timestamp in a follow up message. One step clock is recommended to use because this eliminates the need to read the transmit timestamp over MDIO and also eliminates the need to send a follow up message. Figure 1 shows an one step clock synchronization. The synchronization of the clocks is achieved using a series of message packets between master and slaves. There are three message types - Sync, Delay Request and Delay Response.



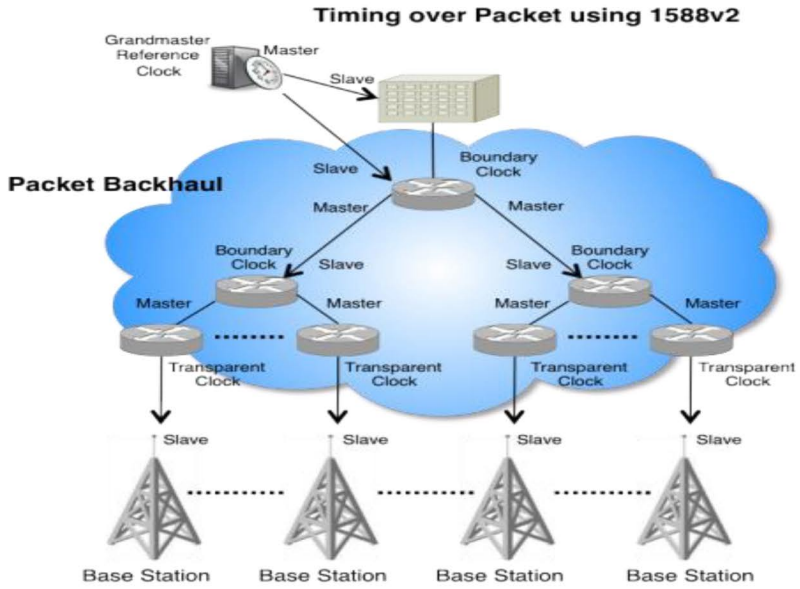
One-step clock synchronization

The master stamps the time (t1) on the Sync message that leaves the master. The message arrives at slave clock at t2 and sends a Delay-Req message at time (t3) to the master, which is received by the master clock at a later time, t4. The master then sends a packet containing t4 to the slave. The slave has all the information needed to calculate the slave offset. In this way the slave use this equations [t2 = t1 + delay + slaveoffset (1) and t4 = t3 + delay + slaveoffset (2)] to obtain following equation:

Slaveoffset = [(t2-t1) – (t3-t4)] / 2 (3)

Now, using this equation the slave arranges its time clock. This equation (3) can be only used if the delays are equal to each other between t1 to t2 delay and t3 to t4 delay.

This measurement is repeated every second between the master clock and the slave clock and the synchronization accuracy can be reduced to approximately 100 ns.



Grandmaster Clock

The root timing reference is called the grandmaster. The grandmaster transmits synchronization information to the clocks residing on its network segment. A grandmaster clock is the highest-ranking clock within its PTP subdomain and is the primary reference source for all other PTP elements**.** In a PTP network a grandmaster is the node that defines the correct time.

Ordinary Clock

An ordinary clock is a PTP clock with a single PTP port. It could be a master clock (grandmaster) or a slave clock. Ordinary clocks are the most common device within a PTP network.

Boundary Clock

A boundary clock is a device between PTP grandmaster and PTP slave clients. A boundary clock has multiple network connections and can act as a source (master) and a destination (slave or client) for synchronization messages. The boundary clock intercepts and processes all PTP messages and passes all other traffic.

Transparent Clocks

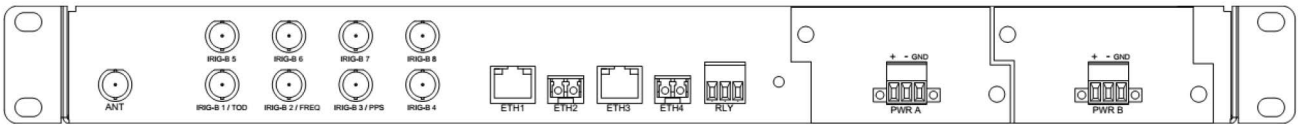
Transparent clocks measure and adjust for packet delay. The transparent clock computes the variable delay as the PTP packets pass through the switch. There are two types of transparent clocks, end-to-end and peer-to-peer. End-to-end transparent clocks update the time interval field for the delay associated. However peer-to-peer transparent clocks measure the line delay associated. Transparent clocks improve synchronization between the master and slave clocks and ensure that the master and slave clocks are not impacted by the effects of packet delay variation.

III. INSTALLATION

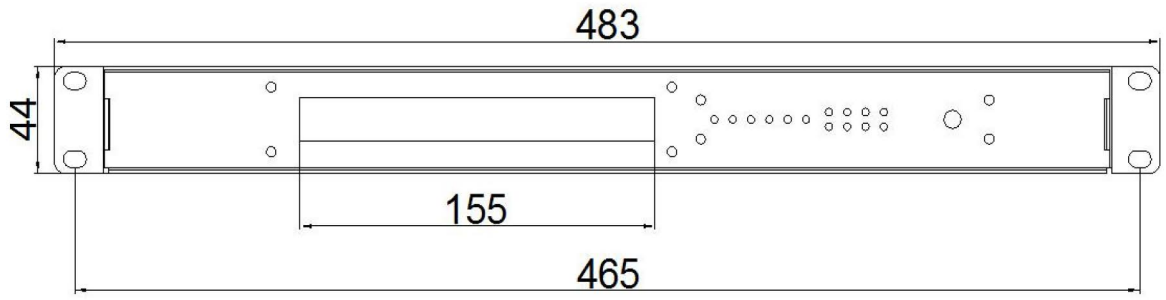
1 Device Hardware

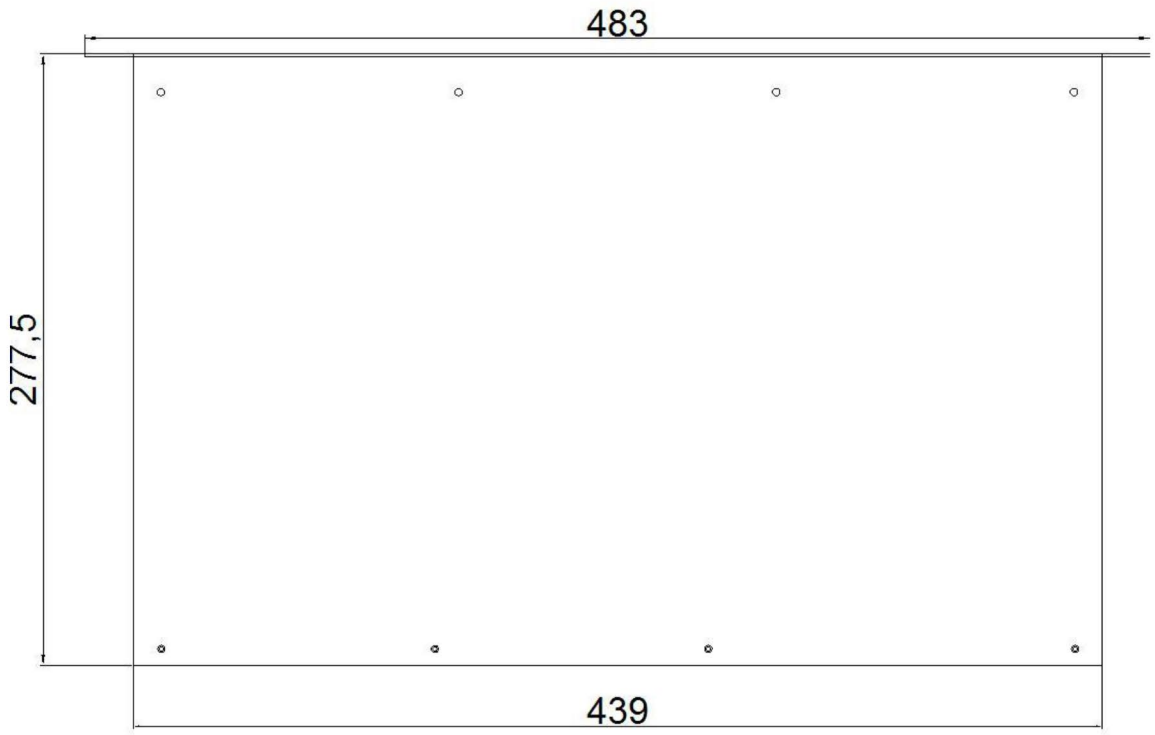
Front Panel View

Rear Panel View



Mechanical Sizes





Hardware Installation

1. Install the antenna in a location with a clear sky view.
2. Install the EKOSync 1588B in the desired location and connect to the antenna.
3. Connect the EKOSync 1588B to the network switch.
4. Connect to power, ensuring the correct DC voltage (90 - 265VDC) is used.
5. Connect the Sync indication relay to the alarm circuit if required.
   (CM = Common, NO = Normally Open, NC = Normally Closed)
6. Once the EKOSync 1588B is installed and configured, connect the clock outputs to your devices.

   – An RG58 cable is recommended to connect devices to the output ports.
   – A termination resistor of 120 Ω can be added to the end of a TTL run to achieve good impedance matching.

IV. CONFIGURATION & SETTINGS

1 Front Panel Overview

This section explains use of the front panel.

LED Indicators

Front panel of the EKOSync 1588B contains fourteen LEDs:

Label	Off	Flashing	On
Sync	-	Sync	Not Sync
PWRA	Red LED	-	Green LED
PWRB	Red LED	-	Green LED
NRM	Red LED (indicates error in device)	-	Green LED (normal operation)
PTP	Red LED	-	Green LED
NTP	Red LED	-	Green LED

Label	Upper LED On	Both LEDs On	Below LED on
ETH	1 Gbit	100Mbit	10Mbit

Menu Architecture

1 -LANGUAGE

1 -ENGLISH
2 -FRENCH
3 -TURKISH

Choose your language in this part.

2 -GPS CONFG.

1 -QUALITY PARAMTRS
2 -BACK
3 -MAIN

3 -SYNC CONFG.

1 -SYNCH1-SYNCH3 → 1 –PPS → 1 –PULSE PERIOD
1- 1s
2- 60s
3- 3600s
2 –PULSE DURATION
1 -100 ms
2 -200 ms
3 -500 ms
3 –EDGE MODE
1 –RISING
2 –FALLING
4 –BACK
5 –MAIN

2 –FREQ → 1 -5 MHz
2 -10 MHz
3 -20 MHz
4 -25 MHz
5 -DISABLE
3 –IRIG-B → 1 –IRIG-B 003
2 –IRIG-B 002
3 –DISABLE
4–BACK

2 -SYNCH4 → 1 –TOD PORT OPT. → 1 –BAUD RATE
1 -4800
2 -9600
2 –PARITY
3 –STOP BITS
4 –DATA BITS
5 –BACK
6 –MAIN

2 –PPS/TOD MODE
3 –ENABLE
4 –ASCII PROTOCOL → 1 –NMEA
2 –ASCII
3 –CM
5 -BACK
6 -MAIN

3 –SYNC MODE
4 -BACK
5 -MAIN

4 -LOCAL TIME OFFS.

1 –UTC
2 –LOCAL → 1 –MIT
2 –HST
3 –AST
4 –PST
5 –MST, PNT
6 –CST
7 –EST, IET
8 –PRT
9 –CNT
10 –AGT, BET
11 –UTC, GMT, WET
12 –ECT
13 –EET, CAT, ART
14 –EAT
15 –MET
16 –NET
17 –PLT
18 –IST
19 –BST
20 –VST
21 –CTT
22 –JST
23 –ACT
24 –AET
25 –SST
26 –NST

5 -LAN CONFG.

IP: 168. 1. 103
Enable Static IP
BACK
MAIN

6 -PRODUCT RELEASE

RELEASE

1 –R1. 0/1.0

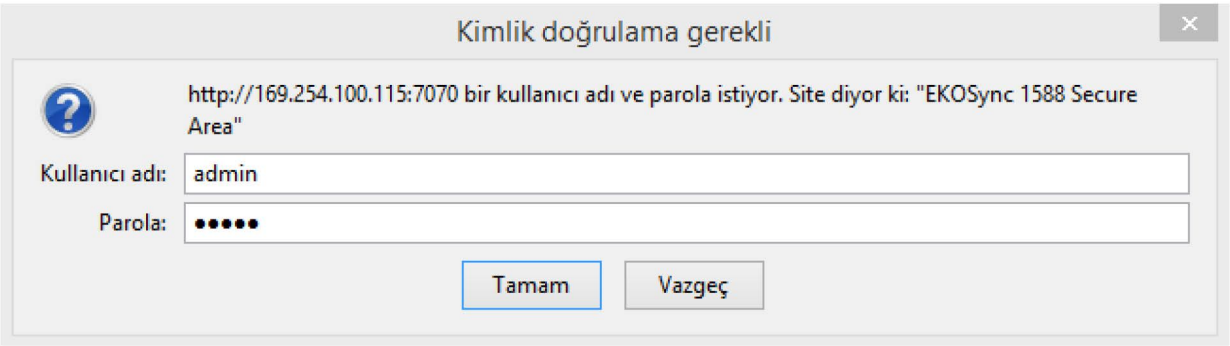
7 -EXIT

Returns the main menu.

2 Accessing the PTP/NTP TIME SERVER

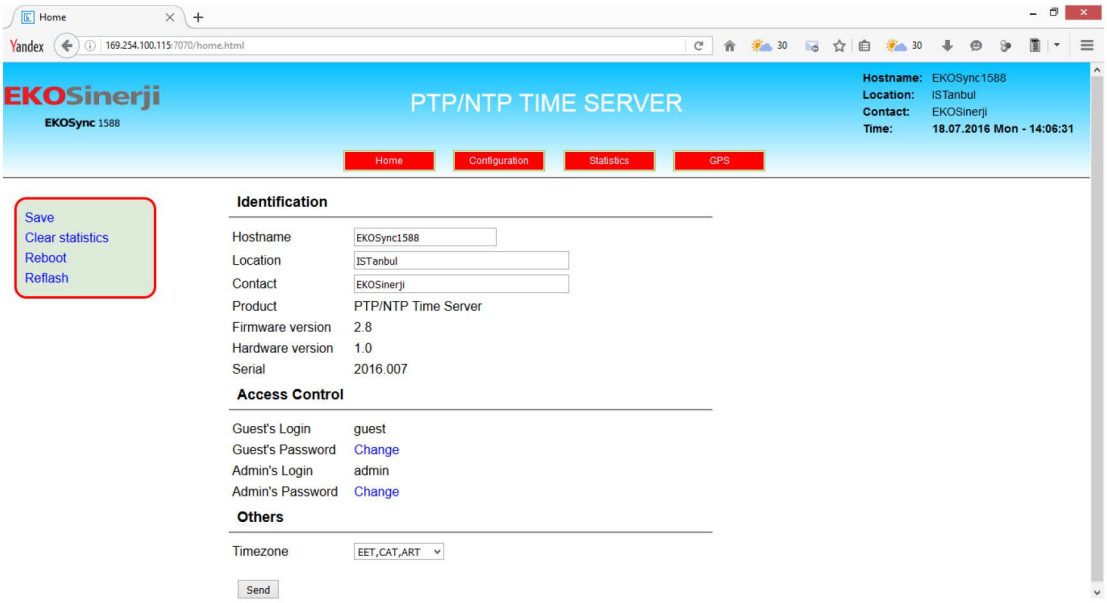
From a PC in your local area network open a Web browser window and configure with an IP address 192.168.0.1.103:7070. Also, you can assign an IP address within your local network.

When you write IP address on your web browser, you will see this picture in the bottom;



Kullanıcı Adı :	admin
Parola :	nimda

Once you access correctly, the following main screen will appear:

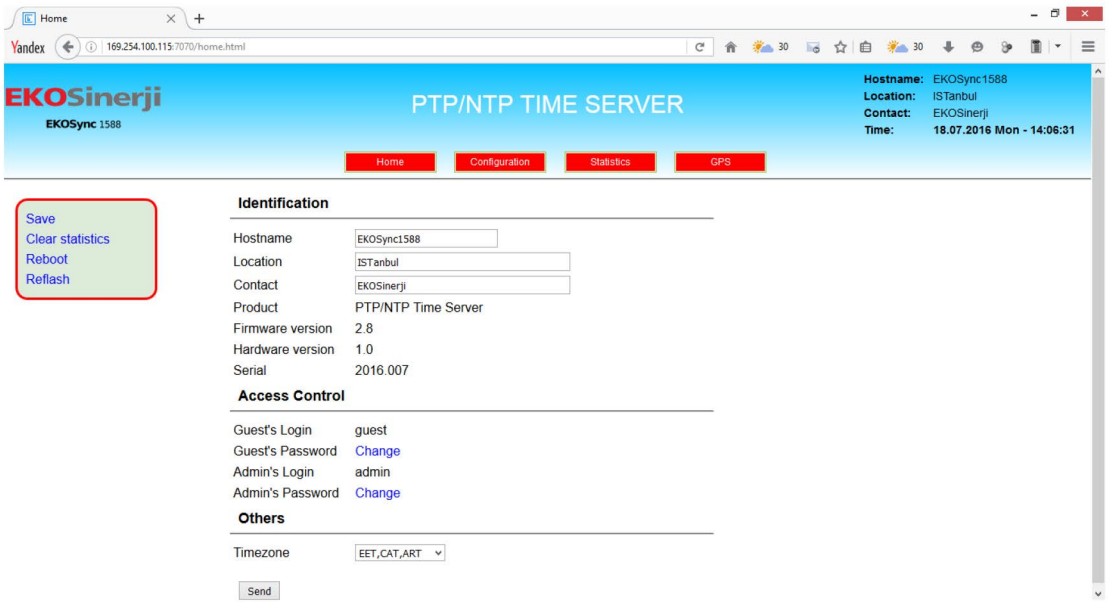


General Commands:

Save: This command saves the configuration changes to **TIME SERVER** flash memory, so they will be available next time the **TIME SERVER** reboots.
Clear statistics: Clear all of statistics.
Reboot: It restarts the **TIME SERVER**.
Reflash: This option allows a firmware upgrade in the **TIME SERVER**.

From Home button;

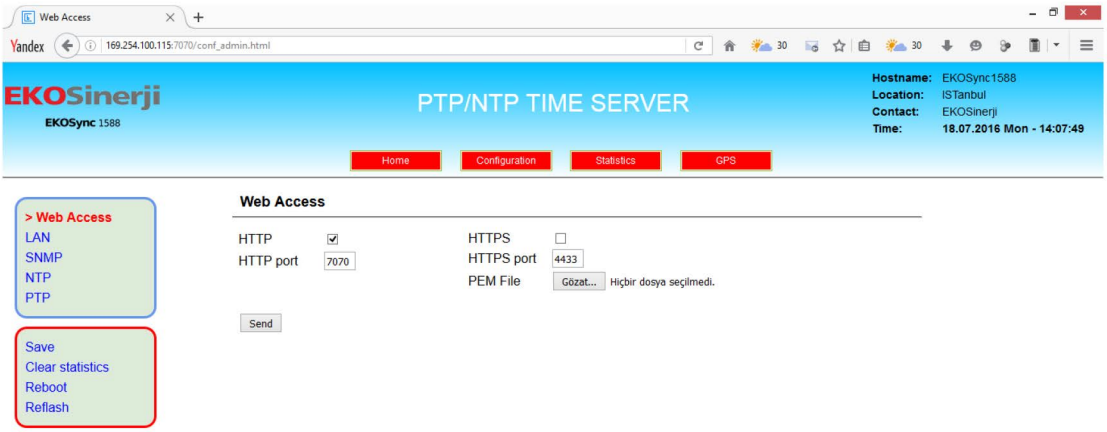
You see general informations about time server. These informations such as the hostname, location, contact and model of the **PTP/NTP Time Server** are provided. In addition; you can change your passwords.



From Configuration button;

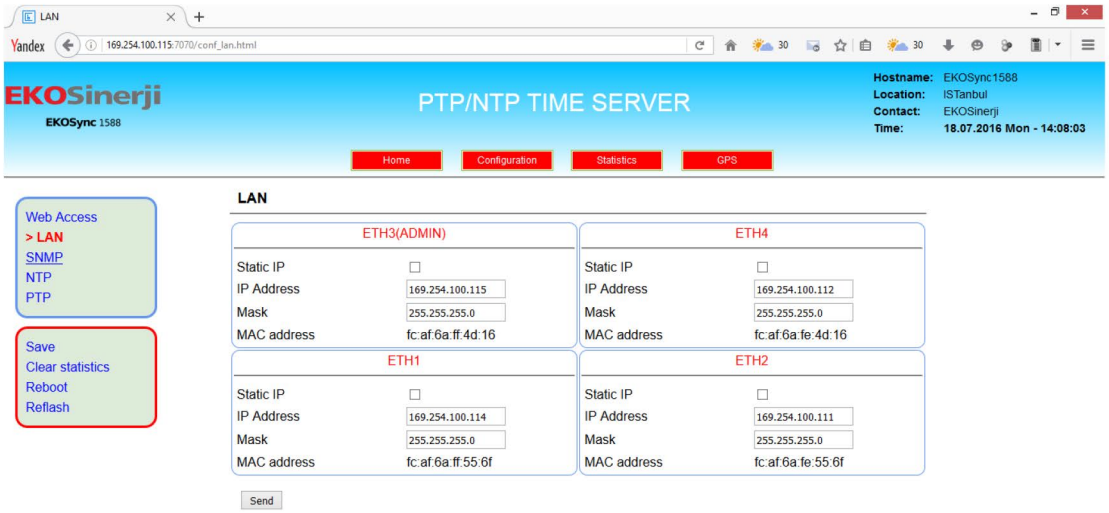
In this menu you will be able to configure many parts as following;

- Administration: you can change http and https ports. Once configuration is complete, click the Send icon.



- LAN: For Static IP settings, check the **Enable** box in the LAN area. Also, you can change IP address manually. Once configuration is complete, click the Send icon.

  If you change the IP address, you should write new IP address on your web browser. Then click the save tab, and press the **OK** button.

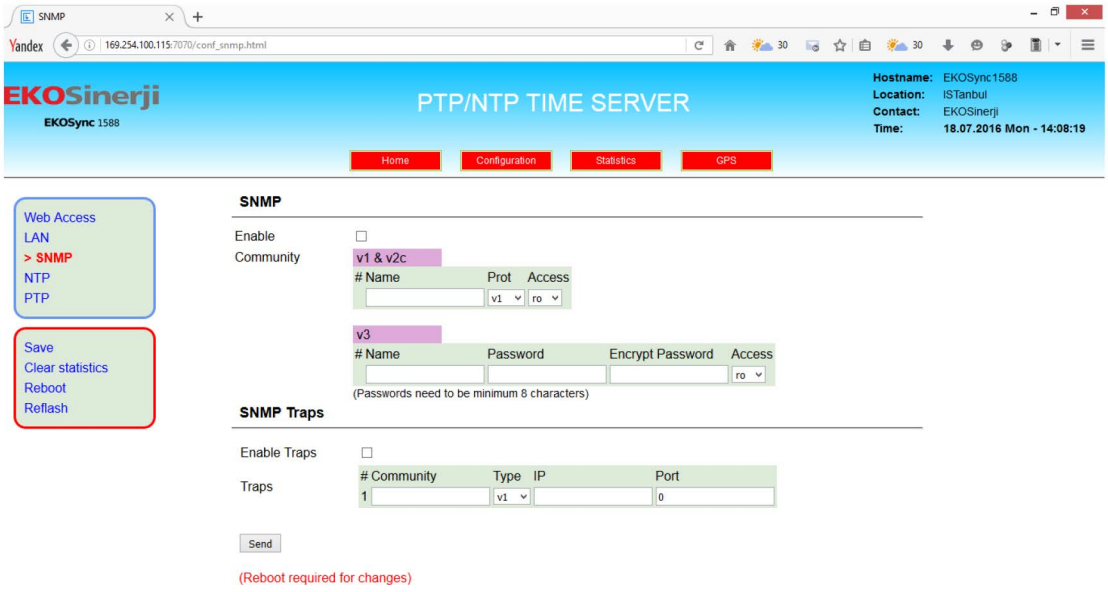


- SNMP:

SNMP agent is enabled by ticking the Enable checkbox. Once SNMP agent is up and running, the user needs to activate traps notifications by ticking Traps Enable.

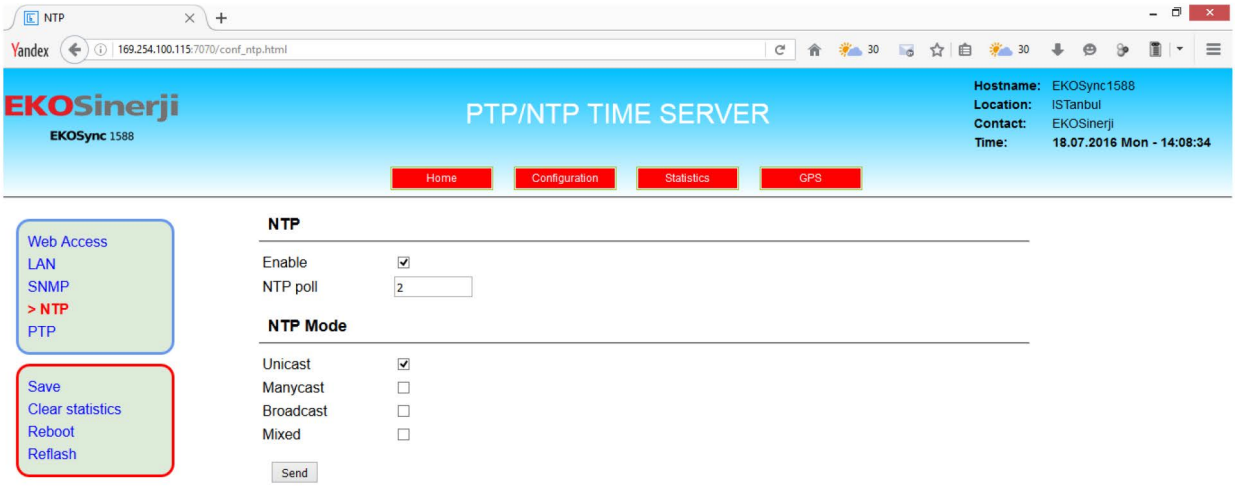
Community "*public*" will only have read access to **TIME SERVER** MIB variables, community "*private*" will have read and write access to **TIME SERVER** MIB variables. Define the type of **Access**: *ro* (read only) or *rw* (read and write). Press **Send** icon.

Enter the **IP address** of the host where the **TIME SERVER** will send the traps. Enter the destination **Port** for the traps. By default is *162*. Press **Send** icon.



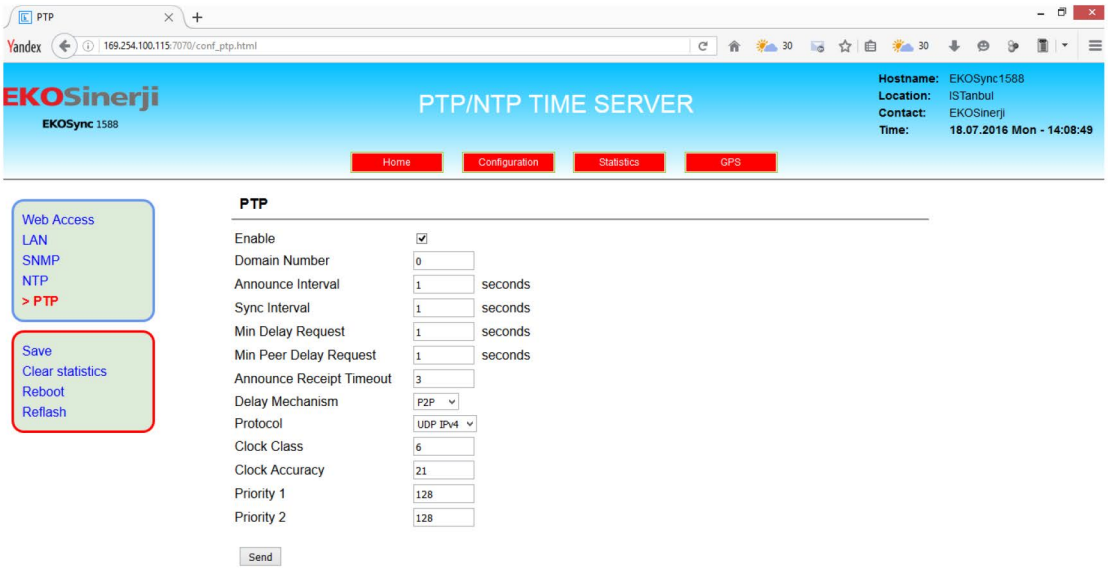
- NTP:

Click the **NTP** tab, and check **Enable** if not already checked. Also, you can change NTP mode which choose one Unicast, Many cast, Broadcast or Mixed.



- PTP:

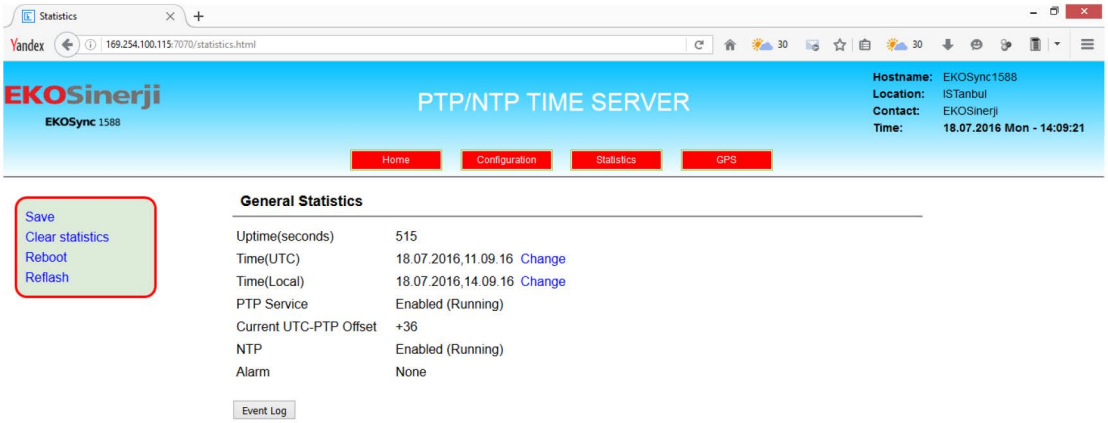
Click the **PTP** tab. Check **Enable**, if not already checked. 1588 accounts for the variable delay to packets from Ethernet switches that inhibits path delay measurements, and allows accuracy down to the nanosecond level at end-device clocks.



From Statistics button:

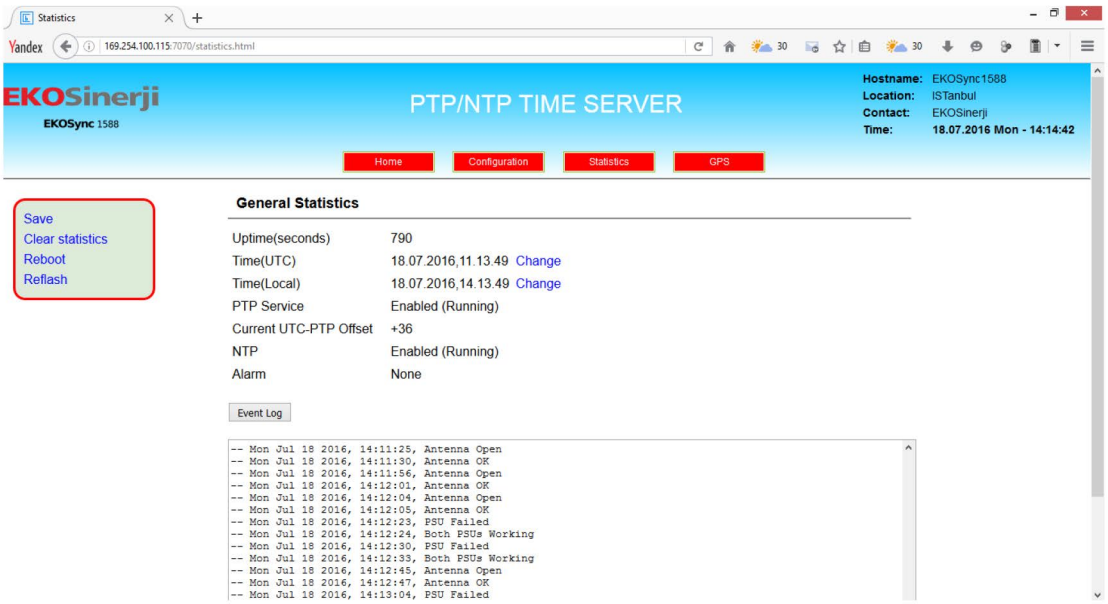
General statistics on the **NTP/PTP TIME SERVER** will appear, such as:

- **Uptime**: Running time of the **TIME SERVER**, from the last time of turning on.
- **Time (UTC):** Date and time indication in UTC format.
- **Time (Local)**: Date and time indication according to the selected time zone.



- Event Log:

Click **Event Log.** Last 100 events can be viewed.



From GPS button:

In this menu the following can be viewed:

-Sattelite Signal Reception

-Location

-Antenna Status

-Mask Angle

-Low Satellites

-Cable Delay