GPS IRIG-B/NTP Time Server

GPS-2-E-NTP

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1 Introduction

The GPS-2-E-NTP Network Timeserver provides a high precision time directly to TCP/IP networks using NTP (Network Time Protocol). It synchronizes time of any NTP clients running on remote PC's. It supports both NTP and SNTP clients for more of current popular operating systems including: Microsoft Windows 95/98/Me/NT/2K/XP, Linux, FreeBSD, IBM AIX and other UNIX family systems. It can synchronize simultaneously thousands of servers, workstations and routers.

The high precision UTC time is powered by cesium atomic clocks coming via GPS (Global Positioning System) satellite system. The independent GPS antenna can be connected optionally too. Both antennas works redundant.

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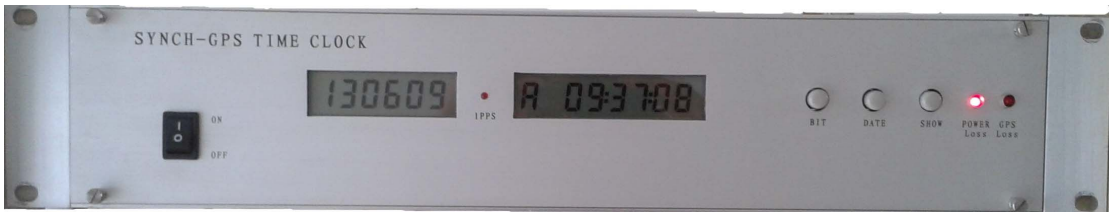


The GPS-2-E-NTP distributes UTC reference time to 1 Ethernet 10/100Mbs sub-network. All time and satellite information is traced on front panel 2 isolated LCDs. More detailed statistic is available by remote NTP software: SNTP Manager for Microsoft Windows 2K/XP.

The installation of GPS-2-E-NTP timeserver is very easy. It simply requires basic TCP/IP address (IP, MASK, GATEWAY) to be set up by ordinary terminal program (e.g. Windows Hyper Terminal). This software can be executed on any remote PC connected to GPS-2-E-NTP via Ethernet 10/100Mbs sub-network.

2 Hardware

The GPS-2-E-NTP timeserver set includes:

- NTP timeserver unit (rack19 mounted 2U)
- GPS antenna with 30m. cable and frequency converter with built-in over voltage protection
- CD with software utility and PDF manual

Timeserver unit is a multiprocessor system with 1 fast Ethernet 10/100Mbs interface. It is design and manufactured without ventilators, fens or any other mechanical parts. Metal housing is an important part of GPS-2-E-NTP cooling system but it is designed on a way that GPS-2-E-NTP can be located in the neighborhood of any device working inside rack19 mount frame.

The 2 LCDs show GPS communication and timestamp information.

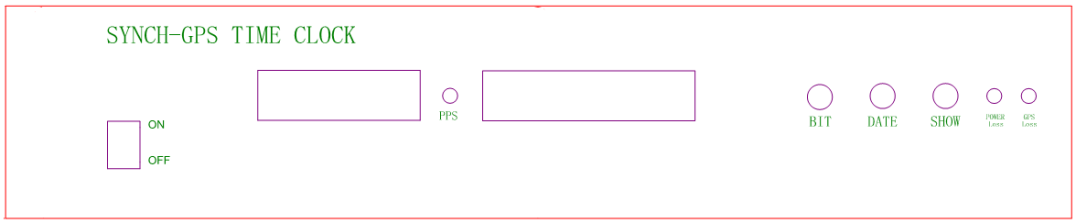


Figure 1: Front panel of GPS-2-E-NTP

BIT: Press it to delete the safe working days number.

DATE: Page up

SHOW: Page down & Return to main menu(Press 3 seconds). Press it to display Date, Work days number, Longitude, Latitude, The time of switching on the device, Altitude…

POWER LOSS LED: Red light when 110-220V AC power is on, LED off while power off.

GPS LOSS LED: Red light is on while GPS source is off.

PPS LED: Blinks every second

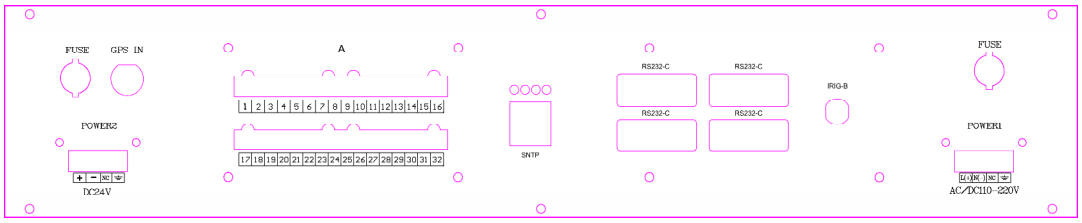


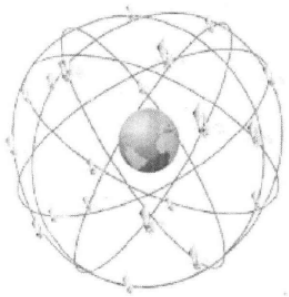
Figure 2: Back panel of GPS-2-E-NTP

LAN connectors contains 4 LEDs: Red indicates cable connection, yellow one flashes while data transmission.

On the back panel there is a power connection 110-240V AC, a power connection 24V DC and GPS antenna rounded connector, 4 RS232-C connectors, a BNC connector for IRIG-B, a group terminal block for pps, ppm, pph, RS485, RS422(IRIG-B), power loss alarm, GPS loss alarm.

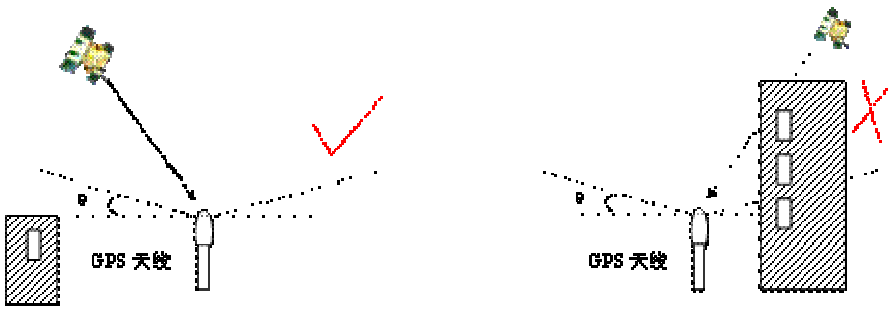
3 Mounting GPS antenna

The GPS satellite time receiver has been designed to provide extremely precise time. High precision available 24 hours a day around the whole world is the main feature of the new system which receives its information from the satellites of the Global Positioning System. The Global Positioning System (GPS) is a satellite-based radio-positioning, navigation, and time-transfer system. The source of time is based on real cesium atomic clocks. Time is represented as UTC (GMT).



GPS worldwide time propagation

The GPS satellites are not stationary but circle round the globe in a period of about 12 hours. They can only be received if there is no building in the line-of-sight from the antenna to the satellite, so the antenna unit must be installed in a location from which as much of the sky as possible can be seen.



GPS antenna installation

4 Powering up GPS-2-E-NTP

If both the GPS antenna and the power supply have been connected the system is ready to operate. Besides that you are ready now to turn on the power.

About 120 seconds after power-up the receiver is warmed up and starts to operate with the required accuracy. If the GPS receiver finds valid almanac and ephemeris data in its battery

buffered memory (and the receiver position has not changed significantly since its last operation)

the receiver can find out which satellites are in its view at that now. Only a single satellite needs to be found to synchronize and generate output pulses, so synchronization can be achieved maximally two minutes after the powerup.

After starting up the system the network function is initiated and the program for communication between GPS and NTP becomes active. The following screen appear on LCDs display while starting.

From the left side there are: time, date, error status.

5 NTP - Network Time Protocol

Before you learn how to setup GPS-2-E-NTP, you also should read about what NTP itself.

NTP is a common method for time synchronization over networks. It is a protocol but a very special one. The NTP is much different from any of known other communication protocols. It is because NTP does not base on the principles of synchronizing machines to each other. It is based on the principles of having all machines get as close as possible to the UTC time provided by GPS-2-E-NTP. How it works?

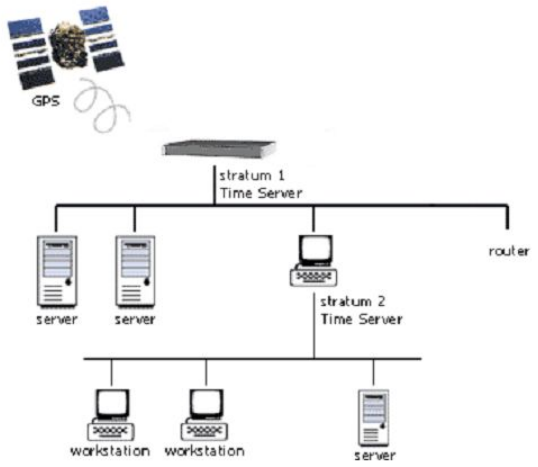
GPS-2-E-NTP forms a statistic of delays and other data necessary to calculate local client RTC offset. Knowing time difference the adjustment of the own RTC clock can be preceded individually by each NTP client.

NTP works on a hierarchical model in which a small number of servers gives time to a large number of clients. The clients on each level, or stratum, are in turn, potential servers to an even larger number of clients on a higher numbered stratum. Stratum numbers increase from the primary (stratum 1) servers to the lowest numbered strata at the bottom of the tree (stratum 15). Clients can use time information from multiple servers to determine automatically the best source of time and prevent wrong time sources from corrupting their own time.

For sure it may take several minutes (or even hours) to adjust a system time to the ultimate degree of accuracy. There are several reasons for this. The most important one is that NTP averages the results of several time exchanges in order to reduce the effects of variable latency. This may take several minutes for NTP to even reach consensus on what the average latency is. Generally it happens in about 5-10 minutes. In addition, it often takes several adjustments for NTP to reach a synchronization. The result is that users should not expect NTP to immediately synchronize two clocks. The ntp date command can be used if an instant synchronization is needed.

The enterprise of GPS-2-E-NTP configuration includes following time sources:

- GPS 1.5GHz radio signal (worldwide)
- RTC internal quartz clock systems for backup



Example of NTP stratum configuration in local LAN peer

A high precision synchronization is chosen by NTP automatically. The NTP always selects best available source of time. Selection is based on several time references like: stratum level, availability of timeserver, network delay, time difference, internal jitter factor etc.

NTP clients of GPS-2-E-NTP are referred to be a Stratum 2 clients. If they serve time to other clients, they are also referred as Stratum 2 servers. The maximum NTP stratum number for a client is 15.

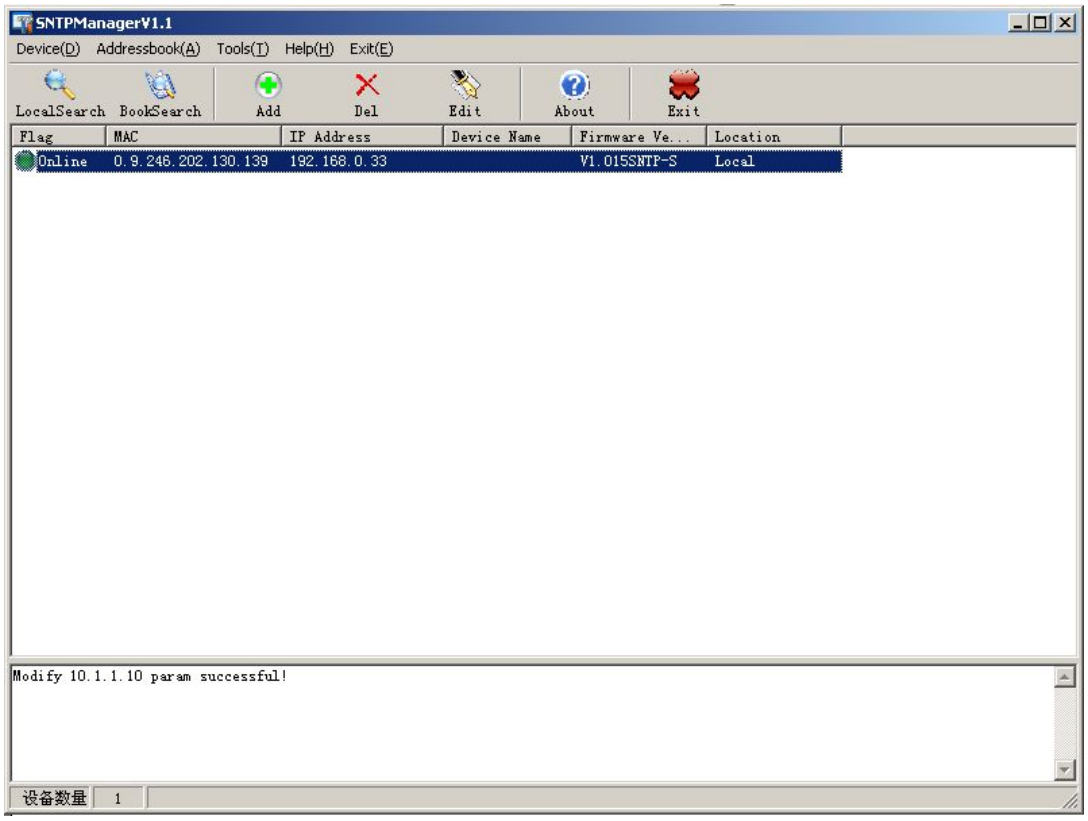
NTP uses the UDP protocol on port 123 to communicate between clients and servers. Attempts are tried at designated intervals until the server responds. The interval depends on a number of factors and ranges from about once a minute to once every 17 minutes. Using UDP prevents retries from using up network bandwidth if a time server with a large number of clients goes down.The bandwidth requirements for NTP are also minimal.

Unencrypted NTP Ethernet packets are 90 bytes long (76 bytes long at the IP layer). A broadcast server sends out a packet about every 64 seconds. A nonbroadcast client/server requires 2 packets per transaction. When the first starts, transactions occur about once per minute, increasing gradually to once per 17 minutes under normal conditions. Poorly synchronized clients will tend to poll more often than those well synchronized clients. Starting from NTP version 4 implementations, the minimum and maximum intervals can be extended beyond these limits, if necessary.

6 GPS-2-E-NTP software Setup

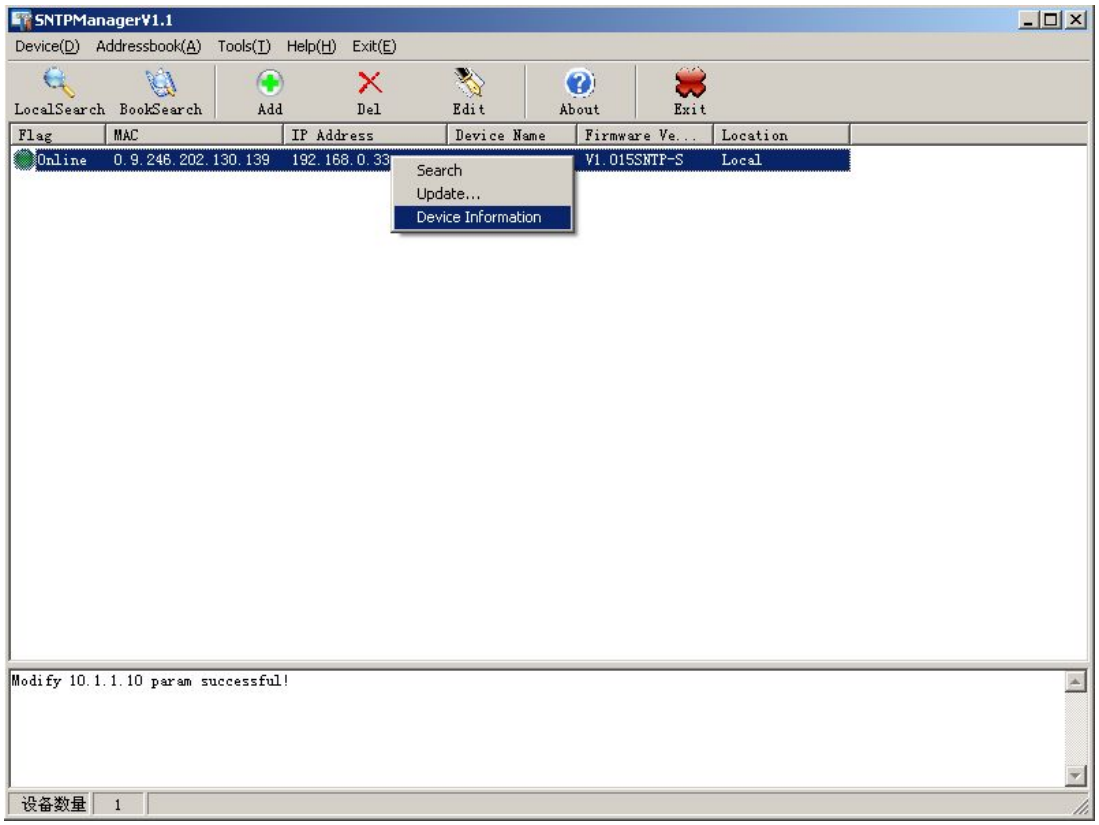
For the very first time of installation the GPS-2-E-NTP has to be configured by sub-network remote terminal software. Please connect your sub-network cable to GPS-2-E-NTP. Other side of cable please connects to any available computer with Windows.

Once terminal is connected the setup appears automatically (after clicking “Local Search” )on screen:

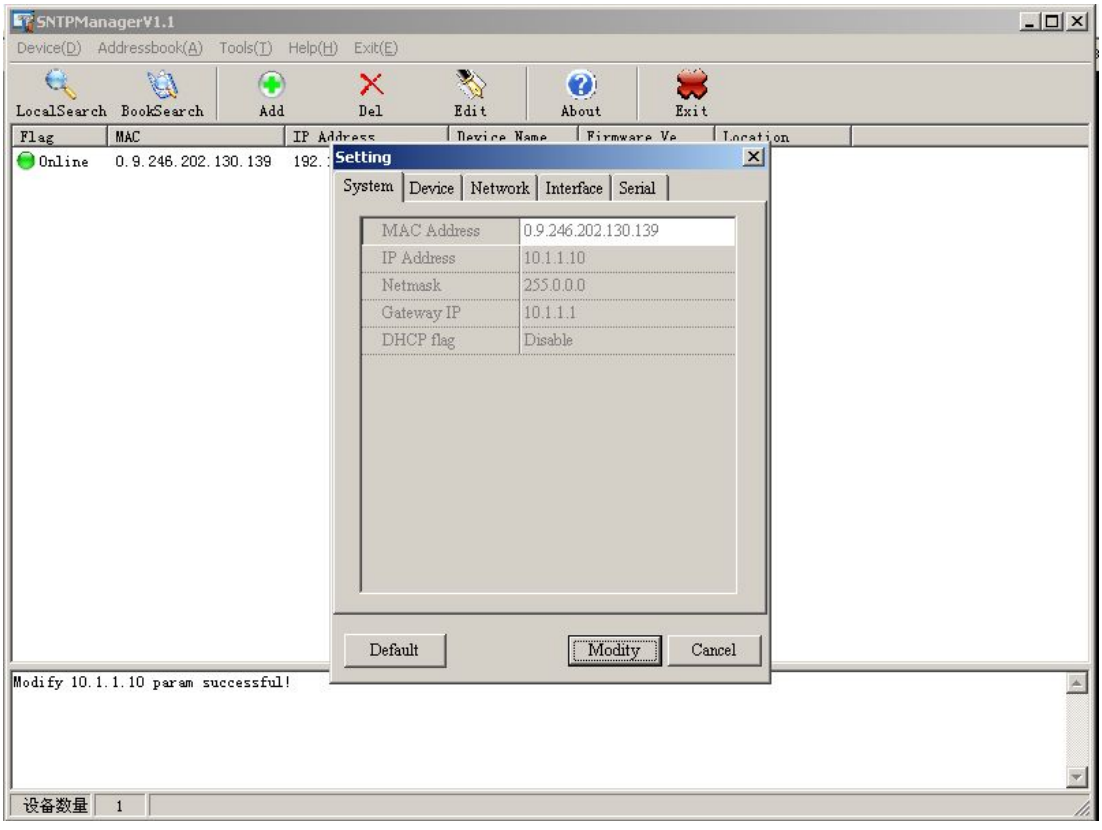


Main menu

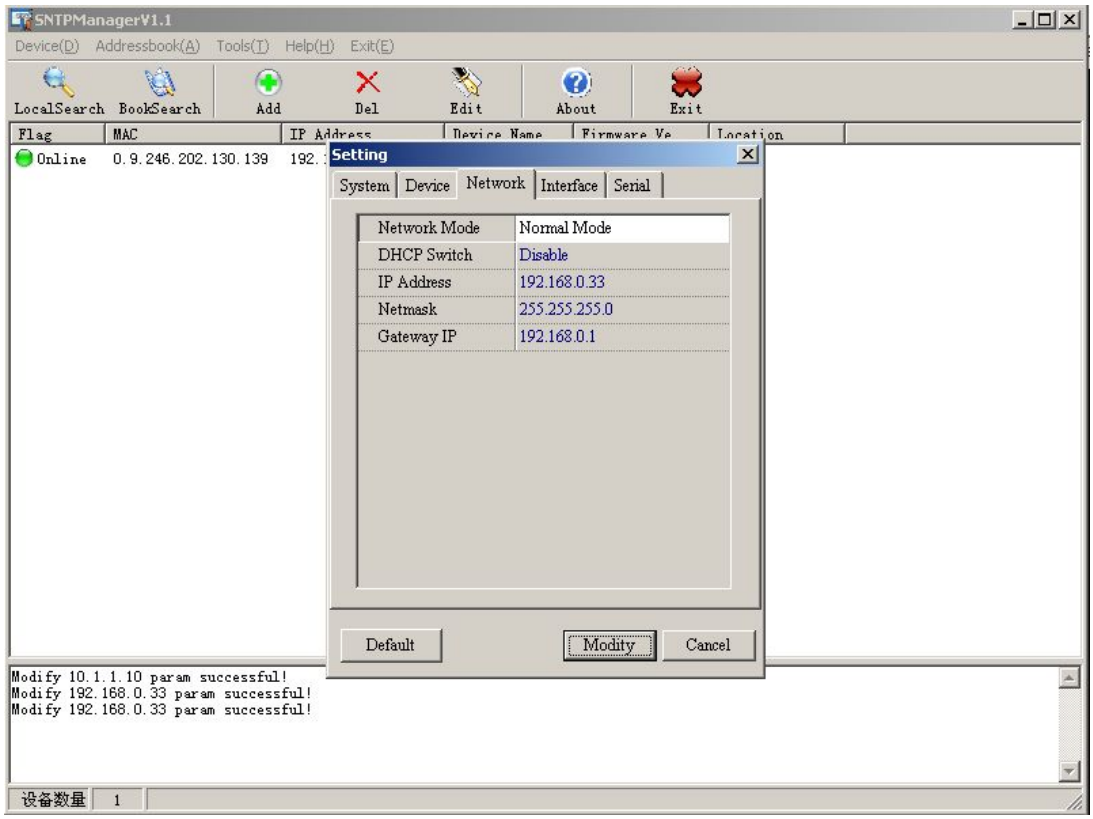
To start configuration you shod first configure the LAN interface by simply placing IP, MASK, DEFAULT GETEWAY for the Ethernet card.



Setting the NTP Service



Setting



Setting IP address, MASK address, GATEWAY address

7 Technical specification

The GPS-2-E-NTP is high quality professional time server for computing, telecom, military and other science purposes. It has been manufactured with no mechanical parts as coolers or hard disk. All cooling system has been resolved on natural air circulation outgoing via metal case of unit.

7.1 SYSTEM

NTP - supports all versions of NTP, SNTP including latest release 4.1.1 supporting modes: CLIENT, SERVER, BROADCAST, MULTICAST. Authentication: MD5 with manual/automatic key generation.

SNTP - supports all versions of Simple Network Time Protocol

OS supports - Windows 95/98/Me/2K/XP/CE, OS/2, VAX-11/785 v4.3, HPUX, SunOS, Solaris, MIPS Ultrix, ALPHA OSF/1, SGI IRIX, A/UX, AIX, Sinix, BSD, Linux, Dell SVR4, SCO Unixware, CISCO products.

7.2 HARDWARE

ANTENNA – BNC connector

LAN - 3x RTL-8139 10/100 Based T: RJ-45 connector IEEE 802.3 - shielded data line

Serial Console – 9 way ‘D’ RS232,4800,N,8,1

IRIG-B – BNC connector

Configuration of terminals on rear panel:

1、CASE - Metal desktop case, 2U
PHYSICAL DIMENSIONS: 483/86/286mm;
2、ANTENNA - BNC Connector ;
3、IRIG-B - Two BNC type connectors, RS485（DC);
4、RS232-C - DB-9 RS-232
send →receive
(9pin)→(9pin)
3 → 2
2 → 3
4 → 6
6 → 4
5 → 5
1 → 7
7 → 8
8 → 1
NC → NC;
5、LAN - 3x RTL-8139 10/100 Based T: RJ-45 connector
IEEE 802.3 - shielded data line
Pin No. Assignment
1 Tx+
2 Tx-
3 Rx+
4 Not in use
5 Not in use
6 Rx-
7 Not in use
8 Not in use

6、POWER - 110-240V AC/DC and 24V DC
L(+): Positive pole (contact 1)
N(-): Negative pole (contact 2)
GND: Ground ;
7、Power loss alarm and GPS loss alarm（270V5A)。

A			
Terminal number		Function	
	1	1PPS	
	2	GND	
	3	1PPS	
	4	GND	
	5	1PPM	
	6	GND	
	7	1PPM	
	8	GND	
	9	1PPH	
	10	GND	
	11	1PPH	
	12	GND	
	13	RS485+	
	14	RS485-	
	15	RS485+	
	16	RS485-	
	17	B(422+)	
	18	B(422+)	
	19	B(422-)	
	20	B(422-)	
	21		
	22		
	23		
	24		
	25		
	26		
	27	KB1	Power loss alarm
	28	COM1	
	29	KC1	
	30	KB2	GPS loss alarm
	31	COM2	
	32	KC2	

7.3 CASE

HAUSING - Metal desktop case, 2U

Front panel: 86mm high / 483mm wide

PROTECTION - rating IP20

DIMENSIONS - PHYSICAL DIMENSIONS: 483/86/286mm

LC DISPLAY - 6 character+8 character

7.4 GPS

CHIPSET - Motorola receiver (8) channel with RAIM

ANTENNA - BNC 1.5GHz / 8m + active converter (IP65 to UTP Cat 5. cable 200m. (max. 500m),

RECEIVER - input frequency 1575.42MHz (L1).

7.5 POWER

INPUT - 110-240V AC/DC(Main Power) or 24V DC(Redundancy Power)

FUSE - 1 electronic

OUTPUTS - +5V / 5A

TOTAL LOAD ≤15 Watt

7.6 ACCURACY

GPS - better than ±100 nsec after synchronization of first 1 hour

better than ±1 μsec during the first hour of operation

NTP - better than 10 msec (with nanosecond kernel)

7.7 OTHER

TEMPERATURE – 0~ 70℃

STORAGE - -40~ 125℃

HUMIDITY - 85% max.