

# Sat Time Synchronizer

## PC time synchronization with sat GPS receiver

for software version 8.0 or higher

(Rev. 3.5 ENG)



This manual is for use with the following products :

SAT TIME SYNCHRONIZER



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## Global Positioning System

### Foreword

The Global Positioning System (GPS) is a satellite-based system that provides location and timing information around the globe. GPS is operated and controlled under the sole responsibility of the Government of the United States of America which is responsible for its availability and accuracy. Any changes in GPS availability and accuracy, or in environmental conditions, may impact the operation of your Sat Time Synchronizer.

Axel Technology srl cannot accept any liability for the availability and accuracy of GPS.

#### Locations

Use of devices with an antenna is prohibited in many hospitals and in other locations. Check local regulations if in doubts.

#### This Document

Great care was taken in preparing this manual. Constant product development may mean that some information is not entirely up-to-date. The information in this document is subject to change without notice. Axel Technology srl shall not be liable for technical or editorial errors or omissions contained herein; nor for incidental or consequential damages resulting from the performance or use of this material

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### Introduction

#### What is 'Sat Time Synchronizer' ?

The Professional Sat Time Synchronizer uses the Global Positioning System (GPS) to provide a world-wide time synchronisation solution. Using Sat Time Synchronizer you can synchronize your computers time to the most accurate clock in the world.

It maintains the computers time to within a fraction of a second of the correct time.

#### Main features include:

- Advanced Global Positioning System (GPS) Precision Clock.
- Accurate Time For Computers and Computer Networks
- Eliminates time drift on computers
- Easy to Install, Configure and Maintain
- Pc powered, no batteries required.

The 'SAT TIME SYNCHRONIZER' doesn't need any connection to the Internet and it therefore represents the most reliable and safe way to get absolute time reference with no risks for virus infections.

#### Other main features include:

- Up to 50 meters cable length (10 meters supplied). NOTE: depending on the quality of the cable shielding, longer distances can be reached.
- On-screen signal strength for fine-tuning antenna location.
- Operates world-wide, anywhere on the planet.
- Reliable and secure source of time for Windows NT/2000/XP/2003/VISTA

#### The Sat Time Pc control software provides status information detailing:

- GMT (Greenwich Meridian Time)
- Current Local Time
- Configured clock type and COM port.
- Synchronisation status, if the PC is currently synchronised to the GPS Clock or not.
- Signal strength, the current real-time signal strength of the radio time transmission.

The Pc 'client' software runs continuously as a background task that periodically gets updates from one or more 'time' servers. The client software may accept or ignore responses from servers that are not currently up-to-date to GPS time.

## Why my Pc should need time synchronization?

Radio and TV stations today rely on networks of computers, all of which have clocks that are the source of time for files or operations they handle. Most of these organizations use a time server to ensure accurate time settings.

As with any other clock, the BIOS clock of any PC is subject to a gradual drift which may amount to 10 sec (or more) per week.

This means critical, time-based applications such as Radio or Video automated softwares cannot rely on the PC's system clock for accurate timing information. Instead they must be able to query an accurate time source for precise timing information. Such accurate time source is typically an atomic clock (which sometimes may be unavailable or unreliable because of communication errors) on the internet or a locally operated Global Positioning System (GPS) receiver.

The Sat Time Synchronizer continuously measures the Pc clock drift and calculates the necessary correction. The clock drift measurement is refined over time and the average accuracy can be kept up to one undredth of a second per week ! The Sat Time Synchronizer can operate on a single Pc or on a Pc network as well.

## What 'GPS' stands for?

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or setup charges to use GPS.

The 24 satellites that make up the GPS space segment are orbiting the earth. They are constantly moving, making two complete orbits in less than 24 hours.

Each satellite continuously transmits its own position and a time code. By measuring the relative arrival times of signals from several satellites, a GPS receiver can determine its own position and get absolute time reference.

GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path.

To meet precise requirements, the GPS system's master clock is always kept within 1 microsecond of the U.S. Naval Observatory's Master Clock. This clock is, by law, the official time-keeper for the United States.

Each GPS satellite has four atomic clocks on board. An American Military body monitors these clocks and the precise position of each satellite through a network of monitoring stations spaced around the world. They then compute and broadcast corrections to keep these clocks so accurate that they are almost always within 250 nanoseconds.

Since the GPS satellites are constantly referenced to a national standards laboratory time base, the GPS system provides a simple and inexpensive way to obtain high precision absolute time, synchronized to UTC, without purchasing and constantly recalibrating a set of atomic clocks. The GPS system is designed to give standard errors of about 150 nsec relative to UTC on a single time fit.

The GPS satellites transmit inside the microwave range (1.5 Ghz) using a spread-spectrum encoding mechanism. This transmission requires a line of sight between the receiver and the satellite. The GPS system was designed so that there would be six satellites in view from any point on Earth at any time.

## Getting Started

### What's in the box

Sat Time Synchronization Kit includes the following:

- Sat Time Synchronizer antenna / receiver with 10 meters serial RS 232 cable connected
- This User Guide
- CD-ROM with Pc Control software and USB drivers
- Serial -to-USB converter/adapter.
- A protective dongle (also mentioned as 'hardware key' on this manual)

### Minimum system requirements

- Operating System: Microsoft Windows™ XP SP2 / NT / 2000 Professional, 2003 Server, VISTA.
- At least 2 (two) free USB Ports (rel 1.1) on the time 'server' computer
- Administrator rights for both time server and time slave computers

### Plugging the USB HARDWARE KEY (DONGLE)

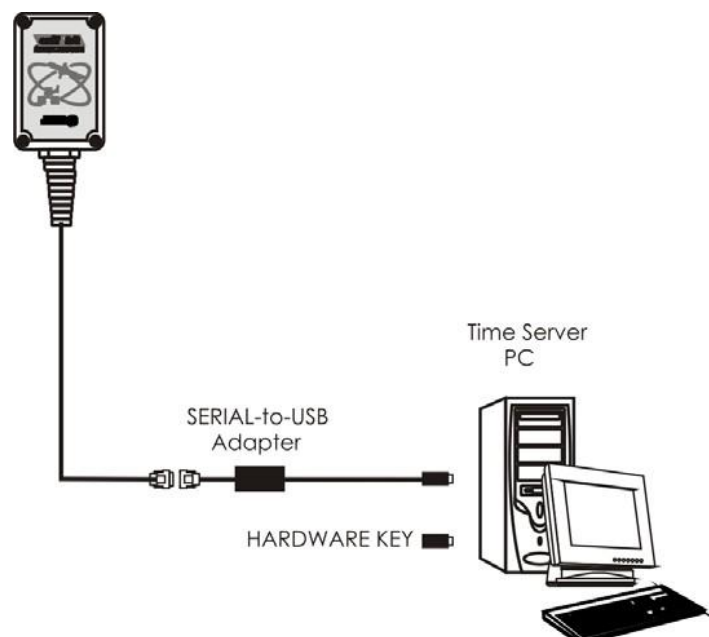
The Sat Time Synchronizer software requires the use of a security hardware key called a dongle. The hardware key provided with every Sat Time Synchronizer must be always plugged to a USB port on the PC where the software runs in the Server mode (i.e. on the computer with the receiver connected to).

NOTE: Dongle is not required when running the Sat Time Synchronizer software on Client mode.



There is no need for specific drivers for this type of key: the dongle is a USB device that uses the driver native to the Windows operating system.

When the dongle is inserted into the USB port, the operating system will prompt you for installing the new device (Found New Hardware message). Just wait until the o.s. will end the installation automatic procedure!!

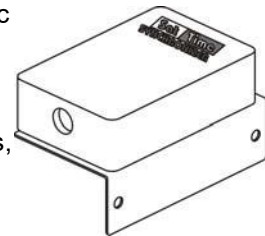


## Positioning The Antenna / Receiver

### Choosing the best location

The GPS antenna and the GPS receiver are integrated together in a small plastic box. ,

The GPS Receiver should be placed where it is exposed to the sky, parallel to the horizon, and unobstructed by trees, roof overhangs, power-lines, etc. If mounting the GPS antenna indoors (not recommended), mount it at the lower edge of a window, exposed to the sky.



Labelled surface must be oriented toward the sky (this is the active antenna surface), thus allowing the antenna to see and track the maximum number of satellites throughout the day.

It must always be taken into consideration that the Receiver's box is WATER-RESISTENT but NOT WATERPROOF (Protection degree is IP 65).

For that reason, select a site which would not allow the antenna to become wet or buried in accumulated snow. It should be protected from direct rain and from direct sun rays as well.

Installations with obstructed views may prove operational, but may experience reduced reception quality and the inability to simultaneously track the maximum number of satellites.

The antenna could receive satellite signals even through glass, canvas, and thin fiberglass, but dense wood, concrete and metal structures shield the signal.

Consider also the length of the cable run when selecting a location. The max length for a regular RS232 cable is around 25meters. However, well-shielded, professional cables have been proven to cover higher distances.

### Avoiding noise sources

The Sat Time Synchronizer receiver contains an active antenna. For optimal performance, place it as far as possible from transmitting antennas, including FM transmitters, radars, satellite communication equipment and cellular transmitters.

Whenever locating the antenna near a transmitter installation, ensure that the antenna is positioned outside of the antenna's cone of transmission. When installing the antenna near satellite communication equipment, follow the same guideline.

As a general rule, for best results, mount the antenna below and several meters away from communication equipment.

Also prevent the receiver from excessive shock or vibration.

## Routing the connection cable

After the smart antenna is mounted, route the connection cable from the Receiver / antenna to the Pc host location.

Choose the most direct path to the host system, while avoiding the following hazards:

- sharp bends or kinks in the cable
- hot surfaces
- sharp or abrasive surfaces
- door and window jambs

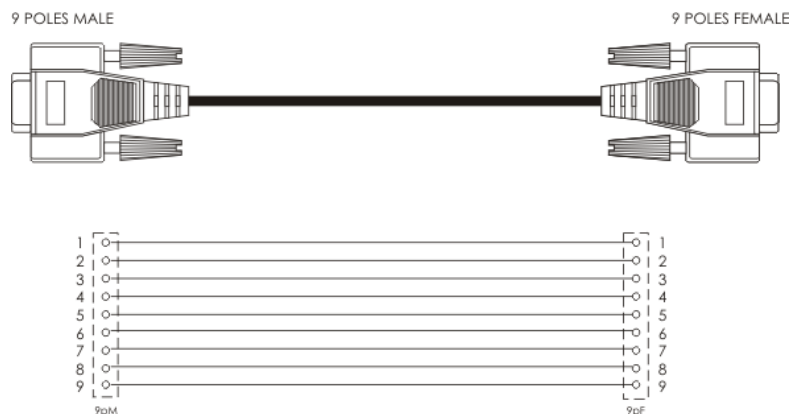
Also route the cable so that it is not likely to be walked on, stretched or pinched by items placed upon or against it.

When you have established the ideal cable routing, secure the cable along the routing using tie-wraps.

## Adding an extension to the cable

The Sat Time receiver comes from the factory with 10 meters of connection cable. If longer cable runs are needed, You may use standard RS232 extensions (9 pins to 9 pins) available at the Pc's shops. You may ask for 10 meter extension also when placing the order. The following picture shows the extension cable pin-out (straight-forward pin-out).

The SAT TIME Receiver is powered by the computer. Its connection cable therefore carries Serial Data + Powering Voltages. **DO NOT** attempt to increase cable length by inserting RS232 repeaters, as this results in damages for the repeater itself!



## Installation steps for 'Time Server' on Windows

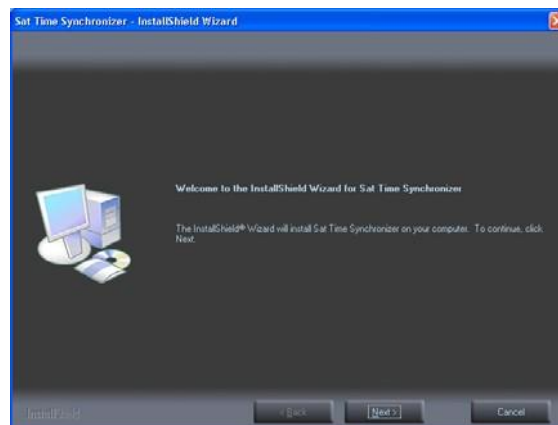
We defined the 'Time Server' as the computer with the Sat Time receiver straightforward connected to.

- 1) Install the provided PC software on the Time Server Pc (see next Chapter "Installing the Sat Time Software")
- 2) Plug-in the USB hardware key (dongle) into a free USB port
- 3) Plug-in the USB connector of the 'USB-to-Seerial' adapter into another free USB port
- 4) Follow the standard Windows procedure to install RS232-to-USB Drivers, as described in the Chapter "Installing USB Adapter drivers"
- 5) connect the Sat Time Synchronizer receiver to the Rs232 connector of the USB adapter
- 6) Place the Sat Time Receiver in the best position by following hints and tips on Chapter "Positioning The Antenna / Receiver"
- 7) Set-up and operate the Sat Time Synchronizer software interface as described in the Chapter "Exploiting the software"

### Installing the Sat Time Software

The Sat Time control software is provided on the CD Rom wich come s with the equipment. We recommend to check the manufacturer web site [www.axeltechnology.com](http://www.axeltechnology.com) for latest release.

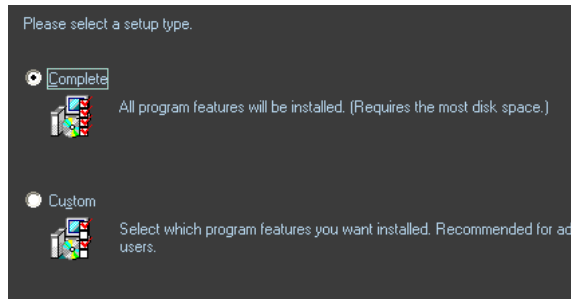
Double-click on the Setup.exe icon (the Globe!) to start the installation process. The InstallShield Wizard will start.



Click Next. The next InstallShield Wizard screen, Customer Information, will display, offering the following fields: User Name, Company Name.

Fill in the Customer Information fields as appropriate and click Next.

Choose the Complete installation option and click Next.



At the next screen, click **Install** to begin installation.

The automatic installation procedure will place application files in the default folder:  
C:\<winprogramdir>\Sat Time Synchronizer.

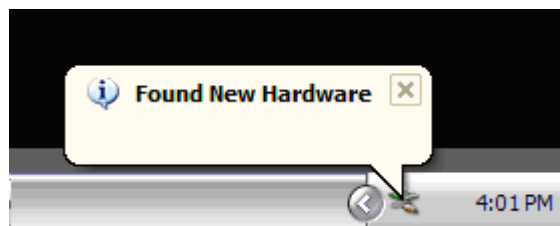
The Sat Time icon will be automatically added to the desktop and the program will be automatically added to Windows Start-up programs, i.e. Sat Time Synchronizer will launch automatically when Windows starts. You can always check the contents of the Startup folder for your own user profile from the path \Start Menu\Programs\Startup).

**Install Shield Wizard Complete** : A message appears stating that the installation was successful, click 'Finish' to close the installation Wizard.

Sat Time Synchronize software (release 8.0 and higher) will automatically load USB drivers onto your operating system, in order to make it ready for hosting Sat Time receiver as soon as the RS232-to-USB adapter is plugged-in.

## Installing USB Adapter drivers

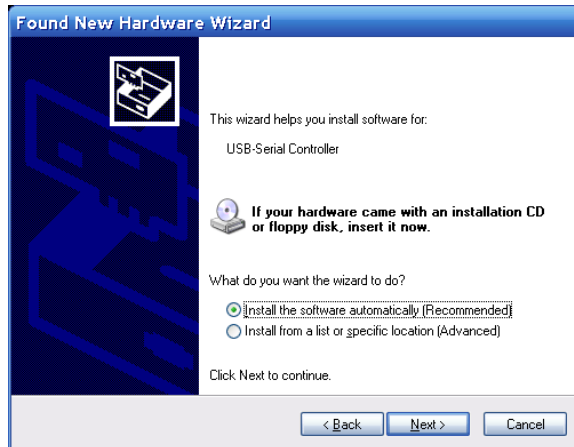
1) After installing the supplied Sat Time software, plug the USB connector into one of the free USB port on the computer. The Pc will detect a new connected device.



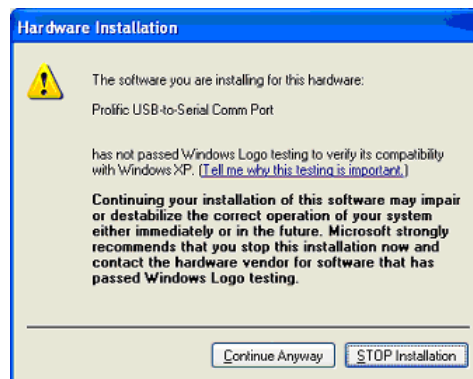
2) On next prompted 'Windows Update search' screen choose 'No, not this time'



3) on the next screen, choose "install the software automatically"



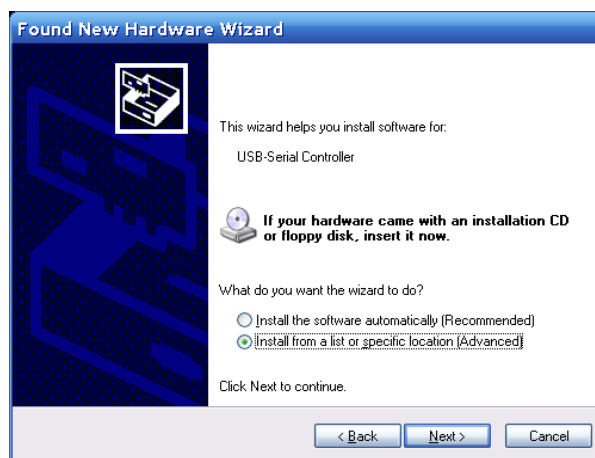
4) When using Windows XP o.s., before Windows installs this, it may prompt you that this device driver has not yet passed Windows XP Logo compatibility. Click Continue Anyway. Windows will then start to install the driver for the USB-to-Serial Comm Port.



5) at this time, Windows should automatically locate proper drivers and install it. After finishing, a 'Wizard has finished installing the software for USB-to-Serial Comm Port' message will appear. You can go ahead with next Chapter

NOTE: in the event the Sat Time drivers are to be installed manually, the following procedure should be observed:

- a) follow the first two steps shown on the previous page
- b) choose 'install from a specific location' option then click the [Next >] button.



On the next screen: Select "Search for the removable media" after making sure the Sat Time CD ROM is loaded into Yr CD-ROM drive and follow instructions the Windows Wizard will show on the screen.

## Running the Sat Time Software

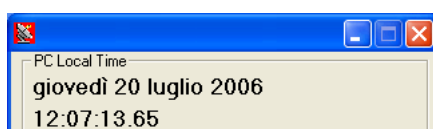
Make sure the Receiver is connected according to instructions provided in the previous chapter. Make also sure the Adapter cable is firmly running between one of the Pc USB port and the RS232 port on the Sat Time receiver. Also make sure the Hardware Key (protective dongle) is inserted into another USB port on the computer.

Launch the Sat Time application from Start ->Programs -> Sat Time Synchronizer or double click the associated icon on the desktop.

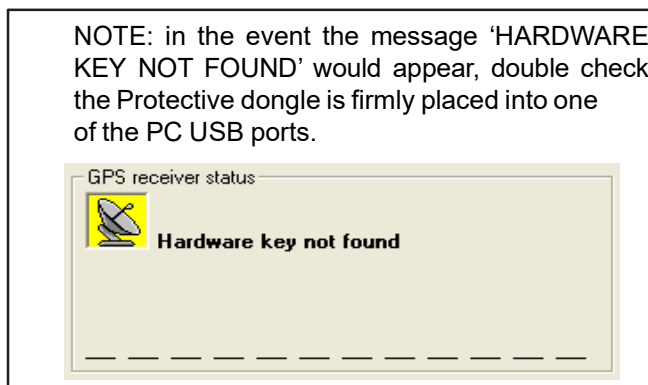


A small red icon showing a satellite dish will appear on the system tray, close to the system's clock.

Double click that red icon: the main Sat Time software mask will appear, showing the current Pc Local



Time and the Pc GMT Time as well. If that window doesn't appear, click the Server button at the left bottom side.

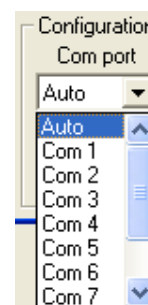


### Selecting the Serial Port

In the Configuration mask, keep AUTO option enabled to let the application scanning automatically all the available serial ports available on the Pc.

If You already know which Pc RS232 port (Com Port) the Sat Time Receiver is connected to, set it from the drop-down menu.

NOTE: Serial Port number (COM xx) is automatically assigned by the system each time the USB connector is plug-in. To know the COM port number(s) assigned to USB-to-serial adapter by Windows 2000/XP/VISTA, open the Windows Device Manager screen and check into the COM port group. Refer also to FAQs at the end of this User Manual



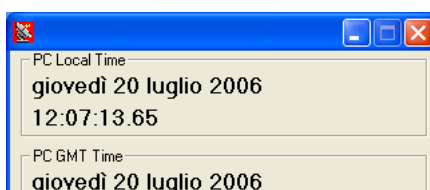
for further suggestions.

Also NOTE: there is no need to set the RS232 communication parameters (Baud Rate, Stop Bit, Parity bit, etc), as the Sat Time software automatically forces the chosen port to operate in the optimal way.

### Getting response from the Receiver

If every connection has been correctly done and the Sat Time card is properly powered, as soon as the Sat Time software comes across the actual Com Port (or after opening the selected COM port), the presence of a connected Receiver will be automatically detected, with an 'Inizializing receiver' message staying displayed for a short time.

After that, the 'Calculating GPS time...' message will appear, meaning the Receiver starts communicating



with the Pc.

If a valid satellite signal (depending on signal strength and number of satellite in view of sight) is present at the Receiver, one or more bars will appear on the bottom half of the window (each bar corresponds to just one satellite). See also next Chapter.

When minimized, the software automatically runs on the background. A small icon on the system tray, close to the system Clock display, informs about the satellite signal receiving status.

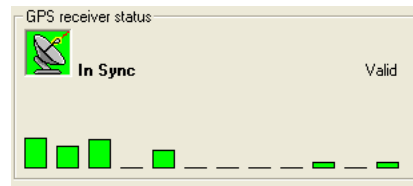
- RED icon: weak or absent received signal / insufficient number of satellites on view - waiting for a valid status
- YELLOW icon: received signal nearly good but not valid yet (See note below for definition of "valid signal")
- GREEN icon: good signal strength and at least three satellite on view: the Pc Clock is being corrected

To exit the software, click right the Satellite icon close on the system tray and choose 'Close'.

To configure the software while it is minimized, click right the Satellite icon on the system tray and choose 'Configuration'.

## How good is the received signal?

The Receiver will be able to provide good Time synchronization (VALID SIGNAL) as soon as the 'parabolic antenna dish' icon turns GREEN.



To fix a location and therefore to get absolute time information from the GPS system, the antenna has to be able to see at least 3 satellites. Whenever only one or two satellites are visible, the receiver is already able to assume a time information, but it could be unreliable. For this reason, the Pc clock is not updated until at least three satellites are seen.

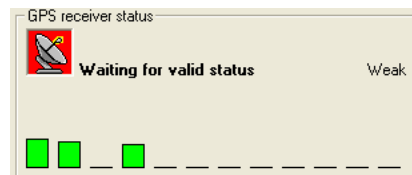
The number of satellites "in view" STRICTLY depends on the time of day and where you are on earth.

If you have an unobstructed view of the sky then your receiver should be able to receive signals from at least three to five satellites. In many cases satellites are often hidden behind obstructions such as walls, ceilings and nearby buildings.

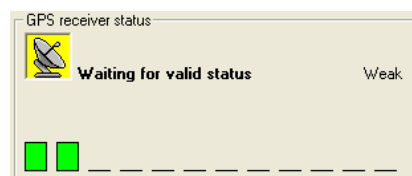
Refer to the Chapter 'POSITIONING THE ANTENNA/ RECEIVER' for location details and suggestions.

DEPENDING ON THE POSITION OF THE ANTENNA AND ON THE LOCATION ON EARTH, YOU MAY EXPERIENCE LACK OF THE SATELLITE SIGNAL FOR SOME MINUTES OR PERIODS DURING THE DAY. THIS IS NORMAL. HOWEVER, ALWAYS TRY TO PLACE THE ANTENNA IN THE POSITION WHERE SATELLITE SIGNAL IS RECEIVED WITH ITS MAX STRENGTH.

When the signal received is lacking or insufficient, the dish icon turns red



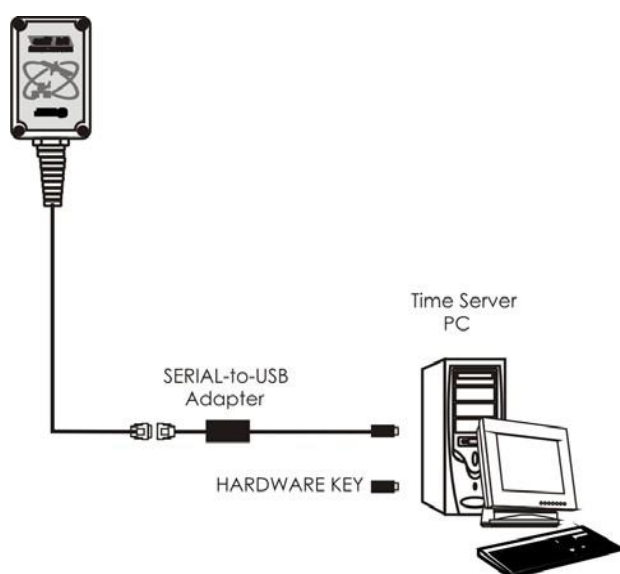
The icon turns yellow when the signal is received but cannot be considered valid (see definition of valid status)



## Single Pc synchronization


This Chapter covers the case of one Pc with Sat Time Synchronizer receiver connected to.

This Chapter covers the case of having just one computer with the Sat Time receiver connected to. That Pc will be considered as the 'Time Server'.

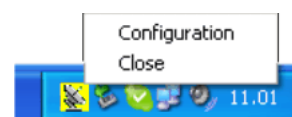


1) Install and run the software by double clicking (or clicking right and choosing 'Configuration' ) the Sat Time Yellow Icon wich appears on the System Tray, next to the system clock display.

2) Press the 'SERVER' key to switch to the Server mask (the mask associated to Time Server mode operation)

3) As soon as the signal received from the satellites becomes 'valid' (green Parabolic antenna logo ) , the Pc clock will be instantly synchronized to the GPS time (or it will be gradually synchronized to the same reference depending whether the 'Gradual Time Adjust' option is not enabled or enabled).

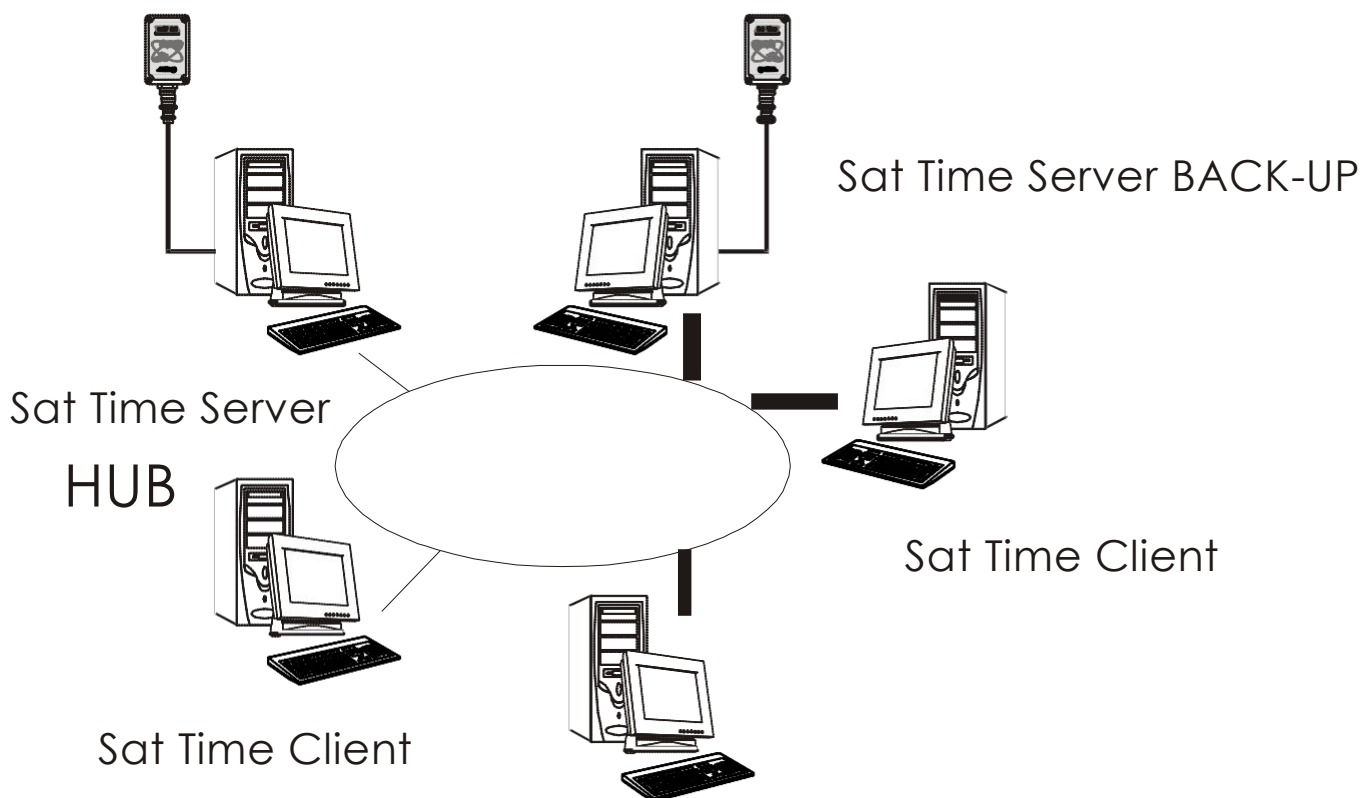
4) On the Sat Time software mask, it is advisable to select the 'AutoStart' option in order to let the software launch automatically with Windows at the next boot. On Windows NT, 2000 Professional, 2003 Server and XP it is very recommended also to keep the 'Gradual Time' option activated.



ENG

## Pc network synchronization

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### Sat Time Client

This chapter covers the case of two or more PCs connected on LAN (Local Area Network) through Hub or Switch (or even via Ethernet crossed cables in the event of just 2 PCs).

The aim is to have all the PCs synchronized to the GPS absolute reference time.

To do this, one of the networked PC will have the Receiver physically connected and will be therefore considered as the 'Time Server' while the remaining computer will act as 'Time Clients' and thus they will run the Sat Time Synchronizer software in its 'client' mode.

For higher system reliability, You may have more than one 'Time server' on the same network. As explained on one of the next sections, the Sat Time Synchronizer - Client part is able to switch from one time server to the alternative one, in the event the first (main) server should fail down.

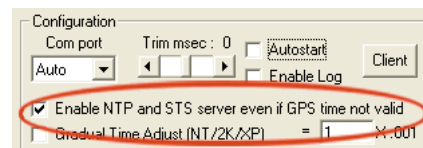
The 'Time Server' machine is not necessarily the Network server: the Time Server is a regular PC with the Sat Time receiver connected to, retrieving the time from the GPS system and sharing it among the other PCs of the network.

Three different protocols (STS, NTP and Microsoft TOD) may be used for distributing time information among the PC. Pros and cons for each protocol are explained on the next pages. Basically, NTP protocol is a widely used, standardized international protocol, while the STS (Sat Time Synchronizer) protocol is a customized version of the NTP, tailored and optimized for the Sat Time application. For that reason, it may provide much better sync performance than NTP protocol. The TOD (Time Of Day) protocol relies on a Microsoft Windows native function.

## Configuring the 'Time Server'

To install Sat Time application on the 'Time Server' machine refer to the previous Chapter.

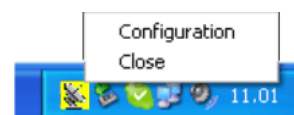
In addition to the settings shown on those pages, the user may decide the client PCs are always to be synchronized to the Time Server, no matter of whether the Time Server itself is updated with the GPS time, or if the clients should update their clock only when the Time Server provides a 'reliable' time reference (i.e. it shows the Green icon). This selection is done via the associated check box on the Server mask. This option is available only when using NTP and STS protocols.



It is advised to use this option just for testing the network and the Sat Time system when installing the software and then keep it disabled for normal operation.

## Configuring the 'Time Clients'

1) Install and run the software by double clicking (or clicking right and choosing 'Configuration') the Sat Time Yellow Icon which appears on the System Tray, next to the system clock display.



2) If not already open, press the 'CLIENT' key to switch to the Client mode mask

3) Type the name of the 'Time Server' or its IP address. Make sure the 'Time server' Pc can be reached across the network.



Current Pc time. With the Green icon, this shows the Sat Time is properly syncing to the time server. Refer to 'brutal vs gradual sync' section for further notes.

As soon as the Client gets a valid time information from the Server across the network, the icon turns green and the update procedure starts, according to the chosen update mode (gradual or 'brutal' sync).

Click SYNCH NOW to force the clock update manually, at any moment. A 'brutal' sync is however performed each time the Sat Time software is launched after the first installation or after a boot of the PC.

This section defines the protocol used for synchronizing with the Time server (see next section).

Type the name of the Time server or its IP address. The second line contains the Name or address of an alternative time server (back-up). The alternative server will be polled once every time the main one becomes unavailable on the network. In the event of both servers unavailable, the Sat Time software will cycle between them.

This section sets the clock update modes. See next Sections for details.

Whenever Server Mode is displayed, the Sat Time

## Choosing the right Sync Protocol

The Sat Time Synchronizer software supports three protocols for PC clock synchronization.

**NTP (Network Time Protocol):** International, standardized protocol. It is specifically designed to synchronize the clocks of computers over a network. It is built on the Internet Protocol (IP) and User Datagram Protocol (UDP), which provide a connectionless transport mechanism. The degree of precision, in the most applications, is +/-1 second. It uses IP Port 37 and the time information is carried by 4 Bytes.

**STS (Sat Time Synchronizer) Protocol.** Customized protocol, tailored on Sat Time Receiver. It provides the best time accuracy (+/- 10 ms). Time information is carried by 15 bytes, plus an additional byte for checksum communication error control, and it uses IP Port 55203. Its use is very advised.

**MS TOD (Microsoft - Time Of Day).** It is based on a native Microsoft Windows function. It allows to get time information from any other Pc available on the network, no matter if that computer has the Sat Time receiver connected to it. Even is often unaffordable, this Microsoft tool may proven useful to synch PCs belonging to different networks, with an accuracy of +/- 20 milliseconds on average. Due to the design of this Microsoft tool, the Sat Time application could freeze if the 'target Pc' (i.e. the Time Server to get the time from) becomes unavailable on the network. NOTE: for a correct operation, all the computers must share the same Time Zone.

## 'Brutal' vs Gradual sync

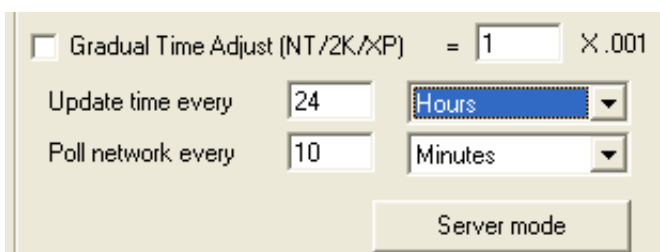
On the Sat Time Client software, once the Sat Time icon turns green (i.e. the connection to the Sat Time server is properly performed), You may always 'force' at any moment the update of the Pc clock by clicking the SYNC NOW button.

A 'SYNC NOW' sync is performed any time the Sat Time software is launched each time the application is run. With the 'Autostart' option enabled, this allows to retrieve immediately the right time synch every time the Pc is rebooted.

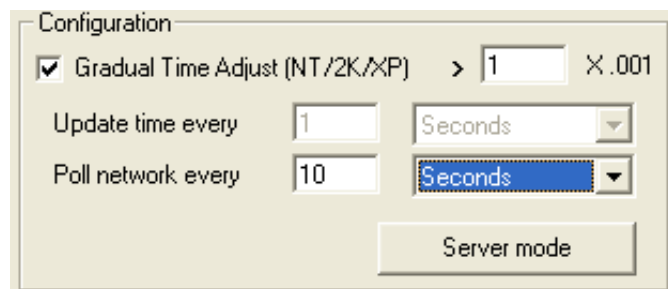
Once the Pc clock is updated, the time may be kept in synch in two modes:

- 1) by forcing the clock update at given time intervals ('brutal' sync).
- 2) in a 'smooth', gradual mode (whenever the associated 'Gradual Time Adjust' option is enabled\*\*)

In the first mode, You can always configure 'how often' the Pc Clock will be updated (Update time every..) and how often the Client will poll the time sever to get time information in the event the the server is not reached at the moment of the scheduled update time. For example, setting Update time every 24 hour, the Sat Time Client will sync the clock now and again tomorrow at the same time, etc. The Server will be polled at the exact time the sync is scheduled (every 24 hours in our example). If the polled Server is not available at that moment, the Client will start polling it at the rate set in the Poll network every... section, in order to retrieve sync as soon as possible.



The second mode (Gradual...) is not based on a forced brutal sync at given (fixed) time intervals, but it is continuously compensating for the Pc clock drift, speeding up or slowing down the PC time.



Rate of acceleration is determined by the value expressed in 1/1000 units in the text box. The difference between correct GPS Time and current PC time is expressed as a Delta Value, defined by a positive or negative number. The DELTA is calculated at every successful polling of the server. That polling is executed, by default, every 10 seconds in order not to generate excess traffic on the network. In the event the Time Server will not 'answer' to time info request (for example, it is disconnected..or not available across the

network), You may decide how often try to get time info by typing the desired time interval into the Poll network every...box.

You may represent the Gradual Time mode as an oscillation around an ideal, absolute time.

For this reason, with Gradual Time Adj mode enabled, at the moment the Time server is polled, the absolute time for the local Pc will be expressed as the Pc local time displayed on the Sat Time mask plus or minus the DELTA factor also displayed on the Sat Time software mask.

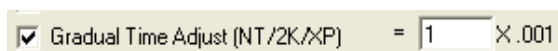
### Why Gradual Time Adjustment mode is preferable

Most network time synchronization softwares restrict themselves to the equivalent of "adjusting the hands of the clock" to Pc clock at certain intervals.

Even if this way of operation may be good in most cases, when using any automated system software, forcing the 'Pc clock hands' at regular intervals may affect the operation of the Automation System.

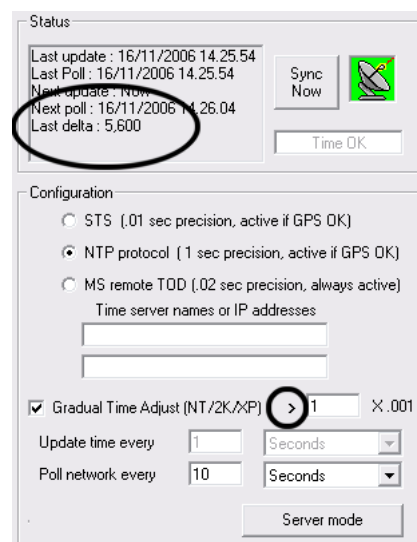
Thus, in order to effect continuous accuracy, it is not very advised to adjust the system time at certain intervals, but it would be better to correct the system clock speed. Once your computer system clock speed is correct, it is only necessary to verify correct time at certain intervals and make minimal corrections where required.

This system clock speed correction is called 'Gradual Time Adjustment' and is available on Windows NT/2000 and XP.



The Sat Time Synchronizer software achieves this by first measuring the difference between the current GPS Time and the current Pc Time (Delta) and then adjusting the operating system clock speed accordingly.

For example a Gradual Time Adjust set to '1' in the related field means that each second will be increased / decreased by one-per-thousand, depending on the sign of the DELTA (> , = or <).



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## Installation Procedure on O.S. Linux SUSE

First of all make sure of having a C compiler installed.

### Server Installation

- 1) Make sure that on boot of the computer the Sat Time Receiver is the only USB Device attached to the computer.
- 2) Log In As root
- 3) Copy linux-ntp folder from CDROM to your Desktop
- 4) Access the folder from shell by typing "cd Desktop/linux-ntp"
- 5) Type "chmod 777 Install" in order to give execution permissions to the installation file
- 6) Type "./Install"

**WARNING!! NTPD DAEMON MUST ALWAYS BE STARTED AS ROOT!!**

Ntpd doesn't have graphic interface, so, to check if ntpd Daemon is running open a shell and type "ntpq"

- "la" let you know clock list, connection status (reject / syspeer) and if the device is reachable.

- "pe" let you know the current list peers of the server, along with a summary of each peer's state, the address of the remote peer, the reference ID, the stratum of the remote peer, the type of the peer (local, unicast, multicast or broadcast), when the last packet was received, the polling interval, in seconds, the reachability register (0 = no reach), and the current estimated delay, offset and dispersion of the peer, all in milliseconds.

### Client Installation

- 1) Make sure that on boot of the computer the Sat Time Receiver is the only USB Device attached to the computer.
- 2) Log In As root
- 3) Copy linux-ntp folder from CDROM to your Desktop
- 4) Access the folder from shell by typing "cd Desktop/linux-ntp"
- 5) Open file ntp.conf with a text editor
- 6) Uncomment lines server and fudge of SAT TIME Server
- 7) Comment the lines server and fudge of Sat Time GPS Clock.
- 8) Type "chmod 777 Install" in order to give execution permissions to the installation file
- 9) Type "./Install"

If after the install is complete the NTP Daemon don't seem to be started, reboot your system and launch NTPQ to check if NTPD is working.

## FAQs

### TROUBLESHOOTING

Q: Even if type the correct name of my 'time' server, the Sat Time icon never turns green and there are no GPS data. It seems, the Time server itself can not be detected across the network.

A: Make sure the Time Server resource is visible from the standard 'Network Resources' window on Yr client Pc. This means, make sure You can see the time Server PC listed in the network resources window. Alternatively, try to perform a 'ping' to the Server: if You get reply, You will likely also synchronize to it. It is also possible, your personal "firewall" is blocking access to NTP's port. If You are using the NTP protocol, make sure the Port 37 is open throughout the network. In particular, make sure that port is open on an hardware firewall if it is present. The STS protocol uses Port 55203.

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Q: I've set the Gradual Time Adjust mode on my Pc, keeping the default setting (one-per-thousand correction). Nonetheless, I'm unable to get the PC perfectly synchronized..What should I do?

A: Some motherboards suffer of a very large drift. The '1 per-thousand' setting could be not enough to comensate that drift. It may be suggested to increase the step of the Gradual Time Adjust to 2 per-thousand.

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Q: I'm installing the Sat Time Synchronizer and my XP operating system has the Windows Firewall activated. What should I do?

A: as soon as the Sat Time software launches for the first time, it detects the status of IP communication ports (Port 37 for NTP protocol and Port 55203 for STS Protocol) . If they are blocked, a message on the screen will be automatically displayed, asking the user to manually set firewall settings to open specified ports to all applications or all ports to sat Time synch.

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Q. My PC is unable to recognize my GPS unit when I connect it to the serial port on my PC. What could be wrong?

A. Have you been able to interface the unit to this PC previously?  
If yes, what may have changed since the last successful interface? new software or new peripheral device? This new configuration could be causing the PC not to recognize the GPS unit.

Also, please check the following:

1. Is the Receiver properly connected to its Interace Card?
2. Are the serial cable inserted completely and not damaged?
3. Is the software interface set to 'Auto' in the Com Port configuration box?

The Receiver unit could also have an internal problem. If an internal problem is suspected (for example, it could be wet, rain could have ruined it, it falled down, etc) , then contact Axel Technology or Yr local delaer for support.

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Q. How do I change the COM port number(s) assigned to my USB to serial adapter by Windows 2000/XP?

A. To change the COM port number assigned to a USB to RS-232 Serial Adapter follow the steps below:

- Open the Windows Device Manager.
- Right click on the COM port you want to change.

- Left click on Properties.
- Click on the Port Settings tab.
- Click on the Advanced... button.
- Use the drop down list to select the COM port number you want to use.
- Click OK. Click on OK again and close Device Manager.

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Q. When I plug the USB adapter into another USB port or USB hub, I get new COM port numbers. What can I do to keep the same COM port assignments?

A. The easiest way to always keep the same COM port assignments is to always plug the unit into the same USB port. However, you can always reassign COM ports using the technique described above.

## A DEEPER KNOWLEDGE ON SAT TIME SYNCHRONIZER

Q: what does the Green Satellite Dish icon mean?

A: On the Sat Time - Client mask, it indicates the client is getting the time reference from the time server. That time information will be used by the Sat Time client software to update the local Pc clock according to the chosen update method ('brutal' update or Gradual Adjustment over the time). For several reasons (depending whether 'gradual Adjustment' mode is engaged or when the last Pc time has been forced to the reference one), the Green Icon may NOT mean the Pc clock is actually updated to the absolute GPS time. On the Sat Time - Server mask, it indicates the receiver is getting the time reference from the GPS satellites.

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Q: How many Time Clients may I have on my network?

A: There is no virtually limit. In the event of a large number of Clients, it is advised to have two Time server (one for back-up).

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Q: What timezone does the Sat Time server use?

A: None. Sat Time Synchronizer is based on "GMT" time (also called "UTC" time), which is the same throughout the world. The translation to a time zone is handled completely by the client software.

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Q: What is the maximum cable length for the GPS antenna ?

A: The maximum cable length for the Professional GPS antenna is 25 meters. However, in some particular conditions, with extrashielded RS232 cables, the max length could be also significantly higher.

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Q: What is Network Time Protocol (NTP) ?

A: Network Time Protocol (NTP) is a client-server UDP protocol for synchronizing the time on IP networks. It was designed to synchronize the clock on client machines with the clock on network time servers. Using NTP packets, the client and server can exchange time information to accurately set the client machines clock.

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Q: Can NTP be used to synchronize routers and other equipment ?

A: NTP can be used to synchronize the time on any computer equipment that is compatible with the Network Time Protocol. This includes CISCO routers and switches, UNIX machines. Novell 4.x, 5.x and 6.x has an integral NTP client that can synchronize to a NTP server. Novell 3.x is not supplied with an NTP client but they are available from the internet.

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## GENERAL KNOWLEDGE ON GPS SYSTEM

Q: What does GMT mean?

A: GMT is sometimes called Greenwich Meridian Time because it is measured from the Greenwich Meridian Line at the Royal Observatory in Greenwich, England.

The Greenwich Meridian (Prime Meridian or Longitude Zero degrees) marks the starting point of every time zone in the World. GMT is Greenwich Mean (or Meridian) Time is the mean (average) time that the earth takes to rotate from noon-to-noon.

Although GMT has been replaced by atomic time (UTC) it is still widely regarded as the correct time for every international time zone. It is widely used as the GMT remains the same all year around.

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Q: What's the GPS signal?

A: GPS satellites transmit two low power radio signals, designated L1 and L2. Civilian GPS uses the L1 frequency of 1575.42 MHz in the UHF band (bandwidth goes from 1567 to 1587.42 MHz). The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains.

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Q: Do I have to subscribe to a service to use my GPS?

A. No, the GPS satellites are owned by the United States Department of Defense and the reception of satellite signals is free to anyone.

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Q: what are the main sources of GPS signal errors?

A: Factors that can degrade the GPS signal and thus affect accuracy include the following:

- Ionosphere and troposphere delays — The satellite signal slows as it passes through the atmosphere. The GPS system uses a built-in model that calculates an average amount of delay to partially correct for this type of error.
  - Signal multipath — This occurs when the GPS signal is reflected off objects such as tall buildings or large rock surfaces before it reaches the receiver. This increases the travel time of the signal, thereby causing errors.
  - Receiver clock errors — A receiver's built-in clock is not as accurate as the atomic clocks onboard the GPS satellites. Therefore, it may have very slight timing errors.
  - Orbital errors — Also known as ephemeris errors, these are inaccuracies of the satellite's reported location.
  - Number of satellites visible — The more satellites a GPS receiver can "see," the better the accuracy. Buildings, terrain, electronic interference, or sometimes even dense foliage can block signal reception, causing position errors or possibly no position reading at all. GPS units typically will not work indoors, underwater or underground.
- 

Q: What is the accuracy of the GPS time signal ?

The GPS time signals are controlled by atomic clocks. An atomic clock is accurate to 1 second in 1 million years. A Windows PC can be synchronized to an average accuracy of 10 milliseconds (0.010 seconds).

## Technical Specifications

### System Requirements

O.s. : Microsoft Windows™ XP SP2 / NT / 2000 Professional , 2003 Server / Vista  
 CPU Pentium 3 or Superior  
 USB: At least 2 free USB Port on the computer acting as 'Time Server'

NOTE: Administrator rights are required for Windows 2000, XP and Vista o.s.

### Physical

Receiver dimensions: 98 x 64 x 36 mm (with cable guide: 150 x 64 x 36 mm)  
 Receiver'box protection degree: IP 65  
 Length of the provided connection cable: 10 mt

### Environmental

Operating range: - 40° to + 70°C

## Warranty

The manufacturer offers a 1-year ex works warranty.  
 Do not open the equipment. The warranty shall be voided if any of the warranty seals are broken.  
 The manufacturer shall not be liable for damage of any kind deriving from or in relation to incorrect use of the product.

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