Trimble GPSBase

User Guide

Version 2.60
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Release Notice

This is the September 07 release (Revision A) of the Trimble GPSBase User Guide, part number 48595-00. It applies to version 2.60 of the Trimble GPSBase software.

Contents

APPENDICES

About this Manual

Welcome to the Trimble GPSBase User Guide. This manual describes how to install, set up, and use the Trimble GPSBase software.

Even if you have used other Global Navigation Satellite Systems (GNSS) products before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product.

If you are not familiar with GNSS, visit Trimble's website (www.trimble.com) for an interactive look at Trimble and GNSS.

This publication assumes that you know how to use the Microsoft® Windows® operating system.

About Trimble GPSBase

Trimble GPSBase is Trimble's autonomous reference station software. It is the ideal tool for most GNSS reference station operations in application areas like land survey, construction, mapping, GIS, and scientific applications. The software allows to:

- Control the standard receiver settings;
- Archive data for post-processing in Trimble DAT file, RINEX and compact RINEX format;
- Control the Trimble receiver's generation of an RTCM/CMR correction stream;
- Generate an RTCM/CMR correction stream itself;
- Analyze GPS and GLONASS data in various ways;

- Compute multipath effects from the receiver's pseudorange data;
- Generate reports for all major functions on a daily basis;
- Generate alarms and to notify the operator via email.

GPSBase is designed in a way to harmonize with Trimble reference station receivers. For detailed information on the receiver and format types we support, see Chapter 5.

GPSBase comes in several modules, including the following main components:

The Ephemeris and Almanac server modules control and provide the orbit information for all other system components; they also store this information permanently to improve the start-up behavior of the system. See Chapter 4, Orbit Information.

The Receivers module is the platform for the administration of the Receiver module. See Chapter 5, Communication Control. The Receiver module controls the GNSS (GPS and GLONASS) receiver (see Chapter 6, Instruments – Data Input) and archives the data in RINEX, Compact RINEX or Trimble DAT format (see Chapter 7, Data Storage). All data is stored in a predefined folder tree structure, which is ideal for distribution via Web or FTP. Multiple RINEX data archives can be generated with different sampling intervals. RTCM data for the reference station position may be transmitted, see Chapter 8, Data Output. The RTCM Manager administrates multiple RTCM Generators: One module for each user.

System monitoring is supported by various modules. See Chapter 9, System Monitoring and Control. The Single Point Position module and various other Analysis modules analyze the data in every respect. They put the results of the calculations at your disposal in graphical and textual form. See Chapter 10, Other Modules.

The Appendices will ease the work with this manual as well as with GPSBase by adding general information on supported receiver types, RTCM messages, antenna height corrections and a list of abbreviations.

GPSBase is designed to operate under professional Windows operating systems, such as Windows 2000 or later. Configuration settings are easily defined using a built-in wizard (see Chapter 3, Getting Started). For a detailed list of GPSBase system requirements, see Chapter 1, Installation and Licenses.

Related Information

The GPSBase documentation is available in portable document format (PDF) from the \Manuals\ folder on the installation CD. After installation, you can also find it in the \Manual\ sub-folder of your program folder.

Other sources of related information are:

- Readme.txt file – a Readme.txt file contains information added after the documentation was completed. To read this file, double-click it or use a text editor to open it.

Technical Assistance

For Support & Upgrade contracts, contact your local distributor. All queries regarding the GPSBase software and the installation can be addressed directly via fax, phone, mail, and e-mail. For contact details, refer to the front of this manual. Trimble undertakes to respond within the shortest possible time within the limits of office hours, public holidays and other occasions when the office is closed. If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. or send an e-mail to Trimble_support@trimble.com.

Your Comments

Your feedback about the supporting documentation helps us to improve it with each revision. E-mail your comments to ReaderFeedback@trimble.com.

CHAPTER

1

Installation and Licenses

In this chapter:

- Introduction
- System Requirements
- Installation
- Software Protection
- GPSBase Basic Functionality

Introduction

This chapter gives you an idea of the Trimble GPSBase system environment and installation-dependent facts. It explains how licensing works and describes the basic GPSBase functions.

The *About* dialog contains information on the GPSBase version and build, the path to the GPSBase root folder, the type and version of currently loaded software modules, and your current license status. To open the *About* dialog, select the GPSBase main menu command *Help / About*.

System Requirements

GPSBase is designed to run under Microsoft Windows 2000/XP/2003 Server.

Minimum hardware and software requirements for GPSBase are:

- Microsoft® Windows® 2003 Server; Windows XP Professional; Windows 2000, Service Pack 2 or later
- Pentium PC with 500 MHz processor
- 256 MB RAM
- 10 GB hard disk (depending on amount of data to be archived)
- Microsoft Internet Explorer, Version 6.0 or later.

GPSBase also can make use of multiple processor systems as well as of dual-core processors.

Installation

An automatic installation of GPSBase is available from the installation CD-ROM, if you put it into the CD-ROM drive. The setup program will start automatically. Alternatively execute the file setup.exe. From the splash screen select *GPSBase*. The installation wizard guides you through the installation process.

Software Protection

GPSBase is license-protected. With your installation CD for GPSBase you have received a serial number and an authorization key that enable GPSBase in combination with one Trimble receiver, such as the Trimble 5700. When starting GPSBase the first time, a dialog appears where you must enter both the authorization key and the serial number. The status bar indicates *BASIC* for the licensing status.

To view your protection status, select *Help / About / Protection* from the main menu.

GPSBase Basic Functionality

Table 1.1 illustrates the functions that are supported in the basic GPSBase.

Table 1.1 Modules in basic GPSBase

Module	Function
GPSBase	The basic module. Includes a Time Server.
Receivers	Communication control. One connection (serial, socket client or server) to a Trimble receiver.
Almanac	Server module for almanac data. Improves startup.
Ephemeris	Server module for ephemeris data. Improves startup.
Receiver	Controls a Trimble concise reference station receiver.
Weather Station	Controls a weather station instrument.
Raw Data Analysis	Analyses raw data. Detects and removes errors, such as cycle slips.
Point Position Analysis	Analyses the position accuracy of the connected receiver at the current location.
RINEX Storage	Creates and stores RINEX files.
DAT Storage	Creates and stores Trimble DAT files.
Raw Storage	Creates and stores raw data files.

Module	Function
Compress	Tool for file compression.
RTCM Single Station Generator	RTCM output of reference station. Serial connections.
RTController	Outputs real-time correction data directly from the receiver.
Alarming	Administration of alarms.
FTP Mirror	Mirrors directories and files to FTP servers.
Disk Watch	Watches your disk and helps you keeping it clean.

CHAPTER

2

GPSBase Environment

In this chapter:

- Introduction
- Connecting the Reference Station to GPSBase
- Connecting the Users to GPSBase

Introduction

This chapter gives you some background information on the reference station operating application Trimble GPSBase.

Figure 2.1 gives you an idea on possible hardware environment in a GPSBase setup. The following sections then describe the communication between the system components.

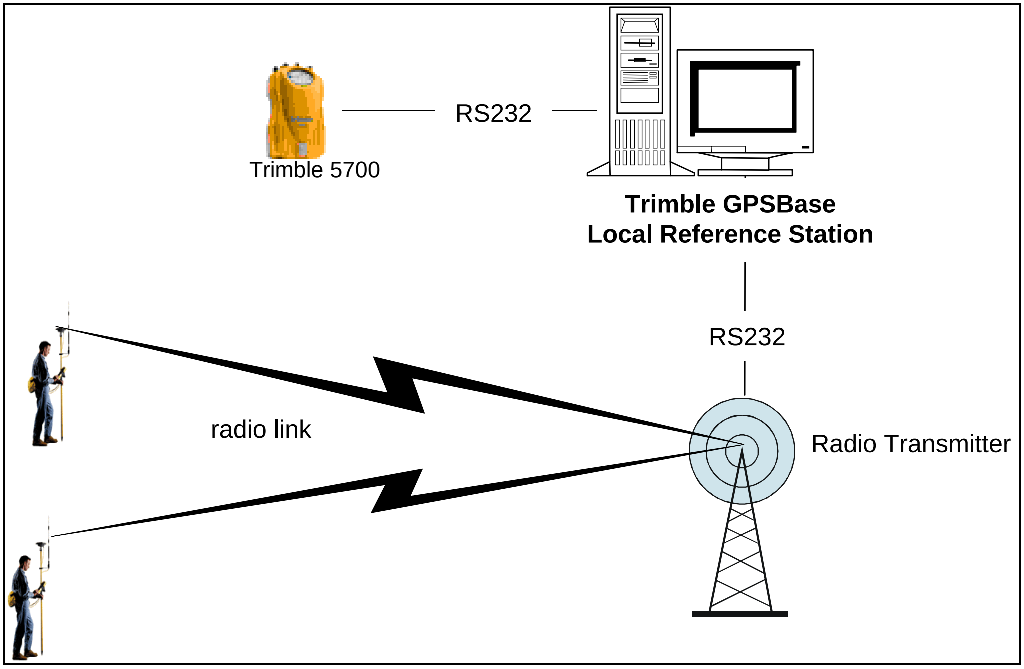


Figure 2.1 Example hardware setup for the reference station system

GPSBase is completely modular. The reference station receiver is connected to the control center using serial communication. For more information see the section Connecting the Reference Station to GPSBase.

The reference station's data can be stored in multiple file formats including RINEX, Compact RINEX (HATANAKA) and Trimble

DAT files for post-mission services like postprocessing or additional Internet services using a Web server.

GPSBase makes data available to users in various formats (RTCM, CMR). See the section Connecting the Users to GPSBase.

***Note** – The GPSBase application is based on a modular concept which can be configured to fit your needs and requirements. Several features, such as the GPServer application and the GPSWeb web server interface, are available as additional options for purchase.*

Connecting the Reference Station to GPSBase

Connect your control center directly to the receiver using a serial cable (RS 232 protocol). Run GPSBase and start the Configuration Wizard to set connection parameters. Find a detailed description of the Configuration Wizard in Chapter 3, Section Setting up GPSBase Using the Main Configuration Wizard.

Different devices and protocols can be used to transfer the data from the remote stations to GPSBase. Other communication links, such as leased lines or frame relay using a TCP/IP interface avoid the physical limitations of serial ports on the GPSBase server.

Connecting the Users to GPSBase

GPSBase supports two ways for the user to receive correction data:

- A modem pool in the control center, connected to the serial ports of the GPSBase computer. Each of these modems is connected to a GPSBase RTCM Generator module, which uses the Windows TAPI driver to control the modem.
- Besides the two-way (bi-directional) communication to the rover receiver, it is possible to configure an RTCM Generator module to continuously send real-time data to cover a whole area with reference station data, for example from a radio transmitter tower.

- Rovers establish Internet connections to the control center using, for example, GPRS. With multiple RTCM Generators, GPSBase connects the rovers to the next available RTCM Generator. The control center routes the data streams the Trimble NTRIP Caster application to the rovers. For more information on the Trimble NTRIP Caster refer to Trimble NTRIP Caster Help.

CHAPTER

3

Getting Started

In this chapter:

- Introduction
- Start GPSBase
- The Main GPSBase Window
- The Output Window
- GPSBase Configurations
- The GPSBase Tree Root
- Reporting
- Mail Server Configuration
- Setting up GPSBase Using the Main Configuration Wizard

Introduction

To get the Trimble GPSBase system started, you must at least connect to the receiver. Typically, you will also add a RINEX storage module to store data for post processing and add a RTCM Generator module for real-time data distribution. A Configuration Wizard leads you through these main tasks.

This chapter gives you an overview of all basic objects involved in GPSBase and introduces into the main Configuration Wizard.

Start GPSBase

In the Start/Programs menu select *GPSBase / GPSBase*. It will automatically start GPSBase loading the last used configuration. The first time you start GPSBase, this will be the *Default* configuration. Later, you may cancel the automatic loading: During startup, press the keyboard button ESC. Select *File / Load Configuration* from the main menu. For more information, see the section on configurations.

Automatic startup of GPSBase

For an automatic logon:

- Start *regedt32.exe* from the command line to modify the registry.
- Bring the window *HKEY_LOCAL_MACHINE* on top.
- In its navigator, go to *Software/Microsoft/Windows NT/CurrentVersion/Winlogon*.
- From the main menu, select *Edit / Add value* to add an entry *AutoAdminLogon*, type *REG_SZ,* with value *1*.
- Select the entry *DefaultUsername*. Add an entry *DefaultPassword*, type *REG_SZ.*
- The user with DefaultUsername and DefaultPassword will be logged on automatically with DefaultPassword.

- From the main menu, select *Security/Permissions*. Change the permissions of the Winlogon key to "*Read*" for ALL users (Everyone) (only in the Winlogon folder). If you do not, you will be logged on only once. The second time the machine will ask for user and password again.
- To test the automatic logon, reboot the computer. You should be logged on automatically.

Warning – Make sure that the user with DefaultUsername has Write access to the registry.

For an automatic start of GPSBase:

- Put a shortcut to GPSBase in the Startup group of your Start/Programs menu:
  GPSBase.exe

The concept of modules

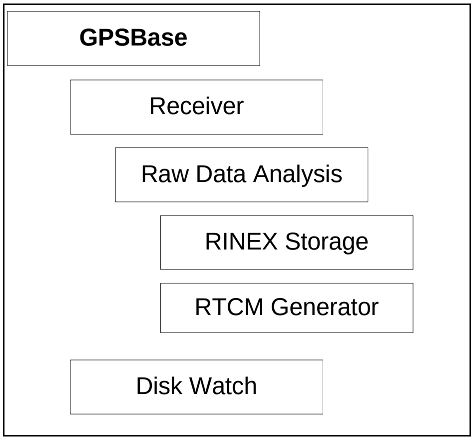
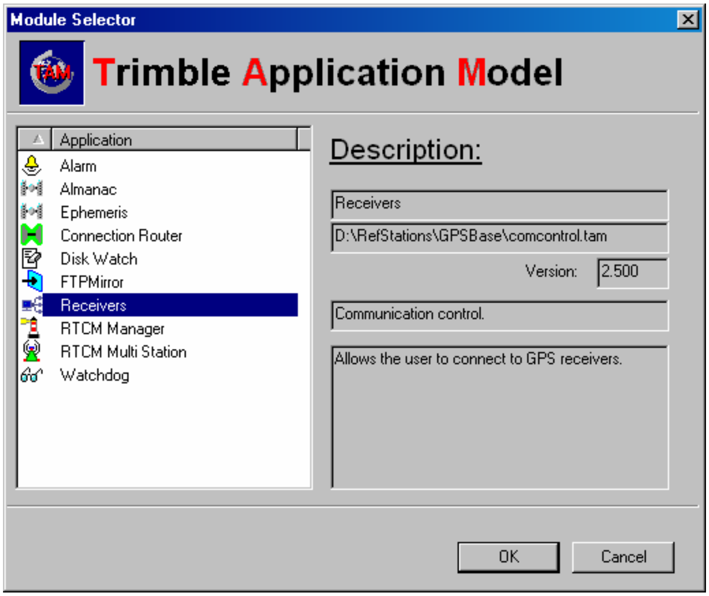


Figure 3.1 Concept of modules

GPSBase is implemented in a modular application system. Different applications can be combined within a common platform to provide the functionality required. Again, the GPSBase application itself consists of sub-modules with distinct functionality, as indicated in Figure 3.1.

Starting and removing further applications

When GPSBase is started the first time, it will only show the root item *GPSBase*. Here you start to add new modules (for example, the Receivers module needed to build up the connections to the reference station) as required by your reference station system. To add a module to *GPSBase* or below another module, right-click this module, and from the shortcut menu that appears select *Insert Module*. The *Module Selector* dialog appears, listing the Trimble Application Model (TAM) modules with additional functionality. Only the TAM modules that can be started below the currently selected module are displayed.



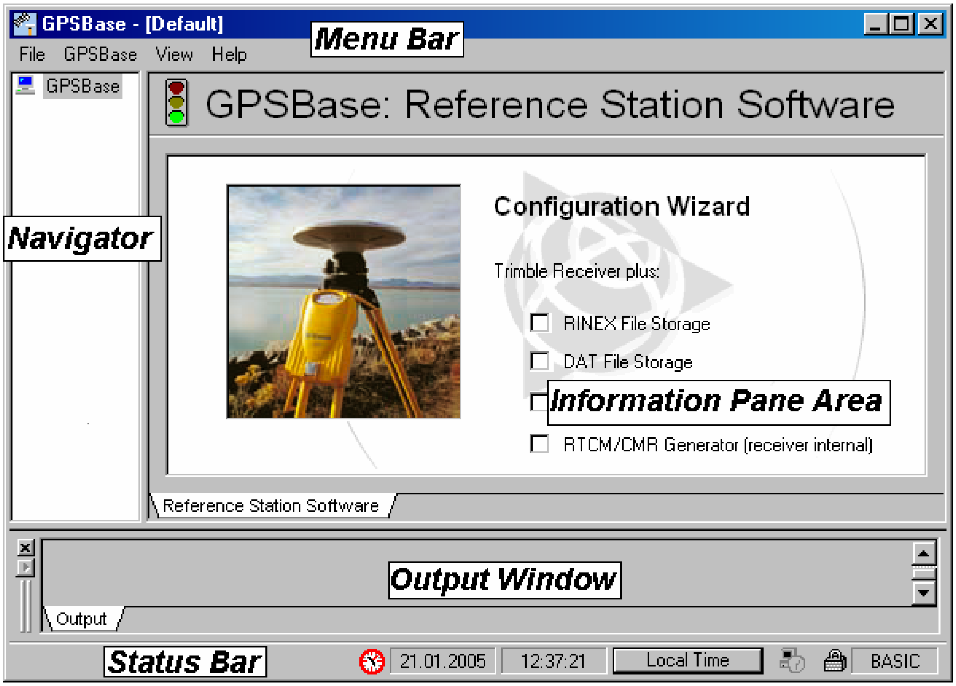
What happens after you have accepted a module depends on the module selected. For detailed description see the module-related chapters.

Removal of a module is easily performed from the module-related commands. To remove a module from the application, select it and open its shortcut menu with the right mouse button. There, you will always find the menu entry *Remove Module*, which removes the selected module and all its sub-modules.

Warning – Removing a central module (the Receiver module, for example) will affect all dependent modules.

The Main GPSBase Window

The main GPSBase window consists of a menu bar, a status bar, a navigator pane and an information pane. The information pane area may offer one or several pages of information. The output window may be docked to the GPSBase main window.



When you start GPSBase for the first time, the navigator will only display the root item *GPSBase*. Afterwards, the navigator will display at startup the last loaded configuration, with the focus on the root item.

The menu bar

When GPSBase starts up, the menu includes a command called *GPSBase*. Here you will find menu options that are specific to GPSBase.

When you select (highlight) a module in the navigator, the menu bar automatically adjusts itself to the module's proprietary commands. That means that all commands that are available using the module's shortcut menu equally are available from the menu bar.

Tip – For simplicity, only shortcut menu commands are given in this manual. All commands are also available from the main menu.

Status bar and time server

The status bar displays the license status and acts as Time Server with graphical indication of the used clock, display of the current date and time, selection of the time system (local time, GPS time).

The Time Server tool automatically starts up with the startup of GPSBase. It puts time information at the system's disposal and sends events through the system on new hour, new day etc. In the status bar, it displays the current date and time in GPS time, as well as in UTC or local time. The Time Server tool additionally allows you to monitor the differences between the time derived from GPS satellites and the computer time and to synchronize the computer time with GPS time.

The Time Server tool searches for time information by the connected receiver and all other instruments. If receiver time is not available, the

Time Server uses the current computer time. If you have exited GPSBase or shut down the system, the Time Server restarts with the last settings for the time system or automatic update.

A clock-shaped  icon indicates the reliability of the time using traffic light colors:

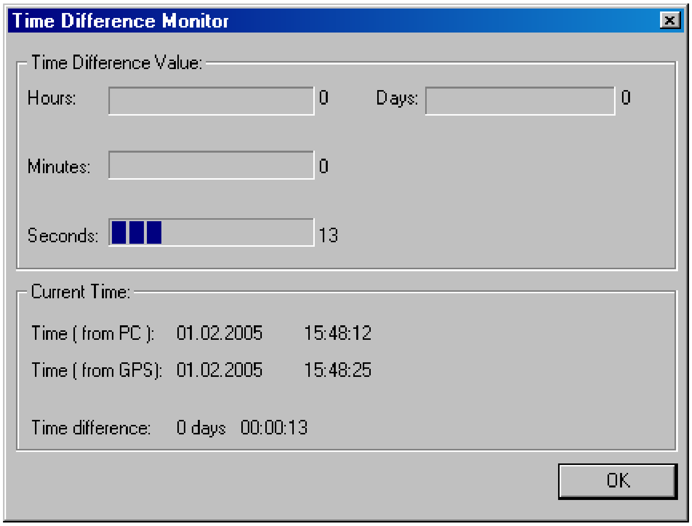
- Green: The time is received from the GNSS receiver.
- Yellow: The time is received from the GNSS receiver, but no information on the leap seconds or no current update by the receiver.
- Red: Time is received from the computer.

The time may be displayed as date and time [hh:mm:ss] in local time, UTC time, or GPS time. Alternatively, also the current week and seconds can be displayed in GPS time. To switch the time display from one of these time systems to another, click the button next to the time fields and then select the time system from the menu. The button always displays the current time system:

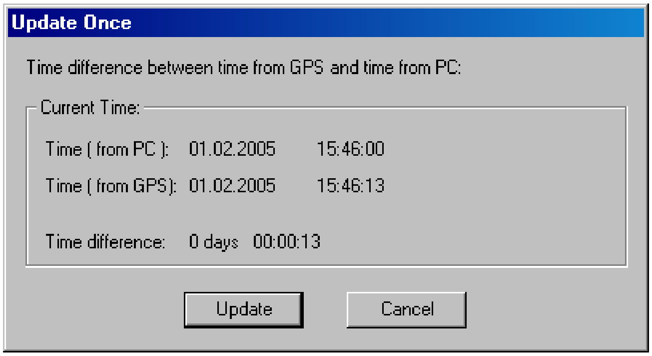
GPS Seconds	GPS time in GPS week and seconds
GPS Time	GPS time in date and time
UTC Time	UTC time in date and time
Local Time	Local time in date and time

To monitor the differences between satellite time and computer time, click the time system button again and select the *Time Difference Monitor* command. This command (as well as the *Update Once* and *Update Automatically* commands) is only available, if the system receives time information from the GNSS receiver. The *Time Difference Monitor* dialog appears displaying graphically the differences between the current system time and satellite time as well as continuously updating the current times of both systems and their difference in numbers.

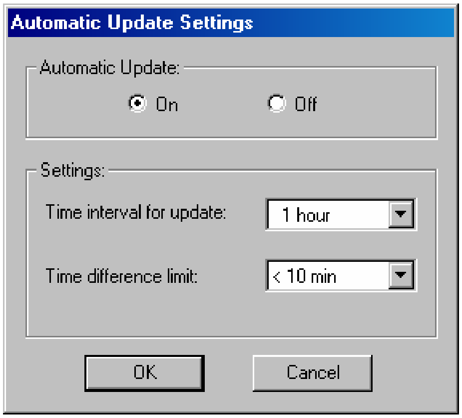
Since the system time usually is not as precise as the time received from the atomic clocks used in the GPS satellites, you may want to synchronize the computer time with the satellite time. Thus, file creation or movement times, which are depending on system time, will be synchronous to GPS time. You can synchronize the system time either per command or you can define repeated synchronizations.



To synchronize the system time with GPS time only once, click the time system button, and then select the *Update Once* command from the menu. The *Update Once* dialog appears. It displays the current times from the computer (*time from PC*) as well as from satellite information (*time from GPS*) and the difference between both times. To synchronize the times, click the **Update** button.



Even after synchronization, the computer clock may gain or lose time. To automatically synchronize it with the receiver time, click the time system button, and then select from the menu the *Update Automatically* command. The *Automatic Update Settings* dialog appears.



By default, the automatic update of the computer time is switched off. To start the automatic update, click the *On* radio button. To define how often the computer time is updated, select from the time intervals available from the *Time interval for update* drop-down list. Default: 1 hour. Automatic update is only performed, if the clock status is green (time received from the GNSS receiver).

If the computer time and the satellite times differ for a high value, the Time Server tool assumes that the computer time may be set by purpose to a different time. It will not perform the synchronization, but will indicate the large difference by changing the color of the icon placed right from the time selection button to red:

 Times are synchronous,

 Times are asynchronous,

 Automatic update is inactive (switched off).

In the *Automatic Update Settings* dialog, use the *Time difference limit* drop-down list to define the limit for the maximum time difference to be corrected for. If the time difference gets larger and the synchronization error icon appears as red, you can use the *Update Once* command to reset the computer time to GPS time at once.

The navigator

The navigator (module tree view) gives you a complete overview of the active modules and of their hierarchical organization. A fully configured system will form a tree-like structure, where each module can be the base of a branch of other modules. Thus, it represents a data flow view.

A good example of this functionality based grouping of modules is the Receiver module: below this module, you can find an RTCM Generator, a RINEX Storage module, and others, all of them working with the data of this specific reference station only.

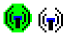
You can freely add and remove modules from the tree view while all other modules are running. For example, it is no problem to add or remove a RINEX Storage module without interrupting the normal operation of the system.

In the navigator, each module is represented by the module name and an icon. The icon may change its appearance depending on the module status. See Table 3.1.

The information pane

On the right side of the main window is the detailed module view, which lets you control the module that is currently selected in the navigator pane. Depending on the module, the information pane may offer one or multiple tab-pages of information, where the status of the module is displayed and module configuration is possible. The tabs at the bottom on the pane give you the access to the pages (see Figure 3.2). The contents of each page are described in the chapter on the relevant module.

Table 3.1 Modules and related icons

Icon(s)	Module(s) represented by the icons
	Main application GPSBase
	Receivers module
	Receiver module; Antenna settings OK
	Receiver module; Antenna settings bad
	Receiver module: switched to backup line
	Receiver module: waiting for scheduled time
	Almanac, Ephemeris server modules
	Analysis modules, such as Raw Data Analysis
	Data storage, such as RINEX Storage or DAT Storage
	Alarm module
	FTP Mirror module
	Disk Watch
	Watchdog module
	Splitter module: indicating status of connection
	RTCM Single Station Generator module, active and inactive
	Status of the module is BAD, according to the red traffic light definition of the module (for more info, see the respective detailed module view).

You may unlock some of the information pages to act as undocked child windows. To make a tab a resizable child (floating) window, click the small window-shaped icon  in the upper right corner of the tab. Thus, you may view more than one information sheet simultaneously and get multiple information on your system. You will additionally be able to compare tabs displaying the same contents with different parameters (such as the ephemeris of more than one satellite, or the tracking status of more than one receiver).

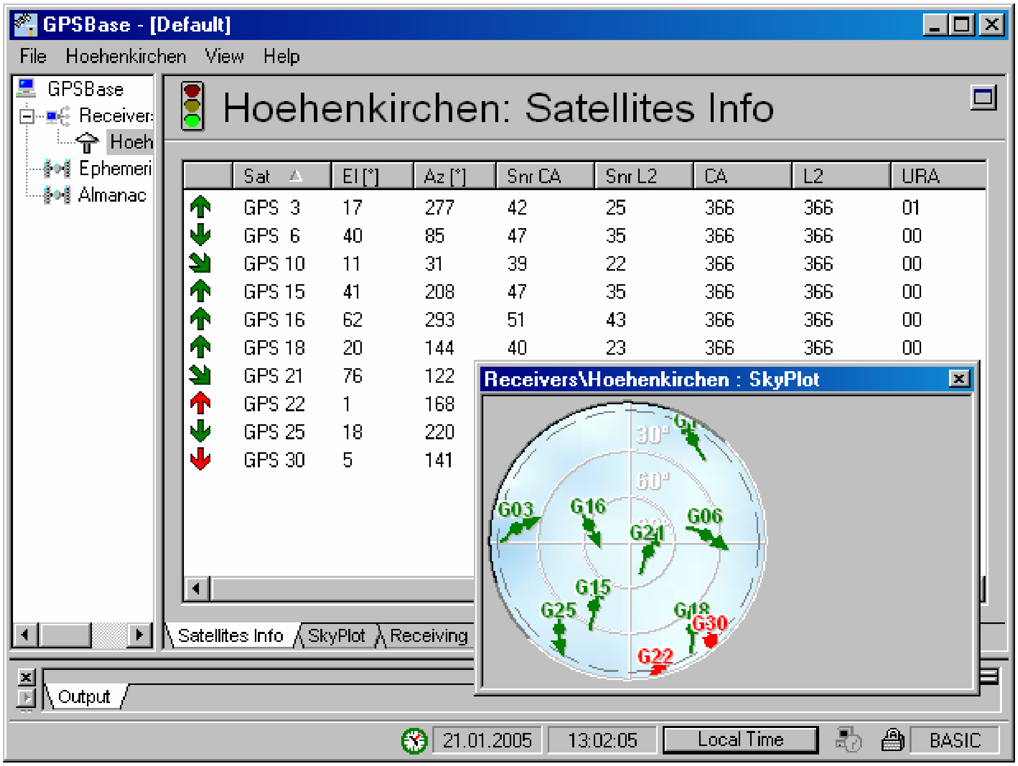


Figure 3.2 Undocked information page “Receiver – Sky Plot”

Graphs

GPSBase comes with many modules that output results in form of graphs. In particular, the analysis tools offer graphical display of their results. To view a graph, click the respective tab of the information pane of a module.

The information panes are described in detail at the respective module. However, the graph pages all show the same general behavior. They have a common set of graph options you can modify; you can switch curves on and off as desired, you can zoom into them, and you can print them.

Contents of a graph window

A graph consists of several regions: the most important being the plot area where the data is displayed in form of curves. Inside the plot area is the title text at the top, the axes with their labels and the axis names, and the optional legend, which matches curve colors with curve names.

The plot area is framed on the left side and the bottom by the two axes. In the plot area, a grid can be switched on to simplify the graph interpretation. The current data will be displayed in this plot area as a polygon-line connecting the data points.

If more than one curve of data has to be displayed – fore example, if you want to display the data of several satellites – a consistent set of colors is used for each satellite. Thus you can identify a satellite by its color.

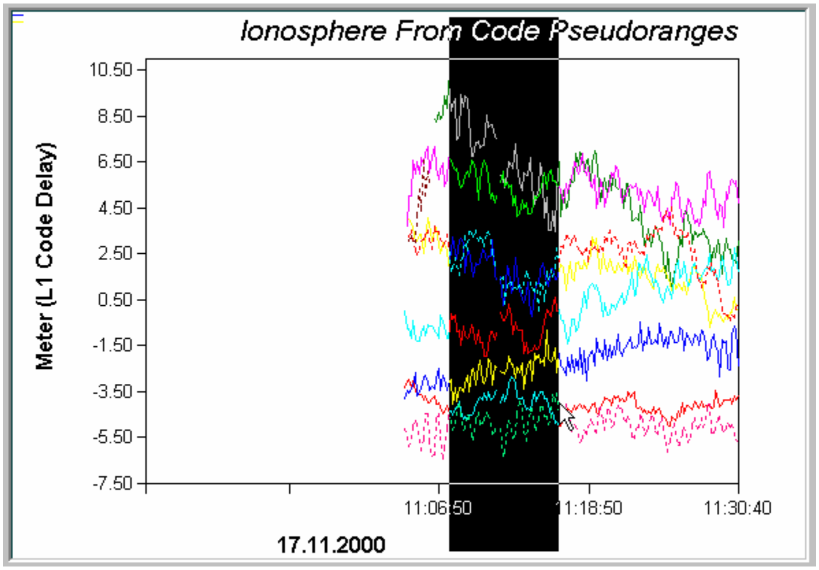
The graph window is designed to be scalable: changing the size of the window will enlarge or shrink the view of the graph. In addition, the title, the axis names and the axis labels will follow. This way, you have the greatest freedom of choosing your personal view of the data: you can maximize one graph to fill the whole screen or you can display dozens of tiny graphs in the main window, while still being able to see useful information.

The graph's axes adjust automatically when you resize the window. Accordingly, the more space is available, the more "axis ticks" and labels will be displayed on an axis. The labels are always adjusted to display appropriate values, so for example no value like 1.66666666 will appear as a label.

Zooming

When you display a graph there are usually so many data points that they cannot be easily distinguished from each other. To allow a close-up onto a specific graph section of interest, the graphs offer an easy-to-use zooming facility.

Click inside the graph and drag a zoom rectangle that corresponds to the region that you want to enlarge. When you release the mouse button, the graph will be zoomed to that region. You can zoom repeatedly until you have focused on your desired region.



To zoom back to the original size, right-click on the graph.

Tip – If you accidentally start zooming and you are still holding the mouse button pressed, you can abort the zooming by simply moving the mouse cursor completely outside the graph window. The zoom rectangle disappears, and you can release the mouse button.

Time, curves, options

For many graphs, you may select a time range for the x-axis values using the drop-down list in the upper right corner of the pane. Depending on the graph, the following ranges may be available:

- Last Minute
- Last Hour

- Last Day / 24 hours
- Last 7 Days

The field below the drop-down list acts as a Curve Selector. Within this field, you can specify which curves of the currently active graph you want to see or hide. Just check the current check box or remove a check.

Curve colors are permanently assigned to specific curves, often satellites. Add the legend to the graph to see which color is assigned to which curve. The legend is available using the **Options** button.

To select from the graph options, click **Options** on the lower right corner of each graph. See Table 3.2 for the available options.

Table 3.2 Graph options

Option	Action
Y-Axis	This option allows you to select the scaling type of the y-axis. With *Auto Scale*, it can be automatically scaled, best fitting the current values and graph size (default). Alternatively, with the *Fixed Scale* option you can define the lower and higher boundary values, if you edit the respective fields in the *Fixed Y Scale* dialog.
GPS-Time	The x-axis displays a time range. Here you can select whether local time and date (default) or GPS-week and –second is displayed.
Show Grid	If you select this option, a grid will help you to easily read the values within the graphs.
Show Legend	Displays a legend within the graph at its right side.
Save Plot	Opens a *Save As* dialog and allows you to store a plot of the current graph in a graphic format.
Print Plot	Opens a *Printer* dialog and allows you to print out a plot of the current graph as you see it on the screen. For example, if you do not want the legend to show on the printout, switch it off before printing.

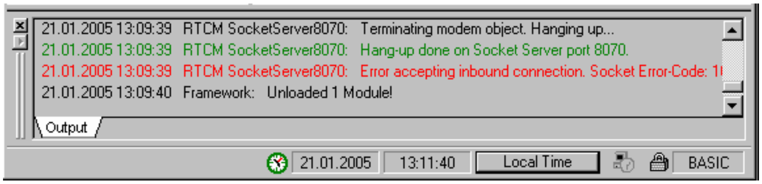
Print

To print out a graph as you see it on the screen, click **Options**, select the *Print Plot* item, edit the printing properties, if necessary, and start.

Warning – When printing a graph, the graph will be automatically scaled to fit to the size of the paper. This also means that in portrait mode the graph will be stretched to be as high as the paper, which can result in some distortion, since graphs are usually not displayed on screen in a portrait orientation. To avoid this, switch the paper orientation to *Landscape* in the *Print* dialog.

The Output Window

The output window helps to control GPSBase's actions. When you first start GPSBase, no output window is available. It appears, when GPSBase starts outputting text of any kind. You may display or hide the output window by checking or clearing the *View / Output Window* menu option.



The output window acts as a control bar and consists of an exit button, a message area and a vertical scroll bar. If it is not docked to the main window, it also has a title bar showing *Output Window* as caption. The process that generates messages runs in parallel to all other tasks of GPSBase, so you can scroll through the text during normal operation.

New messages are added to the output window even if they are not visible (for example because you have scrolled to an earlier section of the output, or the window is closed). All messages get a time stamp in local time.

The output window holds up to 32,000 lines of messages. Once the limit is reached, the older messages are discarded making space for the newer ones.

The message type is color coded:

- Black information message
- Green warning message
- Red error message

A short-cut menu allows modifying the appearance of the window and performing actions on the displayed messages.

Table 3.3 Output window options

Option	Action
Allow Docking	A toggle option. If the command is ✓ checked, the output window will dock to a docking station of the client area. By default, it is docked to the bottom of the screen. As soon as you drag the top of the window near to a docking station, such as the bottom of the client area or the toolbar area, the output window will dock there. If you disable this option, the output window becomes an independent, floating window, resizable and moveable to anywhere on the PC's screen.
Hide	Hides your output window. To re-open it select the menu *View / Output Window*.
Filter	Filters the output window contents for display. You have several selections, either for the type of message (errors, warnings, status) or for the modules that create the messages.
Store Output	A toggle option. If the command is ✓ checked, the shortcut menu indicates the folder where the current text file(s) reside(s), into which output window messages are written. Lets you select to store the text once or continuously. See the following two rows.
Store Output: Once	Opens a Standard File Selector and allows you to specify a text file, to which all messages are saved. When you click **Save**, GPSBase writes the contents of the output window into the text file.

Option	Action
Store Output: Start Continuous	Continuously writes output messages into text files. When selected, the *Location* dialog appears. Use this dialog to specify the root folder for the path to the output files and to specify the base for the filename creation. The file names are automatically created from that base. Three numerical digits and a character identify the day and hour of creation. For detailed information on how the path structure to the files is created see the section Settings of the Location dialog in chapter 7, Data Storage.
Store Output: Stop Continuous	Stops continuous storage of output window contents.
Clear Window	Deletes the contents of the output window. All messages are discarded.
Font	Opens a standard Windows font selector dialog allowing you to change the font and font attributes of the output messages.
Float In Main Window	If selected, the output window is a child window of the main window. Then, the *View* menu lets you toggle the display of the output window. Possible selections are: *1<configuration name>* and *2 Output Window*. If *1<configuration name>* is selected, the navigator and information pane of the current configuration are visible on top. *2 Output Window* toggles to the display of the output window.

GPSBase Configurations

When you start the Receiver module, the Almanac and the Ephemeris server modules are also started automatically.

Once you have configured your GPSBase system with all required components, save the configuration by using the main menu item *File / Save Configuration*. The *Select Configuration Name* dialog lets you enter a new configuration name.

Also, when you terminate the application after changes were made, you are asked if you want to save the current configuration.

Tip – Trimble recommends that you save your configuration. Thus, the system will reload the last saved configuration automatically when starting up, e.g., after power failure. Accordingly, you should configure your computer using the Windows Startup program folder to automatically log on and start the operating system and GPSBase after reboot. See Section Automatic startup of GPSBase.

GPSBase supports the management of several configurations. Use the *File* menu to:

- save the current configuration (*Save Configuration*).
- save a changed configuration under a different name (*Save Configuration As*).
- load a configuration without terminating GPSBase (*Load Configuration*).
- remove an unused configuration from the internal list: Select *Save Configuration As*, activate the configuration name in the list field and then click **Remove Selected Configuration**. Even if you then cancel the dialog, the selected configuration is deleted and is no longer available.

The GPSBase Tree Root

When you start GPSBase the first time, only the *GPSBase* root item is available at the tree. Here you start to add new modules, (the Receivers module, for example) as required by your reference station system. The information pane displays the main Configuration Wizard, see Section Setting up GPSBase Using the Main Configuration Wizard. If at least one receiver is connected to GPSBase, it additionally displays the *Satellites* Info page of the (first) Receiver module.

Available modules

From the root item, you can add the following application modules:

- Alarm
- Almanac
- Disk Watch
- Ephemeris
- FTPMirror
- Receivers
- Watchdog

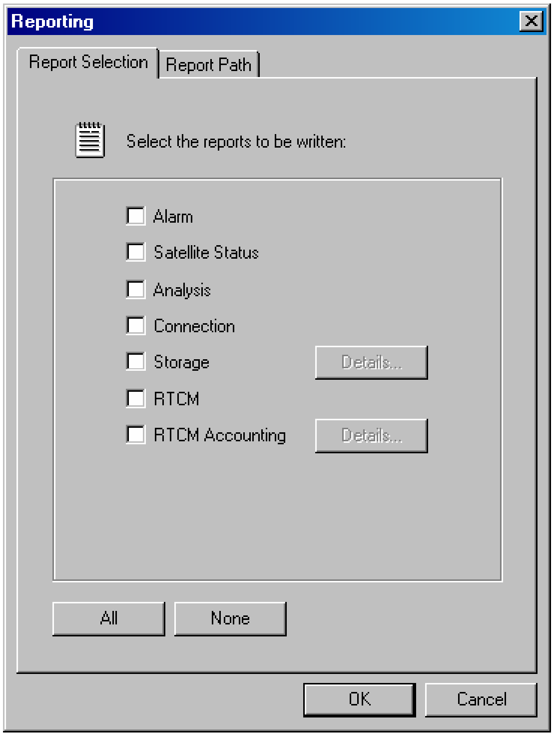
These modules can be added either directly or using the *Insert Modules* command. The commands are available from the short-cut menu of the *GPSBase* navigator root item as well as from the main pull-down menu command *GPSBase*. For more information on the navigator, see Section The navigator.

Reporting

One of the major tasks of GPSBase is the generation of data output. Data may be output as observational data files (raw data format, RINEX, Compact RINEX, Trimble DAT observation file format, and others, see Chapter 7, Data Storage), but also in the form of formatted text, called reports. GPSBase generates text in the XML format. It uses Windows Internet Explorer (IE) 6.0 (or any other browser that can parse and display XML documents) to display reports.

To start the reporting, select the main menu command *File / Reporting*. The *Reporting* dialog appears. It consists of the following two tabs:

- *Report Selection*
- *Report Path*



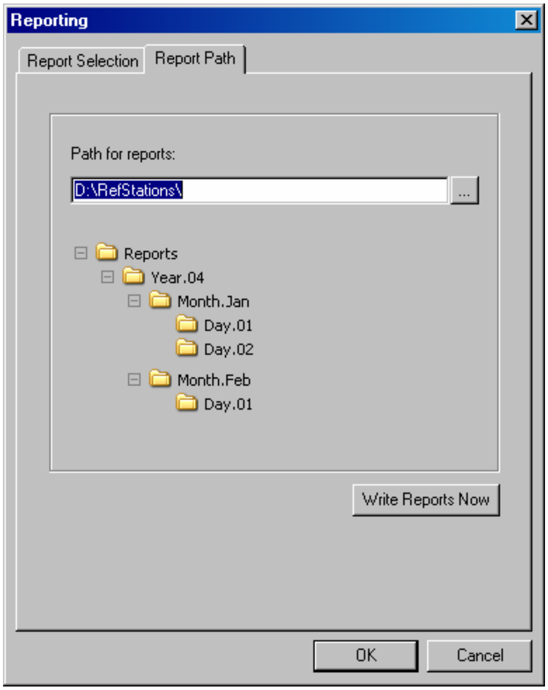
The *Reporting Selection* dialog lets you enable reporting depending on the generating module(s).

For the reports generated by the Storage modules and for RTCM accounting information additional settings are available.

The *Special Storage Reports* dialog appears immediately, if you select *Storage Reports*. You can view and change it any time, if you click the **Details** button next to the *Storage Reports* checkbox. The dialog lets you select several report types to be created additionally to the standard XML reports. For more information see Chapter 7, Data Storage.

With *RTCM Accounting Information* selected an additional SAP-compatible file will be written. This file contains information for each rover dial-in session. The *Accounting Details* dialog appears immediately, if you select *RTCM Accounting Information*. You can view and change it any time, if you click the adjacent **Details** button. For detailed information on accounting see Chapter 8, Section Accounting.

Use the *Report Path* tab of the *Reporting* dialog to define the path for the storage of reports. The *Path for reports* edit field becomes available, if at least one type of reports is selected at the *Report Selection* tab. The reports are stored to an enhanced folder structure. If you click **Write reports now** many report generating modules immediately write their current observations and results into the respective report files.



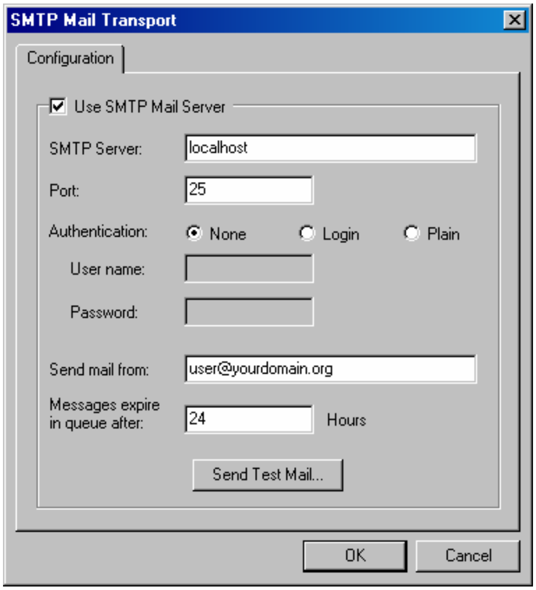
Click **OK** to make reports available to GPSBase. Some files will be copied to the location you have defined and the report generator will be started at once. It automatically writes the reports of the currently active modules in XML and text files. For a detailed description of all available reports, see Appendix G.

Mail Server Configuration

Several of the modules offer an e-mail service option. For example, if a situation occurs that induces an alarm (see the section on the Alarm module in Chapter 9, System Monitoring), it can make sense to send an automatically generated e-mail to the system administrator to have him informed about the current state of the application. GPSBase uses the SMTP protocol for e-mail transport.

With modules that generate e-mails, it is essential that the computer running GPSBase is configured in a way that allows automatic e-mail transport. To start the configuration select the main menu command *File / Configure Mail Server.* It opens the *SMTP Mail Transport* dialog with the *Configuration* tab. By default, e-mailing is disabled, and the configuration does not apply.

***Note** – When adding modules to the system, which need to know the SMTP server, the* SMTP Mail Transport *dialog appears automatically, if e-mailing is disabled.*



Select the *Use SMTP Mail Server* check box to enable the SMTP mail server. Specify the address and IP port of the server computer. The default port number is 25, the standard for listening ports at servers. Specify whether the mail server does not require user authentication (*None*, default selection) or else the authentication type, either *Login* or *Plain*. With user authentication needed, provide the *User name* and the *Password*.

Specify a valid e-mail account at the SMTP server, and a time period, after which messages expire, if the connection to the server fails. You may test the connection using the **Send Test Mail** button.

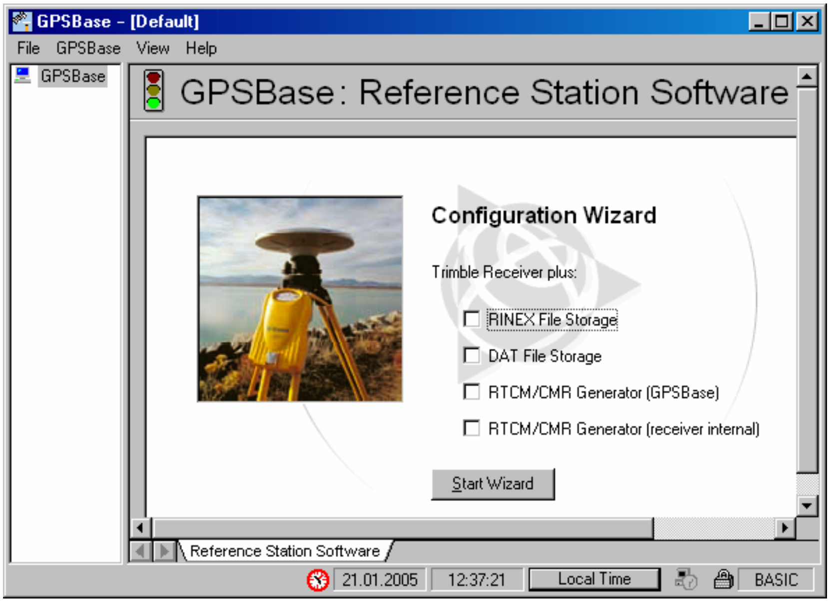
Setting up GPSBase Using the Main Configuration Wizard

When you start GPSBase the first time, the information pane displays a Configuration Wizard. The Configuration Wizard leads you through the setup of GPSBase for one receiver and, if selected, for data storage and distribution. Orbit information will then also be available to the system. With all options selected you have a full GPSBase reference station system.

The Configuration Wizard assumes that the Trimble receiver is connected with a serial cable to the PC running GPSBase.

Tip – To use other connection modes, select the *Insert Modules* command from the *GPSBase* tree root. From the *Module Selector* dialog, select *Receivers*.
GPSBase supports various connections to receivers, such as modem connections using TAPI, or TCP/IP connections in a LAN or WAN. For a detailed description on how to connect to receivers, see Chapter 5, Communication Control.

All you have to do for setup is to select from the modules for data storage (do you want to store the receiver raw data in RINEX files or in the Trimble DAT format?) and for real-time data distribution. For RTCM/CMR data sent directly from the receiver select *RTCM Generator (receiver internal)*. To use the enhanced GPSBase functionality for RTCM or CMR data distribution, select *RTCM Generator (GPSBase)*. Click **Start Wizard**. The following description assumes that you have selected all options. If you did not, some dialogs may not appear and the navigator tree will not show the same structure.



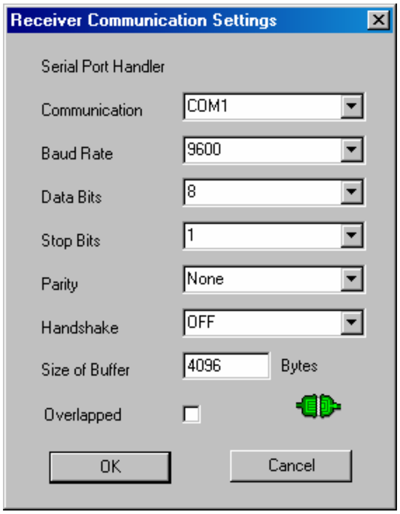
***Note** – After a module is configured for the receiver, the respective option is selected and grayed out in the Configuration Wizard. You may re-configure it, if you first remove that module from the navigator. Then the option is available again.*

Receiver settings

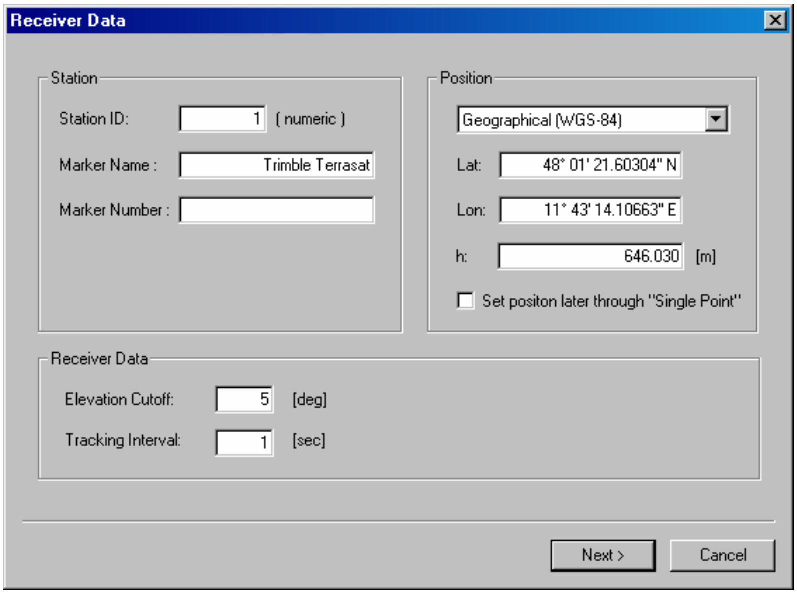
The *Receiver Communication Settings* dialog appears. It lets you define the com port, baud rate, number of data bits, number of stop bits, parity type, handshake type, size of buffer and overlapping type. Select the parameters from the respective drop-down lists.

These settings define a serial port connection. The connection name is *Trimble Receiver 1*. The navigator now displays the Receivers module and the Almanac and the Ephemeris modules for orbit information.

Tip – For detailed information on the Almanac and the Ephemeris server modules, see Chapter 4, Orbit Information.



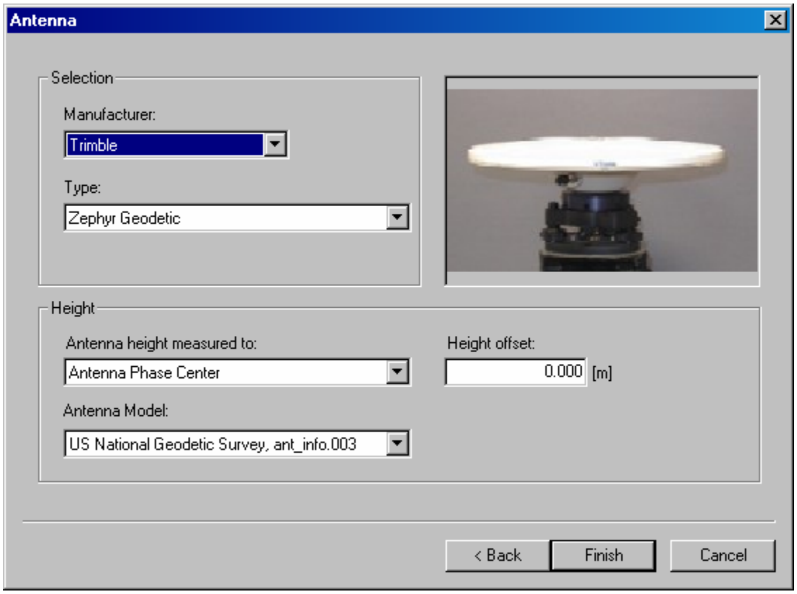
Click **OK**. GPSBase detects the receiver – this may take a couple of seconds – and then opens the *Receiver Data* dialog.



The *Receiver Data* dialog lets you define the station information, such as a numeric Station ID, marker name and number, and the known reference position. Instead of entering known coordinates you can select the *Set position later through "Single Point"* option. This adds to the Receiver module a Single Point Position module and uses its averaged positions as known coordinates for the reference station receiver. You may keep or modify the default receiver settings for elevation cutoff and tracking interval.

Tip – The settings for elevation cutoff and tracking interval directly influence the receiver. For detailed information on Receiver modules, see Chapter 6, Instruments: Data Input.
If you have selected the *Set position later through "Single Point"* option, the *Average Position* dialog appears that lets you define minimum thresholds for time and epochs. See Chapter 10, Section Single Point Position.

Click **Next**. The *Antenna* dialog appears.



Trimble is pre-selected as the antenna manufacturer. The antenna type selection in the *Type* field depends also on the selection in the

Antenna Model field. Currently, three antenna models are available. Make sure you have selected the matching antenna model and the height measurement method in the *Antenna height measured to* field. Then edit the *Height offset* field. Click **Finish**.

Tip – For detailed information on how corrections for the antenna in use are applied in GPSBase, see Appendix C, Antenna Corrections.

The *Trimble Receiver 1* Receiver module is now added to the Receivers navigator item. The information pane displays the *Satellites Info* page.

Tip – After you have first defined the settings, they will always be available for editing using the module's shortcut menu command *Properties*.

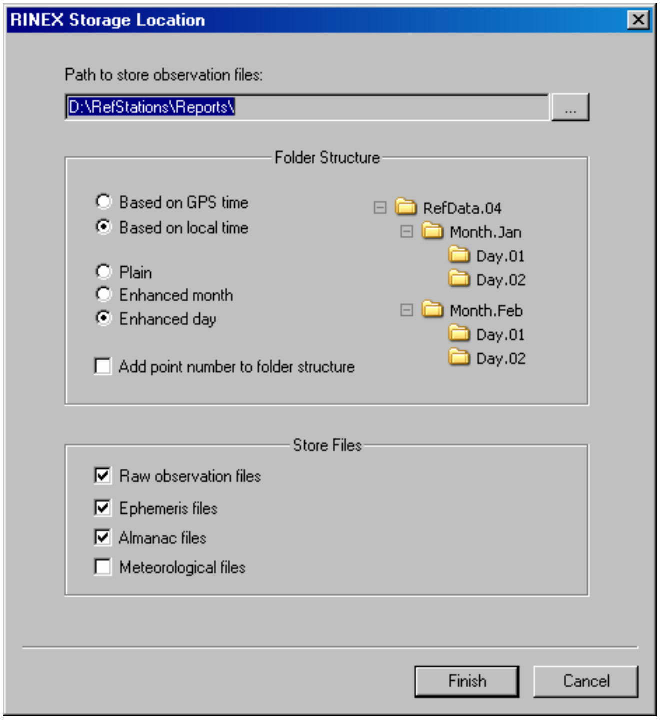
RINEX file storage settings

If you have selected *RINEX File Storage*, the *RINEX Storage Location* dialog appears. It lets you view and define the target path and folder for the file storage.

Select the file types to be stored from the *Store Files* group.

Select the destination using the Browse button next to the top field. Select the type of folder structure for file storage. If you select one of the *Enhanced* types, you do not have to trouble with data organization. GPSBase will automatically add to the path selected the sub-folders for the year (RefData.YY), month (Month.MMM) and, if you have selected the *Enhanced day* option, the folders for the day (Day.DD). Select the type of file naming and data structure. If you select the *Add point number to directory structure* option, the observation files are written into sub-folders named according to the full point number of the station.

Click **Finish**. The RINEX Storage module is now added to the *Trimble Receiver 1* navigator item.

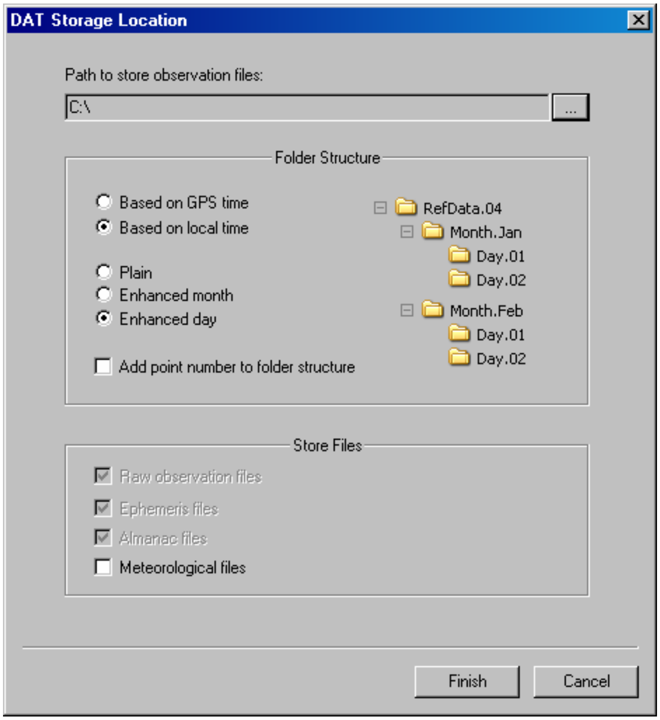


Tip – After you have first defined the settings, they will always be available for editing using the module's shortcut menu command *Properties*. Detailed information on RINEX file storage can be found in Chapter 7, Data Storage.

DAT file storage settings

If you have selected *DAT File Storage*, the *DAT Storage Location* dialog appears.

This dialog lets you view and define the target path and folder for the storage of files in the Trimble DAT format. It has the same functionality as the *RINEX Storage Location* dialog, see above. Edit it and click **Finish**. The DAT Storage module is now added to the *Trimble Receiver 1* navigator item.



Tip – After you have first defined the settings, they will always be available for editing using the module's shortcut menu command *Properties*. For information on DAT file storage see Chapter 7, Data Storage.

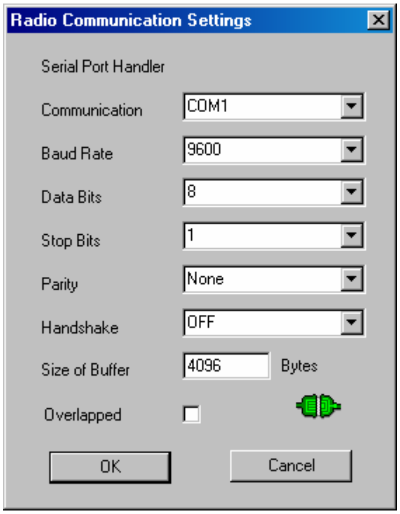
RTCM/CMR Generator (GPSBase) settings

Note – *If you have also selected* RTCM/CMR Generator (receiver internal) *the* Real-time Message Transmission *dialog appears first. See the following section.*

If you have selected *RTCM/CMR Generator (GPSBase)*, a Raw Data Analysis module is automatically added to the Receiver module *Trimble Receiver 1*. The Raw Data Analysis module analyses the consistency of dual-frequency data for each satellite. It detects receiver errors and generates pseudo-range and range rate corrections. If a cycle slip has been detected, the module tries to correct it. Data, which can not be corrected, is removed from the data set, before it is passed on to the RTCM/CMR Generator module.

Tip – Find more information on Analysis modules in Chapter 10, Other Modules.

The *Radio Communication Settings* dialog appears. The settings on this dialog define a serial port connection for data output. It is used in the same way as the *Receiver Communication Settings* dialog, see above Section Receiver settings. The default connection name is *Radio 1*. Click **OK**.



The navigator now displays the RTCM Single Station Generator module *RTCM Radio 1* below the Raw Analysis Data module.

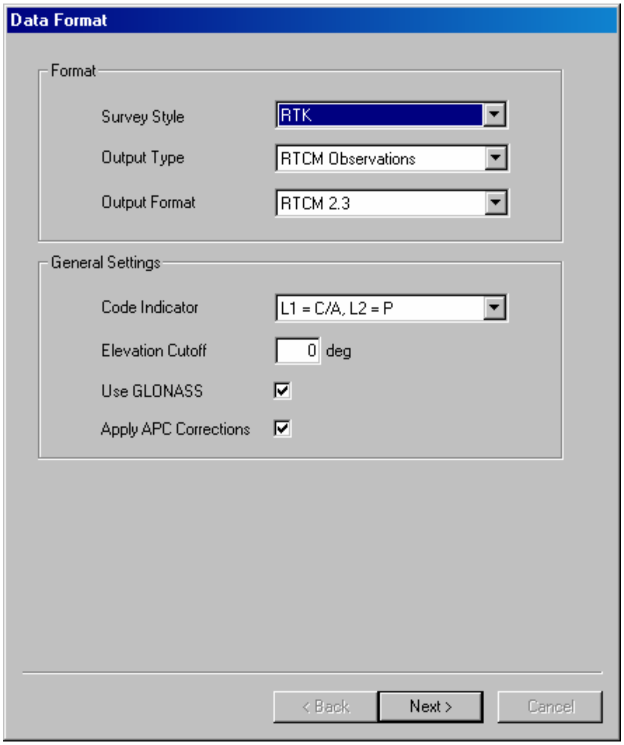
The *Data Format* dialog appears.

First, select the *Output Type*: *RTCM Observations* stands for output in RTCM format, versions 2.1, 2.3 and 3.1. CMR stands for data output in the Trimble CMR/CMR+ format. Accordingly, the selection in the *Output Format* depends on your selection in the *Output Type* field.

See Table 3.4 for the relation between *Output Type* and *Output Format*.

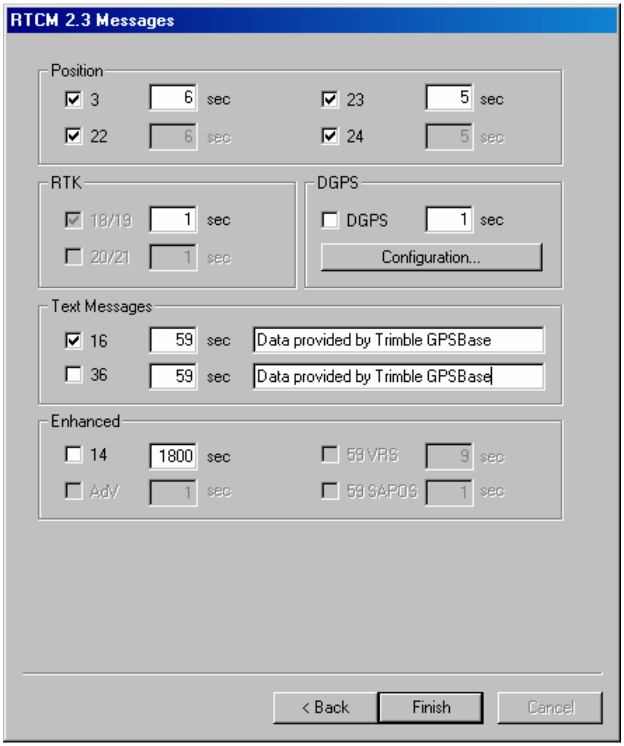
Table 3.4 Selections and Settings dialogs for the RTK survey style

Output Type	Output Format	Settings Dialog Name
RTCM Observations	RTCM 2.1	RTCM 2.1 Messages
	RTCM 2.3	RTCM 2.3 Messages
	RTCM 3.1	RTCM 3.1 Messages
CMR	CMR	CMR Messages
	CMR+	CMR+ Messages



Click **Next**. A settings page appears which lets you configure the output messages. The name and options of the Settings dialog adjust themselves to the chosen output format. See Table 3.4 for the possible dialog names. For example, if you have chosen observations and RTCM 2.3, the *RTCM 2.3 Messages* dialog appears.

Only those messages are possible that match the chosen output format. Some of the messages may be obligatory for the chosen format, and therefore, can not be disabled. You may select other messages and define the output rates. With DGPS messages selected, click **DGPS Configuration** to see and edit the settings for DGPS messages. Click **OK**.



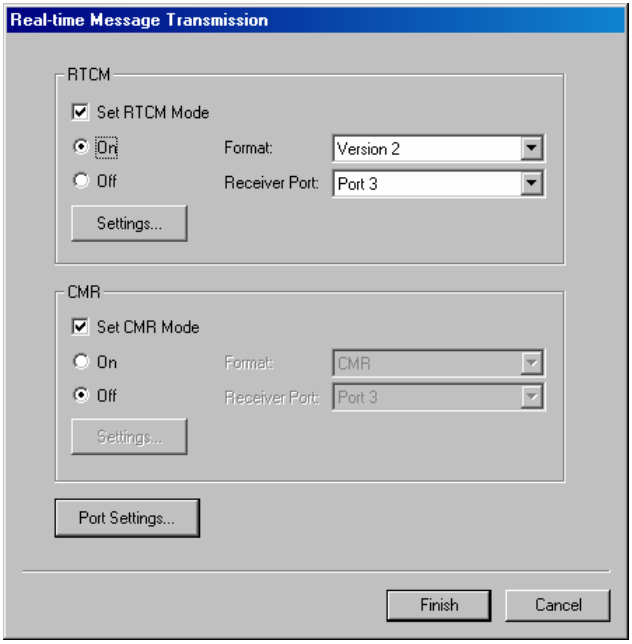
To finish the settings for the RTCM Single Station Generator click **Finish**.

***Note –** According to the RTCM specifications, some of the RTCM messages and some of the output rates depend on each other. You will notice that you are not allowed to set combinations that do not work.*

Tip – After you have first defined the settings, they will always be available for editing using the module's shortcut menu command *Properties*. For detailed information on the RTCM Generators and their settings see Chapter 8, Data Output (Real-time).

RTCM/CMR Generator (Receiver internal) settings

If you have selected *RTCM/CMR Generator (Receiver Internal)*, the *Real-time Message Transmission* dialog appears. Use it to configure an RTController module that lets you broadcast the real-time correction data in RTCM and/or CMR format.



***Note –** The Trimble receiver has to support the RTCM and/or CMR broadcast option. If not, the* Real-time Message Transmission *dialog and the respective settings will be grayed out, and the receiver cannot be activated.*

Select the output format, either *RTCM Mode* or *CMR Mode*. To edit the respective settings for the selected mode, select the *On* option and click **Settings**.

- In RTCM mode, the *RTCM Messages Settings* dialog appears. Select the secondary messages and output rates, and enter the station ID and text for message #16, if selected. Accept your settings.
- In CMR mode, the *RTCM Messages Settings* dialog appears that lets you define station ID and time delay. Accept your settings.

To configure the receiver port, click **Port Settings**. For more information on the parameters, refer to your receiver manual. Accept your settings.

Click **Finish**. The navigator now displays the RTController module below the Receiver module *Trimble Receiver 1*.

Tip – After you have first defined the settings, they will always be available for editing using the module's shortcut menu command *Properties*. For detailed information on the RTController and its settings see Chapter 8, Section RTController.

CHAPTER

4

Orbit Information

In this chapter:

- Introduction
- Almanac Server
- Ephemeris Server

Introduction

The Ephemeris and Almanac server modules collect the orbit information and provide it to all other modules in GPSBase. The information is stored to improve the startup behavior of the system.

Almanac Server

The Almanac server stores the GNSS almanac data. In combination with the antenna phase correction table the almanac is used to calculate elevation dependent antenna phase offsets. It writes the last valid almanac value into the registry and deletes the former one. Thus, the best available almanac is immediately at GPSBase's disposal, also if a system restart should be necessary.

The Almanac server is started automatically when you insert the Receiver module into GPSBase. You may, however, also start an Almanac server manually, if you highlight the navigator item *GPSBase* and select its shortcut menu item *Almanac*.

When you first click the navigator item *Almanac*, GPSBase will automatically load the current almanac file. For the module, two pages of information exist.

Tip – As it is the case throughout GPSBase, the icon in the upper right corner of the information pane lets you undock the currently activated information page. The floating window will then stay permanently in front of the main window.

Almanac – Status

The list on page *Status* displays:

- *Sat*: Satellite and health status in form of a traffic light

  Green: healthy

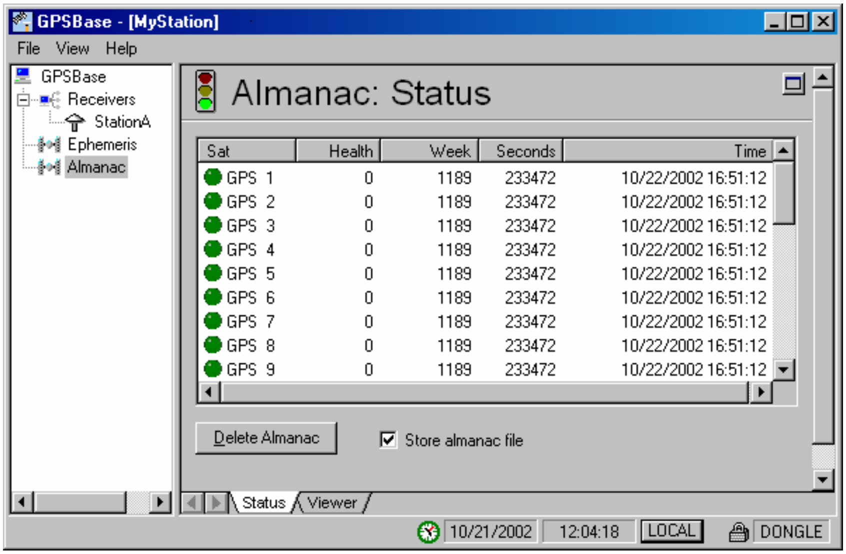
  Yellow: almanac too old or not available

  Red: unhealthy

- *Health*: health indicator, where 0 stands for healthy, all other numerals for unhealthy
- *Week:* GPS week
- *Seconds*: GPS seconds
- *Time*: Date and time.

The **Delete Almanac** button allows you to delete the current almanac. If you want the current almanac to be stored, select the *Store almanac file* check box.

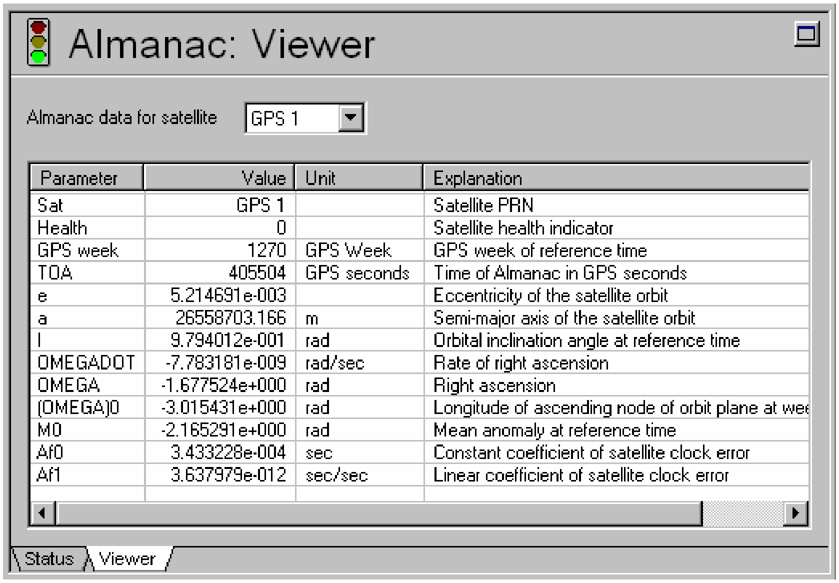
A file called almanac.YYa will be stored into the GPSBase installation folder. YY stands for the creation year.



Almanac – Viewer

The *Viewer* page of the Almanac server displays detailed almanac information for each satellite. Select the GNSS satellite for which the almanac should be displayed on top of the pane using the *Almanac data for satellite* drop-down list.

Besides standard parameter information, a full explanation of this parameter is displayed.



Parameter	Value	Unit	Explanation
Sat	GPS 1		Satellite PRN
Health	0		Satellite health indicator
GPS week	1270	GPS Week	GPS week of reference time
TOA	405504	GPS seconds	Time of Almanac in GPS seconds
e	5.214691e-003		Eccentricity of the satellite orbit
a	26558703.166	m	Semi-major axis of the satellite orbit
I	9.794012e-001	rad	Orbital inclination angle at reference time
OMEGADOT	-7.783181e-009	rad/sec	Rate of right ascension
OMEGA	-1.677524e+000	rad	Right ascension
(OMEGA)0	-3.015431e+000	rad	Longitude of ascending node of orbit plane at wee
M0	-2.165291e+000	rad	Mean anomaly at reference time
Af0	3.433228e-004	sec	Constant coefficient of satellite clock error
Af1	3.637979e-012	sec/sec	Linear coefficient of satellite clock error

Almanac report

With Reporting activated, you may view a report generated from Almanac.xml using Windows Internet Explorer or any other browser that can parse and display XML documents. For more information on the reports, see Appendix G, Reports.

Ephemeris Server

The Ephemeris server manages the GNSS satellite ephemeris for GPSBase. It writes the last valid ephemeris values into the registry and deletes the former ones. Thus, the best available ephemeris is immediately at GPSBase's disposal, also if a system restart should be necessary.

An Ephemeris server is started automatically with default properties, when you insert the receiver module into GPSBase. You may also start an Ephemeris server manually, if you highlight the navigator item *GPSBase* and select its shortcut menu command *Ephemeris*.

For the Ephemeris module, there are three pages of information.

Tip – As it is the case throughout GPSBase, the icon in the upper right corner of the information pane lets you undock the currently activated information page. The floating window will then stay permanently in front of the main window.

Ephemeris properties

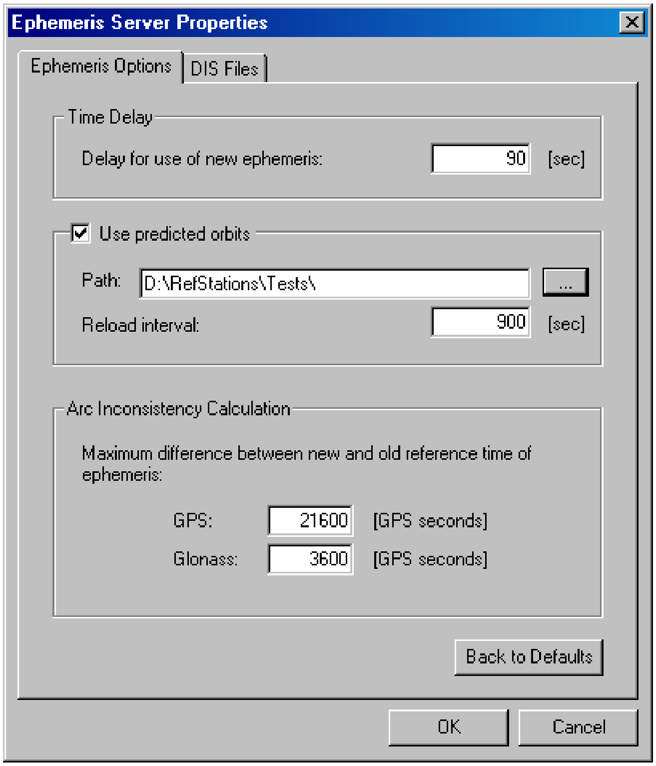
When an Ephemeris server module is first started, it works with the default settings. You may change the settings at any time: In the navigator, set the focus on the module and select the shortcut menu command *Properties*. The *Ephemeris Server Properties* dialog appears with the *Ephemeris Options* and *Dis Files* pages.

Ephemeris options

To avoid inconsistencies between the reference station and rover and to make sure the rover can use the same ephemeris as the reference, the usage of the ephemeris at the reference station receiver is delayed. Use the *Time Delay* group of the *Ephemeris Options* property page to set a value for this delay. The default delay value is 90 seconds. GPSBase does not use predicted orbits.

Arc inconsistencies

When GPSBase receives new ephemeris, it can calculate the position of the satellites in the constellation in two ways: using either the old ephemeris data or the new one. The differences between the results are the arc inconsistencies. These can be stored in a data folder.



Arc inconsistencies are only calculated, if the ephemeris data age is less than a given value. The *Arc Inconsistency Calculation* group lets you set the maximum age difference between the old and the new reference time of ephemeris. You can set values, in GPS seconds, for GPS satellites and GLONASS satellites. Default values: 21600 GPS seconds for GPS, 3600 GPS seconds for GLONASS.

To return to the default settings of the *Ephemeris Options* tab, click the **Back to Default** button.

DIS file storage

To store arc inconsistencies as files with the extension .dis select the *Store arc inconsistencies to file* option and set the path for the data folder using the browse button. From the *Browse For Folder* dialog you can select from existing folders or create a new one: Click **Make New Folder**. For a description of the file format see Appendix F, Trimble File Formats.

Ephemeris – Status

The list on the Ephemeris server's information page *Status* displays:

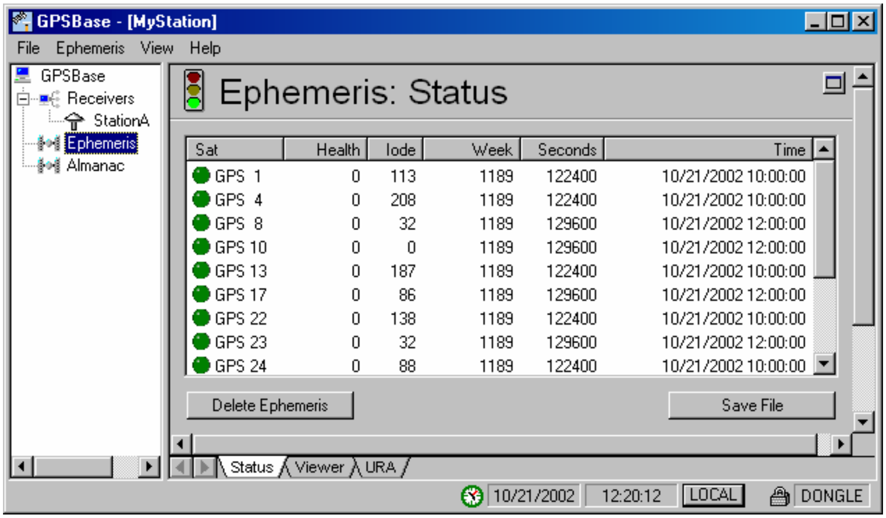
- *Sat*: Satellite and health status in form of a traffic light

  Green: healthy

  Yellow: broadcast ephemeris too old or not available

  Red: unhealthy

- *Health*: health indicator, where 0 stands for healthy, all other numerals for unhealthy.
- *Iode*: Issue of data (ephemeris)
- *Week*: GPS week
- *Seconds*: GPS seconds
- *Time*: Date and time

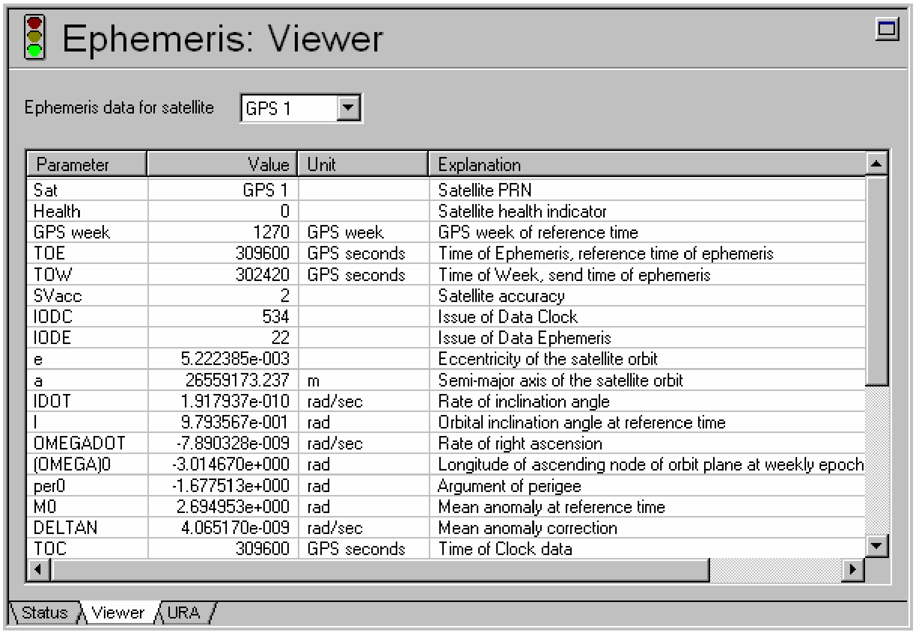


The **Delete Ephemeris** button allows you to internally delete all ephemeris information. If you want all ephemeris to be stored in a file, click the **Save File** button to define the path to the target folder. The RINEX ephemeris file is written immediately.

Ephemeris – Viewer

The *Viewer* page of the Ephemeris server information pane shows the full ephemeris information for a selected satellite. To display ephemeris information for a satellite, select the satellite name from the list at the top of the pane.

The list shows the standard parameter name, value, unit, and a full explanation of the parameter.

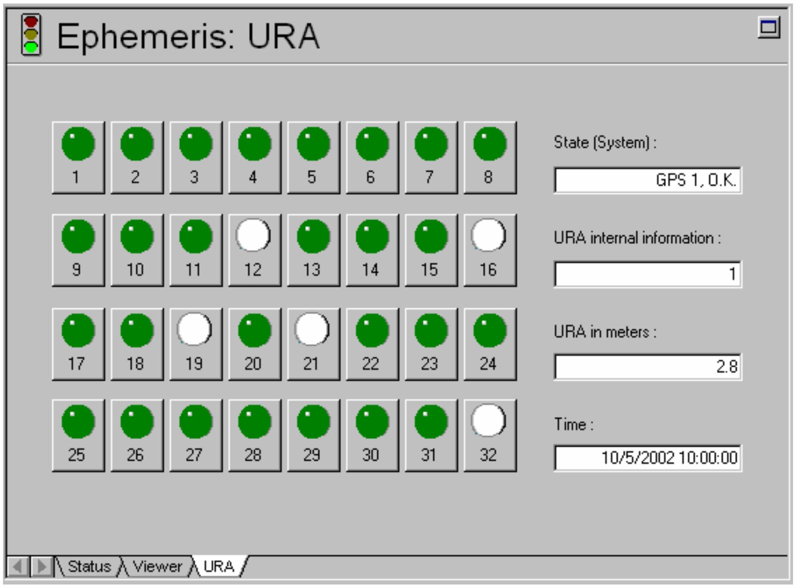


Parameter	Value	Unit	Explanation
Sat	GPS 1		Satellite PRN
Health	0		Satellite health indicator
GPS week	1270	GPS week	GPS week of reference time
TOE	309600	GPS seconds	Time of Ephemeris, reference time of ephemeris
TOW	302420	GPS seconds	Time of Week, send time of ephemeris
SVacc	2		Satellite accuracy
IODC	534		Issue of Data Clock
IODE	22		Issue of Data Ephemeris
e	5.222385e-003		Eccentricity of the satellite orbit
a	26559173.237	m	Semi-major axis of the satellite orbit
IDOT	1.917937e-010	rad/sec	Rate of inclination angle
I	9.793567e-001	rad	Orbital inclination angle at reference time
OMEGADOT	-7.890328e-009	rad/sec	Rate of right ascension
(OMEGA)0	-3.014670e+000	rad	Longitude of ascending node of orbit plane at weekly epoch
per0	-1.677513e+000	rad	Argument of perigee
M0	2.694953e+000	rad	Mean anomaly at reference time
DELTAN	4.065170e-009	rad/sec	Mean anomaly correction
TOC	309600	GPS seconds	Time of Clock data

Ephemeris – URA

The info page *URA* displays User Range Accuracy values for GPS satellites. You will find a button for each GPS satellite, displaying its PRN number (1 to 32) and its status in form of traffic light colors.

- Green: User Range Accuracy is less than or equal to 5,7 meters
- Yellow: User Range Accuracy is between 5,7 and 16 meters
- Red: User Range Accuracy is higher than 16 meters
- White: No information available for this satellite.



On the right side, you will find information corresponding to the currently selected satellites.

The information includes user range accuracy internal coding (*URA internal information*), user range accuracy converted to meters (*URA in meters*) and the time reference for these user range accuracy values (*Time*).

The URA value in meter is calculated from the SVacc value of the ephemeris (see page *Viewer*). Table 4.1 gives the relation between SVacc and URA in meters.

Table 4.1 Relation between SVacc values and URA

SVacc	URA in meters
0	2.0
1	2.8
2	4.0
3	5.7
4	8.0
5	11.3
6	16.0
7	32.0

SVacc	URA in meters
8	64.0
9	128.0
10	256.0
11	512.0
12	1024.0
13	2048.0
14	4096.0
15	8192.0

RINEX navigation files

When RINEX Storage is active (see Chapter 7, Data Storage), the ephemeris server writes hourly ephemeris data into the folder specified by the RINEX Storage module, where the station identifier is replaced by the characters "Ephm", such characterizing the ephemeris file valid for all stations.

CHAPTER

5

Communication Control

In this chapter:

Introduction

Communication control is one of the main tasks of GPSBase during system setup and maintenance. Communication control is equally essential for data input and output. A Connection Wizard guides you through all steps necessary to establish connections for data transfer in any direction.

The Receivers module is used to configure your connection to the reference station receiver and to a weather station for data input. Different connection methods are available that allow you to transfer, for example, the reference station data from the remote station to the control center.

Similarly, GPSBase controls the connections for position and correction data output to rovers using the connections to its RTCM Single Station Generators.

This chapter details the use of the Receivers module as well as how to select the matching driver DLL and to set up connections using the Connection Wizard.

Tip – Before adding a Receiver module to the module-tree of GPSBase, make sure that the data transmission between receiver and the control center computer is working without problems. To successfully operate a reference station system, it is crucial that all hardware and software used for data transfer is working correctly. For information on testing the data transmission, see Appendix B, Testing Your Data Lines.

Connection Configuration for Input Data

The main tool for configuring your reference station system within GPSBase is the Receivers module. Read this chapter for detailed information on this module. Configuring connections to instruments (receiver, weather stations) is described in Section Setting up a Connection: The Connection Wizard.

***Note** – GPSBase uses the* **Receivers** *module to configure the system. The reference station receiver that is connected to GPSBase is represented by the* **Receiver** *module, a specific type of an* **Instrument** *module.*

Connection configuration for the reference stations: The Receivers module

The Receivers module lets you configure the connection to your reference station system within GPSBase. The module itself is a branch of the main module GPSBase. To add the Receivers module to GPSBase, right-click *GPSBase* in the navigator, then select the shortcut-menu command *Receivers*. The module will immediately show up in the navigator. Click the navigator item *Receivers* to activate it.

There are two ways to start an instrument module:

- Right-click the navigator item *Receivers* to open its shortcut-menu and select the item *Connect*.
- From the information pane *Receivers – Port Info* click the **Add connection** button.

Both actions start the *Connection Wizard* with the *Decoder* page (see Section Setting up a Connection: The Connection Wizard). After you have finished the connection setup and started the instrument, the navigator will show the entry *<Receiver name>* or *Weather Station* as a branch of *Receivers.* An Almanac server and an Ephemeris server are automatically started when the reference station receiver is connected.

If a reference station connection is not used any more in the system, you may remove the connection to the reference station using the shortcut menu command *Remove Module* of the instrument.

If GPSBase does not find the receiver specified in the connection profile after a specified time limit (length depends on the receiver type), the decoder will be loaded in a passive mode. GPSBase now waits for incoming data.

Tip – If the receiver is recognized correctly and its properties are configured, the *Receiver* information pane will show detailed information on the reference station. Detailed information on the Receiver module is given in Chapter 6, Section Receiver Modules.

Other functions of the Receivers module

For use in postprocessing software or for later re-import to the system, you have two options to export the reference station information of all connected stations in the system.

- You can export ***the station position*** to a position file in the ASCII text format. You can update automatically the position in the system using the *File / Update Positions* command from the main menu (see Chapter 6, Section Settings on the Receiver Data page). To write the position to a text file, select the shortcut menu command *Save Positions* of the Receivers module. It opens a Windows file storage dialog that lets you edit the file name and path to it.
- You can export ***general reference station information*** to a file in the IGS site log format. To do so, select the *IGS Site Logs / Export* shortcut menu command from the Receivers module. It opens the *Browse For Folder* dialog that lets you select the folder for the automatically created log files. For how to import positions from an IGS Site Log file, see Chapter 6, Section Settings on the Receiver Data page. Export information includes the following:
  - Marker Name: to correspond the 4 character ID used by the IGS site logs, it is essential that the marker name does not contain more than 4 characters, otherwise the export will fail.
  - Marker Number corresponding with the IGS Site name.
  - Positions in Cartesian X,Y,Z coordinates.

- Receiver information, such as type, observed satellite system, serial number, firmware version, and elevation cutoff setting.
- Antenna information, such as type, serial number, height offset. GPSBase works with horizontal position offsets and alignments of 0.000m.
- RINEX header information, such as agency and observer (the latter corresponding to the site log entry Preferred Abbreviation), and an unlimited number of 40-character comment lines.

If reporting is activated, the Receivers module creates the Overview of Connected Receivers report. You can view the report by opening the file Receivers []status $<sessionID>.xml in your Web browser. For more information on the reports, see the Appendix G, Reports.

The Receivers information pane

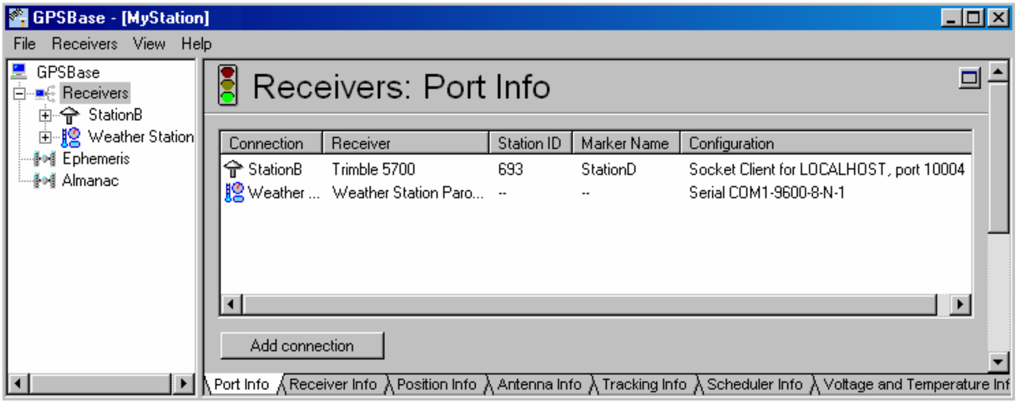
The *Receivers* information pane displays six pages of information:

- Port Info
- Position Info
- Antenna Info
- Tracking Info
- Scheduler Info
- Voltage and Temperature Info

After you have set up the receiver and added the connection to it to GPSBase, the *Receivers* information pane displays all available information in numerous tabs. The name and tracking status of the connection profile is always given in the first column *Connection.*

You can double-click the connection name, and the focus will automatically jump to the selected Receiver module (for more details on the receiver information see Chapter 6, Information pages for Receiver modules).

An intelligent sorting algorithm lets you sort the stations according to several properties by clicking the headers of columns. For example, to sort the stations according to their Station ID, click the *Port Info* tab and click the header of the *Station ID* column.



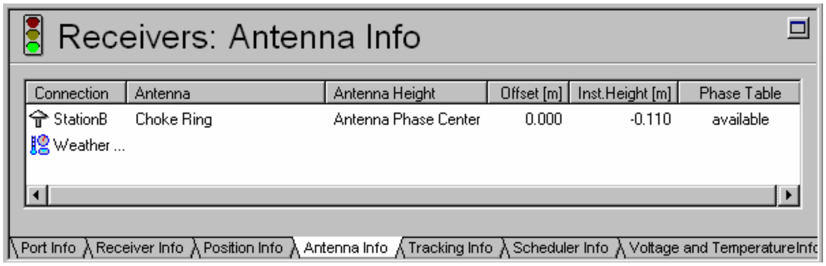
The *Receiver* column on the *Port Info* page gives the receiver or weather station identification. The *Station ID* and the *Marker Name* are also derived from the receiver settings. The connection parameters are summarized in the *Configuration* column.

If you have defined a connection profile, but the connection is not available due to, for example, a failure of the transmitting media, the receiver will be identified as *Not available*.

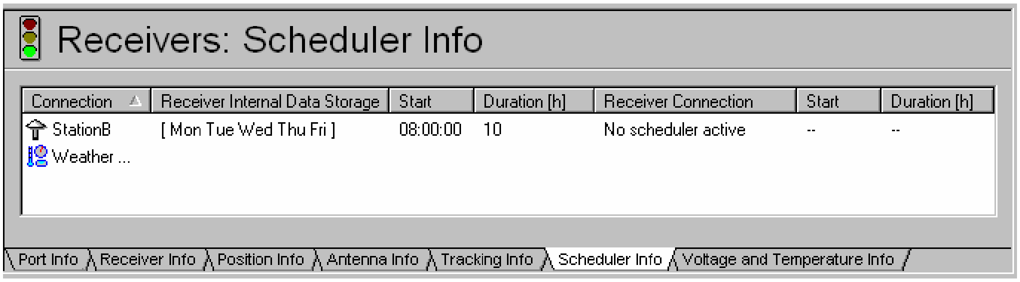
The **Add connection** button activates the Connection Wizard. See Section Setting up a Connection: The Connection Wizard.

With bi-directional connections, the *Receiver Info* page gives more information on the receivers connected: For each connection, the type, serial number, and firmware version of the receiver used at the station with the given *Station ID* are listed. In passive mode, the entries for *Serial Number* and *Firmware Version* are *UNKNOWN*.

The *Position Info* page displays the known Lat, Long, h, and X,Y, Z coordinates of the station. Antenna information, such as the antenna type, the height measurement type and antenna offsets, is summarized for each station in the *Antenna Info* page. The respective tracking rate, the elevation cutoff and the PRN numbers of tracked satellites can be found on the *Tracking Info* page.

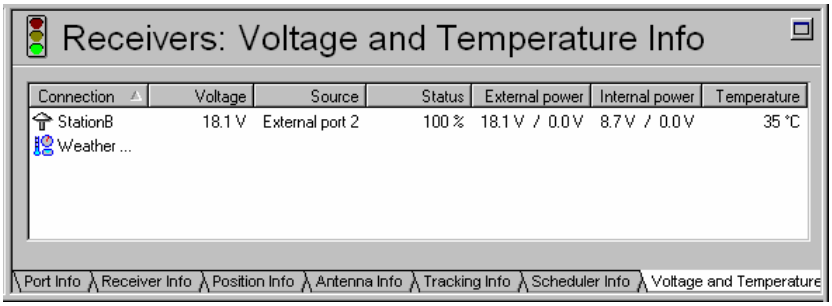


The *Scheduler Info* page lets you view the scheduler settings of the receiver. Thus, you can easily provide consistent settings for both types of schedulers, the data logging and/or the receiver connection scheduler. For more information on the schedulers, see the respective sections in Chapter 6, Instruments.



The first three columns of the table refer to the settings for data logging scheduler as input in the *Receiver Data Logging Scheduler* dialog. The *Receiver Internal Data Storage* column displays for each connection, whether data logging is active or not. If it is, you see the scheduled days of the week there. The daily start time and the duration in hours of scheduled data storage follow. The next three columns refer in the same way to the receiver connection scheduler.

View the voltage and temperature status of an actively connected Trimble reference station receiver at the *Voltage and Temperature Info* page. The first three columns of the table refer to the ***current*** voltage source. They show for each connection the current voltage (*Voltage*), the voltage source (*Source*, either number of the external port or of the internal battery slot), and the relative value of the current voltage in percent of the maximum available voltage from that source (*Status*). The *External power / Internal power* columns refer to the current status of all possible power sources in absolute volt values. For the current internal receiver temperature, see the *Temperature* column. With receivers that are passively connected or cannot transmit their physical status, the status is *Not available*.



Connection Configuration for Data Output

GPSBase has many tools to output data to rovers or other addresses. Such tools are the RTCM Single Station Generator modules, but also the Splitter modules. These modules are added to the tree at different locations, depending on the data they are propagating.

For detailed information on data output, see Chapter 8, Data Output.

Setting up a Connection: The Connection Wizard

The Connection Wizard always appears, when you begin configuring a connection. The pages it displays depend on the purpose of the connections. The following information is needed to identify a connection:

- The decoder type for the receiver data (only for incoming data, for example from a reference station or weather station).

- The interface driver type and settings for connection to the station.
- The unique connection name.

The Connection Wizard stores this (and more detailed) information in connection profiles. It allows you to define and remove connection profiles and to establish a connection using the selected connection profile.

Selecting the decoder

When a decoder for input data is needed, the connection profile has to provide decoder type information. The following modules need decoder type information:

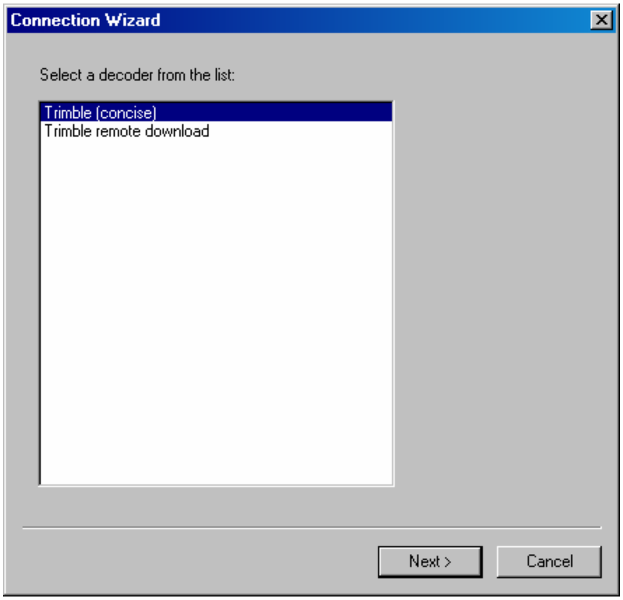
- Receiver modules, i.e. reference station modules
- Weather station modules

In these cases, select *Receivers*, then use either the shortcut menu command *Connect* or the **Add Connection** button in the *Receivers* information pane.

This will start a search for all available decoders in your installation of GPSBase. A decoder is a Dynamic Link Library (DLL) module, which is designed for communicating with one specific type of receiver. New receiver types can easily be added to your installation by purchasing the corresponding decoders and adding them to the installation folder.

Currently, the GPSBase installation offers the following decoders:

- Trimble (concise)   fits into 9600 baud
- Trimble remote download   used for postprocessing
- Weather Station (NMEA output format)
- Weather Station Vaisala HMP243



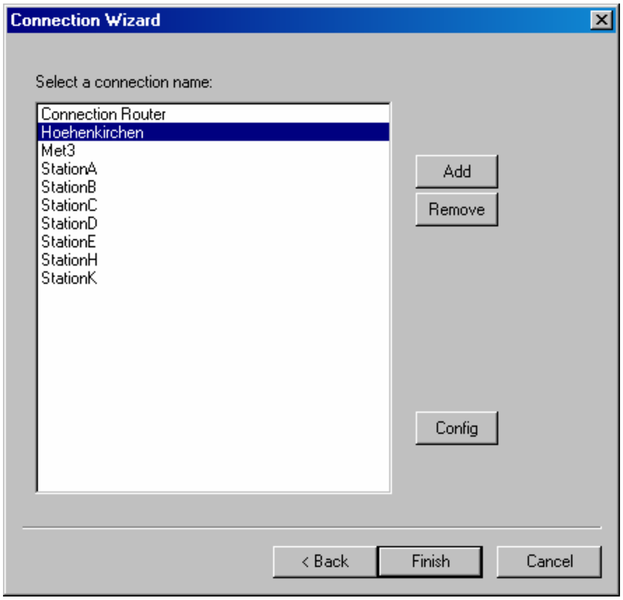
For a list of all supported receiver types and their corresponding decoders see Appendix A, Supported Receiver Types.

Select a decoder type matching your receiver type and click **Next**. The next dialog of the Connection Wizard allows you to define a new connection or to select a pre-defined connection.

Selecting a connection name

A set of connection parameters is called a “Connection” or a “Connection Profile”. A connection profile may differ from another connection profile only by a single parameter. (For example, you may set the data transfer rate to different values for a reference station, or select a different COM port).

GPSBase manages its connection profiles in separate lists, depending on the application.



Use this dialog to add, to configure and to remove connection profiles, and to select one for establishing a connection.

Adding a connection

The first time you use the Connection Wizard for a specific list of profiles, no connection profiles are available. To add a connection profile, click the **Add** button in the connection profile dialog. The *Enter Connection Name* dialog appears. Enter ***a unique connection name***. Typically, you will enter either a station name or a reference to baud rate, or Com port (e.g., *Munich_COM7_9600Bd*). This name will be used to represent the connection in the system.

After you have accepted the new name with **OK**, the *Driver Selector* allows you to select from the current list of interface drivers for connection to the instrument. For information on how to proceed see the section Driver Selection. Depending on the selected driver, you will then define the respective parameters.

Table 5.1 Examples for Connection Wizard's first lines

For a list of …	Used by this module …	The first line of the respective Connection Wizard page reads…
Input connections	Receiver, Weather Station	*Select a connection name,*
Output connections for raw data	Splitter (output)	*Select connection*
Output connections for correction data	RTCM Generator	*Select RTCM output medium*
Connections to device monitoring computer activity	Watchdog	*Select connection name*

Selecting a connection: Activating the connection

To select a pre-defined connection profile, highlight its name in the connection profile dialog of the Connection Wizard and click **Finish**.

GPSBase loads the connection profile and uses it to search for the instrument and connect to it. Its name and configuration parameters will show up in the respective information pane. The navigator will display the instrument as a branch of the parent module.

Configuring a connection

To edit a connection profile, click **Config**. Depending on the choice of the Driver DLL, different setting dialogs pop up, for example, the *Communication Settings* dialog for the *Serial Port Handler*, or the *Socket Client Configuration* dialog of the *Socket Client* handler DLL. Note that the configuration will change immediately after you have closed a settings dialog with **OK**.

Removing a connection profile

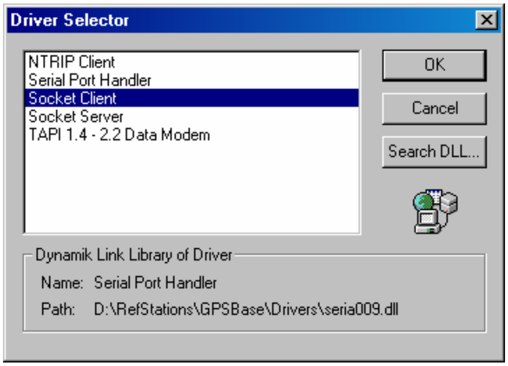
If you do not need a specific connection any more, you may remove the profile from the list of connections. Highlight the respective connection name in the list, then click **Remove**.

Finishing the connection

After you have chosen the connection name from the connection selection dialog, and have accepted the settings, finish the creation of the connection by clicking **Finish**. When the connection is detected for the first time, the *Properties* dialog for the module will pop up and allow you set all module-dependent parameters. Instructions on how to set the parameters are described in the referring chapters for the module.

Driver Selection

The *Driver Selector* dialog lets you select from the current list of interface drivers for connections to instruments. It appears when you are adding a connection.



Handlers or drivers are Dynamic Link Library (DLL) files, which provide the communication interfaces for GPSBase.

There are currently six of these communication interface-DLLs available in GPSBase:

- *Ntrip Client*: connecting an instrument or a Connection Router to an NtripCaster using a Source-table list for selecting the data source.
- *Serial Port Handler*: connecting a data source (receiver, network router modem) using a serial cable directly to the GPSBase computer.
- *Socket Client*: for connecting the GPSBase program with the data source (receiver, network router) within a WAN/LAN using a TCP/IP interface. In this case, the data source will act as *Socket Server.*
- *Socket Server*: for connecting the GPSBase program with the data source (receiver, network router) within a WAN/LAN using a TCP/IP interface. In this case, the data source will act as *Socket Client.*
- *TAPI 1.4 -2.2 Data Modem*: For a connection to the data source (network router modem) via telephone line using any type of modem supported by Windows TAPI interface. GPSBase's handler is compatible to the TAPI standard Versions 1.4 up to 2.2.
- *Multicast Socket Server*: Multiple connections on one TCP/IP address on the same port. Only available when GPSBase is configured for the output of data (for example, for communication between GPSBase and the rovers using the RTCM Generator, or for a Splitter).

The list of drivers gives you an overview of all version-compatible communication interfaces that GPSBase has detected and can use for the current application. The selection displayed depends on your current application.

The socket driver DLLs come in pairs: there is a Socket Server and a corresponding Client. Due to the communication concept of sockets, one of two connected applications must be a server, while the other one is a client.

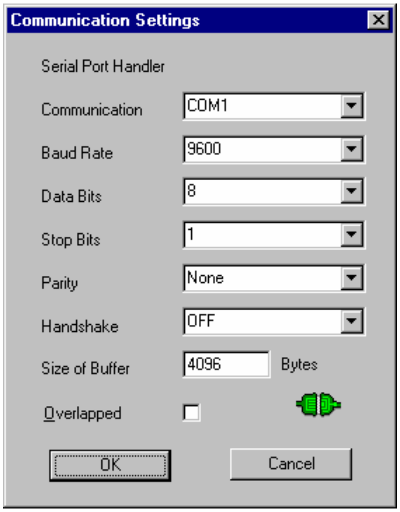
At the bottom of the *Select Driver* dialog, the group *Dynamic Link Library of Driver* gives you more information about the driver DLL that is currently selected. Its identifying *Name* is displayed as well as its file name including the complete folder *Path*.

Select the driver and click **OK**. Depending on the choice of the handler, different settings dialogs will pop up, for example, the *Communication Settings* dialog for the *Serial Port Handler*, or the *Socket Client Configuration* dialog of the *Socket Client* handler DLL.

***Note** – The configuration will change immediately after you have closed a settings dialog with **OK**.*

Configuring a serial COM port connection

For the Serial Port Handler the *Communication Settings* dialog lets you define the com port, baud rate, number of data bits, number of stop bits, parity type, handshake type, size of buffer and overlapping type. Select the parameters from the respective drop-down lists and click on **OK**.

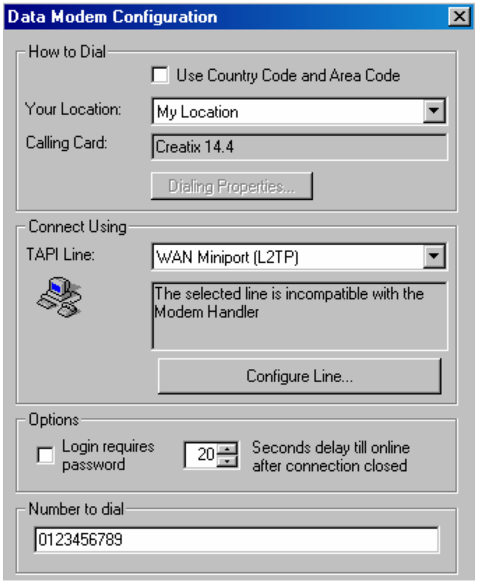


Configuring a modem connection

The modem connection is typically used for directly connecting rover receivers to the control station.

Follow these steps to set up a modem interface in GPSBase:

1. Install the modem driver on your computer and test whether the connection to your modem is working correctly.
2. Set the modem communication parameters and make test calls using your modem.
3. If you are using a leased line for connecting GPSBase with the receiver, test the correct operation of the line.
4. Use the *Modem Configuration* dialog to make the modem known to GPSBase (this section).
5. Test the connection to the reference station receiver by trying a manual dial-in using terminal software.



When you configure this handler DLL (select the *TAPI 1.4-2.2 Data Modem* list item, then click **OK**), the *Data Modem Configuration* dialog pops up. It lets you set the dialing properties for the modem (for example, if your phone system requires you to dial a leading zero before the actual number) and to select and configure the modem driver and COM port. For data output, the number to dial can also be entered here.

Click **OK** to close the *Data Modem Configuration* dialog. The program starts the *TAPI Data modem*. You can see the initialization messages in the Output Window.

There are two further options:

Required password for login

Do not activate the *Login requires password* option, since rover receivers do not support user name and password authentication.

Time delay after connection closed

After a modem connection has been closed, GPSBase re-initializes the modem to prepare it for the next incoming call. This re-initialization can be delayed by entering a value in the *Seconds delay till online after connection closed* list field.

Setting this field to, for example, 30 sec will release the modem after a connection has been terminated. The modem is free for access by other programs within this period. After 30 sec, GPSBase will try to initialize the modem again and start waiting for incoming calls.

Set this option to a value other than zero, if you are using different applications concurrently on one modem or if the modem needs a longer time to recover from a call hang-up.

Configuring a socket connection

A possible setup of the system may be, for example, the data transfer from the receivers using Terminal Servers to a network router. The network router then manages the incoming data. If the reference receiver and the GPSBase computer are running within a computer network (Internet or a Wide Area Network similar to the Internet), you can use this network for the communication between GPSBase and the receiver.

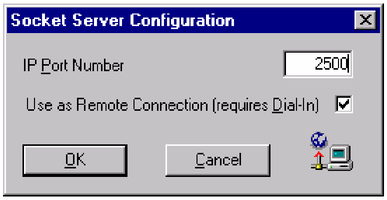
The mechanism employed for communication on a Wide Area Network (for example, Frame Relay) is called “Socket”. It is also known as "TCP/IP-Protocol" and one of its major applications is the Internet. It is a standardized way of connecting two applications on different computers and to exchange information and data between them. Therefore, it is required that each computer has a unique address ("IP-address") within the network of computers it is running. This network can, for example, be a Local Area Network (LAN, for example within a company) or the Internet.

Once a communication partner is located using its IP-address, there's also the need to correctly identify the application program on that computer, to which one wants to "talk" to. Within the TCP/IP communication standard this addressing is done using "IP-port numbers" which are also known as "sockets". The port number again has to be unique within its environment, meaning each application which uses Socket communication on the computer must use different port numbers.

Moreover, the Socket communication is realized as a "client-server" concept. One of the two communicating applications must be configured to take on the role of the "server", who is continuously waiting for others to connect to its socket. The other application is the "client" (possibly one of multiple clients) who connects to the server's socket and disconnects again, when data exchange is finished.

To configure a GPSBase receiver module as the ***Server*** for a ***Socket*** connection, use the *Socket Server* handler DLL (from the *Driver Selector* dialog, select the *Socket Server* list item, and then click **OK***)*. It will allow the use of TCP/IP protocol standards for the communication between the computers.

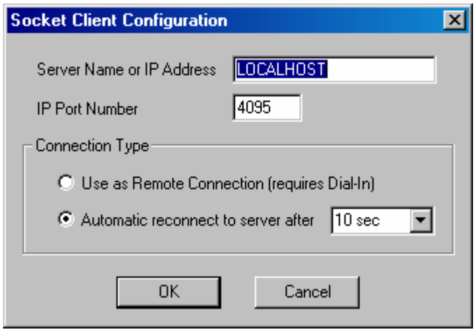
The *Socket Server Configuration* dialog pops up. It lets you define the IP port number, which will be used for the communication via the TCP/IP protocol. You may select any number, which is not occupied by another service or protected by a firewall system.



Tip – Make sure that the selected IP Port is available and ready for communication. Firewall concepts may prevent the establishment of a communication channel to free IP Ports. Ask your network administrator for more information.

If you want to make the socket connection work similarly to a modem connection with dial-in and hang-up functionality, select the *Use as Remote Connection* check box. After closing the *Socket Server Configuration* dialog with **OK**, the program starts the Socket Server. You can see the initialization messages in the Output Window.

To configure a Receiver module of GPSBase as the ***Client*** for a ***Socket*** connection, use the *Socket Client* handler DLL as active handler. Within the *Driver Selector* dialog select the *Socket Client* list item, then click **OK.** The *Socket Client Configuration* dialog pops up.



Define the name of the server computer here. If the server and the client programs are running on the same computer, the server name may be replaced by *LOCALHOST*. Enter the server's *IP Port Number*, which will be used for the communication via the TCP/IP protocol.

Tip – The selected server IP Port must be available and ready for communication at the server computer or device. Ask your network administrator for more information.

The following options let you define the behavior of the socket client, when the connection to the server was interrupted:

Only activate the *Use as Remote Connection (requires Dial-In)* option in cases, when you want a "modem-type" or a scheduled behavior of the client. The Socket connection then uses the same manual dial-in and hang-up functionality as a modem connection for establishing and terminating a connection.

If the program suites are running on different computers, a shutdown of one of the computers or a breakdown of the network connection (for example, unplugged network cable) may cause an attempt to automatically re-connect. Select the *Automatic reconnect to server* option. Only then the *Reconnect after* list is activated. It lets you define a delay, after which the client will attempt a re-connection to the server. Note that in the case of an unplugged network cable of the server computer, the client will now continuously try to access the server in the specified interval until it succeeds.

After closing the *Socket Client Configuration* dialog with **OK**, the program starts the *Socket Client*. You can see the initialization messages in the Output Window.

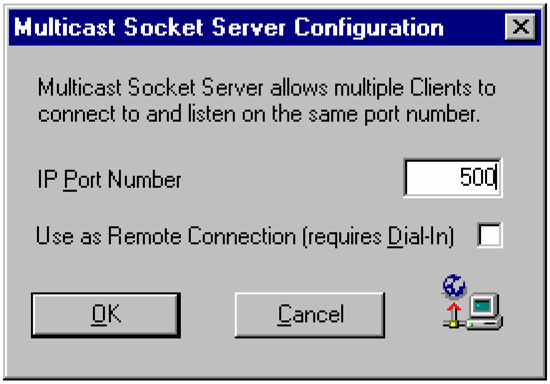
Configuring a multicast socket connection

A Multicast Socket Server acts similar to a (Single) Socket Server connection. However, it allows multiple clients to connect to the same port number and to dial-in simultaneously. A Multicast Socket Server is a way to broadcast RTCM observations and/or corrections to groups of users (clients). It is a unidirectional connection, used only for Data Output (RTCM Single Station Generator, RTCM Multi Station Generator, Splitter and Connection Router).

To configure a GPSBase module as the ***Server*** for a ***Multicast Socket*** connection, select the *Multicast Socket Server* list item from the

Driver Selector dialog, then click **OK**. The driver will allow using the TCP/IP protocol standards for the communication between the computers.

The *Multicast Socket Server Configuration* dialog appears. Its options are identical to those of the *Socket Server Configuration* dialog: It lets you define the IP port number that will be used for the communication using the TCP/IP protocol, as well as the behavior of the server. For more details see Section Configuring a socket connection.



Note *– When the* Use as Remote Connection *option is selected the Multicast Socket connection works similarly to a modem connection with dial-in and hang-up functionality. The first client that dials-in starts the broadcast of RTCM messages. The server stops broadcasting when the last of the active clients hangs-up.*
Note that this functionality is only valid for a connection to an RTCM Single Station Generator.

Configuring an Ntrip client connection

If reference station data is distributed in real-time through the Internet using the Ntrip protocol, you can connect to these data streams and use them as data input into your GPSBase system. A main advantage of this connection type is that in a firewall system it does not require more than one port open for connections. Moreover, the Ntrip concept allows data request from multiple broadcasting networks.

A connection configuration using the Ntrip client driver acts similarly as a socket client. However, it always runs in auto-connect mode with 10 seconds reconnect time.

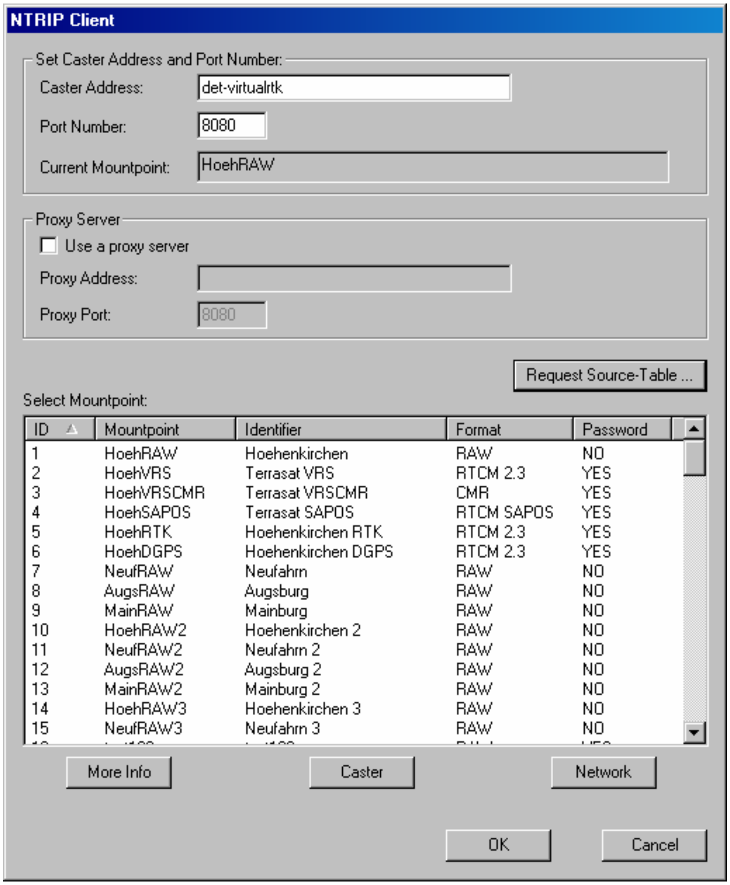
Tip – For more information on the basics of the Ntrip concept and its main components (the NtripSources generating data streams, the NtripServer collecting the data streams, the NtripCaster making the data streams available using source-tables, and the NtripClients requesting the data streams), refer to Chapter 4, Trimble GPServer – The Software in the Trimble GPServer User Guide. Detailed information on the Ntrip concept is available from igs.ifag.de/index_ntrip.htm.

To configure a GPSBase module to connect to an Ntrip data stream select the *NTRIP Client* driver from the *Driver Selector* dialog, then click **OK**. The Ntrip client driver is available for instrument modules. The *NTRIPClient* dialog appears. Use it to define the IP address and port of the server computer, to request a source-table and to select the unique source mountpoint.

Selecting the Mountpoint

The *Set Caster Address and Port Number* group specifies the source of the data stream. For details see Table 5.2. The entry in the *Current Mountpoint* field updates automatically, when you select a mountpoint (by double-clicking a record or by selecting a record and clicking **OK**) from the list.

The *Use a proxy server* option specifies whether the access to the NtripCaster should be routed via a proxy server or not. A proxy server may be necessary if a firewall blocks the port on which the NtripCaster is running. Default: *No*. If *Use a proxy server* is set to *Yes*, use the *Proxy Address* field to specify the name (IP address or host name) of the proxy server to use. *Proxy Port* then specifies the IP port number of the proxy server to use. Default: *8080*.



The *Select Mountpoint* list field is empty, when you access the *NTRIPClient* dialog for the definition or reconfiguration of a new connection. You have to load a source-table first. Source-tables are maintained by the NtripCasters. They contain information on available NtripSources, networks of NtripSources, and other NtripCasters to be sent to an NtripClient on request. To request a source-table, click **Request Source-Table**.

Table 5.2 Parameters of Set Caster Address and Port Number

Field	Description	Comment
Caster Address	Source Internet host domain name or IP address	Both address formats are allowed. Directs to localhost, when the *NTRIPClient* dialog appears for a new connection. Enter a valid address that allows you to request a source-table.
Port Number	IP port of the source	Mandatory. Directs to port 2101, when the *NTRIPClient* dialog appears for a new connection. Port 2101 is registered by IANA (Internet Assigned Numbers Authority) in the list of well known ports for the usage of GNSS data.
Current Mountpoint	Unique caster mountpoint. Identifies the service in the source-table.	Used to identify the Ntrip source. Information field. Empty, when the *NTRIPClient* dialog appears for a new connection. After selection of a mountpoint from the list, its name appears here.

Table 5.3 Entries in the Mountpoint list

Field	Description	Comment
ID	Identifier	Consecutive number in order as the mountpoints appear in the source-table.
Mount Point	Unique caster mountpoint. Identifies the service in the source-table	Identifies the Ntrip data stream by an abbreviated description. Typically contains important information on the service, for example location and/or output data type.
Identifier	Source identifier, for example source location	For example, Hoehenkirchen
Format	Data type and format	For example, RAW, RTCM 2.1, RTCM VRS.

Field	Description	Comment
Password	Is user authentication necessary?	YES or NO. If you select a data stream, where authentication is necessary, the *User Name / Password* dialog appears that lets you enter both user name and password.

The list of mountpoints gives you the most important information on all mountpoints found in the selected source-table. See Table 5.3 for a description of its columns. To find more detailed information on the services identified by the mountpoints, select a record from the list and click **More Info**. A dialog appears whose name consists of the identifier and the format details of the selected service. Table 5.4 gives you an overview on the parameters and possible values displayed here.

Table 5.4 Verbose mountpoint information

Field	Description	Comment
Authentica-tion	Is user authentication necessary?	None – no user identification necessary Basic – basic user identification with user name and password
Bit Rate	Minimum bit rate of data stream necessary to guarantee correct and complete data transmission.	Integer numbers
Carrier	Does the data stream contain carrier phase information?	For example: No; L1; L1 & L2
Client must send NMEA	Necessity for Client to send NMEA GGA message with approximate position to Caster	For example: No Yes

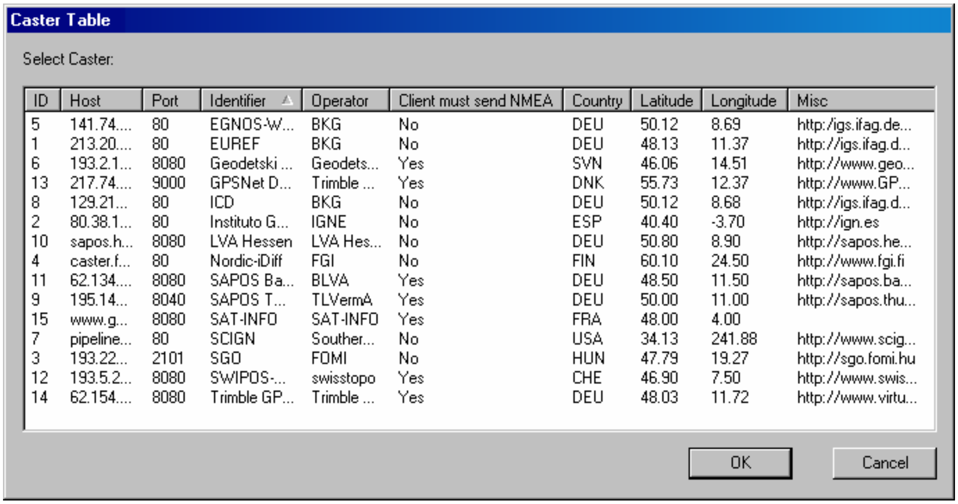
Field	Description	Comment
Compres-sion	Compression algorithm	None
Country	Three character country code in ISO 3166	Language depends on computer settings
Fee	User fee for receiving this particular data stream.	Either: No user fee Or: User is charged or Yes
Format Details	RTCM message types or RAW data format, update rates in parenthesis in seconds	For example: with RAW data: Trimble concise; with RTCM 2.1: 1(1),2(1),3(30).
Generator	Hard- or software generating data stream	For example: Trimble NetRS.
Latitude	Position relative to North	Floating point number, two digits after decimal point.
Longitude	Position relative to East	Floating point number, two digits after decimal point.
Misc	Additional comments, miscellaneous information.	
NavSystem	The navigation system, the data is based on.	GPS GPS+GLO EGNOS
Network	Network of the data sources, for example a VRS network.	You can add information on further networks to the source-table using the using the **Network** button in the *NTRIPClient* dialog.
Solution	Is the stream generated from single reference station or from networked reference stations?	Either: Single base Or: Network

To select a mountpoint for the data stream and to finish the driver configuration, set the focus onto the mountpoint record in the list and click **OK** or double-click the entry.

***Note** – The* Client must send NMEA *parameter value* Yes *corresponds to the* Point to Point (VRS) *option of the iGate module properties, while* No *corresponds to the* Broadcast *option (refer to Trimble GPServer User Guide, Chapter 4).*

Selecting another Caster

Source-tables can contain not only information on individual services (mountpoints) but also on networks of data streams and on other NtripCasters providing more data streams. To open the *Caster Table* dialog, click **Caster**. Use it to view the list of Casters derived from the current source-table, and to move to another NtripCaster. See Table 5.5 for a description of its columns. To move to another Caster and to load its source-table into the system, select a record and double-click it or click **OK**. The *Caster Table* dialog closes, and the *NTRIPClient* dialog now displays the contents of the new source-table.



ID	Host	Port	Identifier	Operator	Client must send NMEA	Country	Latitude	Longitude	Misc
5	141.74....	80	EGNOS-W...	BKG	No	DEU	50.12	8.69	http:/igs.ifag.de...
1	213.20....	80	EUREF	BKG	No	DEU	48.13	11.37	http://igs.ifag.d...
6	193.2.1...	8080	Geodetski ...	Geodets...	Yes	SVN	46.06	14.51	http://www.geo...
13	217.74....	9000	GPSNet D...	Trimble ...	Yes	DNK	55.73	12.37	http://www.GP...
8	129.21...	80	ICD	BKG	No	DEU	50.12	8.68	http://igs.ifag.d...
2	80.38.1...	80	Instituto G...	IGNE	No	ESP	40.40	-3.70	http://ign.es
10	sapos.h...	8080	LVA Hessen	LVA Hes...	No	DEU	50.80	8.90	http://sapos.he...
4	caster.f...	80	Nordic-iDiff	FGI	No	FIN	60.10	24.50	http://www.fgi.fi
11	62.134....	8080	SAPOS Ba...	BLVA	Yes	DEU	48.50	11.50	http://sapos.ba...
9	195.14...	8040	SAPOS T...	TLVermA	Yes	DEU	50.00	11.00	http://sapos.thu...
15	www.g...	8080	SAT-INFO	SAT-INFO	Yes	FRA	48.00	4.00	
7	pipeline...	80	SCIGN	Souther...	No	USA	34.13	241.88	http://www.scig...
3	193.22...	2101	SGO	FOMI	No	HUN	47.79	19.27	http://sgo.fomi.hu
12	193.5.2...	8080	SWIPOS-...	swisstopo	Yes	CHE	46.90	7.50	http://www.swis...
14	62.154....	8080	Trimble GP...	Trimble ...	Yes	DEU	48.03	11.72	http://www.virtu...

Table 5.5 Caster information

Field	Description	Comment
ID	Identifier	Consecutive number in order as the Casters appear in the source-table.
Host	Caster Internet host domain name or IP address	Both address formats are allowed.
Port	IP port of the caster host	
Identifier	Descriptive identifier of the caster.	For example: Trimble GPSBase
Operator	Name of institution / agency / company operating the caster	For example: Trimble Terrasat
Client must send NMEA	Necessity for Client to send NMEA GGA message with approximate position to Caster	For example: No Yes
Country	Three character country code in ISO 3166	Language depends on computer settings
Latitude	Position relative to North	Floating point number, two digits after decimal point.
Longitude	Position relative to East	Floating point number, two digits after decimal point.
Misc	Additional comments, miscellaneous information	

Network information

The current source-table will typically also contain information on the network providing the data streams offered and possibly also on other networks. To open the *Network Table* dialog, click **Network**. See Table 5.6 for a description of its columns. Use the dialog to view the list of networks derived from the current source-table and to move to the website of the service provider. To do so, select a record and double-click it or click **OK**. The *Network Table* dialog closes, and your default web browser comes up loading the requested website. The *NTRIPClient* dialog still displays the contents of the current source-table and allows you to proceed with the configuration of the connection.

Table 5.6 Network information

Field	Description	Comment
ID	Identifier	Consecutive number in order as the networks appear in the source-table.
Identifier	Descriptive identifier of the network.	For example: Terrasat
Operator	Name of institution / agency / company operating the caster	For example: Trimble Terrasat
Authentica-tion	Is user authentication necessary?	None – no user identification necessary Basic – basic user identification with user name and password
Fee	User fee for receiving data streams.	Either: No user fee Or: User is charged
Web-net	Web-address for network information	
Web-str	Web-address for stream information	
Web-reg	Web address or mail address for registration	
Misc	Additional comments, miscellaneous information	

Satellite Selection

There are several ways in GPSBase to exclude specific satellites from the application.

There are the overall settings for the system, available from the satellite properties of the Receivers module. Selections made here define the satellite tracking for all Receiver modules defined in GPSBase, whether they are currently connected or not. This action we call “global satellite selection”. Different satellite selections for a single Receiver module consequently are available, when selecting the satellite properties of this specific Receiver module.

For deselecting satellites, you have to distinguish, whether satellites are to be disabled for the use within the real-time system only or for the use in postprocessing as well. In the first case, real-time only, the observations from disabled satellites will be written into data files such as RINEX files, if data storage is activated. Thus, they are available for postprocessing. However, these observations will not be passed on to other modules, such as the RTCM Single Station Generator.

When a satellite is disabled for real-time ***and*** postprocessing applications, no satellite observation passes the respective Receiver module. However, with a passive connection to the receiver, the receiver still tracks disabled satellites. Modules, which get the data stream before the Receiver module gets it, will, therefore, nevertheless receive this satellite’s observation. Examples for such modules are the Splitter or the Raw Data Storage modules.

All in all, we have three satellite disabling states:

-  Enabled,
-  Disabled for real-time application (RT disabled),
-  Disabled for real-time application as well as for post-processing (RT/PP disabled).

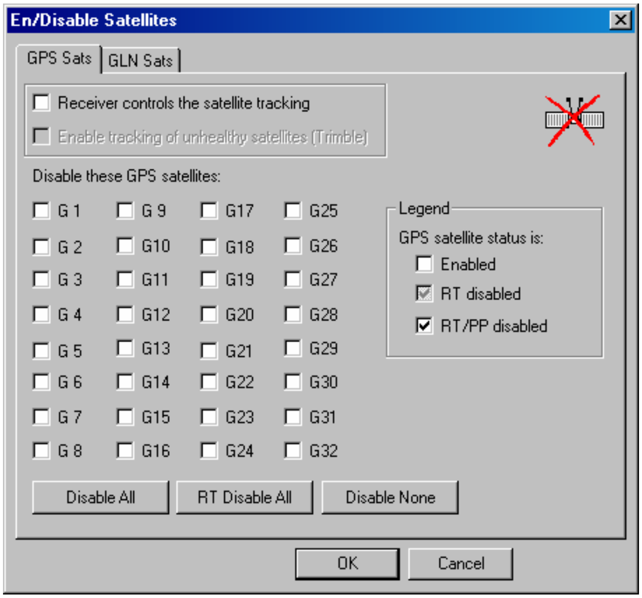
In the following, you will first find a detailed description of the global settings for satellite selection, see Section Global satellite settings.

Then, a short description follows for individual receivers in Section Local satellite settings at a specific receiver.

Global satellite settings

The *En/Disable Satellites* dialog appears, when you select *Properties Satellites* from the shortcut menu of the Receivers module. Depending on the receiver type, you may edit the satellite settings for GPS or GLONASS satellites or both at the <*Satellite System*> *Sats* pages. If WAAS is active, the additional *WAAS* page lets you select a geostationary satellite. For more information on WAAS, see Section Wide Area Augmentation System WAAS.

Tip – Depending on the connection type established between GPSBase and the receiver, the settings for the satellites control the receiver (if a bi-directional connection is established) or not (Receiver module in passive mode).



To disable the satellite selection from this dialog, select the *Receiver controls the satellite tracking* check box. If you select this option, all satellite check boxes are grayed out, and the reference receiver controls the satellite tracking even if bi-directional, active connections to the receivers are established.

For each satellite system, the respective The *<Satellite System>* page lets you disable single satellites either for real-time only, or for real-time and postprocessing by ***repeatedly*** selecting the respective check box. To disable all or none of the satellites use the **Disable All** / **RT Disable All** / **Disable None** buttons. See the legend and the description above for how the activation status of a satellite is indicated by different check mark colors. By default, no satellite is disabled.

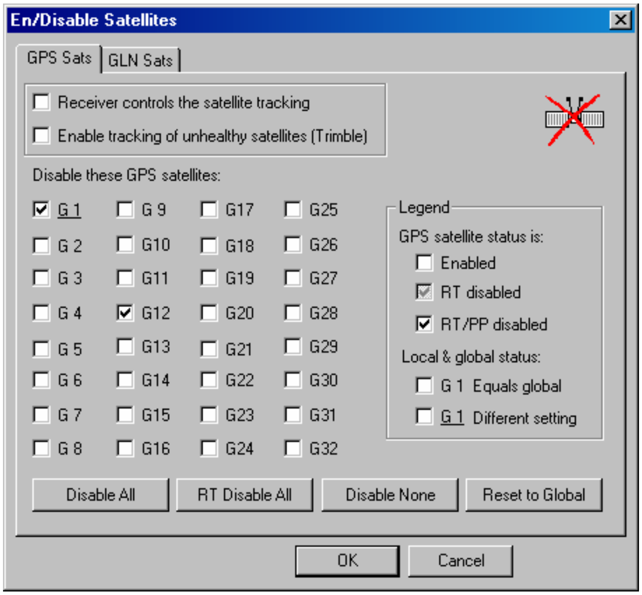
Tip – If you have to disable a satellite for a specific Receiver module only, make sure you first set the global satellite selection for the GPSBase system. Any new setting at the global *En/Disable Satellites* dialog overrides existing individual settings. A warning message will appear in this case.

Local satellite settings at a specific receiver

If you have to disable a satellite for a specific Receiver module only, you will do this from the context menu of this Receiver module. There, select *Satellite Properties* to open the receiver specific *En/Disable Satellites* dialog.

The tabs of this dialog behave and look very similar to the global settings. There are only the following differences.

- Of course, all settings apply for the selected receiver only. They do not touch the global satellite selection.
- An additional button, **Reset to Global**, lets you remove all individual settings and resets the selection to the global settings.



- You can easily see if for single satellites the settings are different at the current receiver. If so, the PRN of that satellite shows up as underlined. For example, the screen dump shows the satellites PRN G1 and G12 disabled for real-time and postprocessing applications. G1 is underlined, thus indicating that the global setting for this satellite is different (either enabled or disabled for real-time applications only).
- The *Enable tracking unhealthy satellites (Trimble)* option can only be selected for individual receiver connections (Default status: not selected).
  Typically, unhealthy satellites are not tracked or used in the position solution. Some Trimble receivers, however, can be set to output the observations of unhealthy satellites. With the *Enable tracking unhealthy satellites (Trimble)* option selected, these observations go into the GPSBase system. They are passed on to Splitter modules, and they are written into data storage files, such as RINEX files. However, unhealthy satellites are ***not used*** in the position solution.

***Note** – Also the* Receiver controls the satellite tracking *option can be different from the global setting and will in this case be underlined.*

Wide Area Augmentation System WAAS

GPSBase interprets the WAAS data stream of, for example, the Trimble WAAS receivers, if you activate this feature.

The Wide Area Augmentation System (WAAS) uses satellites (initially geostationary satellites – GEOs) to broadcast GNSS integrity and correction data to GNSS users, and to provide a ranging signal that augments the GNSS.

The signal broadcast via the WAAS GEOs to the WAAS users is designed to minimize standard GNSS receiver hardware modifications. The GPS frequency and GPS-type of modulation, including the Coarse/Acquisition (CA) PRN code on GPS L1 carrier frequency, is used.

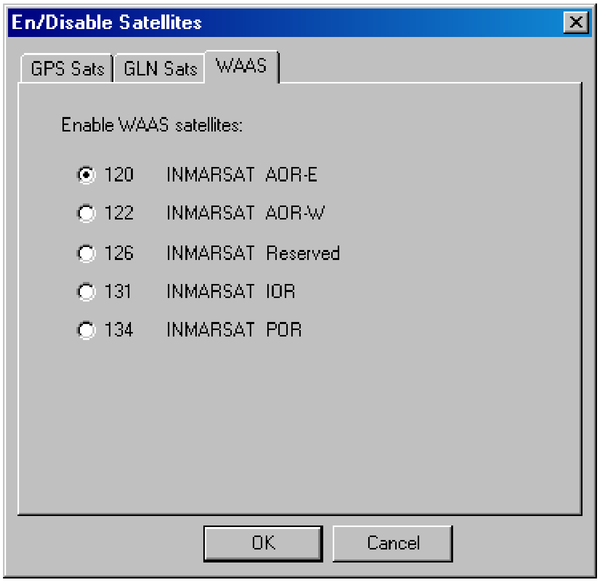
The WAAS codes (the CA codes to be used by WAAS GEOs to broadcast GPS look-alike signal) are identified by the PRN number, starting with 120.

A given WAAS GEO broadcasts either coarse integrity data or both such data and Wide area corrections. The coarse integrity data includes *use/do not use* information on all satellites in view of the applicable region, including the GEOs. Correction data include estimates of the error after application of the corrections. WAAS provides data for a maximum of 51 satellites.

There are two types of correction data – fast and slow. The fast corrections are intended to correct for rapidly changing errors, such as GNSS clock errors, while the slow corrections are for slower changing errors, due to the atmospheric and long term satellite clock and ephemeris errors.

Activating WAAS

To activate the Wide Area Augmentation System for a WAAS receiver, right-click the Receiver name in the navigator and select the shortcut-menu item *Activate WAAS*. This induces the receiver to send the WAAS signal to GPSBase. The additional information pane WAAS for the Receiver module will display the current information. If a "*do not use*" signal arrives, the information will be forwarded to the Availability module.



Select the appropriate GEO satellite for the region of your survey from the *WAAS* page of the *En/Disable Satellites* dialog, which is available using the *Satellite Properties* command from the Receiver's shortcut menu. The *WAAS* page only shows up, if WAAS has been activated previously.

See Table 5.7 for the currently available INMARSAT satellites, which cover the region indicated by the abbreviation characters. Click the respective option button to select the fitting satellite.

Table 5.7 INMARSAT satellites and the regions covered by them

Sat ID	Code	Region
120	AOR-E	Enables the geostationary satellite for the Atlantic Ocean Region – East
122	AOR-W	Enables the geostationary satellite for the Atlantic Ocean Region – West
126		Reserved
131	IOR	Enables the geostationary satellite for the Indian Ocean Region
134	POR	Enables the geostationary satellite for the Pacific Ocean Region

Deactivating WAAS

With activated WAAS, the WAAS related shortcut-menu command of the Receiver module changes to *Deactivate WAAS*. You can deactivate WAAS at any time without touching other functions of the receiver or of GPSBase.

WAAS information pane

If you have activated WAAS augmentation, the Receiver module will offer an additional information page, the *WAAS* pane, see Chapter 6, Section Information pages for Receiver modules.

CHAPTER

6

Instruments: Data Input

In this chapter:

- Introduction
- Receiver Modules
- Weather Station Module

Introduction

The most important sources for data input into the GPSBase system are the reference station receiver and weather stations. Data input is controlled by Receiver and Weather Station modules. Both types of modules are connected to GPSBase using the Receivers module. This chapter discusses their functionality.

Receiver Modules

The Receivers module gives a full overview of the connections to the reference station receivers (and weather stations as well), while a Receiver module controls the data received by the respective connected receiver.

In the navigator, a Receiver module is represented by its connection name and the status-identifying icon.

 Receiver connected and data being received.

 Receiver connection is not active

 Redundant receiver line

 Receiver disconnected

 Bad antenna settings

 Status of the receiver is BAD: no data received from the reference station.

For the navigator item *Receiver,* at least four pages of information exist in the information pane. See the Section Information pages for Receiver modules.

You may configure the receiver properties and, additionally, the satellite properties. See the sections starting with the Receiver properties section.

Connecting a Receiver module

The connection to a receiver must be made explicitly known to GPSBase. This procedure differs slightly from the adding procedure used elsewhere in GPSBase. A receiver is connected using the Receivers module.

There are two ways to connect a receiver:

- Right-click the navigator item *Receivers* to open its shortcut menu and select *Connect*.
- From the information pane Receivers – Port Info click the **Add connection** button.

Both actions start the *Connection Wizard* with the *Decoder* page. For a real-time system select the Trimble concise decoder. To set up GPSBase for post-processing receiver data, select the *Trimble remote download* decoder. For detailed information on connections, see Chapter 5, Communication Control.

When the connection is selected, set the properties of the receiver. Later you may edit your settings, if you select *Properties* from the shortcut menu. The *Receiver Data* and *Antenna* settings pages will appear.

Additional setting pages can appear, depending on the decoder and connection type selected. To move through the pages, click the **Next** button; **Cancel** closes the dialog without accepting the changes. **Back** lets you return to the previous page. Finally, click **Finish** to accept the changes. When displayed as *Properties* pages, you will find the usual buttons **OK**, **Cancel** and **Apply**. For details, see the Section Receiver properties.

If a receiver is not connected correctly to the Control Center, the GPSBase Receiver module will fail to recognize the receiver. Its status will change to BAD (). Nevertheless, it will start up completely, expecting that the receiver will send data by itself and be on-line later (passive mode).

Restarting a Receiver module

To re-initialize a receiver using the current settings (provided that an active connection is established), open the shortcut menu of the respective module and select *Restart Receiver*.

Removing a Receiver module

You may remove any module at any time from GPSBase: Open its shortcut menu and select *Remove Module*. But, if you remove a Receiver module from GPSBase, be aware that this will likely influence the operation of other modules.

Adding modules to a Receiver module

You may add further modules, if you select *Insert Module* from the instrument's shortcut menu. The following modules are currently available for a Receiver module. Further analysis, data storage and data output modules are available under the Raw Data Analysis module, which provides consistent and error-reduced data.

Analysis Tools (see Chapter 10, Section Analysis Tools), such as

- Point Position Analysis
- Single Point Position
- Raw Data Analysis - this module provides data for the RTCM corrections (for example, #20/#21, or DGPS)

Data Storage modules (see Chapter 7), such as

- RINEX Storage
- DAT Storage
- RAW Storage

Data output or routing modules (see chapters 8 and 10), such as

- RTController (Trimble)
- Splitter

Receiver properties

When connecting a Receiver module to GPSBase you define receiver properties in form of a settings wizard. You may change the properties at any time, when you select the shortcut-menu command *Properties* of a Receiver module. Then the *Receiver Properties* dialog appears. Use it to view and edit the properties of the module.

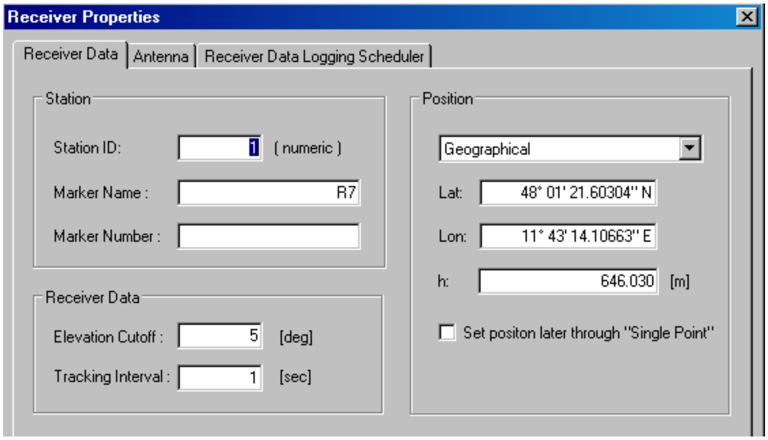
Settings are collected on the following tabs:

- *Receiver Data*
- *Antenna*
- *Scheduler* (only with non-permanent remote connections, see Section A scheduled reference station)
- *Receiver Data Logging Scheduler* (only with Trimble receivers that allow data storage at the receiver, see Section Data logging)
- *Trimble Remote Download* (only with the Trimble remote download decoder, see Section Remote data download)

Settings on the Receiver Data page

The *Receiver Data* dialog lets you define and control the following in its *Station* group:

- *Station ID*: must be numeric, 0…1023.
- *Marker Name*: alphanumeric characters are allowed. The first 4 digits will be used for output files obeying the CORS naming convention.
  Allowed characters are A…Z, a…z, 0…9, +, -, _, and the space, comma and dot characters.
  Note that only 4-character marker names are allowed, when importing or exporting IGS log files.
- *Marker Number*: additional information about the station. Alphanumeric characters are allowed.



The *Receiver Data* group in the *Receiver Data* dialog lets you set an elevation cutoff angle in degree and a tracking interval in seconds. Based on the settings here, the Receiver module filters the data and passes the filtered data on to its depending modules, even if the receiver provides observations with lower elevation or higher tracking rate.

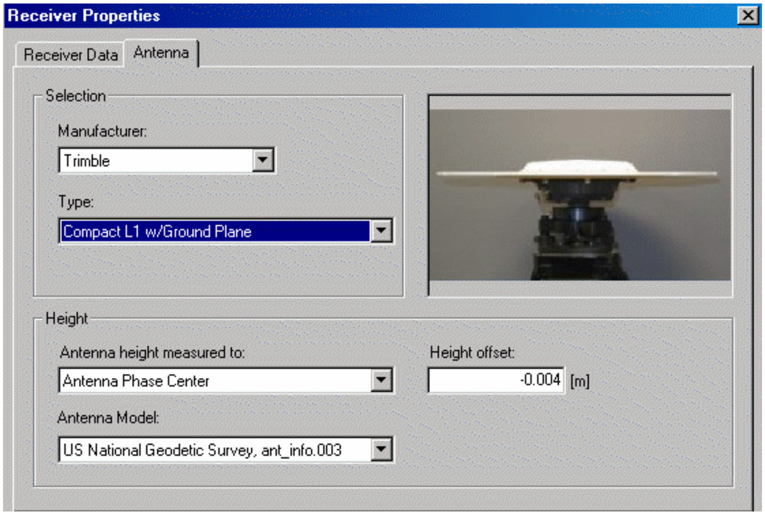
Note – Depending on the connection type established between GPSBase and the receiver, the settings for *Elevation Cutoff* and *Tracking Interval* control the receiver (if a bi-directional connection is established) or not (Receiver module in passive mode). In the latter case, the values displayed here are only used for data filtering in the system.

Finally, the *Receiver Data* page additionally lets you enter the known coordinates of the reference station manually or automatically using position files. The coordinates in the *Position* group depend on the coordinate system. Using the drop-down list in the upper right corner you may select to display the reference coordinates either as geographical latitude, longitude, height (default) or as Cartesian X,Y,Z coordinates. For more details on the position information see Section Known coordinates of the reference station.

Settings on the Antenna page

Antenna information is to be set and found on the *Antenna* page of the receiver properties. All selections on this page depend on an antenna information file, the antenna.ini file. For detailed information on the use of antenna.ini and on antenna phase corrections, see Appendix C.

The *Selection* group lets you edit antenna type information. Select *Trimble* from the *Manufacturer* field, and then select an antenna type from the *Type* field. The selection offered depends on the manufacturer chosen. For the selected antenna, a bitmap is displayed that may give you the geometrical relations for eccentricity values.



Antenna eccentricities are defined by the settings in the *Height* group. Edit the *Height offset* and select the location on the antenna, where the antenna height is measured to. The selection offered depends on the antenna type.

Currently, three antenna models are available:

- Default Trimble Calibration
- US National Geodetic Survey
- Institute for Geodesy Absolute Calibration

Importing station data from IGS site logs

Besides manually entering the settings, you can also import most of the station data from data files in the IGS site log format. Additionally, several methods exist to enter or update the reference station position (see Section Known coordinates of the reference station).

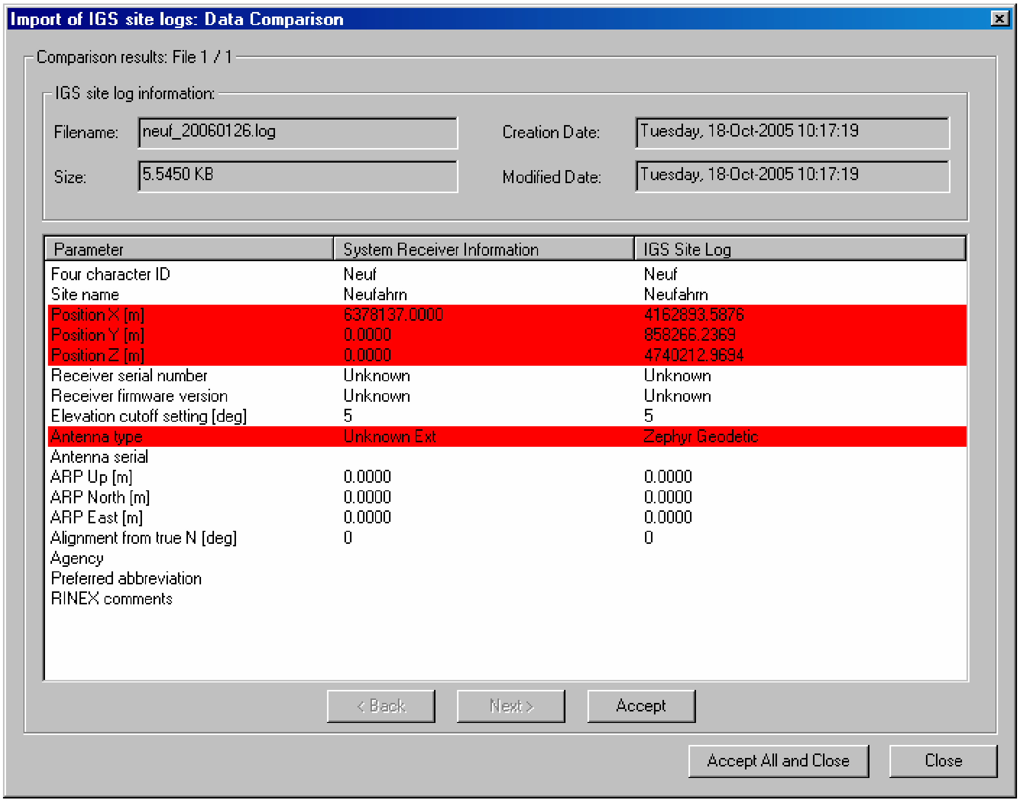
The IGS site logs are ASCII text files conforming the format specified by the IGS Central Bureau. For detailed information on the file format, refer to igscb.jpl.nasa.gov/igscb/station/general/blank.log. The site logs contain detailed information on site properties, such as position information, antenna information, meteorological information, and much more. After import of site log information, the Receiver modules store the information internally, even if it is used by other modules only. For example, if you add a RINEX Storage module later (see Chapter 7, RINEX Storage), the comment lines of the RINEX header can already automatically be filled in, if the respective information has been imported from the site log.

IGS site logs maintain the history of the site information. When importing data from such a file, GPSBase always respects the last available entry, thus ensuring that the most up-to-date settings are used.

Provide the location of the site log files, thus you do not have to select a file from a list. GPSBase recognizes the matching file from the 4 Character ID of the station as defined within the IGS site log. Files, for which no matching active connection is found, are dismissed from data import. During import, GPSBase compares its known station settings with those from the site logs, displays the differences and lets you discard the import of objectionable data.

Tip – Before starting the import of station data from IGS site logs, make sure that the respective reference station is already connected to the Receivers module ***and*** that its *Marker Name* is identical to the 4 Character ID within the site log file.

To start the import from IGS site logs, open the *Receivers* shortcut menu and select *IGS Site Logs / Import*. The standard *Browse for Folder* dialog lets you select the folder, where the site logs reside in. The default folder for the import of IGS site logs is <InstallDir> \ IGS \ Import. If you import files from another folder, this one becomes the default folder. The importer scans all existing files in the selected folder. With multiple files for the same station, it automatically selects the latest one. The *Import of IGS Site Logs: Data Comparison* dialog appears.



The dialog displays a table of comparison results for the reference station, if the *Marker Name* matches the 4 character ID within the site log. Accept updating the station with **Accept** or with **Accept All and Close**. **Close** closes the dialog without changes.

***Note**: Receiver modules or site logs where the system finds no match do not appear at the* Import of IGS Site Logs: Data Comparison *dialog.*

The *Import of IGS Site Logs: Data Comparison* dialog gives you some information on the current site log file (filename, size and creation / modification date) and lets you view the information on important parameters from both, the Receiver module and the site log. Rows with different values appear in red highlight. Accepting the site log updates all settings with differences. If the site log contains invalid values, such as an antenna type missing in the antenna.ini file, you cannot import the data for this station (the **Accept** button stays inactive).

Known coordinates of the reference station

There are several methods how to introduce the known coordinates of reference stations to GPSBase.

- You can, of course, manually edit the coordinates for each station. See Section Settings on the Receiver Data page.
- You can import positions (combined with other station data) from files in the IGS site log format. See Section Importing station data from IGS site logs.
- You can import the coordinates for all reference stations of your network from an ASCII position file. See Section Importing coordinates using a position file.
- If no known coordinates are available, you can use the single point position as reference coordinates. See Section Using the averaged single point position.

Importing coordinates using a position file

Tedious typing-in of Cartesian coordinates for reference station configuration and maintenance can easily be avoided: Use a position file in the ASCII text format, which contains the StationID and respective X, Y, Z coordinates, separated by spaces or tabs. Anything following a # character is a comment and is ignored.

For example

272 4191647.0092 899148.6687 4707396.7464 # York 5700cons. TRM41249 0.000

You can create position files using any text editor or by any software that outputs text in the required format. The Receivers module, for example, lets you output position files, if you use its shortcut menu command *Save Position*.

To update positions using a text file select the main menu command *File / Update Position* and open that file. GPSBase then updates the coordinates for all stations with the coordinates found here. Of course, other station information remains untouched.

Tip – The position update is done for all stations found in the text file that are known in any configuration made for GPSBase.

Using the averaged single point position

If known coordinates are not available, you can use the averaged position provided by the Single Point Position module. At the *Receiver Properties* dialog / *Receiver Data* tab select the *Set position later through "Single Point"* option. This adds to the Receiver module a Single Point Position module and uses its averaged positions as known coordinates for the reference station receiver.

A scheduled reference station

You may schedule your connection to the reference station receiver to be activated for data transfer only during pre-defined periods.

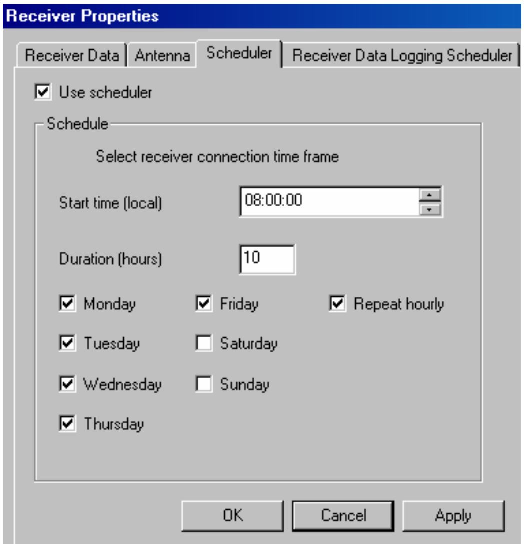
For a scheduled connection, configure the connection profile with one of the following settings:

- Select a Socket Client driver and select the *Use as Remote Connection* option.

- Select a TAPI Modem driver.

After you finished the connection and selected the receiver type, the *Scheduler* settings page will appear additionally to the *Receiver Data* and *Antenna* settings pages. Use it to select …

- A daily period (start time and duration),
- The days, for which this period applies,
- For a system using a remote data download decoder, the additional option *Repeat hourly* (selected) starts the scheduled download every hour within the defined time period.

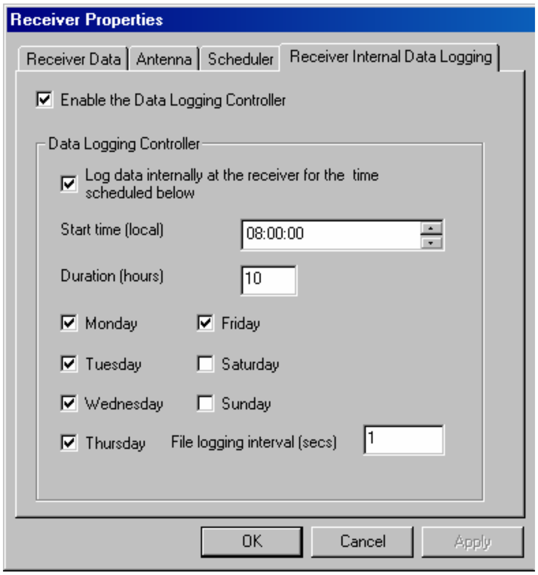


For a scheduled reference station, you may manually start and stop the connection using the *Start Connection* and *Stop Connection* commands from its shortcut menu, if the *Use scheduler* option is not selected.

During times that are excluded by the scheduler, the navigator icon for the receiver changes to , indicating that the receiver is sleeping.

Data logging

Trimble receivers can store observation data files to the internal memory. ***With an active connection***, you can configure this data logging in the Trimble receiver by an external command from the GPSBase control center using the *Receiver Properties / Receiver Internal Data Logging* dialog.



The *Enable the Data Logging Controller* option defines, whether the Receiver module controls the internal data logging at the receiver or not. If this option is not selected, the selections at the *Data Logging Controller* group are disabled. In this case, you can use the dialog to view the current settings at the receiver. If you select the *Enable the Data Logging Controller* option, the selections at the *Data Logging Controller* group immediately get active and will control the receiver settings, as soon as you accept the changes.

To switch on logging at the receiver, make sure the *Enable the Data Logging Controller* option is selected and then select the *Log data internally at the receiver…* option. Use the scheduler options at the *Data Logging Controller* group to define a logging time schedule: Select a time range (*Start time* and *Duration*) for each day and a number of days during the week. Edit the F*ile logging interval* field to define the epoch update rate [in seconds].

To switch off logging at the receiver, make sure the *Use scheduler to control internal receiver data logging* option is selected and then remove the selection from the *Log data internally at the receiver…* option.

Tip –For the setup process of the connections Trimble recommends to never select the *Enable the Data Logging Controller* option. Thereafter, if you wish to configure data logging from the control center, go to one of the active connections to this receiver, re-open the *Receiver Properties / Receiver Data Logging Scheduler* dialog, select the *Enable the Data Logging Controller* option, and then select, whether logging is to be switched on or off together with the time schedule, if applicable.

Remote data download

You can run GPSBase not only as a real-time system, where the receiver immediately sends the observation data, but also in post-processing mode. In post-processing mode receivers store the observation data internally, until the data is requested by the GPSBase Receiver module by a scheduled connection.

The combination of real-time and remote download decoders is not possible. You can run the system only in either of the modes.

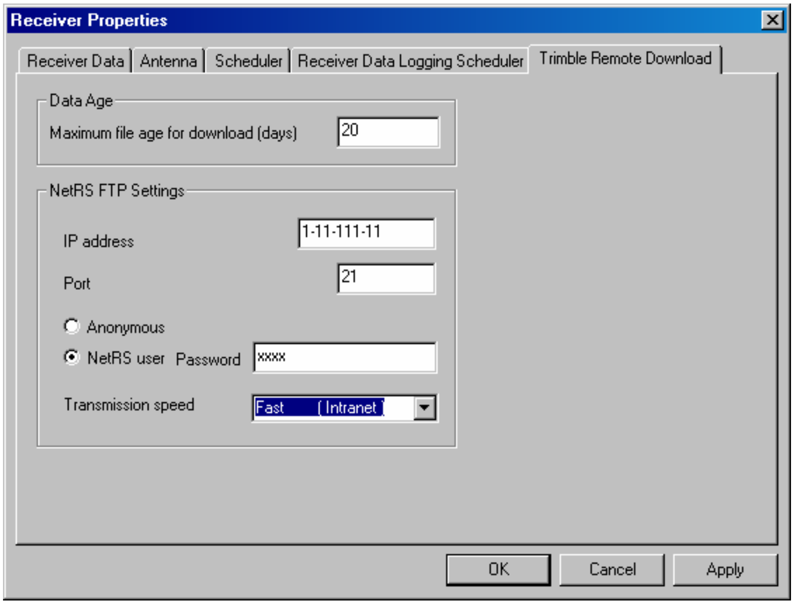
***Note** – During first configuration of a post-processing system the remote receiver must be available. A passive setup is not allowed.*

To start a GPSBase system in postprocessing mode, select the *Trimble remote download* decoder, when connecting the receiver to the system. The connection must be set up as a remote connection. After you have selected the connection, the connection wizard comes up with five settings pages:

- The default *Receiver Data* and *Antenna* pages.
- The *Scheduler* page to schedule the (daily) connection to the reference station receiver. In post-processing mode, the

additional option *Repeat hourly* is available. If it is selected, GPSBase starts the data request every hour within the defined period.

- The *Receiver Data Logging Scheduler* page that defines the amount of data that is written to the receiver's internal memory.



- The additional *Trimble Remote Download* page. Its *Data Age* group lets you define the maximum file age of data for download (in days). Files older than the age defined here are deleted from the receiver's internal memory.
  Trimble NetRS receivers are designed for data download using an FTP connection over the internet. Use the settings of the *NetRS FTP Settings* group to make the Trimble NetRS receiver's IP address and FTP port known to the system. If the receiver is set up in a way that it requires a password for remote control, select the *NetRS user* option and edit the *Password* field. If no password is required, you can keep the default selection *Anonymous*. Depending on the network connection to the receiver select a transmission speed (fast,

medium or slow, see Table 6.1) in the *Transmission Speed* field.

Table 6.1 Transmission speed

Speed	Network type	Approximate transmission time per 1 hour data file
Fast	Intranet	2 minutes
Medium	DSL	5 minutes
Slow	ISDN	10 minutes

The further system configuration is identical for both processing modes.

Satellite settings

The *En/Disable Satellites* dialog appears, when you select *Properties Satellites* from the shortcut menu of a Receiver module. Depending on the receiver type, you may edit the satellite settings for GPS or GLONASS satellites or both. For each satellite system, the respective *<Satellite System> Sats* page lets you disable single satellites either for real-time only, or for real-time and postprocessing by ***repeatedly*** selecting the respective check box. To disable all or none of the satellites use the **Disable All** / **RT Disable All** / **Disable None** buttons. By default, no satellite is disabled. For more detailed information on satellite selection, see Chapter 5, Section Satellite Selection.

Input of meteorological and tilt data

Some types of receivers, such as the Trimble R7 or Trimble 5700 receivers are capable of requesting data, such as meteorological data or tilt measurements, from multiple external instruments and to pass the data through to the GPSBase system. An active connection to the receiver is necessary.

The sensors and the receivers need to be capable of supporting the "daisy chaining" of multiple instruments on a single serial port. This feature is most often used to support data collection using both meteorological and tilt sensor devices on a single RS232 port. Daisy chaining may be accomplished using custom cabling where the "transmit data" (TXD) RS232 line from one instrument is connected to the "receive data" (RXD) RS232 line of the next instrument. The receiver sends a command to the first instrument in the chain. Each device responds to a specific address. If the command is addressed to the instrument, it sends a measurement response to the next device in the chain. Otherwise, the command is transmitted without modification, and the next device has an opportunity to process it. The receiver receives and logs the response from the last instrument in the chain.

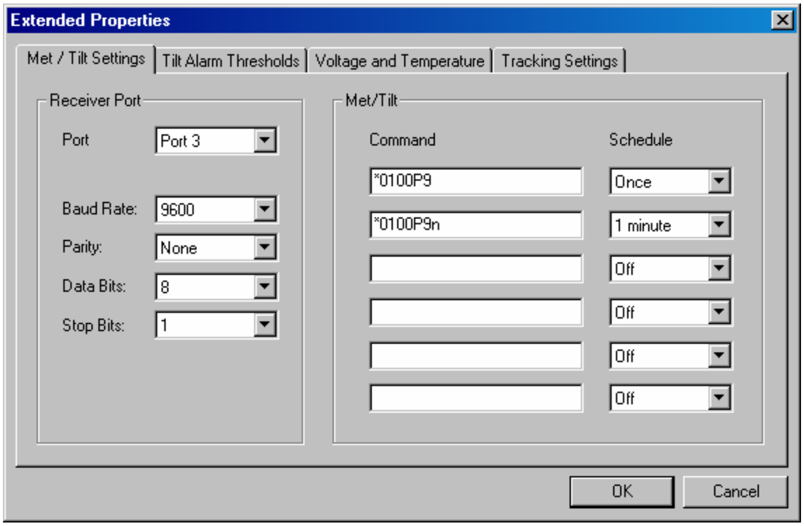
***Note –** Find a list of the currently available decoders for weather station data in Appendix A. You may also add a weather station directly to the system, whose data don’t loop through a receiver. For detailed information, see the Weather Station Module section of this chapter.*

Met and tilt settings

To define the communication settings for external sensors select the *Extended Properties* command from the Receiver module’s shortcut menu. The *Extended Properties* dialog appears.

The *Met / Tilt Settings* tab contains the parameters and commands to be used for the communication with the sensors. Use the *Receiver Port* group to select the serial port of the receiver the sensor is connected to and to set the port parameters, such as the transmission baud rate, parity, data bits and stop bit.

The *Met/Tilt* group lets you set the command strings to be sent to the sensor. For information on initial and repeat strings refer to the operating manuals of the sensors. Enter the strings in the *Command* field and schedule the repeat time in the *Schedule* selection field next to the respective string. For scheduling an initial string and for testing the connection select the scheduling option *Once*. You can define multiple command strings in a single edit field, if they are repeated with the same update rate.



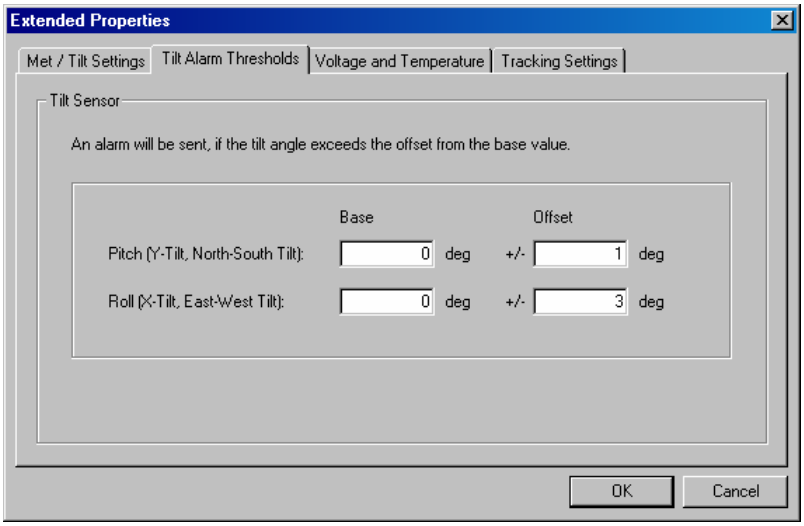
Tilt alarm settings

You can configure the Receiver module in combination with the Alarm module to issue alarms, if the external sensor detects offsets from given values. The Alarm module lets you select the following alarm condition for the Receiver module:

- Tilt angle exceeds threshold

Set the limits for the alarm conditions in the *Tilt Alarm Threshold* dialog. For detailed information on the Alarm module see Chapter 9, System Monitoring and Control.

For tilt sensors, you can define two threshold values. If the tilt angle exceeds either of them, an alarm will be sent. For a known tilt of the sensor, you can predefine a base angle for tilts in Y and X axis (pitch and roll) in the *Base* edit fields (default: 0°). Edit the values for the maximum allowed offsets from that base value in the *Offset* fields. Alarms are only sent, if the tilt exceeds the addition of the values in the *Base* and in the *Offset* field for either the pitch (default: 1°) or the roll angle (default: 3°).

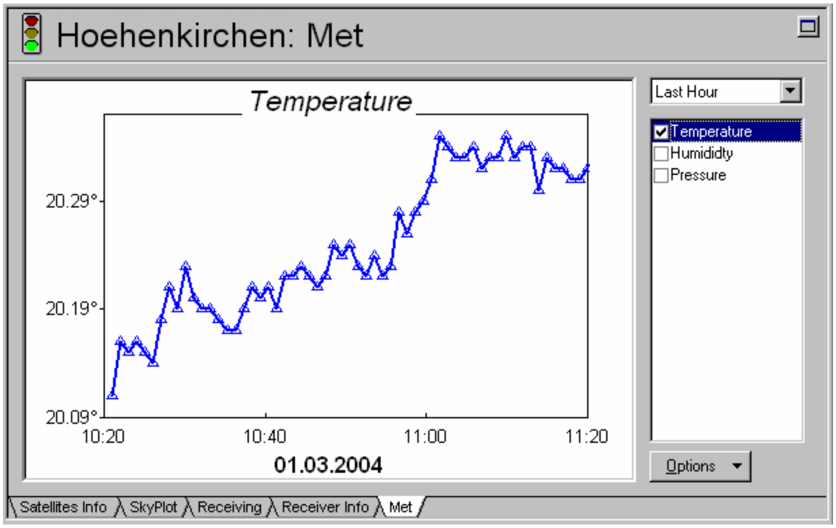


Display and storage of sensor data

If the decoder is able to decode the response string for meteorological data from sensors in chain, the Receiver module information pane adds a view for this data. The *Met* tab graphically displays the temperature, pressure and humidity values. It displays the values for the last hour and 24 hours, depending on your time range selection. Select the parameter to be displayed using the selection bar at the right side of the graph. For a detailed general description of graphs, see Chapter 3, The Main GPSBase Window.

Tip – The responses from the sensors received by the Receiver module are displayed in text style in the *Receiving* tab of the information pane. With a DAT Storage module added to the Receiver module, the response string is saved in text style in the DAT file.

If a RINEX Storage module is appended to the Receiver module, it creates additional RINEX MET files from the decoded response strings.



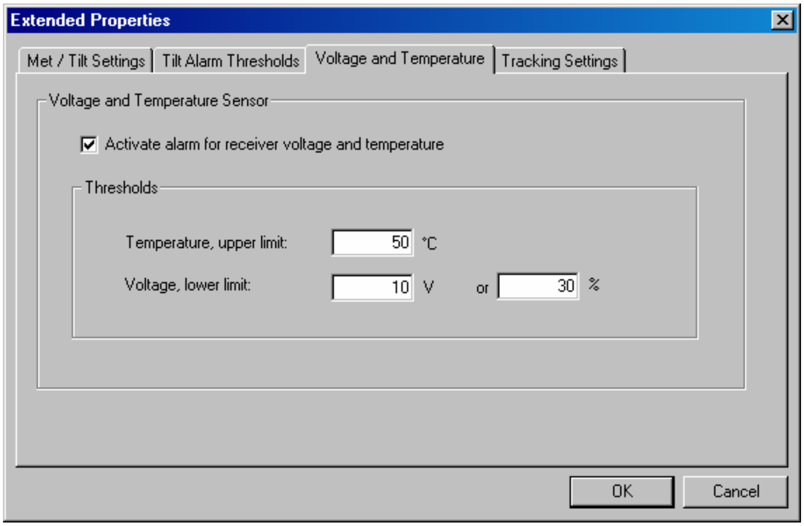
Receiver voltage and temperature

Modern Trimble reference station receivers, such as the 5700, R7 and NetRS receivers, actively connected to the control center can transmit information on their temperature and voltage status. GPSBase requests the voltage and temperature status every five minutes. The voltage status is given for external power supply as well as for internal batteries in volt and/or in percentages. To view the voltage and temperature status of a single receiver, use the *Receiver Info* tab in the receiver's information view (see Section Information pages for Receiver modules). The information is also available at the *Voltage and Temperature Info* tab in the Receivers module's information view. See Chapter 5, Section The Receivers information pane.

You can configure the Receiver module in combination with the Alarm module to issue alarms, if the internal Trimble receiver sensors detect offsets from given values. The Alarm module lets you select the following alarm conditions for the Receiver module:

- High temperature in the receiver
- Receiver running on low voltage

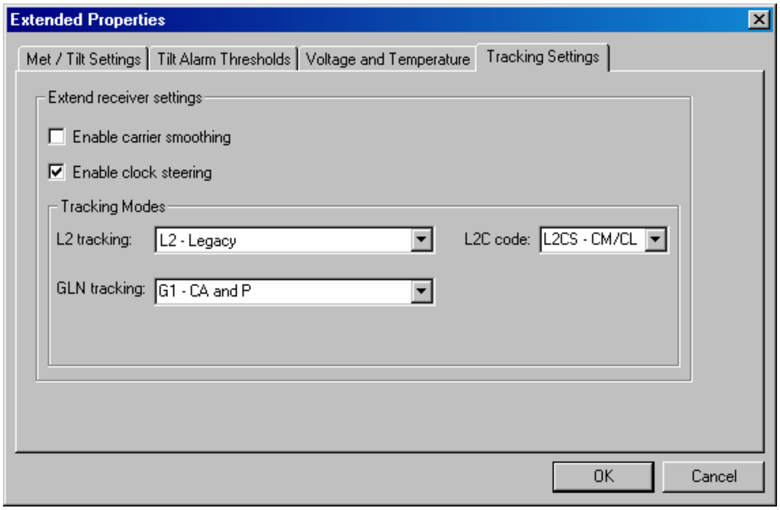
To set the limits for the alarm conditions select the *Extended Properties* command from the Receiver module's shortcut menu. The *Extended Properties* dialog appears. Select the *Voltage and Temperature* tab. For detailed information on the Alarm module see Chapter 9, System Monitoring and Control.



By default, alarming for physical receiver properties is not activated. To activate alarming, check the *Activate alarm…* checkbox. Use the *Temperature, upper limit* edit field to define the threshold value for high receiver temperature. Default: 50 °C. To set the alarm thresholds for low receiver voltage, edit the values for the minimum allowed voltage in absolute and relative numbers (in volt and percentage) in the *Voltage, lower limit* edit fields. Default values are 10 V and 30 %. If the receiver's temperature or voltage exceeds any of the values, an alarm is issued.

Tracking settings

The newer Trimble reference station receivers provide many advanced settings for internal receiver configuration, such as carrier phase smoothing of the raw observation data (starting with the 5700 receiver) or the observation of the new civil signal on the L2 carrier phase, L2C (R7 and later). ***With active connections***, you can configure these settings in the Trimble receiver by external commands from the GPSBase control center. To do so, select the *Extended Properties* command from the Receiver module's shortcut menu. The *Extended Properties* dialog appears. Select the *Tracking Settings* tab.



To enable carrier smoothing at the receiver, select the *Enable carrier smoothing* checkbox (default: not selected).

As the internal time at the receiver is not perfectly stable with respect to the GPS time standard, this drifting effect will cause receiver time and GPS time to slowly diverge. Trimble receivers such as the NetRS and later can compensate for this drift by periodically re-synchronizing the receiver time with GPS time using the estimated receiver clock offset. This periodic resynchronization is referred to as clock steering. To enable clock steering, make sure the *Enable Clock Steering* checkbox is selected (default).

Use the *Tracking Modes* group to select the settings for the codes on the L2 frequency and, if applicable, for the GLONASS G1 frequency. For available L2 tracking modes see Table 6.2.

***Note**: For Trimble receivers not supporting one or several of these tracking modes, these are not displayed for selection.*

Table 6.2 L2 tracking modes

Tracking mode	Description
L2 – Legacy	Uses C/A and P code on L2.
L2 – CS with Legacy fallback	Uses the civil signal L2C, which consists of some combination of L2 CM, L2 CL, and data. If the L2C is not available, the receiver falls back to the Legacy tracking mode.
L2 – CS and Legacy	Uses both L2C and Legacy.

The *L2C code* selection applies for the civil signal on L2: With *L2CS – CM/CL*, the default selection, the receiver tracks both the Moderate length code (CM) and the Long length code (CL); to track only the Long length code, select *L2CS – CL*.

Use the *GLN tracking* drop-down list for selecting which code to track for GLONASS or if to track GLONASS not at all (*Disable*). To only track the CA code on the first GLONASS frequency, select *G1 – CA*, to track both CA and P keep the default selection *G1 – CA and P*. If GLONASS tracking is not disabled, the second GLONASS frequency is tracked anyway.

Receiver control using a web browser

The Trimble NetRS receivers are designed for remote control of their functions using any Internet browser. To activate direct control from inside GPSBase, right-click the NetRS Receiver module name in the navigator and select the *Direct Receiver Control* command. This action opens your default Internet browser with the receiver’s homepage. For detailed information refer to your receiver’s manual.

Information pages for Receiver modules

For the Receiver, four standard information pages exist. You may select them by clicking on the tab at the bottom of the information pane. If the WAAS option has been activated, a further information page will show up. If weather data are derived from sensors in chain, the additional *Met* info page is available, see Section Input of meteorological and tilt data.

A traffic light in the upper left corner indicates the general tracking status:

- Green: Tracking
- Red: Not tracking

Information page Satellites Info

The *Satellites Info* information page displays the tracked satellite data for the current epoch. On top, it displays the full receiver name. The tracked satellite information is given in the format as listed in Table 6.3.

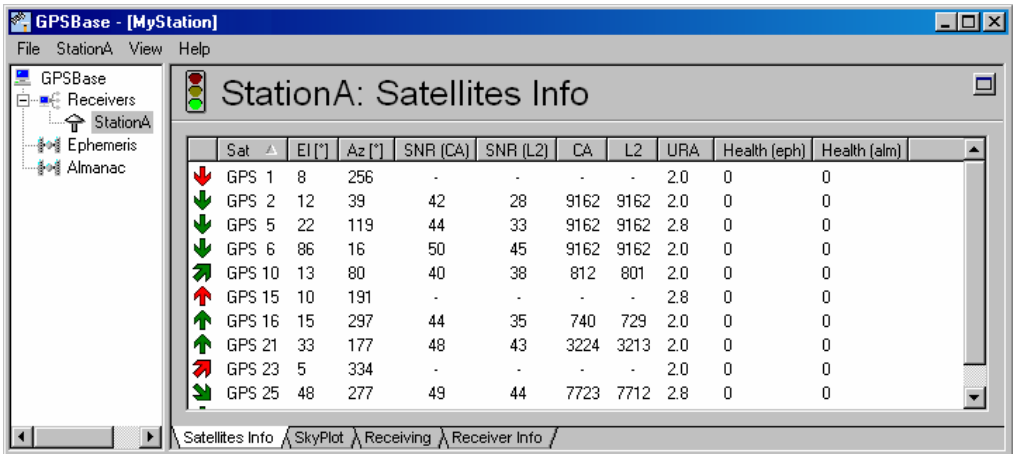
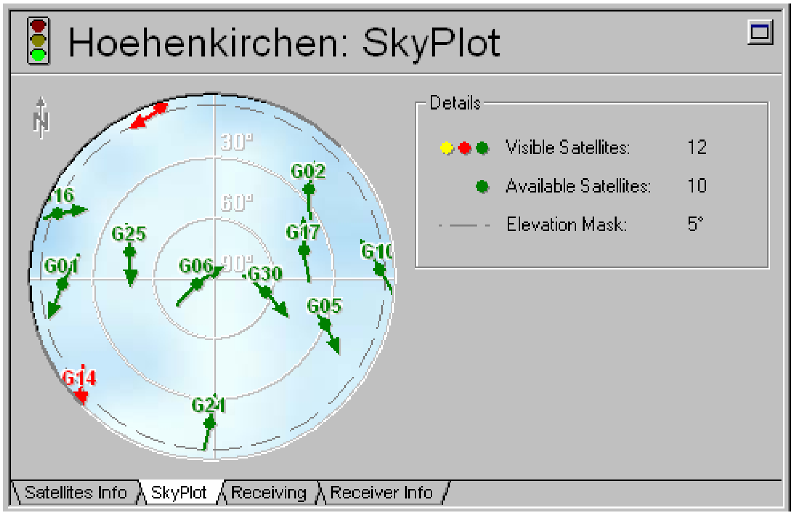


Table 6.3 Satellite information from the Receiver information page Satellites Info

Column header	Arrow is..	Specification
Sat		Satellite system (GLN or GPS) and PRN number; graphical satellite status in form of colored arrows:
	Green	Satellite is healthy
	Yellow	Broadcast ephemeris too old or not available; almanac not available
	Red	Unhealthy; below cutoff
		Fast ascending satellite (> 3° / 10 min)
		Slowly ascending satellite (< 3° / 10 min)
		Not tracking
		Slowly descending satellite (< 3° / 10 min)
		Fast descending satellite (> 3° / 10 min)
El		Satellite elevation in degrees
Az		Satellite azimuth in degrees
SNR (CA) SNR (P1) SNR (CA/P1)		Signal-to-noise ratio on L1, either in CA code or P code or both [dB/Hz]
SNR (L2) SNR (L2C)		Signal-to-noise ratio on L2, either legacy or civil code [dB/Hz]
CA		Tracking counter without LLI (CA) if tracked, but unhealthy: value = *0*
L1		Tracking counter without LLI (L1) if tracked, but unhealthy: value = *0*
L2		Tracking counter without LLI (L2) if tracked, but unhealthy: value = *0*
URA		URA
Health (eph)		Health status value according to ephemeris
Health (alm)		Health status value according to almanac

Information page Sky Plot

The polar sky plot shows the locations of visible and available satellites. The satellite visibility (azimuth and elevation) is computed from the almanac information provided by the Almanac module.



The plot is North-orientated: the upward vertical axis points to North. Center of the circles is the zenith (elevation angle 90°) and the outer circle shows elevation 0° (i.e., the horizon). The dashed line indicates the current elevation mask setting, whose numerical value is given in the *Details* group.

The tracks of all selected visible satellites are projected onto this map. The dot in the center of the track indicates the current satellite location. The traffic light colors indicate the satellite availability in the same way as the arrow icons do in the *Satellites Info* information pane.

Arrows through the satellites indicate their movement for the last and the following half an hour. For unhealthy satellites (yellow, red) or where ephemeris is not available movements cannot be displayed.

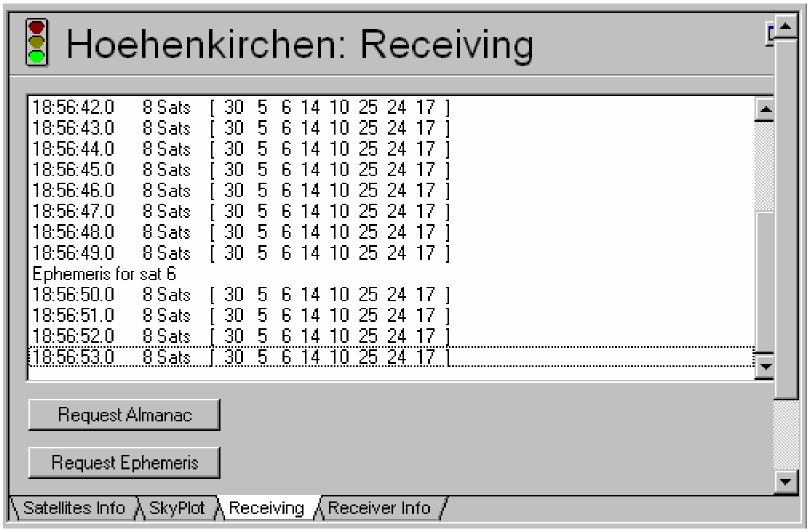
The *Details* group summarizes the number of all visible and available satellites as well as the current elevation cutoff.

Information page Receiving

The *Receiving* page displays the following for each tracked epoch:

- The time
- The number of satellites tracked
- The PRN numbers of the tracked satellites in brackets
- Received ephemeris
- Received almanac
- Received data from external sensors, such as weather or tilt data

With a bi-directional connection, you may also manually request a new almanac and updated ephemeris for all satellites using the **Request Almanac** or **Request Ephemeris** buttons.

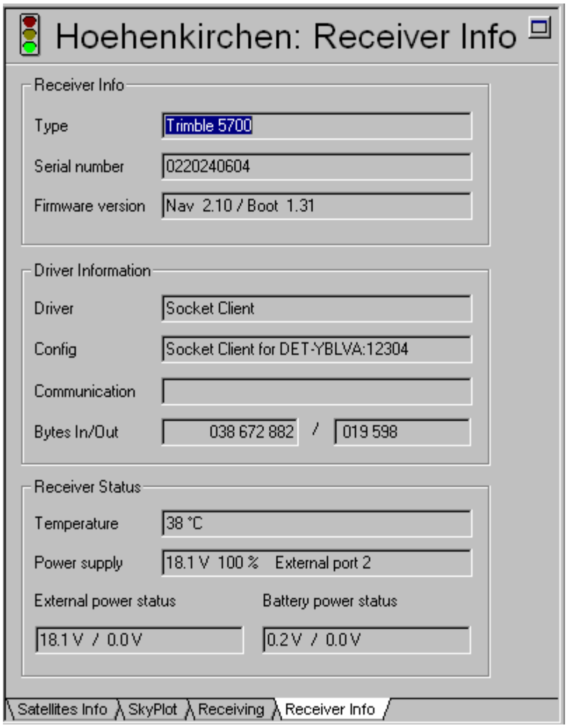


Information page Receiver Info

With a bi-directional connection, the *Receiver Info* group of the *Receiver Info* page gives information on the receiver connected to the current port:

- Receiver Type
- Serial number
- Firmware Version

In passive mode, the entry for the receiver type is derived from the decoder; all other entries of the *Receiver Info* group are *UNKNOWN*.

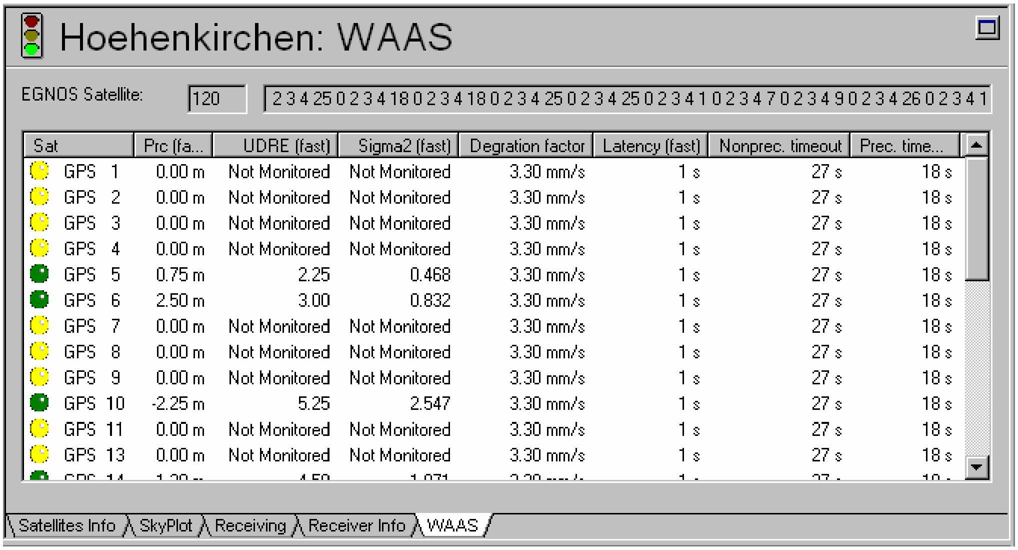


For information on the connection (driver and connection settings) and the connection status, see the *Driver Information* group. The *Communication* field displays current status information. For the time the connection is running, the *Bytes In / Out* fields accumulate the received (in) or transferred (out) bytes.

The *Receiver Status* group gives you full information on the physical status of a Trimble reference station receiver. *Temperature* displays the current temperature in the receiver. A summary of the current status of the power supply in use, including the voltage in absolute numbers, its percentage of the maximum possible voltage of the respective power supply, and the current power source (external port number or internal battery slot), follows in the *Power supply* field. The fields below indicate the absolute voltage for all available external ports for power supply (*External power status*) and batteries in internal slots (*Battery power status*). In passive mode all entries are marked by “- -“. For information on how an alarm can be issued in case thresholds are exceeded, see Section Receiver voltage and temperature.

WAAS information pane

If you have activated WAAS augmentation, the Receiver module will offer an additional information page, the *WAAS* pane.



Sat	Prc (fa...	UDRE (fast)	Sigma2 (fast)	Degration factor	Latency (fast)	Nonprec. timeout	Prec. time...
GPS 1	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 2	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 3	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 4	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 5	0.75 m	2.25	0.468	3.30 mm/s	1 s	27 s	18 s
GPS 6	2.50 m	3.00	0.832	3.30 mm/s	1 s	27 s	18 s
GPS 7	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 8	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 9	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 10	-2.25 m	5.25	2.547	3.30 mm/s	1 s	27 s	18 s
GPS 11	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s
GPS 13	0.00 m	Not Monitored	Not Monitored	3.30 mm/s	1 s	27 s	18 s

The *WAAS* page displays information in two areas: above, it displays the name of the information service and the identification number of the current INMARSAT satellite. For example: In Europe, it is the European Geostationary Navigation Overlay Service (EGNOS), which is broadcast by the satellite 120 (INMARSAT AOR-E).

Next to the satellite ID, a field continuously displays the message types that are currently received by the receiver. The message type 0 indicates that the following messages can only be used for testing. Currently, GPSBase supports the message types as listed in Table 6.4.

Table 6.4 Supported WAAS message types

Type	Contents
0	Do not use this WAAS signal for anything (for WAAS testing)
1	PRN Mask assignments, set up to 51 of 210 bits
2 to 5	Fast corrections (Prc, UDRE, σ^2_{UDRE})
6	Integrity information
7	Fast correction degradation factor
24	Mixed fast corrections / long term satellite error corrections
25	Long term satellite error corrections

The list displays for each satellite the current integrity data and wide area corrections (see Table 6.5).

Redundant communication link

To make sure that the communication with your reference station receiver is working, even after a breakdown of the primary communication link (for example, if the public communication network is down, or if a modem fails to work properly), you can set up your Receiver module for the use of a second hardware or software connection. Typically, you will select a dial-in mode connection as secondary line. GPSBase activates the second line automatically after a pre-defined timeout. When the primary line is again working correctly, an automated procedure makes sure that this primary line is reactivated.

Table 6.5 WAAS integrity data and wide area corrections

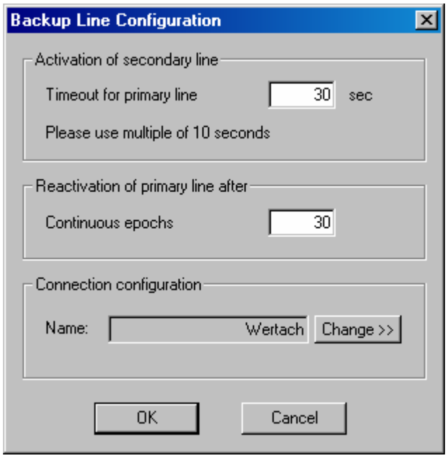
Column header	Specification
Sat	Satellite PRN
Prc (fast)	Fast corrections [meter]
UDRE (fast)	User Differential Range Error [meter]
Sigma2 (fast)	The parameter σ^2_{UDRE} is the variance of a zero-mean Normal distribution, which overbounds the user differential range errors, which are due to fast corrections and long term clock and ephemeris corrections, given the current performance of the system. [meter^2]
Degradation factor	The degradation of accuracy is modeled to account for the possibility that any messages are missed by the user
Latency (fast)	Difference between WAAS time signal and current time [seconds]
Nonprec. Timeout	Time-out interval for non-precision approach [seconds]
Prec. Timeout	Time-out interval for precision approach [seconds]

Adding and removing the backup functionality for a receiver

To make the second line known to GPSBase or to change settings for the backup, right-click the Receiver module in the navigator and select the shortcut menu command *Redundant Communication*. Select *Prepare Backup Line*. The Connection Wizard allows you to (add and) select a connection configuration that defines the secondary line.

Tip – For backup lines, Trimble recommends remote connections with dial-in function, such as a modem or a socket connection used as remote connection.

After you have finished the configuration the *Backup Line Configuration* dialog appears.



Use *Timeout for primary line* of the *Backup Line Configuration* dialog to define how long the backup line waits until it starts up after the primary line stopped transmitting data. Multiples of 10 seconds are allowed for editing. Default: 30 seconds. The settings of the *Re-activation of primary line* group define when the primary line will be reactivated, after the system has recognized that the line is available again. Set a minimum number of epochs that the Receiver module must continuously receive from the primary line before it reactivates that line automatically. The default value is 30 epochs.

The *Name* field in the *Connection configuration* group displays the selected connection configuration. To change the connection settings click **Change**. The Connection Wizard appears and allows you to select another connection.

To manually stop using the redundant line right-click the Receiver module in the navigator and select the shortcut menu command *Redundant Communication*. Select *Disable Backup Line*.

Manually starting and stopping the secondary line

If you want to start the data transmission using the secondary line (for example, to test that line), right-click the Receiver module in the navigator and select the shortcut menu command *Redundant Communication*. Select *Start Backup Line*. After a secondary line has started (either forced by timeout of the primary line or by a manual start), stop the data transmission by the secondary line and return to the primary communication link. To do so, select the Receiver module's shortcut menu command *Redundant Communication/Stop Backup Line*.

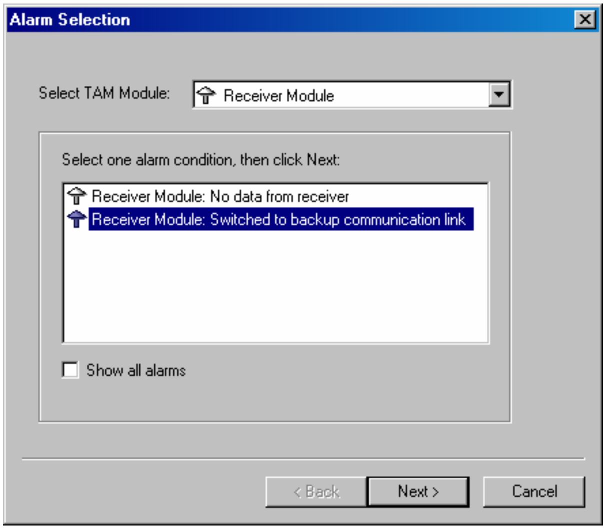
Actions of the backup functionality

If the primary connection stops to continuously transmit data, the backup function waits for the time defined in the *Timeout* setting. Then the Receiver module uses the secondary connection.

At the navigator, the icon of the Receiver module icon visually displays the use of the backup line:  indicates that the primary line has been disconnected (red) and the secondary line is working (green). The information view pages *Receiver Info* (for the Receiver module) and *Port Info* (for the Receivers module), always display the actually used configuration, either the primary one or the backup line.

Tip — A Receiver module continues using its second communication link until the primary line continuously restarts sending data for a pre-defined number of epochs or until you stop it using its shortcut menu command *Stop Backup Line*.

If an alarm has been set for the case that the receiver switches to the backup communication line, then also the Alarm module reacts and issues the specified alarm (see Chapter 9, Section Alarm System).



Weather Station Module

The Weather Station module graphically displays the data received by the connected weather station.

The Weather Station module is added to the Receivers module using its *Connect* options. For general information on the connection of modules to the system, see Chapter 5, Communication Control. For the specific connection to the weather station, mind the following:

- From the *Connection Wizard*, select one of the Weather Station decoders. Currently, you can select from the following decoders:
  - *Weather Station (NMEA output format)*.
  - *Weather Station Vaisala HMP 243*.

- For the *Weather Station (NMEA output format)* decoder, note the following:
  - The decoder can be used for the communication with different weather station brands and models (see Appendix A) with standard settings.
  - The decoder sends the following P9 command to the weather station: *0100P9<cr><lf>
  - As answer from the weather station the decoder expects an NMEA string like the following: $PASHS,XDR,P,<Pressure Value>,B,<SN>,C,<Temperature value>,C,<SN>,H,<Humidity value>,P,<SN><CR><LF>
  - The decoder expects and can identify the following units:
For pressure P: B, meaning bar
For temperature C: C, meaning Celsius
For humidity H: P, meaning percent
  - <SN> is the Transducer Serial Number (typically in the format DQ#####)
- Add a new connection. The connection name represents the Weather Station module. After the connection is finished, it will show up in the navigator below the Receivers module.
- If the weather station is connected using a serial cable, select the *Serial Port Handler* for the driver DLL. Select a COM port and the connection parameters, click **OK.**
- Alternatively, you can use the Socket Server or Socket Client driver DLLs, depending on your hardware setup.
- Edit the settings for the new module. For a description of the settings see the next paragraphs. For a Vaisala weather station only: If your system has a separate barometer sensor, use the *Barometer Selection* dialog to define the second connection.
- Click **Finish**.

Weather Station properties

When connecting a Weather Station module to GPSBase define the instrument properties in form of a settings wizard. You may change the properties at any time, when you select the shortcut-menu command *Properties* of a Weather Station module. Then, the *Weather Station* dialog appears. Use it to view and edit the properties of the module.

Settings are collected on the following tabs:

- *Station Data*
- *Barometer Selection* (only with a Vaisala weather station).

Use the *Station Data* dialog to edit the *Station Name* and to define an *Update Rate* for the data collection.

With the Vaisala decoder selected, the additional *Barometer Selection* settings dialog is available. It applies, if your Vaisala meteorological station consists of two separate instruments. The main connection is reserved for the temperature and humidity sensors, while the barometer needs a second connection. In this case, select the *Add Barometer Vaisala PTB220* option. (If the option is not selected, the barometrical data does not contribute to the system, even if a connection to the barometer is known.)

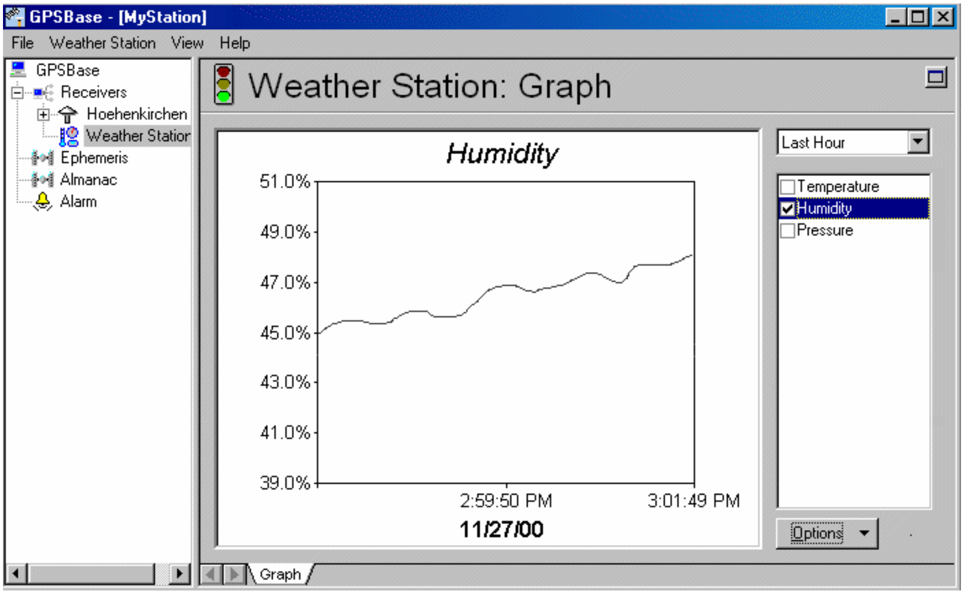
Click **Change** to make the connection to the barometer known to the system or to change a known connection. The driver selection dialog appears offering only the following two selections:

- Serial Port Handler
- Socket Client

Select the matching driver and finish the connection as described in Chapter 5, Section Driver Selection. Then, the connection name shows up in the *Barometer Selection* dialog.

Weather Station information pane

For the Weather Station module, there is the *Graph* information page. It graphically displays the meteorological parameters (temperature, pressure or humidity values) either for the last day or for the last hour, depending on your time range selection. Select the parameter to be displayed using the selection bar at the right side of the graph. For a detailed general description of graphs, see Chapter 3, The Main GPSBase Window.



CHAPTER

7

Data Storage

In this chapter:

- Introduction
- Storing Receiver Data to Hard Disk
- RINEX Storage
- Compact RINEX
- DAT Storage
- Raw Data Storage
- Compressing Data Files
- Storage Integrity
- File Rollover Command

Introduction

To analyze or post-process the system GNSS data it is necessary to store the receiver's data. This chapter describes all Data Storage modules and compression / integrity tools supported by GPSBase.

Storing Receiver Data to Hard Disk

GPSBase comes with a huge selection of modules for reliably collecting and storing files for post-processing. You can add one or more data storage modules to each Receiver module, Raw Data Analysis module, Weather Station module. Set the mouse focus onto the respective module and right-click to access its shortcut menu. Select *Insert Modules* to open the module selector dialog.

Depending on the root module, you can select from the following storage modules:

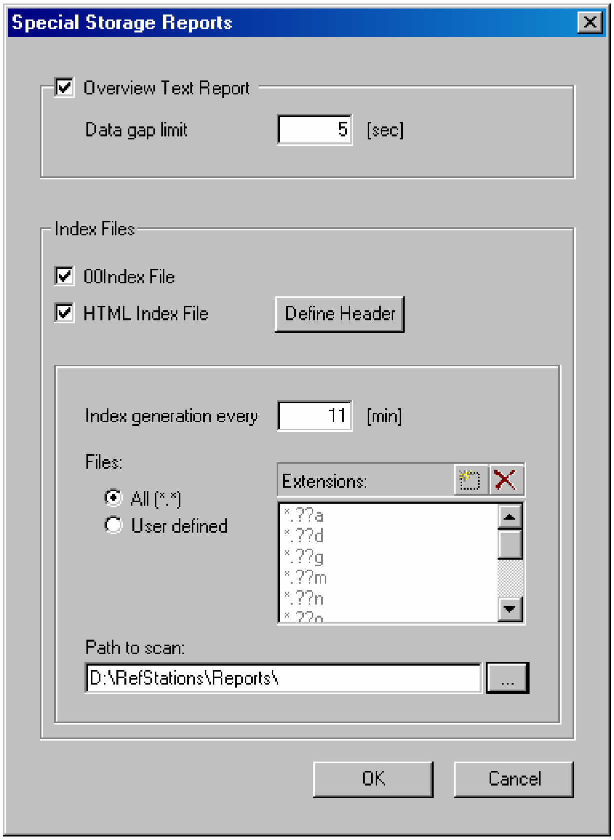
- RINEX storage
- Compact RINEX storage
- DAT file storage (Trimble Navigation data format)
- Raw data storage (receiver type specific binary data)

Each of these can be configured to write to a local hard disk or onto a network drive. Note that you can also start as many modules of the same type as you like (for example, to write one second RINEX files to a local hard disk and to concurrently write 15 seconds RINEX files to any other path for the same reference station).

Reports on stored data

Some data storage modules additionally write log protocols into reports. If you have activated reporting for data storage (see Chapter 3, Section Reporting), then by default two types of reports are generated in XML format, the <data type> Report and the <data type> Summary report. See Appendix G, Section Data Storage Reports. Additional reports are available on demand.

To start reporting, select the main menu command *File / Reporting* to open the *Reporting* dialog. From the *Reporting Selection* tab, select the *Storage Reports* check box. The *Special Storage Reports* dialog appears at once. If, however, storage reports are already selected, you may view and edit the *Special Storage Reports* dialog at any time using the adjacent **Details** button.



The *Special Storage Reports* dialog lets you select one or several of the following files to be created additionally to the standard reports.

- Overview Text Reports: With the RINEX and DAT data writers, these summary report files in text format list the available data. For each data type, one daily file is written and stored in the ***reports*** folder, whose file name obeys to the format YYMMDDFFF.txt, where YY stands for the year, MM for the month, DD for the day of month, and FFF stands for the data type.

For example: 041011rnx.txt is the Overview Text Report for RINEX data created October, 11th, 2004. The content of the text file is similar to that of the standard Data Storage Summary report. Each storage module of a type (such as the RINEX Storage module or the DAT Storage module) generates for each tracking interval one line of text. If data gaps occur that are greater than the defined limit, a new line is written. To change this limit, edit the *Data gap limit* edit field. Default value: 5 seconds.

The following is an example of valid text lines in the Overview Text Report, where the RINEX Storage module is reporting that station 0257 has several data gaps of less than 5 seconds in its first time segment and a data gap from 05:45:13 to 05:49:16.

```
0257;RINEX;01.0;3600;D:/Reports/;1;2004/08/26;00:00:00; 05:45:12;20698
0257;RINEX;01.0;3600;D:/Reports/;1;2004/08/26;05:49:17; 23:59:59;61843 (FTP:3000)
```

Each text line contains the Station ID, observation type, interval, and sample rate, followed by the path and a marker, whether the enhanced file structure is selected (1= yes, 0= no). Finally we see the date, start time and end time, and the number of available epochs. If some of the data is downloaded using FTP, because the Storage Integrity module has detected missing data, this is indicated in brackets (FTP, followed by the number of epochs expected for the selected time range and update rate).

- 00Index text files: Text files created in each ***data*** folder listing the available files in the respective data folder. One text file will be written for each day in the same folder structure as the data.
- HTML Index files: HTML files created in each ***data*** folder listing the available files in the respective data folder. One HTML file will be written for each day in the same folder

structure as the data. For this file type, you can edit up to five lines as header of the HTML file if you click **Define Header** and edit the *HTML Index Header* dialog.

For index files of both file formats you can define the log interval (edit the *Index generation every x min* edit field, default: 11 min), the types of files to be respected for the index (see next paragraphs) and the path to the folder to be scanned for the index.

The *Files* selection gives you the following choices for the types of files to be respected for the index:

- All (*.*): All files of the folders will be used.
- User defined: You may enter a selection of file extensions. Only files with that extension will be considered: By default, the list contains the files of the type which are created by GPSBase (i.e. .??a,. .??d, .??g, .??m, .??n, .??o, .dat, .org, .zip).

You may modify this list to fit your needs: To delete a file type from the list, highlight the respective extension and click the little cross shaped **Delete** button. To add a file type to that list, click the rectangle-shaped **Add** button and then enter the file type into the displayed edit field.

RINEX Storage

The RINEX Storage module allows you to archive the data received by the connected receiver into data files following the RINEX 2.10 convention. For detailed information on the RINEX convention refer to the following web site of the US National Geodetic Survey:

www.ngs.noaa.gov/CORS/Rinex2.html

When the RINEX Storage module is first being added to GPSBase a configuration wizard forces you to set its properties. For more information on the settings, see the section RINEX Storage settings.

Further modules are available if you select *Insert Module* from the module’s shortcut menu:

- Compress (see Section Compressing Data Files)
- Compact RINEX (see Section Compact RINEX)
- Storage Integrity (see Section Storage Integrity)
- File Rollover (see Section File Rollover Command)

You may remove the module from GPSBase any time you want: Open its shortcut menu and select *Remove Module*.

RINEX Storage settings

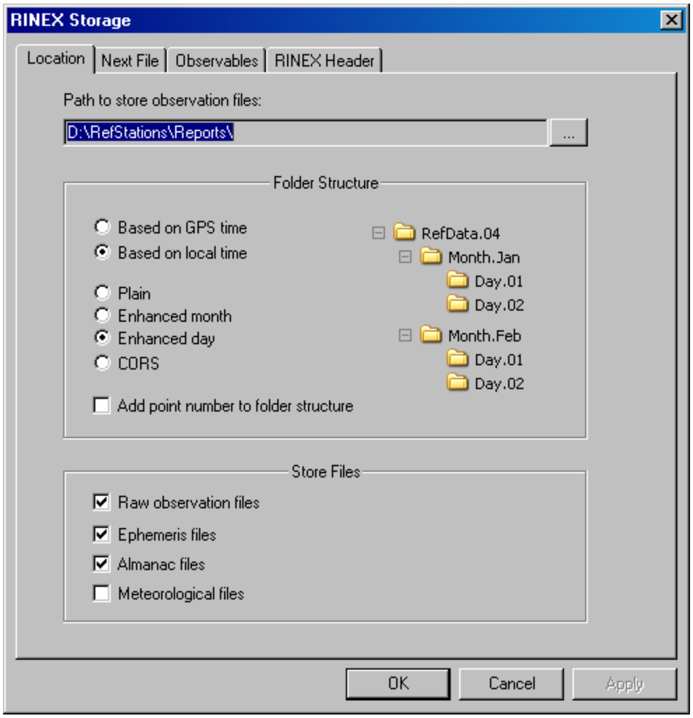
When you set up a RINEX Storage module, a configuration wizard forces you to define the module settings. Later, you may view or edit the settings at any time by selecting the *Properties* command from its shortcut menu. This action opens the *RINEX Storage Settings* dialog with the following pages.

- *Location*
- *Next File*
- *Observables*
- *RINEX Header*

Settings of the Location dialog

The *Location* dialog lets you view and define the target path and folder for the file storage. Use the radio buttons to select the folder structure.

Select the destination using the browse button next to the top field. From the *Browse For Folder* dialog, you can select from existing folders or create a new one: Click **Make New Folder**.



The first two options of the *Folder Structure* group refer to the time system that is used for file naming and for the folder structure, if you have selected an enhanced file structure (see Table 7.1). Both, the automatically created file names and the file contents refer to the tracking date and time. If you select *Based on GPS time*, the file names and their contents are based on GPS time. With an enhanced folder structure, the files are located in folders whose structure depends on GPS time. Accordingly, with *Based on Local time* selected, the local time is used for file naming and folder structure.

For example: With *Based on GPS time* selected, the first session of a new day starts at 00:00:00 GPS time. If your local time is GPS + 3h (the UTC to GPS time offset is not respected), the first session in local time starts at 03:00:00 with respect to GPS time.

Select the type of folder structure for file storage from the next group of options in the *Folder Structure* group. For detailed information on the options see Table 7.1.

Table 7.1 Path structure depending on the time system

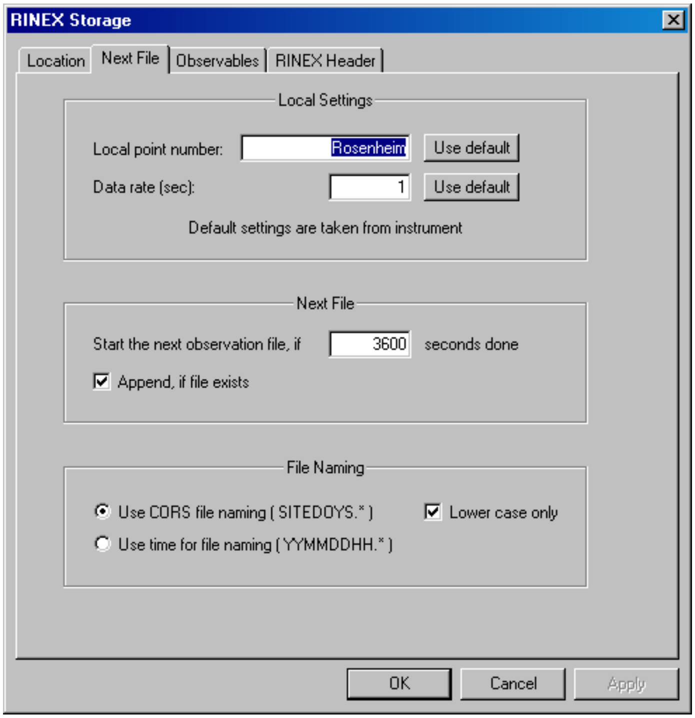
Option	File Location	Folder names depend on…
Plain	All files will be stored into one folder.	- Your input in the *Path* field.
Enhanced month	An enhanced data folder structure is applied to the data. This option writes all files generated within a month into the monthly folder.	- Your input in the *Path* field, - Year and month. For example: C:\Refdata.YY\Month.MMM*.*
Enhanced day	An enhanced data folder structure is applied to the data. For each day a folder is created and files are written into the daily folder.	- Your input in the *Path* field, - Year, month, ***and day***. For example: C:\Refdata.YY\Month.MMM\Day.DD*.*
CORS	An enhanced data folder structure is applied to the data. Below the root, for each file type a folder is created, which then contains folders for the year, day, and point.	- Your input in the *Path* field, - File type, year, day, and point. All characters in lower case. The point is characterized by a four character site ID. For example: C:\rinex\YYYY\DDD\SITE*.*

The data structure, regardless of which one was selected, may be further enhanced by the point number, if you select the *Add point number to folder structure* option. Then the observation files are written into a folder named according to the full point number of the station. If the *Plain* option is selected, the folder is created as a sub-folder to the folder named in the *Path* field. With the *Enhanced month* option selected, the <Station> folder is added below each <Month>

folder. Similarly, the <Station> folder can be found below each <Day> folder, if you have selected *Enhanced day*. With a *CORS* based folder structure, the <Station> folder is automatically created and, therefore, the *Add point number to folder structure* option is selected and grayed out.

The *Store Files* group allows you to select the file types to be stored, i.e. observation files, ephemeris files, almanac files and meteorological data, if available from a connected instrument. Select or clear the check boxes to do the selection.

Settings of the Next File dialog



The second page is the *Next File* dialog. For the RINEX Storage, you may separately define the storage rate and assign a different point name to the file. The *Local Settings* group, by default, displays the settings taken from the instrument properties that you may edit or reset to default.

Use the *File Naming* group to select the file name format. With *Use CORS file naming (SITEDOYS.*)* selected, GPSBase follows the CORS convention, where a file name consists of the first 4 characters of the site name (“SITE”), the day of the year (“DOY”) and a session identifier “S”. The session identifier is given in alphabetical characters. If the daily number of sessions exceeds 26 characters, the session identifier is increased at the expense of the day identifier. *Lower case only* forces all characters of the resulting file to be written in lower case, even if the original site name contains upper case characters. To accept the use of upper case characters for the site and session identifiers, clear the *Lower case only* check box.

Tip – To force strict CORS file naming, where the session identifier indicates the hour of the day, select a writing period of 3600 seconds and the *Append, if file exists* option. Make sure that the *Lower case only* check box is selected.

The *Use time for file naming (YYMMDDHH.*)* option creates file names that contain the full date and hour.

The *Next File* group defines the start and end of RINEX files depending on the duration of tracking. The edit field lets you set an upper time limit for the output file. If this threshold is exceeded, a new file will be created. If you change the limit during operation, the tracking into the current file will continue until the new limit is reached. The default (and minimum) for this field is 3600 sec.

The *Append, if file exists* option defines how many files are written, if you have stopped and restarted data storage within one hour. In this case, files already exist in the current folder that are named according to the current definition and that contain the data up to the time the storage was stopped. Depending on your selections (see Table 7.2), either a new file is created with increased session identifier, or the data is appended to the old file and the file name is kept, or the file is overwritten.

Table 7.2 GPSBase action if a file with the same name already exists

Type of File Naming	The option *Append, if file exists* is …	This will happen
CORS	selected	The data will be appended to the file until the time limit for a file is exceeded.
CORS	cleared	A new file is created. Its session identifier is increased.
Time	selected	The data will be appended to the file until the time limit for a file is exceeded.
Time	cleared	The existing file is overwritten until the time limit for a file is exceeded. Previous data is lost.

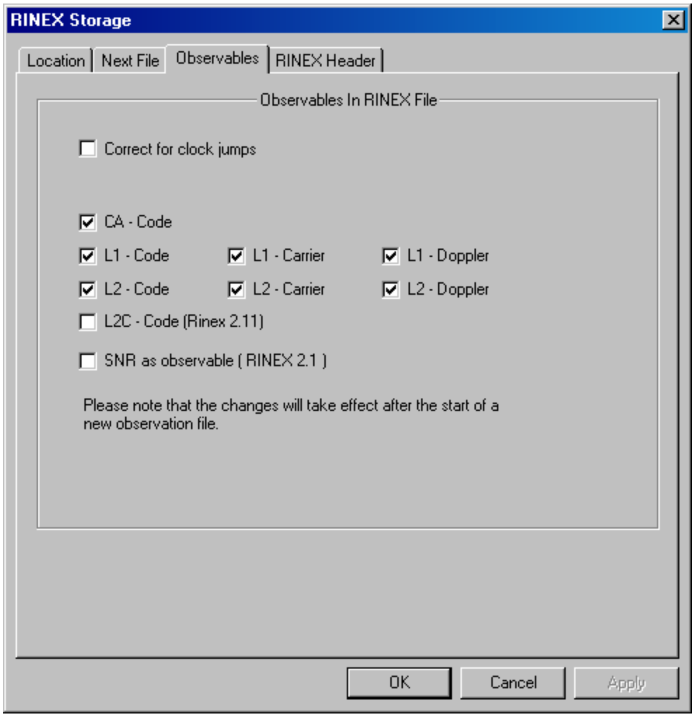
Warning – Make sure that the path and file names for data storage are unique. If, for example, the first four characters of two site names coincide, the respective file names will automatically be identical. GPSBase recognizes the coincidence. A warning dialog appears that lets you change your settings.

Settings of the Observables dialog

You may select the observables to be stored in the RINEX files by selecting the respective check boxes on the *Observables* tab. According to the RINEX 2.1 standard, you can select to store the signal to noise ratio (SNR) as observable, too. With Trimble receivers supporting the tracking of the new L2C signal, you can also select to store L2C code in the RINEX 2.11 format.

Some receiver types correct their internal clock in millisecond jumps. If the *Correct for clock jumps* option is cleared, the ms-jumps created by the receiver clock remain in the observables written to the RINEX observation files. If selected, these receiver clock jumps are corrected before writing the observables.

Note that these changes will take effect only after the start of a new file.



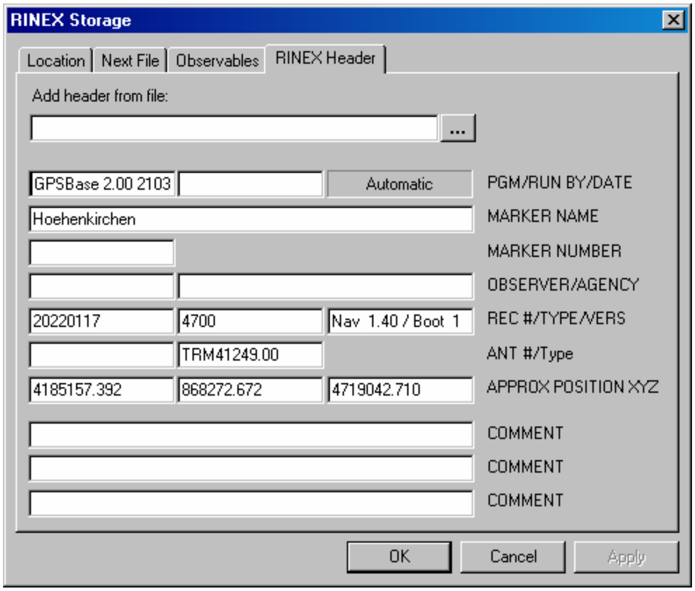
Tip – To force the RINEX Storage module to start at once with a changed selection of observables, remove the module and add it again.

Settings of the RINEX Header dialog

The *RINEX Header* dialog allows you to view and define the contents of the header of the new RINEX files. There are two ways to define the header contents:

- Load the header contents from a file of RINEX header format (just copy the header lines to a text file): Use the browse button to open a Windows file selector dialog or edit the path into the *Add header from file* field.

- Edit the entries manually. The edit fields given comply with the RINEX version 2.10 convention.



Tip – The RINEX Storage module automatically fills-in some of the edit fields with the data derived from the instrument properties, etc. You may edit them at any time. However, there is one exception: The RINEX Storage module automatically writes the creation ***date*** (in local time) into the file each time a new file is created. Therefore, you cannot edit the date. You'll note the entry *Automatic* in the respective field of the *RINEX Header* dialog.

Note – *The RINEX Storage module always stores the latest header information. That means that when you load the contents from file, it will overwrite previous information. If you have already loaded information from a file, manual entries in the edit field will overwrite the previous information from header text files. There is only one exception: If the current header file contains more than three lines of comment, the RINEX Storage remembers the path and name of the RINEX header file and always reloads comments from there even if* *you have manually edited the* Comment *field(s). Remember, information on* Agency, Observer, *and* Comment *field(s) may also be derived from an imported IGS site log; see Chapter 6, Section Importing station data from IGS site logs.*

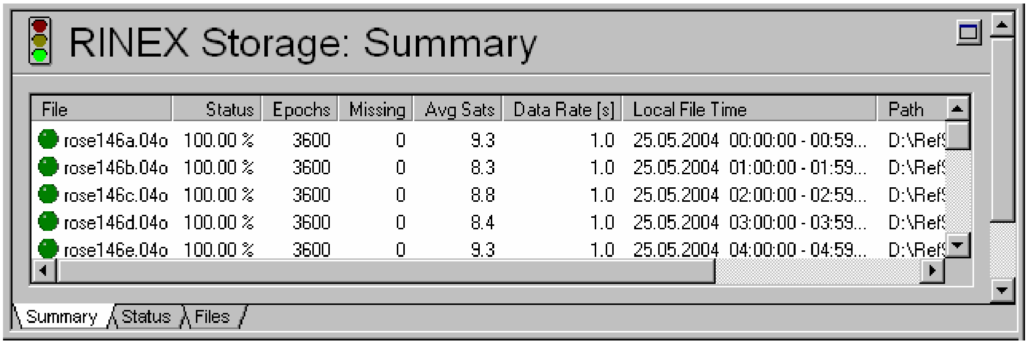
You may even edit only parts of the header. Items that are not known at the time of file creation will be set to zero and/or blank. Consequently, items with missing header records will be set to zero or blank by the program reading RINEX files.

RINEX Storage information pages

For the RINEX Storage, three information pages exist. You may select them by clicking onto the tab on the bottom of the information page.

RINEX Storage Summary

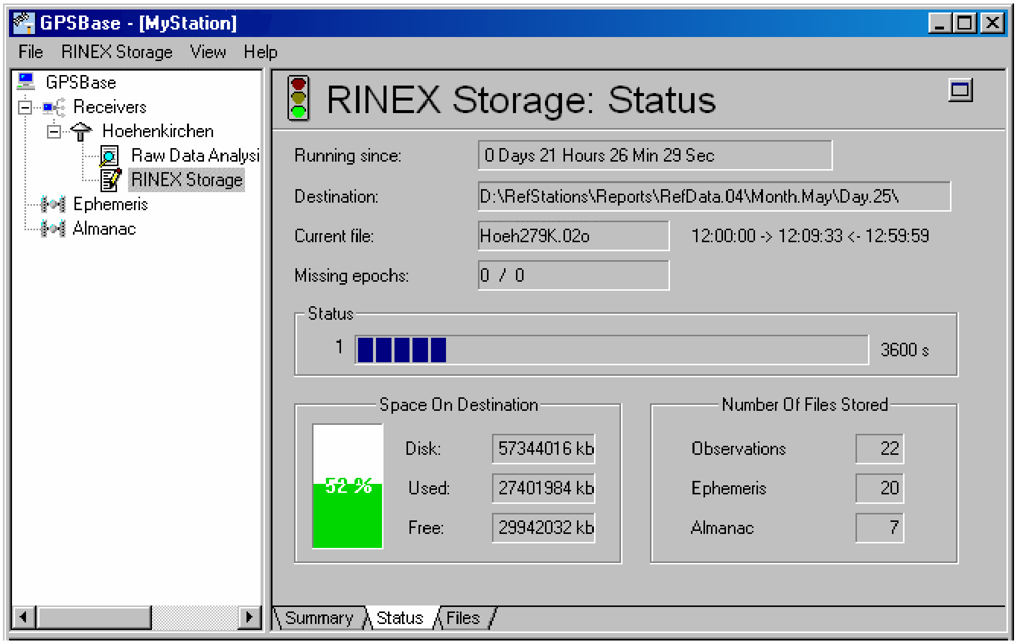
For each file created, this view displays important information, such as the current status, number of epochs written and epochs missing, and the average of satellites tracked. The update rate used to write the file depends on your RINEX Storage settings as well as on the Receiver settings. Finally, there are the storage time and the path to the file. This information is also written into the report.


RINEX Storage: Summary

File	Status	Epochs	Missing	Avg Sats	Data Rate [s]	Local File Time	Path
rose146a.04o	100.00 %	3600	0	9.3	1.0	25.05.2004 00:00:00 - 00:59...	D:\Ref
rose146b.04o	100.00 %	3600	0	8.3	1.0	25.05.2004 01:00:00 - 01:59...	D:\Ref
rose146c.04o	100.00 %	3600	0	8.8	1.0	25.05.2004 02:00:00 - 02:59...	D:\Ref
rose146d.04o	100.00 %	3600	0	8.4	1.0	25.05.2004 03:00:00 - 03:59...	D:\Ref
rose146e.04o	100.00 %	3600	0	9.3	1.0	25.05.2004 04:00:00 - 04:59...	D:\Ref

RINEX Storage Status

The *Status* information page allows you to monitor the writing of data. It displays general information on that subject, such as the start of writing, destination of files, number of files, current file, missing epochs (current file / all files) and disk space information.



The file name of the current file follows the CORS convention SSSSDDDH.YYO, where SSSS stands for the four digits of point number, DDD stands for the day of the year, and H stands for the file sequence number within the day (session ID). YY is the year and O the file type for observation data.

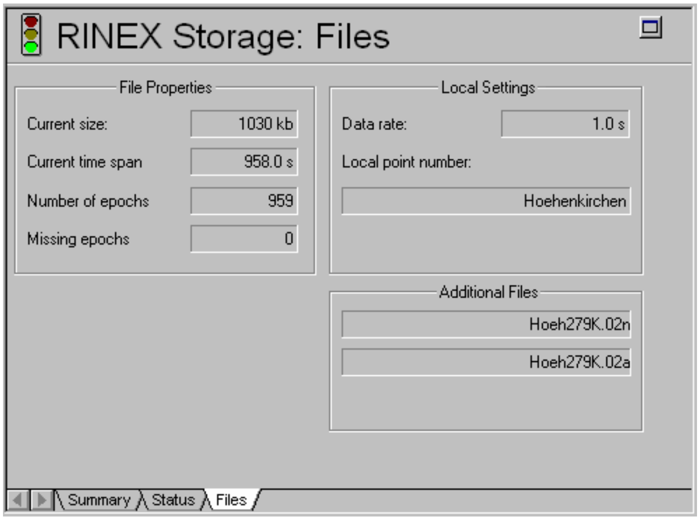
If you have forced CORS file naming, the session ID will represent a certain hour of the day.

The traffic light at the upper left corner indicates the disk space status:

- Green OK, sufficient free disk space!
- Yellow disk space lower than 5 %
- Red Disk space lower than 2 % , storage stopped

RINEX Storage Files

The *Files* information page gives information on the currently written observation data file. The information given here refers to the actual file properties such as size, time span, number of epochs and missing epochs, local settings, and corresponding data files, such as ephemeris and almanac files.

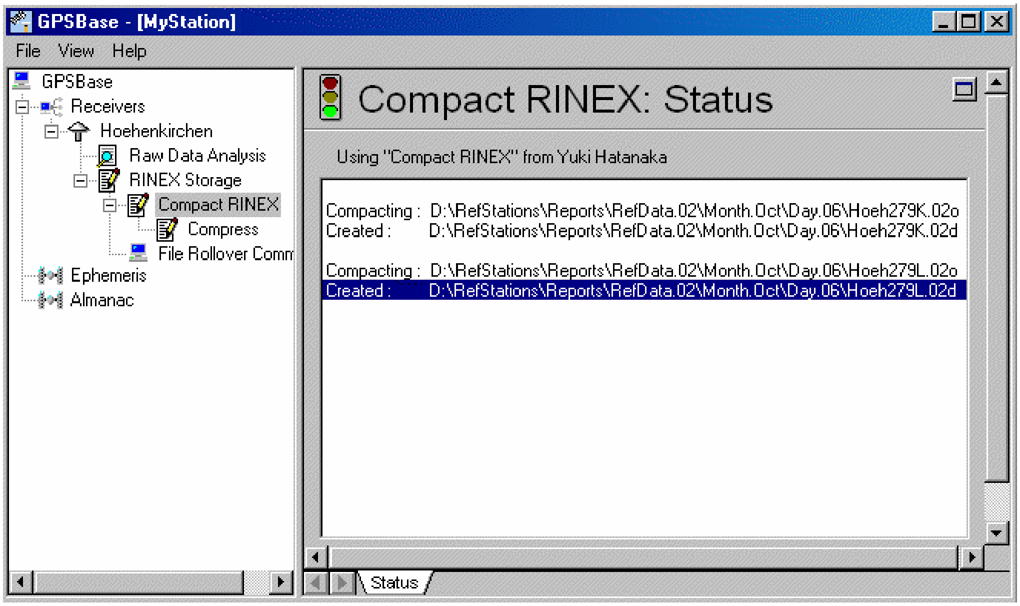


Compact RINEX

You may also store compressed RINEX data according to the format developed by Yuri Hatanaka. The Compact RINEX module allows you to compress the written RINEX data into files with the standard

RINEX file naming and the extension .??d. For more information refer to the following URL: www.ngs.noaa.gov/CORS/Rinex2.html.

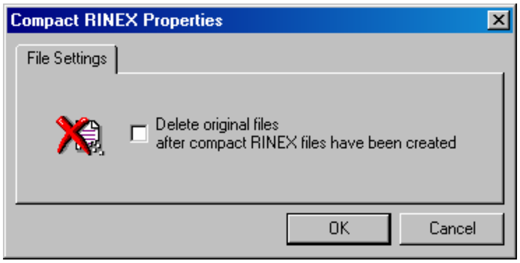
The module consists of the single page *Status*. When first starting the module, the page is empty. The compression starts whenever a RINEX file write-session has finished.



The traffic light at the upper left corner indicates the disk space status:

- Green: OK. Sufficient free disk space
- Yellow: Disk space lower than 5 %
- Red: Disk space lower than 2 %. Storage stopped.

The Compact RINEX module deletes the original RINEX files after compression, if the option *Delete original files…* is selected in the *File Settings* tab of the *Compact RINEX Properties* dialog. This dialog appears automatically, when you add the Compact RINEX module and is later available from its shortcut menu command *Properties*.



Two further modules are available if you select *Insert Module* from the module's shortcut menu.

- Compress (see Section Compressing Data Files)
- File Rollover (see Section File Rollover Command)

You may remove the module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

DAT Storage

With DAT storage, you can store and archive the real-time receiver data in the Trimble navigation DAT file format. These files can then be used for additional analysis and post-processing campaigns with any Trimble post-processing package.

The basic functionality and feature list of the DAT Storage module is similar to the RINEX Storage module (see Section RINEX Storage). But there are two exceptions:

- The RINEX Storage specific setting pages *Observables* and *RINEX Header* are obsolete.
- Only the Compress (see Section Compressing Data Files), the Storage Integrity (see Section Storage Integrity) and the File Rollover Command (see Section File Rollover Command) modules are available for further extension.

You may remove the module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

Raw Data Storage

Raw data storage is equivalent to a binary data logging instrument without modifying or converting the data coming through the communication links. This is a useful tool to analyze in a post session (simulation) any disturbances and errors which occurred during real-time performance.

Section RINEX Storage also applies to the RAW Storage module. There are only these exceptions:

- The RINEX Storage specific setting pages *Observables* and *RINEX Header* are obsolete.
- Only the Compress (see Section Compressing Data Files) and the File Rollover (see Section File Rollover Command) modules are available for further extension.

You may remove the module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

Compressing Data Files

To minimize used disk space you may add the Compress module to compress the written output data files.

When first being added to GPSBase, you have to set the properties of the Compress tool. Later you may edit your settings, if you select the *Properties* command from its shortcut menu. When you have accepted the settings, the Compress module uses the (new) settings for compression the next time output files are completed. Previously created files will not be affected.

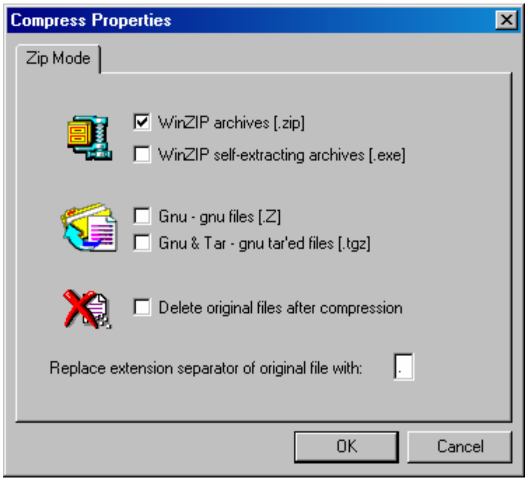
For the Compress module one page of information exists. See the section Compress information.

You may remove any module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

Compress settings

The *Zip Mode* dialog allows you to set the properties of the compress tool. Basically, the module offers two methods of compressing: the Windows-based Zip method and the Unix-based Gnu/TAR method. For Zip archives you may choose between archive files (.zip) or self-extracting files (.exe). With RINEX data, the archive file contains all RINEX files of the same file name and year extension (for example, navigation or almanac files). You do not have to define the names of the compressed files, since these will be created automatically from the observation file name with the correct extension appended to it (for RINEX files, for example: SITE001A_99o.zip contains SITE001A.99o, and, if available, SITE001A.99a, SITE001A.99n, and SITE001A.99g).

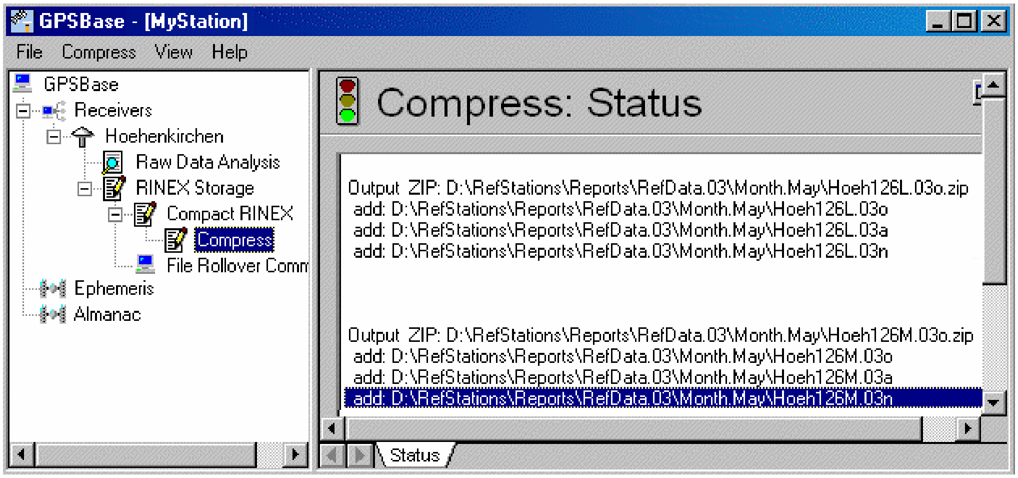
If the *Delete original files after compression* check box is selected, the source data files will be removed after the compression has been performed correctly, independent of the compression method.



Gnuzipped files may be stored to two different archive types. If the zip file contains only one file (select *Gnu – gnu files .Z*), it gets the file extension .Z. For RINEX files, it may be preferable to select *Gnu & Tar – gnu tar'ed files*. This selection adds the files of a session to a tar'ed file and then gnuzips that file into one archive using the extension .tgz. By default, the new file name contains two dots as separators. To get rid of the first dot separating the original file name and its original extension, edit the *Replace extension separator of original file* field. You could use, for example, an underscore character instead.

Compress information

The *Compress* page of the Compress information pane helps you to monitor the compressed files created. Every time the compression starts, the list shows the tool used for compression, the location and name of the (new) compressed file and the location and name of the files added.



The traffic light at the upper left corner indicates the disk space status:

- Green OK, sufficient free disk space
- Yellow disk space lower than 5 %
- Red Disk space lower than 2 %, storage stopped.

Storage Integrity

The Storage Integrity module ensures full reliability of file collection for post-processing. It may be loaded underneath a Data Storage module, such as the RINEX Storage and the DAT Storage.

If data is lost at the GPSBase server (for example, due to network downtime or instability of the communication links/devices), the module retrieves the data logged at the remote receiver or computer running GPSBase.

With the default connection to the central server running GPSBase, the Receiver module receives the raw receiver data. The data storage modules store the raw receiver data at the server in the format corresponding to the selected storage module (for example, RINEX or Trimble DAT format). To be able to use the storage integrity functionality receiver data must additionally be stored on either the internal disk of a remote receiver or on the hard disk of a remote computer which can be accessed via FTP.

To ensure storage integrity for the GPSBase system, you have to set up a second connection to the reference station. The Storage Integrity module then uses the second connection to control and handle the data download from the remote reference station.

***Note** — The second connection does not influence the main raw data transfer to the Receiver module in any way.*

In case of a download the whole data file is downloaded into a temporary file. Receiver raw data is automatically converted to the file type defined by the data storage module. If the temporary file is better than the original file, it replaces the original file at the defined storage folder. There is no injection of epochs in the current file, but a replacement of the whole file.

***Note** — With Remote Data Download activated, you can not use the Storage Integrity functionality.*

Adding and removing a Storage Integrity module

The Storage Integrity module is added to a data storage module, such as the RINEX Storage module. During startup it checks, if the setting for the file size is at least 3600 seconds and if the storage is based on the *Append to existing file* option. If the test fails the module comes up with a warning message and closes itself.

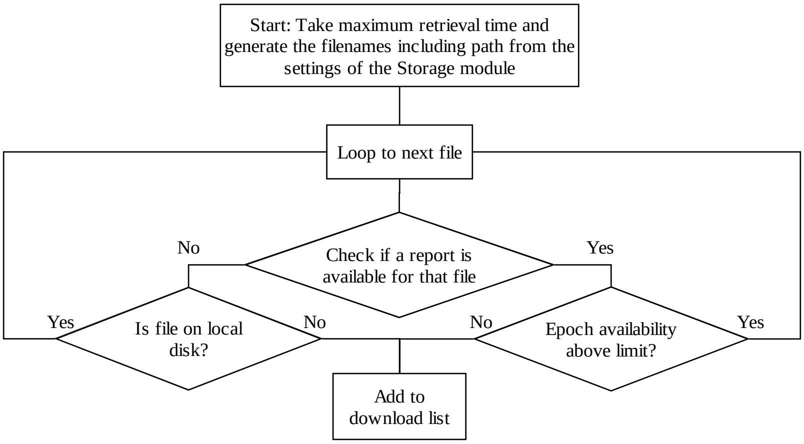


Figure 7.1 Checks and actions during Storage Integrity startup

If the test passes and the module has connected to a storage module, it checks with every startup of the system all files during the retrieval time starting with the oldest one following Figure 7.1.

When the Storage Integrity module is first being added to GPSBase a configuration wizard forces you to select the connection type and to set its properties.

You may remove the module from GPSBase any time you want: Open its shortcut menu and select *Remove Module*.

Storage Integrity settings

When you set up a Storage Integrity module, a Configuration Wizard forces you to define the module settings. Later, you may view or edit the settings at any time by selecting *Properties* from its shortcut menu. This opens the *Storage Integrity Properties* dialog with the *Data Retrieval* page:

Settings of the Data Retrieval dialog

The *Retrieval Time* group lets you select the retrieval time in days. The default value is three days.

The retrieval time setting serves a twofold purpose:

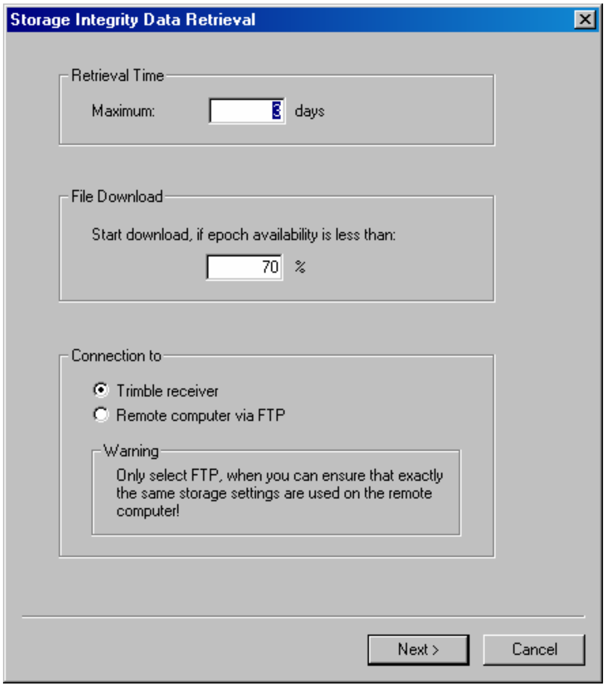
- At startup it defines the time period, for which the data files are checked (see the flow chart in Figure 7.1).
- If the connection to the reference station is disturbed for a longer time: after reestablishment of the connection, the Storage Integrity module downloads only the data files covering the period set here.

See Table 7.3 for how the maximum retrieval time value determines the date of the first and following data files to be respected by the module.

Tip — You can select a time range for each day and a number of days during the week for the receiver to store files to the internal memory. To do so, use the *Receiver Properties / Receiver Data Logging Scheduler* dialog.

Table 7.3 Local file time of the first file to be searched for after the start of the Storage Integrity module in dependency of the Maximum value

Maximum	Local file time of the first file
0 days	- 3 hours
1 day	- 24 hours
2 days	- 48 hours
x days	-24 x hours



The *File Download* option refers to epoch availability in the data files. It gives a percentage of available epochs that a data file must contain. The default limit is 70%.

For the current and previous day, GPSBase stores information on available epochs in its local memory. Moreover, this information is stored in the storage reports. Trimble, therefore, recommends that you enable reporting when using the Storage Integrity module. (For more information on reporting see the section on Reporting in Chapter 3, Getting Started.)

Based on the epoch availability information, the Storage Integrity module decides, if it is necessary to replace a data file on the GPSBase computer. The test is performed at the end of a file storage session; that means, for hourly files at the end of each hour and for daily files at the end of the day. The test does not start earlier than the end time (GPS) of the file plus 10 minutes. If less than the percentage of available epochs is found in the file, the file on the GPSBase server is deleted and replaced by the data of the receiver.

The file check is performed prior to passing on the file to a connected module like the Compact RINEX module or the Compress module.

Tip — If reporting is not selected, the retrieval of files during start up is based on file existence and not on file completeness.

When first setting up the Storage Integrity module, select the type of the second connection. For a Trimble receiver, select the *Trimble receiver* option.

Settings for a Trimble receiver

The settings for a Trimble receiver differ depending on the receiver type the Integrity Storage module is connected to.

With , for example, a NetRS receiver in real-time mode, the *Trimble Remote Download* dialog appears that lets you define the maximum age of the receiver data and the NetRS FTP settings. For a more detailed description of the settings, see Chapter 6, Section Remote data download.

To use the Storage Integrity module with , for example, a Trimble 5700 or NetR5 receiver, it must be connected to the server running GPSBase using a second connection, such as a socket, serial or modem connection. The connection typically can be a temporary modem-like connection with dial-in function.

Tip – With a modem connection, hourly data file creation and a typical data transfer time of less than 15 minutes, you can consider setting up one modem for up to four reference stations.

After you have selected *Trimble receiver* as connection type and accepted the settings at the *Retrieval Data* dialog, the Connection Wizard dialog appears. Use it to add, delete or select a connection to the Trimble receiver. The following three types of connections are available:

- Serial Port Handler
- Socket Client
- TAPI 1.4 – 2.2 Data Modem

With a socket client connection, Trimble recommends that you set it up to be used as remote connection (requires dial-in). For detailed information on the Connection Wizard and driver selection see Chapter 5, Communication Control. After you have defined a connection and finished the Connection Wizard, the Storage Integrity module immediately connects to the respective storage module.

Storage Integrity information pane

For the Storage Integrity, three information pages exist. You may select them by clicking onto the tab on the bottom of the information page.

- *Download Status*
- *Files to Download*
- *Log*

Storage Integrity download information

Three pages give full information on the current duties of the Storage Integrity module. Both are empty as long as the Integrity Storage module does not detect any missing file and did not start to download.

For each file to be downloaded from the reference station, the Download Status view displays important information, such as the file name and the local file time, the current progress of download and the path to the file. After the file was successfully downloaded, a  flag icon precedes the file name. If the flag is missing, see the *Result* column for details. For more information on the possible results see Table 7.4.

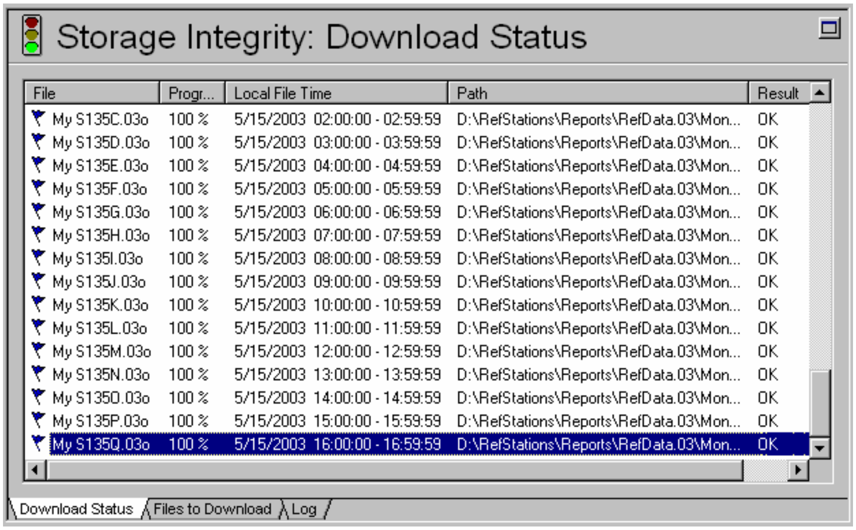


Table 7.4 Storage Integrity Download information page: Possible results of file download

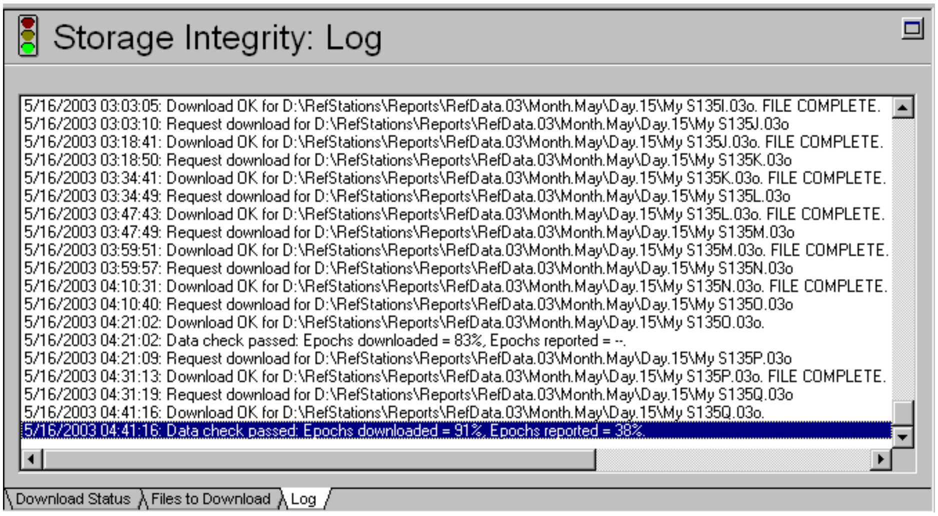
Result	Indicates
OK	File transfer complete.
File N / A	Requested file not available at the receiver side.
Retry	Download will be retried. Possible reasons are - timeout - connection error
File not used	Receiver only: The downloaded file contains less epochs than the existing file.
Error	Receiver only: An error occurred while checking the epoch availability of the downloaded file.

The *Files to Download* view lists all files which the Storage Integrity module has detected to be currently missing. The files are numbered consecutively in the order they will be downloaded. The list further contains the file names, local file times and the paths to the files.

Storage Integrity Log

The *Log* view gives a history of the module's activities. At startup it summarizes how many files are to be downloaded. Then, it lists further requests for data files and the status of file download.

If you want to clear the log window go to the navigator, right-click the module to access its shortcut menu, and then select *Clear Log View*.



Logging and reporting

If logging is enabled, each Storage Integrity module continuously writes the information for its station into a text file. The log file is named StorageIntegrity_<station_name>.log. It contains the same information as the *Log* view displays (clearing the log window does not affect the log file, of course).

To enable logging, make sure that the *Use Logfile* command from Storage Integrity's shortcut menu is selected.

The Storage Integrity module uses information from the reports created by its root storage module. It looks for the epoch availability stored in the reports, if the local memory does not provide this information.

Warning – To use the reports, they must be stored at the location defined by the path in the *Reporting* dialog. Reports moved to a different location will not be found by the Storage Integrity module.

After a successful file download the respective reports of the root Storage module are updated. See Figure 7.2.

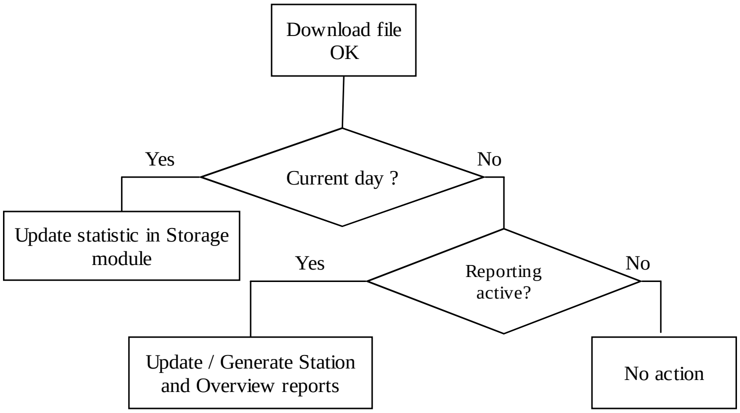
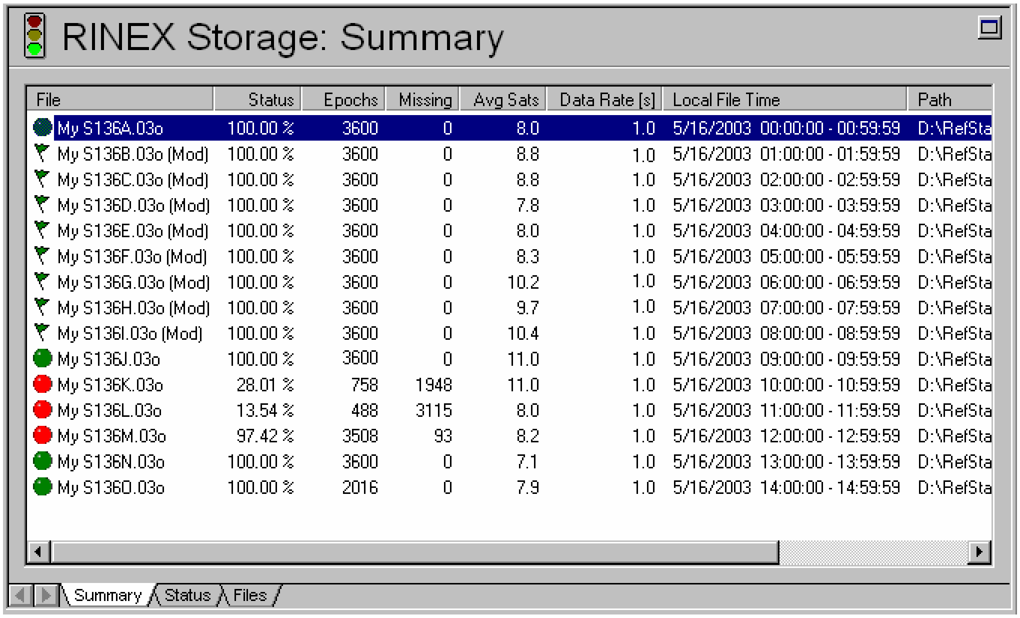


Figure 7.2 Report and statistics update after download

Interaction with the Storage modules

After file download, the parent storage module indicates the action in its *Summary **view*** (only for the current day) as well as in its ***reports***.

If a data file was missing and the Storage Integrity module inserted a new file, a new row is added for an inserted data file. The file name has the appendix (In). If a previously existing file consisted of fewer epochs than the availability limit required and the Storage Integrity module replaces it by a newly downloaded file, the new data file gets the appendix (Mod).



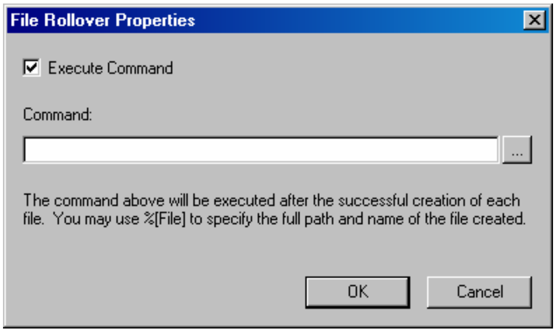
After insertion, a status flag indicates the epoch availability for the file. The color of the flag indicates relative epoch availability. For the default percentage values, which are derived from the Storage modules, see Table 7.5. For data files downloaded by FTP, only a gray status flag is displayed, since the Storage Integrity module has no information on epoch availability.

Table 7.5 Flags at the Storage information page: Default color assignment

Flag	Indicates
(green)	100 % availability
(yellow)	>= 99 % availability
(red)	>= 1 % availability
(gray)	>= 0 % availability

File Rollover Command

The File Rollover module lets you enter a command. The command will be executed after a file has been successfully written to disk. The command may be a batch file or an executable program. Add it to any data storage module. Use the *File Rollover Properties* dialog to enter the command. The dialog is available when you first set up the module and after that at any time using the *Properties* command from its short-cut menu.



You need not to specify file names manually: Use the string **%[File]** within your command to apply it to all files that will be created by the "parent" module.

You may stop executing the command without removing the module from GPSBase: Clear the *Execute Command* check box.

After an action has been performed, the *Status* page of the information pane displays date, time and status of the action.

CHAPTER

8

Data Output to Clients (Real-time)

In this chapter:

- Introduction
- RTCM Generators – General
- Starting an RTCM Generator
- RTCM Generator Properties
- Connection Settings
- The RTCM Single Station Generator Information View
- Accounting
- Caller Identification Using SNMP
- RTController

Introduction

The main purpose of the RTCM Single Station Generator module is to output observations, positions and further messages according to the RTCM or the Trimble CMR format. The RTController module is used to configure a reference station receiver to broadcast the real-time correction data in RTCM and/or CMR format.

Find all information on data output in real-time in this chapter. It also contains details on the implementation of databases and reports used for caller identification and accounting.

RTCM Generators – General

RTCM (Radio Technical Commission for Maritime Services) has established a standard for differential GNSS applications, which allows the broadcast of standardized messages, to differentially correct mobile receivers. GPSBase supports v2.1 format and v2.3 format as well as the new v3.1 format. For detailed information about the RTCM formats, see Appendix D, RTCM Messages.

Subsets of the output formats are also available:

- For RTCM, the Standard format as well as AdV formats (coded format of the German SAPOS organization) are offered.
- For CMR, you may select between CMR and CMR+.

The RTCM Generator module

The RTCM Single Station sends out the data of a specific reference station to a rover that connects to it. Thus, it acts as a typical DGPS reference station. The rover immediately receives data from the Single Station RTCM, when it connects to it. The RTCM Single Station is started via the shortcut menu command *Insert Module* below the reference station's Raw Data Analysis module. It takes the improved data from the Raw Data Analysis (fixed cycle slips, for example) For details on Raw Data Analysis see Chapter 10, Section

Analysis Tools. From the *Module Selector* dialog, select *RTCM Single Station*.

The number of RTCM Generators that should be added to GPSBase depends on the number of rovers that will ask simultaneously for differential reference station data. The RTCM Generator waits for any incoming call by a rover system. After the termination of a connection, the RTCM Generator will be available for the next client.

The RTCM Generators support RTK on Demand for rovers using a Trimble Survey Controller™ 11.02 or later. With RTK on Demand, users can tap a button at the Survey Controller to pause reference station data transmission for periods where they are not needed. Thus, it saves them data transport costs, if they are billed by data amount.

Reporting

If reporting is activated, each RTCM Generator module will generate a report, each time a user is connected to it. Use your Internet browser or any other browser, which can parse and display XML documents. You will find the report for a connection session generated using the naming format RTCM [<RTCM Generator name>] YYMMDD HHMMSS <UserName> $X.xml. For more information on the reports, see Appendix G.

Gap detection in RTCM Generators

The RTCM Generator determines the expected output rate for satellite data and then recognizes, whether this output occurs in the expected interval or not. If the output does not occur, the RTCM Generator logs this event to the report file and also writes a warning message in the Output Window. When the situation is fixed (output happens again as configured), the report and the Output Window will be updated accordingly.

The RTCM Generator detects output gaps by remembering the last time (PC-clock) of satellite data output (but not of other data, such as position or antenna), which can be RTCM messages 18, 19, 20, 21, 1, 31, 9, 34, CMR/CMR+ message type 0, or RTCM 3.1 message types 1003 or 1004. It takes the minimum value of all output rates of the activated messages. When the next expected message has not been sent after an interval twice as long as the configured output rate, an entry is added to the report, stating that zero satellites are sent. The time stamp for the report entry will be the one of the expected output time.

The defined time delay allows situations where the output of the next epoch is slightly delayed because CPU load has a short peak. For example, when the output of RTCM 18/19 is at 1 sec, the problem will not be detected before 2 sec have passed without output.

Adding modules

You may add further modules below an RTCM Generator module by, selecting *Insert Module* from the RTCM Generator's shortcut menu. The following modules are available:

- RAW Storage (for all RTCM Generator types)
- Splitter (for all RTCM Generator types)

Removing the module

You may remove any of the modules at any time from GPSBase: Open its shortcut menu and select *Remove Module*. Note that this will automatically remove all modules linked below this module (for example, the RAW Storage).

Starting an RTCM Generator

To start the RTCM Single Station Generator, activate the Raw Data Analysis module and select from the shortcut menu the *Insert Module* command. Select *RTCM Single Station*. When started the first time, you must specify a unique name for each RTCM Generator. It is recommended to name the RTCM Generators according to the interfaces they are connected to, for example "**Socket Server 7000**", "**COM7**" or "**GSM <phone#>**". This will make it easier to recognize the configuration again the next time it should be started.

Tip – The connection options should be set up in a way that the connection is established each time a user calls in. With the Socket Connection Configuration, make sure that the *Use as Remote Connection (requires Dial in)* option is selected.

After you have defined a new connection configuration or have chosen an existing one, the RTCM Generator *Properties* wizard appears for choosing (or reviewing the currently chosen) configuration settings.

Typical connections to clients

Which driver is to be selected depends on how your clients will connect to the RTCM Generator. See Table 8.1. See also Chapter 2, Section Connecting the Users to GPSBase.

Table 8.1 Typical user connection to RTCM Generators

Medium	Driver	Description
Modem	TAPI Data Modem	Rovers call in using one ore more telephone lines: analog, GSM, ISDN, etc. Each modem is connected to a specific RTCM Generator.
Serial cable	Serial Port	RTCM data stream is broadcast via a radio transmitter.
Internet, LAN	Socket Client Socket Server Multicast Socket Server	A rover establishes an Internet connection to the control center (e.g. using GPRS). The data stream is routed via iGate or Trimble NTRIP Caster to the rover

RTCM Generator Properties

Each time you (re-)start an RTCM Generator, a configuration wizard will step you through the Generator's *Properties* pages, where you can configure all its parameters (for example, output rate). When the connection is already running, you may review/edit your settings, if you select the *Properties* command from its shortcut menu.

The following settings can be found in the respective *Properties* pages:

- *Data Format*: defines the message format and type; general settings
- *<Selected format> Messages*: lets you define in detail the properties of the data format broadcast by the RTCM Generator. The name and contents of that page depends on the general format selected on the *Data Format* page. For example, with a CMR format selected, the *CMR Settings* page will be available.
- *Caller Identification*: only available, if all conditions for caller identification are fulfilled. See the Section Caller Identification.

To move through the wizard pages at module start, click **Next**; **Back** returns you to the previous page. Finally, accept the entries using the **Finish** button. When displayed as *Properties* pages, you will find the usual buttons **OK**, **Cancel** and **Apply**.

Figure 8.1 shows the selections offered for an RTCM Single Station Generator.

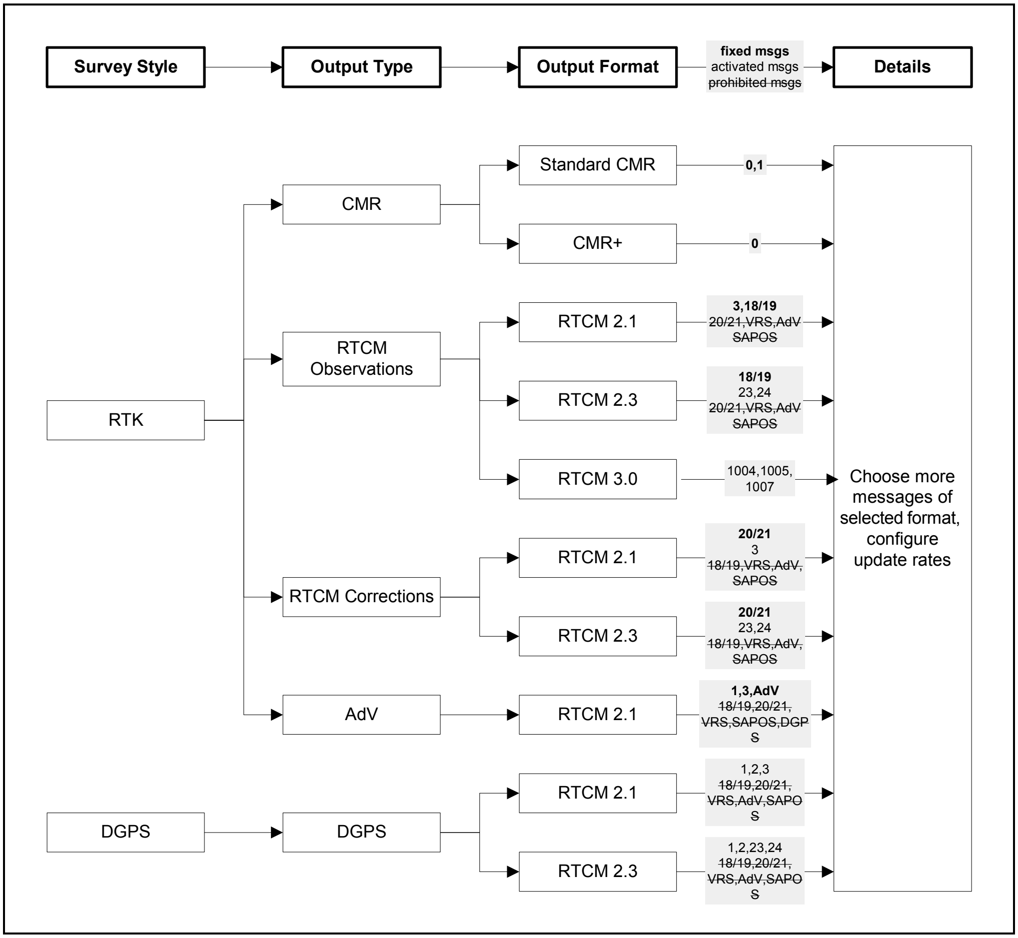


Figure 8.1 Output options of an RTCM Single Station Generator

The following subsections give you a detailed description on the *Properties* pages.

RTCM Generator properties – Data Format

This page lets you select the real-time data type for broadcast in the *Format* group. The following selection is available under *Survey Style*:

- *RTK*: RTK accuracy
- *DGPS*: DGPS accuracy

The choices within the *Output Type* field depend logically on the selection under *Survey Style*. Additionally, the selections are intelligent, meaning they influence the appearance and possible choices on the second Settings page. See Figure 8.1 for an overview on possible selections for the RTCM Single Station Generator.

One or several of the following options may be available:

Table 8.2 Output types in RTCM Generators

Output Type	Function
DGPS	DGPS correction messages
AdV	Encrypted corrections 20/21 (only used in Germany)
RTCM Observations	Standard RTCM, sending 2.x observables 18/19, or RTCM 3.1 observables.
RTCM Corrections	Standard RTCM, sending 2.x corrections 20/21
CMR	Trimble Format, observations

A special hardware key is required on your PC to generate the encrypted AdV Format output types.

***Note** – When the chosen output is "RTCM AdV", the SAPOS Decoder box and the Smartgate have two tariffs for charging the customer: A base-mode (broadcast) and a GSM-mode. The choice of the tariff depends on a GSM-flag, which is coded into the AdV data stream by the RTCM Generator module. By default, GPSBase's RTCM Generator modules send out the GSM-flag as zero indicating base-mode.*
If the tariff should be changed to GSM-mode, the value of the

Windows Registry entry "AdvGsmMode" of the RTCM Generator module's "RTCM" section has to be changed from 0 to 1. Then the module has to be unloaded and loaded for this setting to take effect.

Similarly to the survey style, the choices within the *Output Format* field depend on the selection in the *Output Type* field. One or several of the following formats will be available:

- *RTCM 2.1*
- *RTCM 2.3 (Default)*
- *RTCM 3.1*
- *CMR* (Trimble format, Standard)
- *CMR+* (enhanced CMR)

Unfortunately, the RTCM standards 2.1 and 2.3 are not compatible, but both are currently in use depending on the rover receiver type. The main differences between the standards are how receiver-clock corrections and multiple message indicators are respected for messages of type #18 and #19. RTCM 2.3 offers the two new message types #23 and #24. It is fully compatible with the former RTCM version 2.2.

***Note** – If you want to transmit in RTCM 2.2 style, disable message types #23 and #24, enable message types #3 and #22. For any RTCM-Generator configured by a GPSBase version previous to 2.0 for RTCM 2.2 output, the settings for these RTCM-Generators will be converted to RTCM 2.3.*

The CMR (Standard) and CMR+ formats are Trimble specific formats. For more information on these formats, refer to the Trimble receiver manuals.

Important – Depending on the chosen format (RTCM or CMR) and on the messages activated, the reference-station position information is rounded to different accuracies. This is due to different definitions in the RTCM version standards.

The following rules apply:

- When output is RTCM 2.1, position accuracy is 1 cm.
- When output is RTCM 2.3 and messages #22 and #24 are disabled, position accuracy is 1 cm.
- When output is RTCM 2.3, message #22 is enabled and message #24 is disabled, position accuracy is 1/256 cm.
- When output is RTCM 2.3 and message #24 is enabled, position accuracy is 0.1 mm.
- When output is CMR or CMR+, position accuracy is 1 mm.

Accordingly, whenever you enable/disable any of the RTCM messages mentioned above, this can result in changes of the reference-station position, which the rover receives.

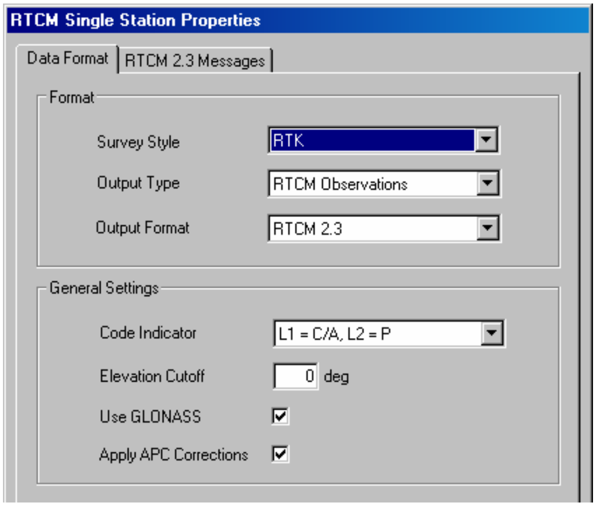
Depending on the output type and on the output format, the second *Properties* page will adjust itself. It allows only those messages to be configured, which are possible according to the chosen format. For example, if RTCM 2.1 is selected, RTCM message #22 will not be available for selection, because it is not defined for this output format. Another example is that only RTCM 2.3 has messages #23 and #24 defined, for RTCM 2.1 they are disabled.

By default, the RTCM Generator generates output of satellite observations of both frequencies, L1 and L2. You may select, whether the P or the C/A code is to be used on either of these frequencies. The following options are available in the *Code Indicator* drop-down list:

- *L1 = C/A, L2 = C/A*
- *L1 = C/A, L2 = P* (default)
- *L1 = P, L2 = P*

In the *General Settings* group on the *Data Format* page, you may also define an elevation cutoff for use in data output.

The *Apply APC Corrections* check box allows choosing, if the output observations/corrections should be corrected from the Antenna Phase Center APC to the Antenna Reference Point ARP (“null antenna”), or if the output should stay uncorrected. In the latter case the observations are identical to what is written into the RINEX files. By default, the *Apply APC Corrections* check box is selected.



Note** – If* Apply APC Corrections *is selected for an RTCM Single Station Generator module, the* RTCM-Config *field in the* Status *view and in the RTCM report adds the string* ***null-antenna. *For example:* ***OBS RTCM 2.3: 3(6), 16(59), 18/19(1), 22(6), 23(5), 24(5); null-antenna***.

RTCM Generator properties – RTCM 2.x Messages

The *Properties* pages *RTCM <2.x> Messages* each apply for the chosen RTCM version (either v2.1 or v2.3).

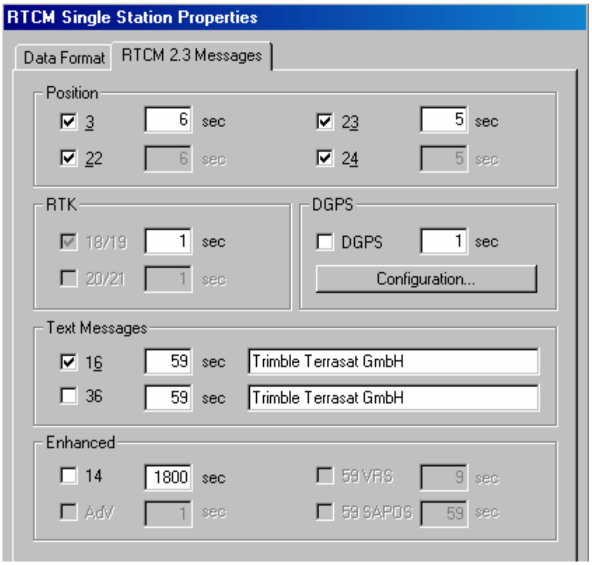
For example: If RTCM 2.1 is selected for the RTK survey type, this forces RTCM message #3. If RTCM 2.3 is selected, the same default configuration enables message #23 and #24, but also allows selecting message #3 (and #22).

The current version of GPSBase lets you select from the most important message types for transmission, such as #3 (Position), #1, #2, #9, #31, #34 (DGPS), #16 and #36 (messages), #18 and #19, #20 and #21 (high accuracy), using any update rate.

ToolTips are available on the *Properties* page, which clarify the meanings of the RTCM message numbers. Move the cursor over an entry field and a short definition will appear.

The *RTCM 2.x Messages* page adapts itself to the type of RTCM Generator according to the following rules.

- If a parameter is essential for the chosen survey style, output type and output format, the respective field is selected and grayed out.
- If a parameter does not apply to the selection (is prohibited), the respective field is grayed out and cleared.
- The check boxes of optional parameters are active for you to enable or disable the respective messages.
- For all messages the default update rates are defined. You may change them at any time.



Use the dialog to combine the optional messages with the forced ones and to define the message update rates in any useful combination.

There are some logical interdependencies between RTCM messages:

- When message #22 is enabled, automatically #3 is enabled with it (#22 without #3 is not defined).
- The output rate of message #22 is identical with the output rate of message #3. It is automatically changed when you put in a new update rate for #3.
- When message #24 is enabled, #23 is automatically enabled with it (#24 without #23 is not defined).
- It is allowed by the RTCM standard to send out #23 without #24.

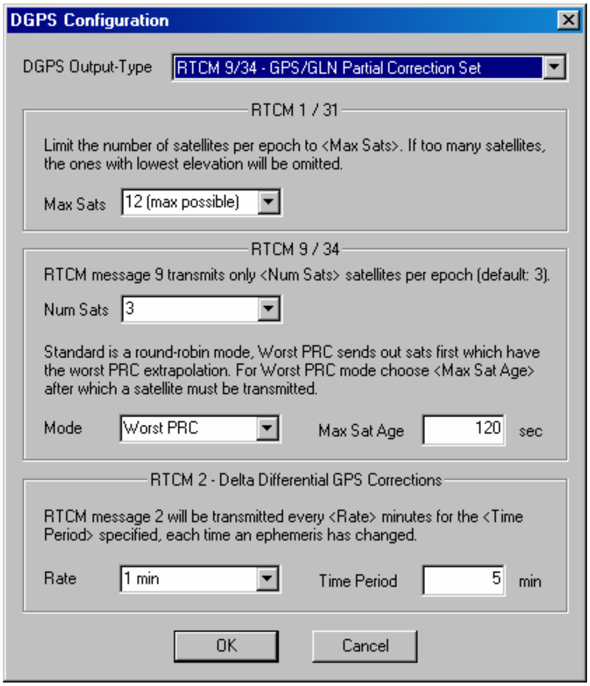
DGPS corrections

For DGPS corrections, additional configuration settings are available, when you click **Configuration**. Here, you can select from two different types of DGPS Output (*DGPS Output Type* drop-down list):

- *RTCM 1/31 – Differential GPS/GLN Corrections*
  This option transmits all satellite corrections of an epoch in one block. At transmission time, this option needs a relatively high bandwidth. During unoccupied periods, the transmitter is idle. Therefore, depending on the available broadcast or transmission rate it can be advisable to set a limit to the number of satellites transferred only for DGPS purposes. Select the maximum number of satellite sets for DGPS in the *Max Sats* drop-down list (*RTCM 1/31* group). RTCM allows data transmission for a maximum of 12 satellites.
- *RTCM 9/34 – GPS/GLN Partial Correction Set*
  This option lets you split the satellites into groups, for which corrections are sent in blocks of an epoch. This results in considerably less bandwidth usage, but not each satellite is transmitted each output epoch. The settings for this option are available in the *RTCM 9/34* group. There, you can select the maximum number of satellites for an epoch of data. The default value of *Num Sats* is 3.

You may select from two options on how the satellites are selected for transmission in the *Mode* drop-down list. The *Standard* mode is a round-robin mode, where the satellites are taken in the order as they have been tracked by the reference station receiver.

More sophisticated is the *Worst PRC* mode (default). Here, satellite that is sent first, is the one the rover needs corrections most urgently for, i.e., that satellite, for which the rover's PRC extrapolation results in the worst value. Here, the parameter *Max Sat Age* applies, which urges the module to send also the corrections for those satellites, whose data age would exceed the limit given (default 120 sec).



RTCM message #2 sends differences between old and new ephemeris. In the *RTCM 2 – Delta Differential GPS Corrections* group you may define, how long these differences are transmitted

(*Time Period*). During that period, the data will be re-transmitted at the rate selected in *Rate*.

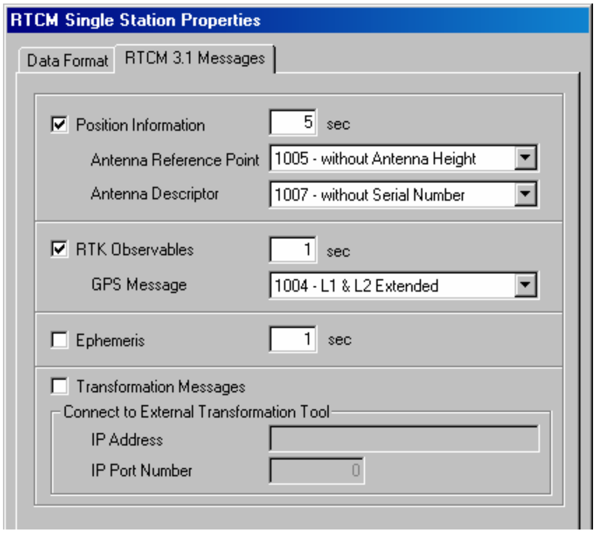
Tip – The *Status* pane of the RTCM Generator's information view will give you full information on the current settings for DGPS corrections. If DGPS is selected for broadcast, its *RTCM-Config* field displays the DGPS message types after the entry *DPGS:*
The following lists some possible examples:
…, DGPS: 1/31(1, maxSat 12), 2(60, for 5 min)
…, DGPS: 9/34(1, numSats 3, maxAge 120), 2(60, for 5 min)
…, DGPS: 9/34(1, numSats 3, maxAge 120, worstPRC), 2(60, for 5 min)

Note the following rules:
- The numbers before the brackets refer to the RTCM message types.
- The first number in brackets is the output rate in seconds.
- The values *maxSats*, *numSats* and *maxAge* refer to the respective DGPS configuration options.
- Whenever the default setting is selected, this will not be mentioned in *RTCM-Config*.
- Values without units are given in seconds.

RTCM Generator properties – RTCM 3.1 Messages

If you choose the RTCM 3.1 standard for data output, the *RTCM 3.1 Messages* page appears. Use it to activate the output (observables, position information, ephemeris), to set output rates for the output, and to select the type of message transmitted. For a list on the available messages in the RTCM v3.1 standard see Appendix D, Section Standard RTCM v3.1 Messages.

The position information is a combination of the position of the antenna reference point at the reference station – message type 1005, does not include the antenna height – and an antenna descriptor (message type 1007 or 1008, the latter includes the antenna serial number). The position information requires a combined output rate for both messages, since the RTCM Generator transmits the position information in successive epochs: First the antenna descriptor information, then the antenna reference point information. Therefore, the minimum output rate is 2 seconds (maximum is 3600 seconds). The default output rate is 5 seconds.



For example: With the default output rate, the position of the antenna descriptor information is sent at epochs x, x+5, x+5, … while the antenna reference point follows at epochs x+1, x+6, x+11, and so forth.

The default output rate for RTK observables is 1 second. Select one of the message types 1003 or 1004 (default type). If GLONASS output is enabled, choosing message 1003 includes also 1011, and message 1012 comes with 1004.

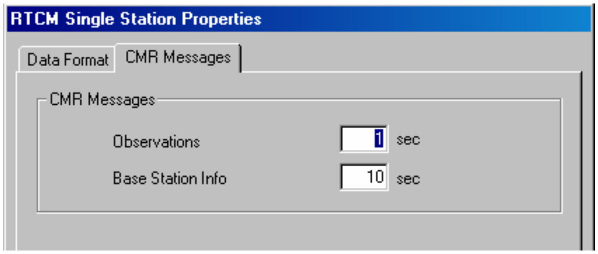
If you want to use RTCM 3.1 as alternative to raw receiver data streams when reference station data is exchanged between customers, you should activate the output of satellite ephemeris data. The default output rate is 1 ephemeris message 1019 per second. For example, when the RTCM 3.1 data stream currently sends 6 satellites, the output for the first satellite may occur in epoch x, that for the second follows in epoch x+1, and that for the sixth one in epoch x+5. In epoch x+6, the first satellite’s 1019 message is again sent out, and so on.

Since 2005, the RTCM 3.1 message types 1021 and following allow the transmission of transformation and shift parameters to the user. This feature requires the following:

- A rover sending its approximate position in an NMEA format (GGA, GGK, or AdV sentences); the GPSBase RTCM Generator must use a bi-directional connection to the rover.
- An external software tool which is able to decode the NMEA sentences, to administrate the transformation parameters for a selected datum, and to select, based on the rover's position, a local 16-point grid from a grid file.
  This external transformation tool must be able to communicate with the GPSBase RTCM Generators.

The RTCM Generator forwards the incoming NMEA position message to the transformation tool, which in turn knows the local datum and selects shifting parameters to a matching local grid. This grid is defined by 16 points resulting in 9 cells, with the rover positioned in the central cell. The software tools communicate using a TCP/IP socket server – client connection, where the transformation tool serves as a socket server and the RTCM Generator acts as socket clients. To activate the transmission of transformation parameters, select the *Transformation Messages* option. Then, enter the server IP address and its IP port number.

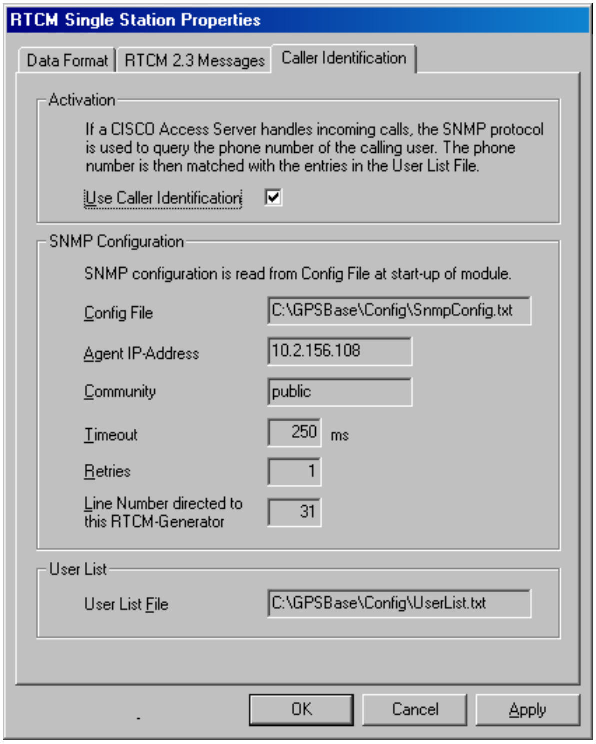
RTCM Generator properties – CMR Messages



If you chose the CMR standard for data output, the *CMR/CMR+ Messages* page appears. On this page, you can edit the update rates of the default message types 0 (*Observations*) and 1 (*Base Station Info*) for CMR (or just of the message type 0 for CMR+).

RTCM Generator properties – Caller Identification

The *Caller Identification* page only shows up, if automatic caller identification is available. The RTCM Generator modules can identify the phone number and the user name of an incoming call, when the call is reaching GPSBase via a CISCO Access Server product, if an SNMP Configuration file and a User List file exist, and if some other conditions are fulfilled. For detailed information, see Section Caller Identification.



In the *Activation* group, the *Use Caller Identification* check box lets you enable or disable the functionality. Default: selected (enabled).

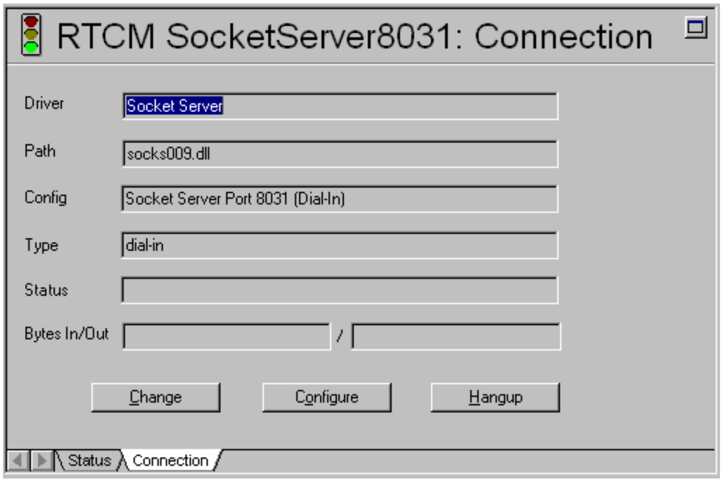
Most fields of the dialog are purely informational. The fields of the *SNMP Configuration* group display the location and name of the SNMP Configuration file as well as the values for the tokens that are defined in there. In the *User List* group, the location and name of the User List file is given.

Connection Settings

The modem-related RTCM Generator settings are available at the *Connection* page of the information pane area. This page displays the current communication configuration and status for the module. Additionally, it lets you change the settings, if you use the buttons offered at its bottom.

The following information is available:

- *Driver*
  Driver name (as displayed when selecting the driver at first initialization of the RTCM Generator module)
- *Path*
  Path to the respective driver DLL



- *Config*
  Configuration information of the selected driver
- *Type*
  How is the communication interface connected to the module? There are two connection options:
  Immediate connect single permanent connect to remote party.
  Dial-in a modem-like connection with manual dial-in and hang-up functionality.

  ***Note** – For RTCM Generators you will always want to have a modem-like behavior activated, where the program recognizes that a rover has dialed into the system and when the rover has hung-up the line again.*
- *Status*
  Interface status. Indicates whether a user is currently connected to the RTCM Generator. If communication errors occur, error messages will show up here.
- *Bytes In/Out*
  Byte counter. Accumulates the received (incoming rover data) and sent (outgoing) bytes. Counting starts each time a rover has connected to the RTCM Generator and stops when the rover disconnects.

To re-configure the user connection to the RTCM Generator, use the buttons of this page.

Warning – In general, use any of these buttons with caution during normal operation of the RTCM Generator, since they will terminate any existing user connection.

Change Changes the connection from scratch: Opens the *Driver Selector* dialog for a renewed selection of the driver DLL. For more information on the driver selection, see Chapter 5, Section Driver Selection.

Configure Opens the *Configuration* dialog for the currently selected driver DLL. You may change your settings such as the server name, an IP port or the connection type (immediate or dial-in). For more information on the dialogs, see the sections on configuration in Chapter 5, Communication Control.

Hangup Terminates the connection to a currently connected user. After that, the user has to dial-in again.

Tip – Note that changes to the driver DLL or its configuration will be remembered under the RTCM Generator configuration (and name) currently selected. For example, you may want to avoid to change to a serial driver DLL when the configuration name is “Socket Server ####”. Instead, it is recommended to use these buttons only for problem analysis.

The RTCM Single Station Generator Information View

The two information views of the Single Station RTCM module allow you to monitor the output (*Status* tab) and its communication settings (*Connection* tab, see Section Connection Settings).

The module’s navigator icon represents the current status of the RTCM Generator:

 when inactive;

 when active and sending messages;

 communication error (the output interface is not working properly, for example, socket port / modem / serial line already used by another application).

RTCM Single Station – Status

This control pane lets you check the outgoing messages of the reference station.

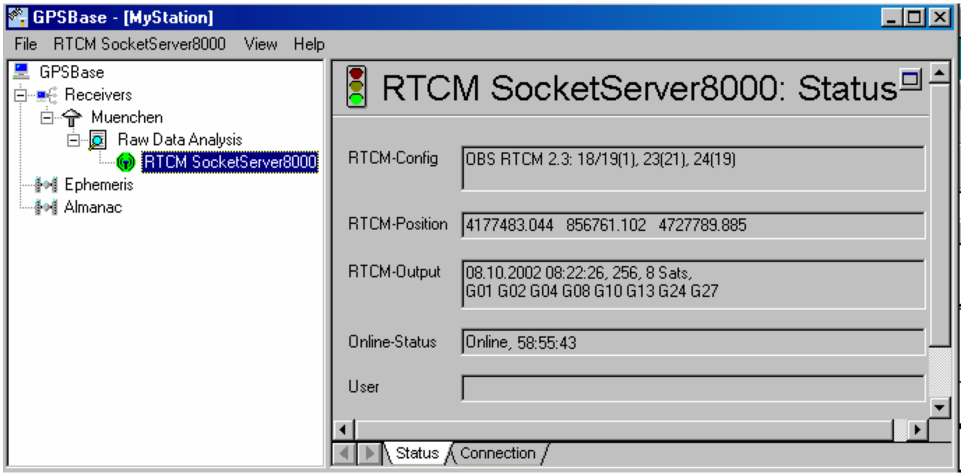
- *RTCM-Config*
Displays, how the RTCM Generator is configured in its *Properties* pages. In abbreviated form you see
– the output type chosen (for example, *DGPS*, *AdV*)
– the type of real-time data you generate (output format *RTCM 2.1*, *2.3, 3.1* or *CMR, CMR+*)
– a comma separated list of all RTCM (or CMR) message types to be sent out, followed by their output intervals in units of seconds (in brackets)
– if DGPS output is enabled, a list of all settings for DGPS corrections is added: The RTCM message types, for example, 9/34, are followed by the output rate and further options (in brackets, for units of seconds the unit is not displayed). For more information, see the Tip in Section DGPS corrections.

- *RTCM Position*
The position of the Reference Station sent out in the data stream. Note that the position may slightly vary from the precise reference station position because of rounding done by the output. For example, RTCM 2.1 position information can only be transmitted to 1cm accuracy.

- *RTCM-Output*
Epoch time of output data, ID of the reference station, where the Single Station RTCM module is attached, # of satellites used, list of all satellites sent out in the latest epoch.
The content of this field will be overwritten by each epoch sent out. So, for example, if output chosen is RTCM DGPS message 9 with 3 satellite output per epoch, this field will show the current 3 satellites sent out, which vary from epoch to epoch.

- *Online-Status*
Current status and duration of the connection to the rover. The following states are available:
- *Offline*: RTCM Generator is waiting for the next rover to dial in. Currently no RTCM output.
- *Online*: A user has connected. The RTCM Generator has started to send out real-time data to the rover. *RTCM-Output* now shows the epoch info sent out.

- *Driver problems*: For example, communication interface failed. Navigator icon: 



- *User*
  If Caller Identification is active within the RTCM Generator module, this field displays the user identification (for example, phone number) as determined from the Access Server and the user name that is associated with the user identification of the rover. If both, user name and user identification, are available, they are displayed as *<user name> [<user identification>]*, for example as *John Doe [012345678]*. For more information on Caller Identification, see Section Caller Identification.

You will find the information that is displayed in the *RTCM-Config* and *User* fields also in the report for the RTCM Single Station Generator.

Accounting

Use GPSBase's accounting functionality in combination with caller identification to create log reports on user activity and on the output of data to callers.

Activating accounting

To start accounting, select the main menu command *File / Reporting* to open the *Reporting* dialog. From the *Reporting Selection* tab, select the *RTCM Accounting Information* check box. If you do this for the first time, the *Accounting Details* dialog appears at once. If, however, accounting details already exist, you may view and edit them at any time using the adjacent **Details** button.

The accounting files are generated in the same folder structure as the Reporting files. (See the Reporting section in Chapter 3 for details on the folder structure.) You need to specify the drive and root-path for this structure.

Accounting files

For each day, a new accounting file is created and stored in the respective day folder. The accounting file name includes date information: AccountingYYMMDD.txt.

After each dial-in session for any RTCM Generator a new line will be appended to the file AccountingYYMMDD.txt, which contains the summarized information of the respective dial-in session.

Tip – If you want to sum up accounting information over more than one day, you can append the day files to each other. This may help you to analyze the data on a weekly or monthly base.

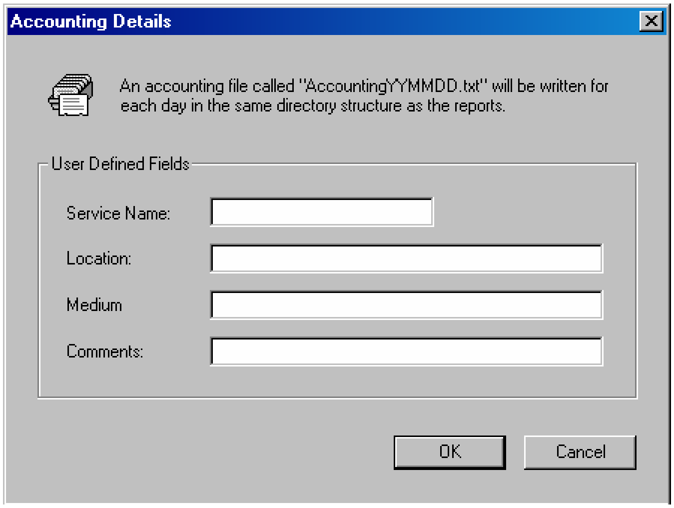
An entry line contains the information in fields that are separated by semicolons. For a detailed description of the records, see Section Data structure.

All RTCM Generators write into the same accounting file. The RTCM Single Station Generator configuration can be found in the data-type related entry field.

Warning –The configuration may have been changed during the session by the operator. In both cases, the last status is reported.

Accounting details

Some details of the accounting record include provider-dependent information. To provide this information to GPSBase using the *Accounting Details* dialog, open the *Reporting* dialog and click **Details**.



The *User Defined Fields* group lets you set the information for all fields that do not contain information that is automatically generated by GPSBase's modules. You may fill in information for the *Service Name*, the *Location* (for example, the location of the GPSBase PC), the *Medium* (for example, GSM) and any comment. The maximum length for the *Service Name* is 15 characters, for all other entry fields it is 255 alphanumeric characters.

Warning – Since semi-colons separate the fields, do not use any semi-colons in any text.

Data structure

Table 8.3 Specification of accounting file records

Field	Source(s)	Specification
Station ID	RTCM Generator	ID of the last station used during a dial-in session.
Date_Start	RTCM Generator	Start of usage - date: DD.MM.YYYY
Time_Start	RTCM Generator	Start of usage - time: hh:mm:ss
Date_End	RTCM Generator	End of usage - date: DD.MM.YYYY
Time_End	RTCM Generator	End of usage - time: hh:mm:ss
reserved	~	~
Service Name	Accounting Settings	Supplier identification. Arbitrary text; max. 15 alphanumeric characters.
Output Type	RTCM Generator	Specifies the RTCM Generator output type selected, such as DGPS, Observations, CMR.
Organization	RTCM Generator, Caller Identification	Contains the user name or organization name as specified in the UserList.txt file.
User Identi-fication	RTCM Generator, Caller Identification	Contains the user identification, which could be the calling phone number (if via AccessServer) or the login account-name (if via Ntrip).
Location	Accounting Settings	Further identification of source. Arbitrary text; max. 255 alphanumeric characters.
Medium	Accounting Settings	Connection to the user, such as GSM, TCP/IP, type of chip card. Arbitrary text; max. 255 alphanum. characters.
reserved	~	~
Number of epochs	RTCM Generator	Number of epochs sent. For example, an update rate of 2 seconds results in 60 epochs for a dial-in session of 120 seconds.

Field	Source(s)	Specification
reserved	~	~
NMEA UID record	RTCM Generator	User identification code 1 of the NMEA UID record from rover, typically a job number. For example: $GPUID,2004-LGN,*hh. Arbitrary text; max. 255 alphanumeric characters.
Comments	Accounting Settings	NMEA position record from rover, followed by a comma-separated, arbitrary text; max. 255 alphanumeric characters.

Using the accounting file

You can read in the accounting file into any accounting software or spreadsheet analysis program (for example, SAP, Microsoft Excel).

Note *– Semi-colons are used as the only valid field separators, since some company names include commas.*

Caller Identification Using SNMP

All RTCM Generator modules can identify the phone number and the user name of an incoming call, when the call is reaching GPSBase via a CISCO Access Server product.

When a user dials in into GPSBase, GPSBase queries the phone number from the Access Server using SNMP. The user name (identification) and the phone number will be displaying in the RTCM Generator's information pane *Status*. It will also be logged to the RTCM Generator report for the dial-in session.

A text-based SNMP configuration file, which the operator of GPSBase can modify, is used to configure the SNMP queries to the Access Server.

Another text-based User List file, which the operator of GPSBase can modify, is used to match phone numbers with user names.

Caller Identification is only available within an RTCM Generator module when all of the following conditions are fulfilled:

- SNMP Service must be installed and started on the computer.
- Connection type must be Socket Server.
- Socket Server must be configured as "Dial-In" connection.
- A valid SNMP Configuration file must be available. For details about the SNMP Configuration file, see below.

- The SNMP Configuration file must contain an entry line which corresponds to this specific RTCM Generator, i.e. the port number of the Socket Server must be identical with the port number specified in that entry.

If any of these conditions are not fulfilled, the Caller Identification will not be available for that specific RTCM Generator module. When the module starts, a green warning message shows up in the output window that informs on the reasons for failure. For example:

```
Cannot use Caller Identification: No entry in SNMP config file
"C:\GPSBase\Config\SnmpConfig.txt" matching my port number 8000
```

Only if these conditions are fulfilled, the *User* field in the *Status* view window of the RTCM Generator displays user name and identifier. Accordingly, you will find the User Name and Phone Number entries in the session reports and the Accounting files.

The SNMP Configuration file

By default, the SNMP Configuration file is located in the folder <InstDir>\Config and has the file name "SnmpConfig.txt". Path and file name can be changed in the Windows Registry.

The SNMP Configuration file is read once when the RTCM Generator module is loaded. Therefore, when the file was modified, the RTCM

Generator module, which is affected by the modification, needs to be restarted for applying the change.

You can edit the SNMP Configuration file using any ASCII text editor (for example, Notepad.exe).

Moreover, since its entries can be separated by TAB characters, one can create that file by exporting from a database or a spread-sheet application (for example, Microsoft Excel) as “tab-delimited” text file.

The following rules apply for the SNMP Configuration file:

- The default file name of this file is "SnmpConfig.txt"
- The default location for this file is in the folder <InstallDir>\config\.
- The file name and path can be changed if that is made known to GPSBase by modifying the Windows Registry key "SNMP Config File" in the Registry location "HKEY_LOCAL_MACHINE/Software/Terrasat/GGSP/RTCM connection".
- A valid entry consists of a line which contains the following entries (further on called tokens) in the given order:
    1. Remote agent IP address (IP address of Access Server)
    2. Community name
    3. SNMP Communications timeout in milliseconds (recommended: **250**ms)
    4. SNMP communications retry count (recommended: **1**)
    5. CISCO Access Server line number (for example: “**31**” or “**2/7**”)
    6. GPSBase port number assigned to the Access Server line number.
- Tokens can be separated by TAB characters (ASCII code 12) or commas.

- There can be as many TAB characters between two tokens as desired, but only one comma is allowed.
- One or more space characters (ASCII code 32) between TABs or commas would be recognized as a separate token. Thus, do not use a mixture of TABs and spaces for formatting this file.
- Leading and trailing spaces are automatically removed from tokens (example: " **token text** " is trimmed to "**token text**").
- Comments start with a '**#**' character and are ignored. There can be separate comment lines starting with '**#**', or comments can be appended to entry lines.
- Invalid lines are ignored. Lines following the invalid line will be read.
- A maximum of 1000 characters is read per line. Text beyond this limit is ignored.

An example of a valid line in the SNMP Configuration file would be:

100.200.300.400 public 250 1 31 20000 # comment

The User List file

The User List file by default is located in the folder <InstDir>\Config and has the file name "UserList.txt". Path and file name can be changed in the Windows Registry.

If no User List file is found at the expected location, the RTCM Generator will use the phone number determined from the Access Server as the "user name".

The User List file is read each time a user dials in, thus it can be modified while the RTCM Generator module is running.

The User List file can be edited using any ASCII text editor (for example, NOTEPAD.EXE). Moreover, since its entries can be separated by TAB characters, one can create that file by exporting from a database or a spread-sheet application (for example, Microsoft Excel) as "tab-delimited" text file.

The following rules apply for the User List file:

- The default file name of this file is "UserList.txt"
- The default location for this file is in the folder <InstallDir>\config\.
- The file name and path can be changed if that is made known to GPSBase by modifying the Windows Registry key "Caller Identification File" in the Registry location "HKEY_LOCAL_MACHINE/Software/Terrasat/GGSP/RTCM connection".
- A valid entry consists of a line which contains two or three entries (further on called tokens) in the following order:
    1. phone number
    2. user name
    3. group name (optional).
- Tokens can be separated by TAB characters (ASCII code 12) or commas.
- There can be as many TAB characters between two tokens as desired, but only one comma is allowed.
- One or more space characters (ASCII code 32) between TABs or commas would be recognized as a separate token. Thus do not use a mixture of TABs and spaces for formatting this file.
- Leading and trailing spaces are automatically removed from tokens (example: " **token text** " is trimmed to "**token text**").
- Comments start with a '**#**' character and are ignored. There can be separate comment lines starting with '**#**', or comments can be appended to entry lines.
- Invalid lines are ignored. Lines following the invalid line will be read.
- A maximum of 1000 characters is read per line. Text beyond this limit is ignored.

Examples of valid lines in the User List file would be:

49810274330, User Name # comment

49810274330, User Name, Group Name # comment

Note that the phone number must be entered into the User List file in the identical format as the Access Server is reporting it using SNMP.

RTController

The RTController module is used to configure a reference station receiver to broadcast the real-time correction data in RTCM and/or CMR format.

When first being added to GPSBase, you must set the properties of the RTController tool. Later you may edit your settings, if you select *Properties* from its shortcut menu (right mouse button). See Section RTController settings.

For the RTController module one page of information exists. See Section RTController information pane. You may remove any module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

RTController settings

The RTController module is available for each Trimble reference receiver. To add the module to the system, right-click the reference station module to open its shortcut menu. Select *Insert Module*. From the *Module Selector* dialog, select the RTController TAM module. The *Real-time Message Transmission* dialog appears.

Use this dialog to configure the broadcast messages.

***Note** – The receiver has to support the RTCM and/or CMR broadcast option. If not, the* Real-time Message Transmission *dialog and its settings pages are grayed out, and the option cannot be activated.*

The dialog is split into two main parts that refer to the settings of RTCM and CMR mode.

RTCM mode

The *Set RTCM Mode* check box of the *Real-time Message Transmission* dialog activates the RTCM correction output mode in the receiver. Use the *On* and *Off* options to start and stop the broadcast.

***Note** – RTCM broadcast formats are available for several RTCM versions: 2.1, 2.2, 2.3, 3.0 and for a 2.2/2.3 combination. For version 3.0, only the* RTK Only *format is available.*

Only if broadcast is set to *On*, the options of this group are available. With the *Format* drop-down list, you may select one from several broadcast formats (see Table 8.4). The formats supported consist of primary and configurable secondary messages. For more information on RTCM messages, see Appendix D, RTCM Messages.

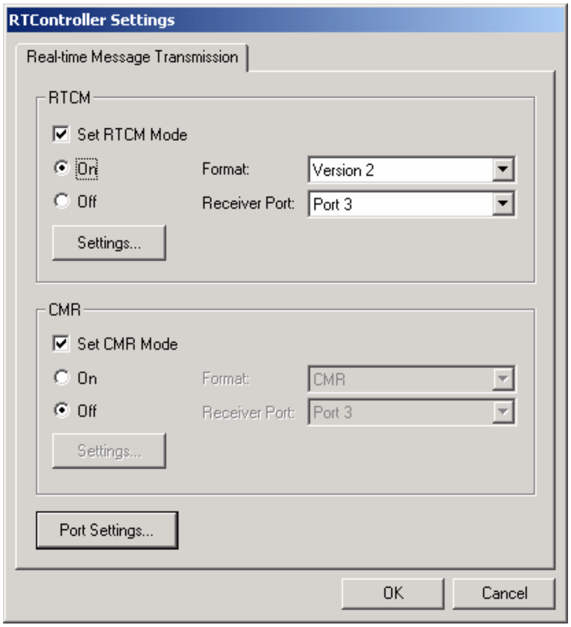
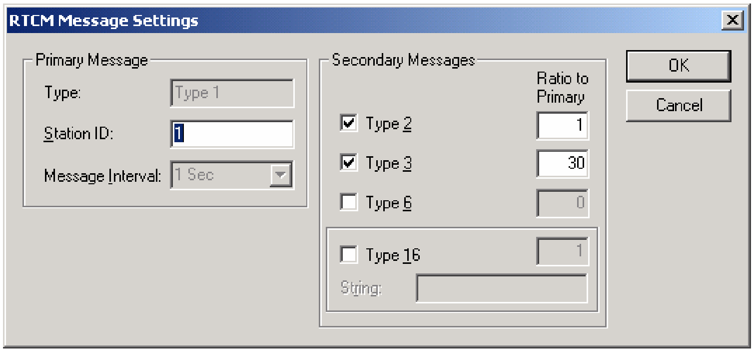


Table 8.4 RTCM broadcast formats supported by RTController

Format	Specification
Version 2	The primary messages are pseudorange (DGPS) corrections.
USCG (9-1) (Version 2.1)	Primary messages are partial DGPS corrections, sent for each satellite separately. They require receivers with high-quality internal clocks, but are useful on very slow data links such as radio beacons.
USCG (9-3) (Version 2.1)	Primary messages are partial DGPS corrections, sent in groups of 3 satellites. They request a wider bandwidth than USCG (9-1).
RTCM+RTK (Version x.x)	Primary messages are both DGPS and RTK corrections.
RTK Only (Version x.x)	Primary messages are uncorrected carrier phases and pseudoranges.

The *Receiver Port* drop-down list lets you select the port to which the receiver outputs the data. It is recommended to first check out for a free receiver port, in order to avoid data overflow on a port.



The **Settings** button opens the *RTCM Message Settings* dialog that lets you configure the secondary messages, station IDs, and so on.

The *Primary Message* group displays the settings chosen by the format and the output interval. The latter depends from the receiver tracking interval. Define the output station ID for the reference station here.

Additionally, RTCM messages of type 2, 3, 6 and 16 may be output, the selection depending on your settings and the receiver's options. If a receiver does not allow outputting a specific RTCM type, it is grayed out. Select the check box of a type in the *Secondary group messages* to select it for broadcast and edit the ratio to the interval of the primary messages. If you have selected message type 16, edit the string to be broadcast in the *String* edit field.

CMR mode

The *Set CMR Mode* check box of the *Real-time Message Transmission* dialog activates the CMR correction output mode in the receiver. CMR is used for RTK measurements only. Identically to the RTCM mode, the *On* and *Off* options start and stop the CMR broadcast.

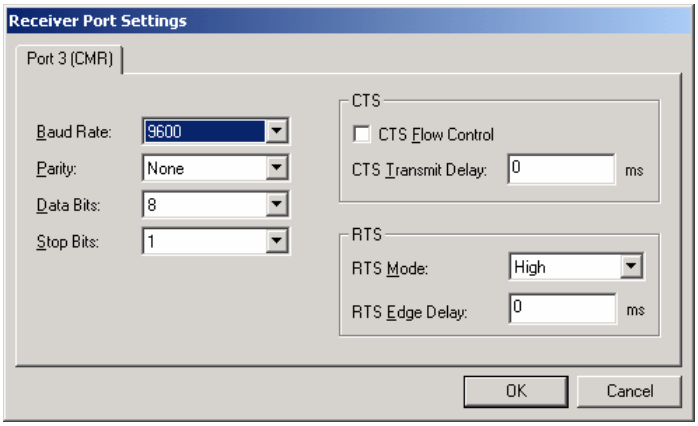
Only if broadcast is set to *On*, the options of this group are available. With the *Format* drop-down list, you may select one from two broadcast formats: CMR and the more advanced CMR+.

The *Receiver Port* drop-down list, again, lets you select the port to which the receiver outputs the data. It is recommended to first check out for a free receiver port, in order to avoid data overflow on a port.

The **Settings** button opens the *CMR Settings* dialog. Here, you set a Station ID (*Station Index)* and can select a time delay tag (*Time Delay*) in milliseconds. The default time delay is 0 milliseconds. Both settings can be used by the rover to distinguish data sent by multiple reference receivers.

Receiver Port Settings

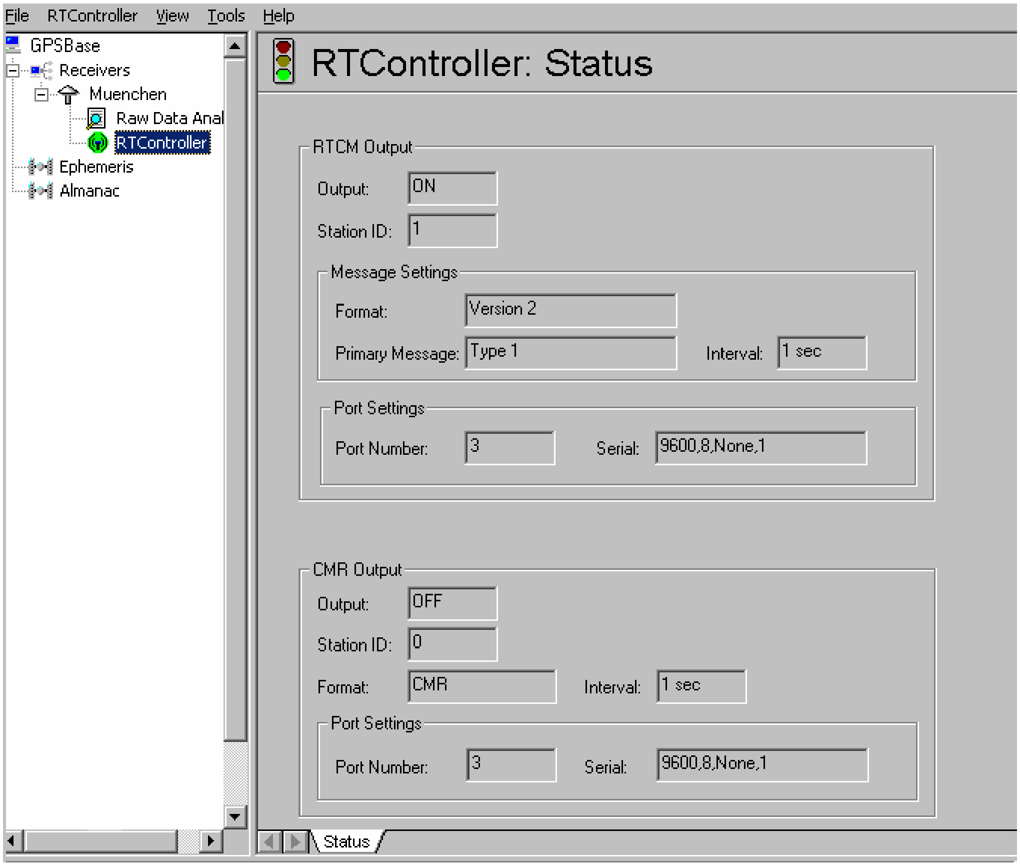
Only if at least one of the broadcast modes is selected and set to *On*, the **Port Settings** button is available. Click it to open the *Receiver Port Settings* dialog. This dialog lets you define the parameters of the receiver port that broadcasts corrections.



The pages of the *Receiver Port Settings* dialog refer to the port(s) selected for the broadcast mode(s). For each port, you may define the communication parameters, such as the baud rate, the parity type, the number of data bits and the number of stop bits. The *RTS* and *CTS* groups let you modify flow control parameters, if supported by a receiver. For more information on these parameters, refer to your receiver manual.

RTController information pane

The *Status* information page of the RTController module displays in two groups the current parameters for RTCM and CMR Output. Most of the information in both groups is similar: You can see, whether data output is *On* or *Off* (*Output*), the *Station ID*, the data format (*Format*) and the output interval (*Interval*), which depends on the tracking interval.



The port number and settings are displayed in the *Port Settings* group. For RTCM Output, you will additionally find information on the primary messages chosen.

CHAPTER

9

System Monitoring and Control

In this chapter:

- Introduction
- Alarm System
- Disk Watch
- FTPMirror
- Watchdog

Introduction

Monitoring and controlling a server system like GPSBase is a very important issue. While so many different modules are running in parallel on a permanent basis, an automatic process of administrating the reference station system is required. This can be either an alarm system issuing alarms when certain thresholds are reached, or automatic file transfer to different locations on a scheduled basis, or even a file storage system controller. This chapter describes the aims and functionality of monitoring and controlling modules.

Alarm System

The automatic alarm system is an essential part of GPSBase. Currently, the following alarms can be set and configured:

- *Disk Watch*: Low disk space
- *Receiver Module*: No data from receiver, switched to backup communication link, temperature, voltage or tilt angle exceeds threshold
- *Raw Data Analysis*: Inconsistent data from receiver
- *GPSBase*: Low virtual memory

If one of the above modules reports an error, an alarm window pops up. Once an alarm is issued based on the individual configuration, GPSBase supports these actions to perform after the alarm is issued:

- *None*
- *Issue alarm sound*
- *Send e-mail*
- *Send compact e-mail*
- *Send modem command*
- *Send boot command to power switch*
- *Run batch file process*

- *Send alarm to socket or serial line.*

The Alarm module is available from the navigator root item *GPSBase*. When you first add the module and no mail server configuration is enabled, the *SMTP Mail Transport* dialog appears. Use it to enable the connection to the SMTP mail server (for details, see Chapter 3, Section Mail Server Configuration).

The default action of the Alarm module is a pop up *Alarm* dialog window. It displays the last (up to) five alarm messages. With **OK**, you just accept the warning and the dialog will close. With **View Alarm**, the alarm dialog will close. (If you select the *Do not show this dialog* option, the *Alarm* dialog will not show up any more.) Additionally, the focus will change to the *Alarm* information pane.

Tip – You may toggle the display of the *Alarm* dialog: Open the shortcut menu of the Alarm module and select *Alarm Message Pop-up*. The *Alarm* dialog will only show up if the command *Alarm Message Pop-up* is selected.

For any other action, first add a set of alarm settings, which define the action that shall be taken when an alarm is received. These alarm settings can be set and removed from the first tab of the *Alarm* information pane.

If Reporting is activated, Alarm will create three reports. You can view the reports by opening the files Alarm*.xml in your Internet explorer. For more information on the reports, see Appendix G, Reports.

You may remove the module at any time from GPSBase: Open its shortcut menu and select *Remove module*.

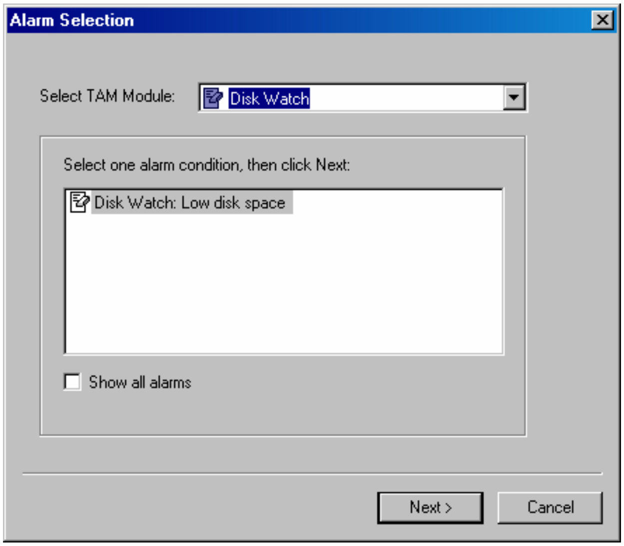
Setting alarms

To add, remove and configure individual alarms, go to the *Settings* tab of the Alarm information pane.

Click **Add** to add a new set of alarm parameters to the list. You may remove any obsolete alarm: Set the focus on the respective list entry and click **Remove**.

Alarm selection

When you have clicked **Add**, the settings wizard appears with its first page *Alarm Selection*.

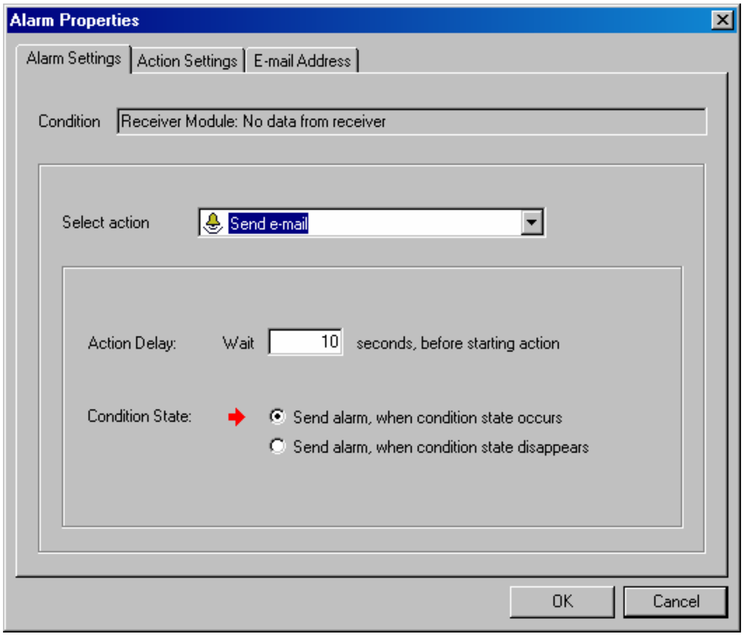


The page displays all alarm conditions that may urge alarm messages. Generally, the alarm conditions are grouped according to the module issuing the alarm. Therefore, first select the respective module from the *Select TAM module* drop-down list, then select the name of the alarm condition in the list field (left mouse button) and click **Next**. By enabling the *Show all alarms* check box, all available alarm conditions will be displayed, independently from the module that triggers the alarm.

Alarm settings

For detailed configuration, just follow the wizard to the next page *Alarm Setting*. It is the main control of actions triggered by the alarm.

Parameters like the condition state that triggers the alarm, the type of action selection and an alarm action delay can be fed within the wizard page.



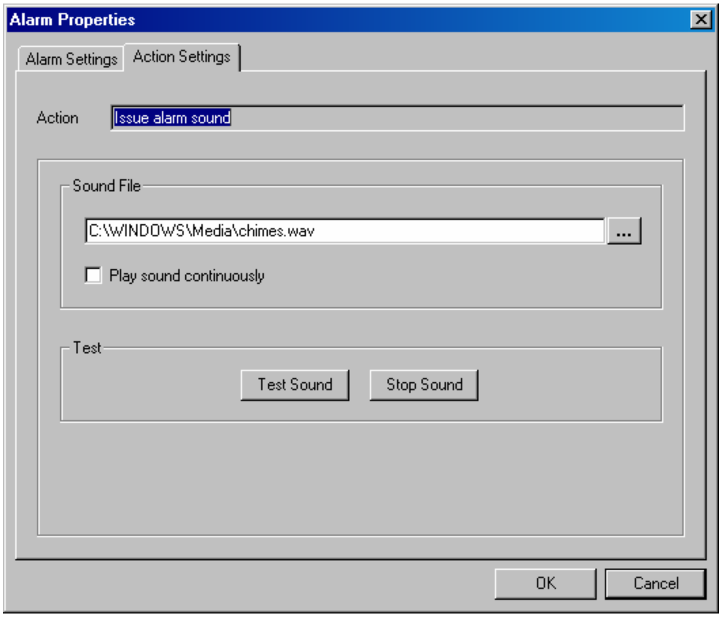
In some cases, it does make sense to send an e-mail to the system administrator to have him informed about the current state situation of the application. There might be some other conditions where you do not need to interfere or have the administrator informed, but you would like the system itself to handle the problem automatically. Therefore, GPSBase offers different types of actions. The subsequent pages of the wizard depend on the action selected.

You may define a time delay before the selected action is executed. This option may help to avoid superfluous alarms.

Send an alarm when the condition state occurs or when it disappears? For example, the condition is ‘Station not available’: the condition state occurs, if the receiver module receives no data from the reference station. As soon as data is received again, the condition disappears. If you want an alarm to be sent in both cases, add another set of alarm settings.

With no action (*None*) selected, finish the definition here (click **Finish**). Otherwise, a third wizard page pops up which depends on the selected action. See the following sections.

Alarm sound settings



For the *Issue alarm sound* action, the *Action Settings* page lets you select the sound file from your hard disk. To test the sound, click **Test Sound**. Click the **Stop Sound** button to stop the test sound, if the sound is set on *Continuously*.

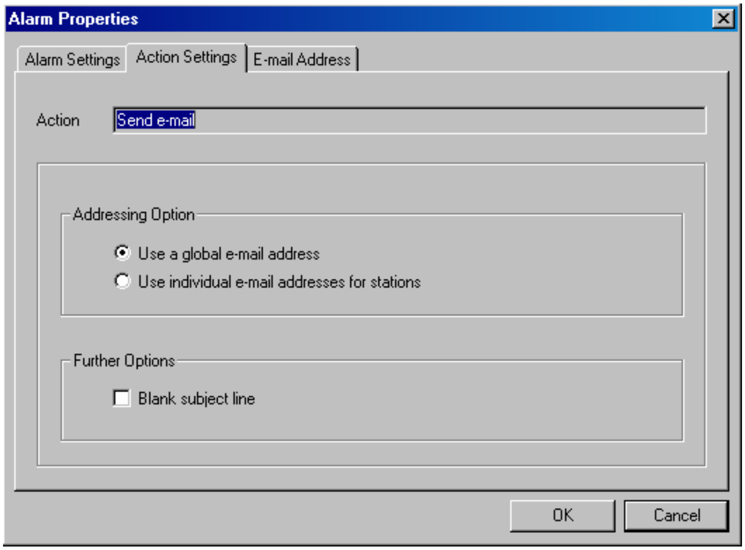
If you select the *Play sound continuously* check box, make sure the popping up of the alarm dialog is active, since a triggered sound will not stop until one of the following happens:

- The alarm condition is not true any more, or
- You accept the alarm at the alarm dialog; click **OK** or **View**.

To finish the definition, click **Finish**.

E-mail and compact e-mail alarm settings

For the actions *Send e-mail* and *Send compact e-mail,* the *Action Settings* pages are almost identical. The chosen action type is displayed in the *Action* field. When an alarm is triggered an e-mail is sent to the recipient(s) specified here. Compact e-mails summarize the alarm information in their subject line only, without any additional text in their body.



Tip – The action type *Send compact e-mail* is especially useful for messages to a mobile phone, if the mobile phone provider supports e-mailing.

Note – *For both action types, a mail server must be configured. To do so, select from the main menu the* File / Configure Mail Server *command. For detailed information on the configuration see the Mail Server Configuration section in Chapter 3, Getting Started.*

Use the *Addressing Option* group to select whether all e-mails issued by this alarm go to the same recipient(s) (select *Use a global e-mail address*) or whether to use different e-mail addresses depending on station numbers (select *Use individual e-mail addresses for stations*). Depending on the selection here, the content of the *E-mail Address* tab varies.

Tip – If you are setting up an alarm for a module not referring to reference stations, such as the Disk Watch module, make sure you select the global e-mail address. Individual e-mail addresses require station ID information derived from the Receiver module.

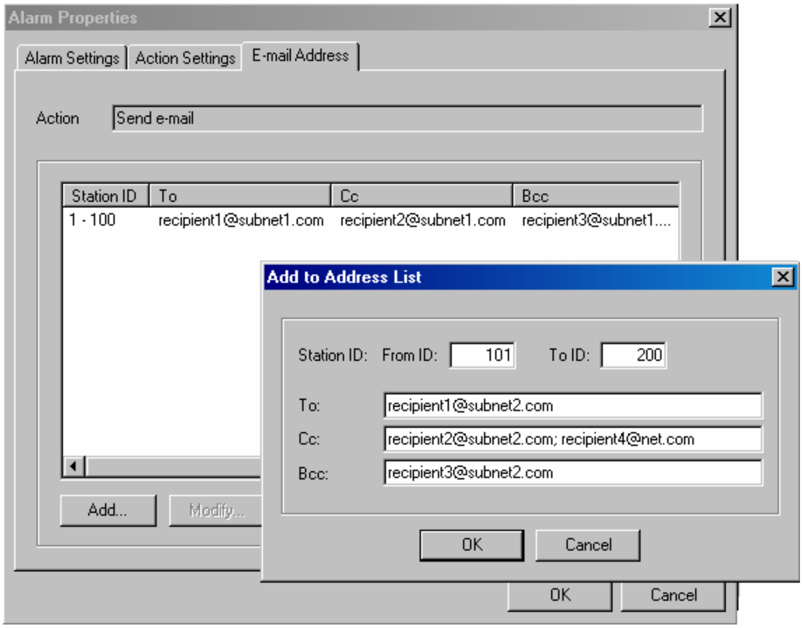
With the action type *Send e-mail*, the resulting e-mail displays the subject *Alarm Notification!* The letter's body then contains the warning condition as well as the condition state (*Alarm* or *Fixed*). With the *Blank subject line* option selected in the *Further Options* group, the subject line will be blank. This option only refers to the *Send e-mail* action type, since *Send compact e-mail* action type will use the *Subject* field to inform the recipient of the alarm and will not show any text body.

Use the *E-mail Address* page to define the e-mail address(es) of the recipient(s). With a global mail address selected, the page lets you edit the *To*, *Cc* (copy), and *Bcc* (Blind copy) fields. You may test the connection using the **Send Test E-mail** button.

If you need to inform different recipients about the alarm, select the *Use individual e-mail addresses for stations* option in the *Action Settings* dialog. In this case, the *E-mail Address* dialog lets you edit a list of e-mail addresses.

Select **Add** to open the *Add to Address List* dialog. Define the station (station number between 0 and 1023), edit the recipients (*To*, *Cc* and *Bcc* fields) and accept. For changes in the entry, double-click the entry in the list. To remove an entry activate it (multiple selection is possible) and click **Remove**.

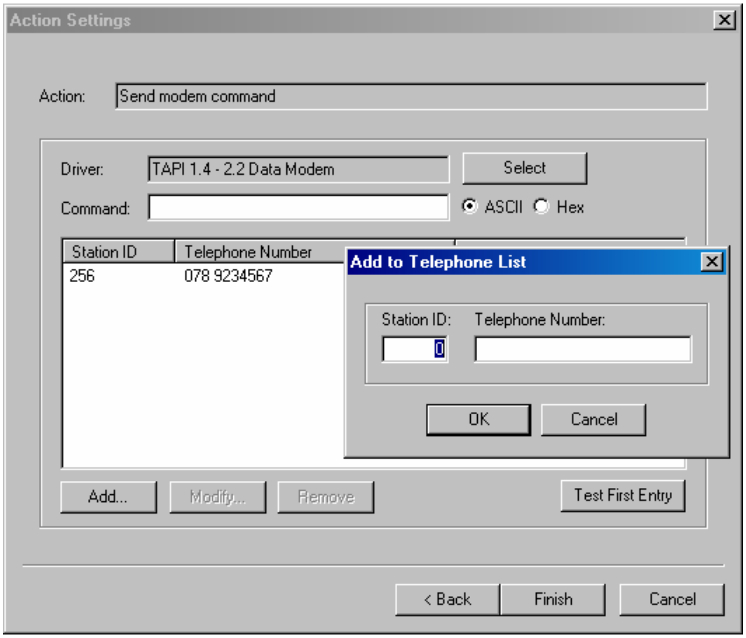
***Note** – The dialog makes sure that station IDs are unique. If you need to setup an identical alarm type and to add further mail addresses,* *add the recipient to the Cc-list or add another alarm to the list of alarms in the main view of the Alarm module. For example: if you define alarm notification to Administrator A for stations 1…4, but want Administrator B to be notified if station 3 fails, then you should define two similar sets of alarms using different e-mail addresses.*



To finish the definition, click **Finish**.

Modem command settings

This action will send a specified command via modem to a remote modem device. For example, sending a boot command via modem to a TimeOut 2400, it will interrupt the power supply and the connected device like a GNSS receiver will reboot. When you first set this option, click the **Add** button at the *Action Settings* dialog. In the *Add to Telephone List* dialog set the ID and the telephone number of the remote station. Click **OK**. Optionally, use the *Command* edit field in the *Action Settings* dialog to key in the AT commands (select whether as ASCII or HEX) you want to send.



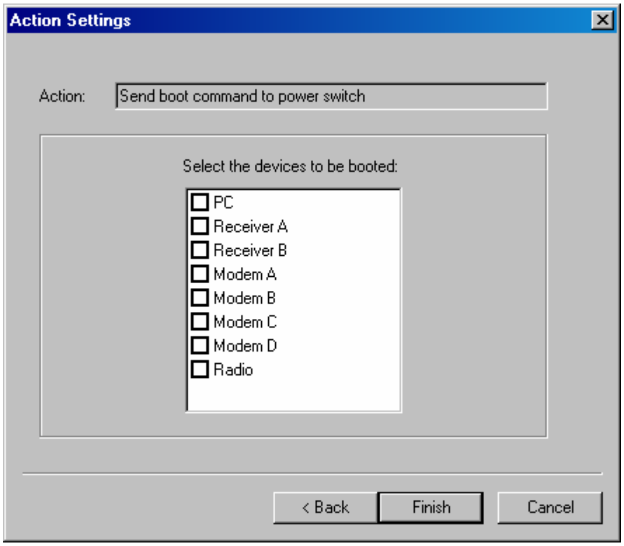
Click **Select** to define the modem connection. The standard configuration dialogs for a connection to a device pop up. They will allow you to select a driver DLL and to configure the connection. These settings are written into the registry. They are valid for all modem actions. They are viewed and edited using the shortcut menu command *Properties* of the Alarm module. See the View and Change Alarm Properties section.

Tip – For detailed information on driver selection and configuration settings, see Chapter 5, Communication Control.

Use the **Test First Entry** button to see whether the connection defined in the first entry in the list is working fine. To remove a modem connection, select the respective line in the list field of the *Actions Settings* dialog and click **Remove**.

To finish the definition, click **Finish**.

Boot command to power switch settings



This action will send a boot command to a remote power switch (for example, a WTI NPS 230) once an alarm is issued. Since the power switch supports several devices (plugs) you can select which device is to be booted using the *Action Settings* dialog and selecting the respective check box. To finish the definition, click **Finish**.

Tip – Use the Watchdog module to make your power switch device known to the GPSBase system. For example, the plugs must be defined when installing the Watchdog module for the power switch.

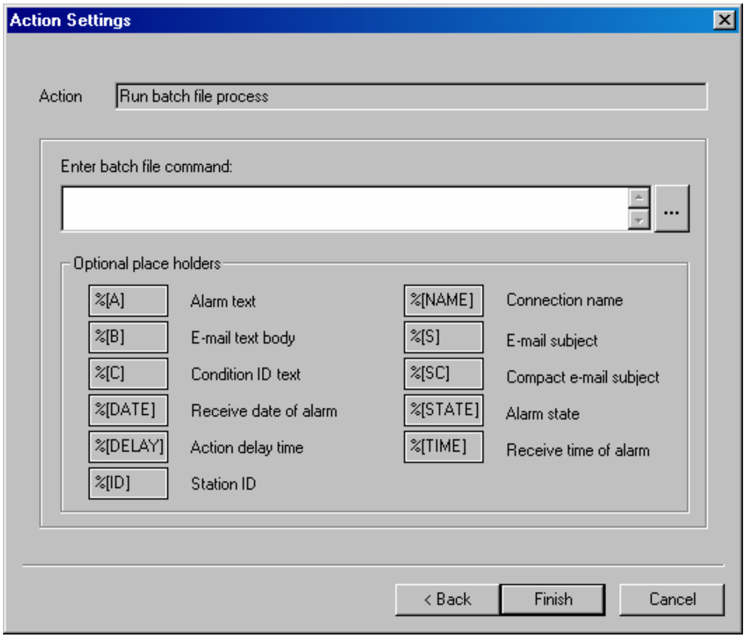
Running a batch file or an executable process

Select the *Run batch file process* alarm type, if one of the following actions is to be performed in case of an alarm:

- Running a batch file,
- Running an executable file.

The *Action Settings* dialog lets you define the file (executable or batch file). Enter the path to the file in the edit field or use the browser button to search for it.

To pass parameters to the batch files or executables use the placeholders offered in the dialog. They will be filled with the appropriate text at execution time, such as the alarm text, the connection name, and so on. To insert a placeholder, you can click the respective icon in the dialog or key it in. Use empty spaces to separate placeholders from each other or from other commands. To finish the definition, click **Finish**.



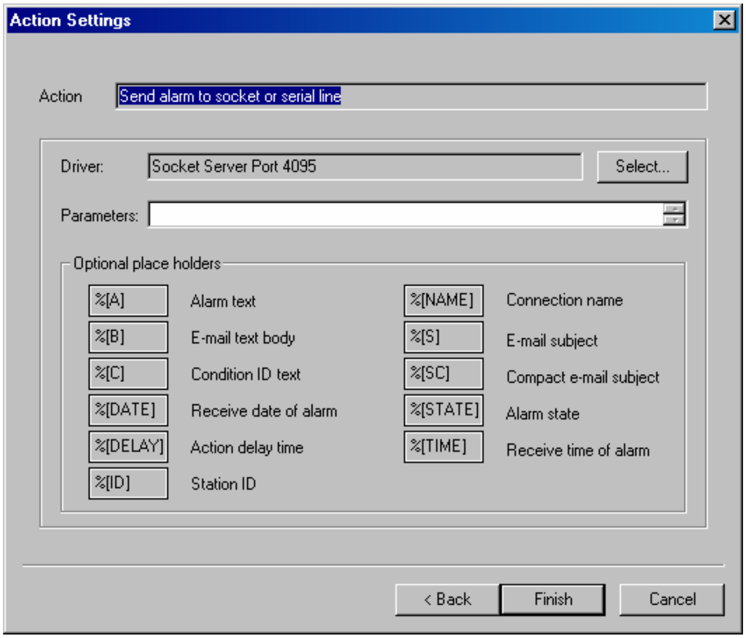
Send alarm output to socket or serial line

Select the *Send alarm to socket or serial line* action type, if you need an individual type of action. This command outputs the data specified by placeholders to an outgoing port. Then you can connect to this port and proceed with the data as needed.

Click **Select** at the *Action Settings* dialog to select the output port from the *Driver Selector* dialog. Available drivers are:

- Serial Port Handler
- Socket Server
- Socket Client

For detailed information on how to use the driver selector and to set up connections, see the Drivers section in Chapter 5, Communication Control.



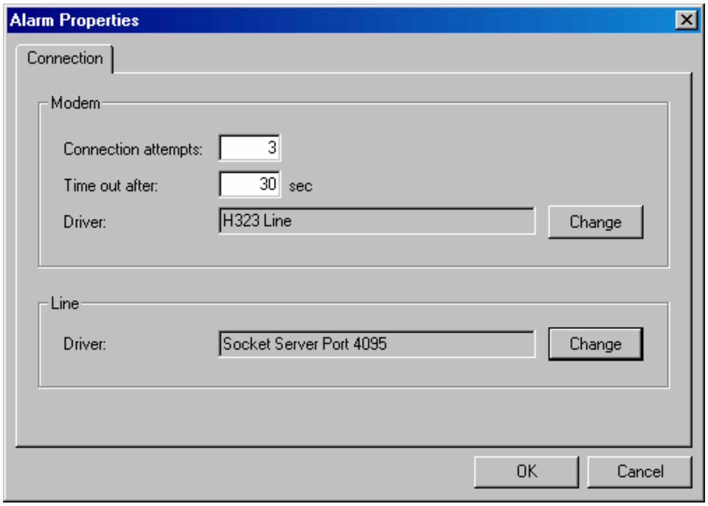
The *Select parameters* edit field lets you define the contents of the output stream. Use the placeholders as displayed beneath the edit field. To finish the definition, click **Finish**.

View and change alarm properties

To view and edit condition settings, go to the *Settings* tab of the Alarm information pane and double-click the condition entry to open its *Properties* dialog. The settings displayed here refer to the specific set of settings only.

For all conditions that trigger an action on an outgoing port, however, there are common settings for the connections. These are available using the shortcut menu command *Properties* of the Alarm module. It opens an *Alarm Properties* dialog with the single page *Connection*.

***Note** – The Alarm module properties are only available, if you have already selected a driver for a specific action type. Action types that need a driver configuration are the* Modem command *and the* Send alarm to socket or serial line *actions.*



Use the *Modem* group to view and change the modem settings, while the *Line* group matches the settings for the *Send alarm to socket or serial line* action.

To define how often the module tries to connect to the modem client if the first attempt fails, edit the *Connection attempts* field. The default value is 3 (three attempts). Any connection attempt is stopped after the period in seconds defined in the *Time out after* edit field. The default value is 30 seconds.

The *Driver* edit field lets you view the current driver. To change the driver DLL or connection settings for one of the action types (Modem or Line) click the **Change** button next to it. The Connection Wizard dialogs appear. Use them to set your changes.

All edits of the *Connection* dialog will be written into the registry as soon as you click **OK**.

Alarm information pages

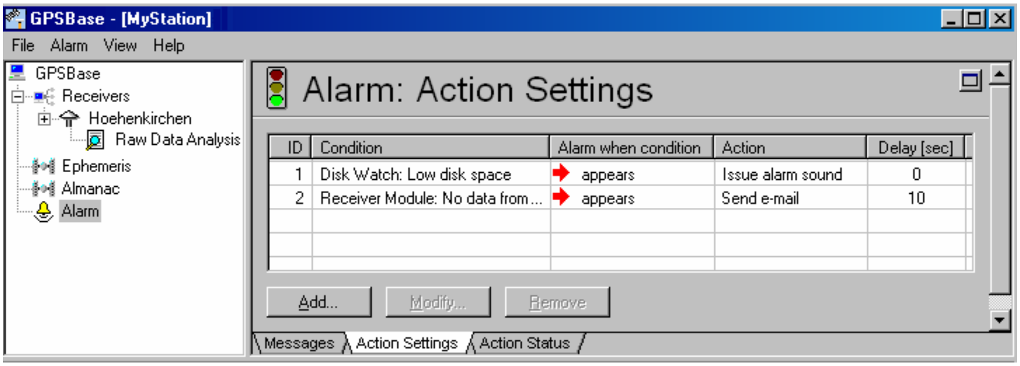
For the Alarm module, three information pages exist. You may select them by clicking onto the tab on the bottom of the information pane.

Alarm – Tab Messages

The *Messages* information page displays the last 100 messages that have occurred since the start of the Alarm module. They are saved to the report file Alarm[]Received $*.XML. If an alarm was configured to start an action, a report file will be saved as Alarm[]Issued $*.XML.

Alarm – Tab Action Settings

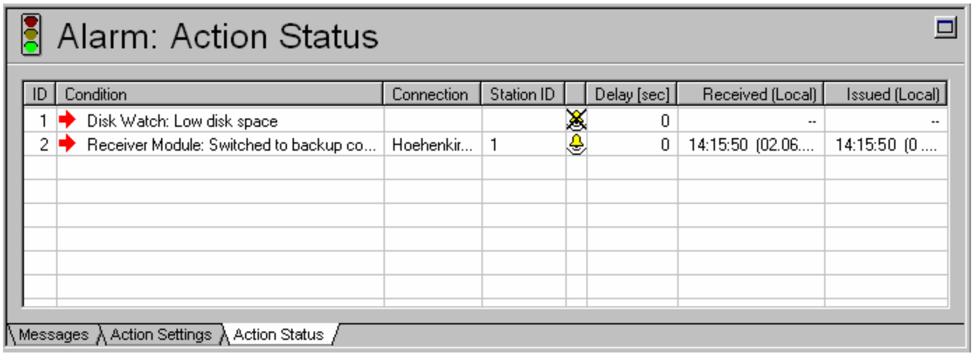
The *Action Settings* information page lets you define and remove any number of alarms. (How to add an alarm is described in detail in Section Alarm settings.) Its list field displays the list of conditions, for which an alarm is set, its condition state, the chosen action and the time delay before the action is started.



For each condition, you may edit its settings: double-click the condition entry to open its *Properties* dialog. Here, the *Alarm Settings* and *Action Settings* pages let you change the parameters.

Alarm – Tab Action Status

You may view the status of alarms on the *Action Status* page. For each defined condition the connection name and station ID, an alarm status identifying icon and the times are given, when the last message was received and when the last alarm was issued. If an alarm message was received recently and a time delay is defined, the column *Delay [sec]* will count down until the alarm is executed.

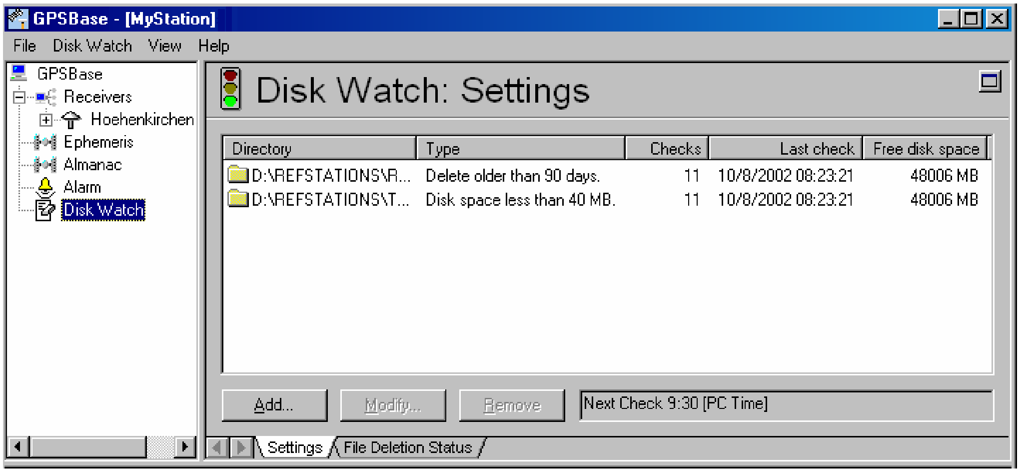


Disk Watch

The Disk Watch module lets you administrate and maintain the data storage on a permanent and automatic basis. It is available from the navigator root item *GPSBase*.

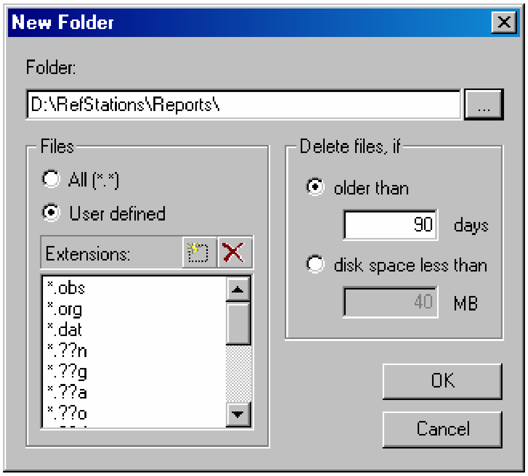
The module displays the *Settings* and *File Deletion Status* information pages. The latter displays status information and lets you run a job immediately. To clear the contents from the display, click into the page and select the shortcut menu command *Clear Window*.

When the module is first being added, the *Settings* page is empty. You must configure jobs first, before the Disk Watch module can start a check. You also may remove a job from here.



Click **Add** to open the *New Folder* dialog. Enter the name of the folder or use the browser button to the right side of the edit field. Select in which case files should be deleted:

- If they are older than x days (enter a value for x)
- If the remaining disk space is less than x MB (enter the value for x). In this case, the oldest files of the selected folder and all its subfolders will be deleted until at least the given minimum disk space is available again.



Tip – As Disk Watch is checking the defined drives every hour, the threshold limit for minimum disk space should be two times the amount of data your system is creating and storing during this period.

You may even define the type of files that will be deleted in both cases: The *Files* group gives you the choice of selecting:

- All (*.*): All files of the folders will be deleted.
- User defined: You may enter a selection of file extensions. Only files with that extension will be deleted: By default, the list contains the files of the type which are created by GPSBase (i.e. .org, .dat, .??n, .??g, .??a, .??o, .??d, .tmp, .zip, .evl, .log, .xml, .jpg).

You may modify this list to fit your needs: Highlight the respective extension and click the little cross shaped **Delete** button. To add a file type to that list, click the rectangle-shaped **Add** button and then enter the file type into the now displayed edit field.

Warning – Make sure that when using wildcard no other files will be selected and deleted, which shouldn't be deleted.

If you have added a job, the list field will display the folder name and deletion type of the job. After the delay of one hour and then every 30 minutes after the full hour, the Disk Watch module changes its status (watch the traffic light) to yellow and checks the given folders. To immediately run the functionality, click the **Run now** button from the *File Deletion Status* page.

If you double-click onto a folder entry or click the **Modify** button, you may edit and customize the settings of the activated job. To remove a job from the list displayed on the Disk Watch *Settings* view, highlight the respective job and click **Remove**.

The *Checks* field displays the number of checks performed since the start of Disk Watch. As soon as at least one check has been performed, the *Last Checks* field displays the date and time of the last check. Then, the *Status* field displays a status message, such as `OK!`

You may remove the module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

FTPMirror

The FTPMirror module is an enhanced built-in FTP client which lets you transfer files and contents of a local hard drive folder (including its subfolders) to a predefined folder on a FTP server. In customized intervals, the FTPMirror builds up connections to a FTP server and transfers the data. FTPMirror is especially designed for transferring files to destinations in other LANs or WANs behind the firewall.

The FTPMirror module is available from the navigator root item *GPSBase*: Right-click to open its shortcut menu and select *Insert Module*. You may remove the module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

When first being added to GPSBase, no connection is known to FTPMirror. You must first add a set of connection settings, called connections. The connections can be added using the *Active Sites* page of the FTPMirror information pane.

FTPMirror information pane

The *Active Sites* page displays a list of all defined connections. For each connection the following information is given:

- Status and name of the connection, where

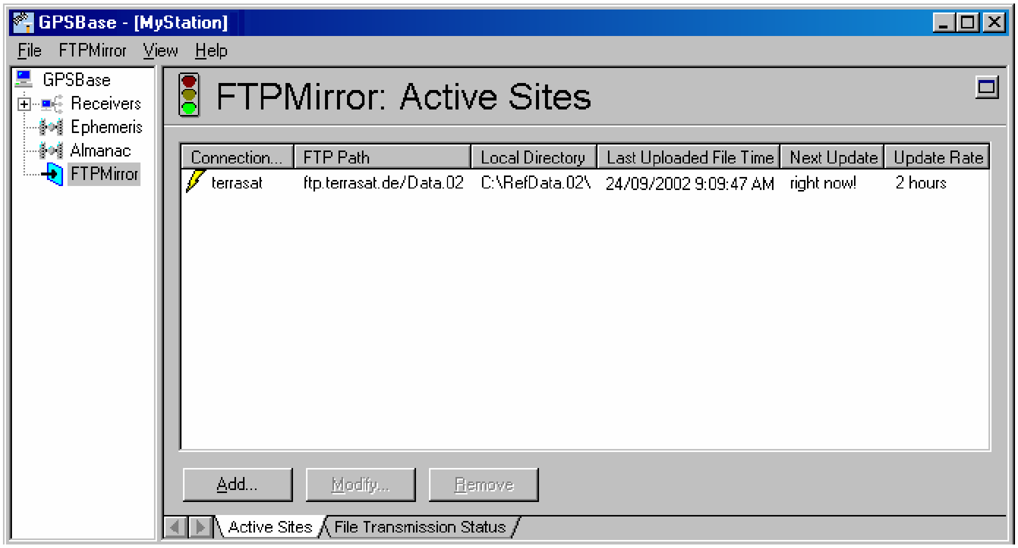
  Green: Idle

  Yellow: Running – Data transfer

  Red: Connection failed
- FTP path
- Path and name of the source (local) folder
- Date and time of last data transfer (*Last update*)

- Date and time (computer time) of next data transfer (*Next update*)
- Update rate.

As long as the status is green, you may change the settings of the connection: Double-click the connection name to open the *Connection Settings* dialog of the connection.



The buttons allow you to add new connections (**Add** button, see following paragraphs) and to remove a connection: Set the focus of the connection to be removed and click **Remove**.

You can cancel the current upload of a running job: right-click the connection in the list and then select *Abort Uploading* from its context menu. This action just cancels the current upload, but keeps the connection. Other jobs will remain untouched. To cancel ***all*** running jobs at a single blow, go to the *File Transmission Status* tab and select from its context menu the *Abort all Uploading jobs* command.

The *File Transmission Status* tab gives you detailed information on the current state of file transfer to the FTP server. This information can additionally be saved to the log file FTPMirror.log. To clear the contents from the display – not from the log file – click into the page and select the shortcut menu command *Clear Window*.

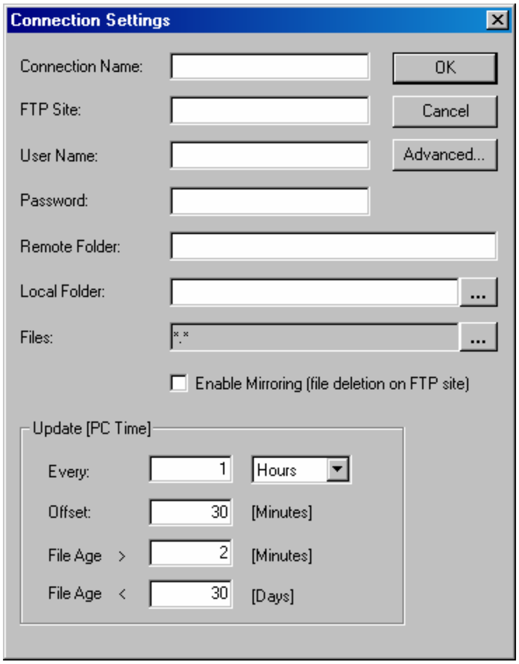
Logging the file transfer

The current state of file transfer is by default logged into the log file FTPMirror.log which is located in <installdir>\Logfiles\. New information will be appended to this file.

The FTPMirror module's *Use Logfile* shortcut-menu command lets you toggle between writing into the file (the checkmark is set) or not writing.

FTPMirror settings

To add a new connection, click **Add**. The *Connection Settings* dialog appears.



The *Connection Settings* dialog lets you enter a new connection name in the *Connection Name* field. Additionally, you can edit the following:

- The name of the *FTP Site* (mandatory)
- The target folder on that site (*Remote Folder*)
- The path to the source folder at your computer (*Local Folder*) – If you use the browse button, you can either select from existing folders or create a new one: Click **Make New Folder**. Note that all subfolders will be included automatically for transfer! (Mandatory.)

  Note *– Changing the local folder after uploads to the FTP server have already been performed resets the* Last Uploaded File Time *entry for this connection, since the new source folder may contain files that have never been copied before.*

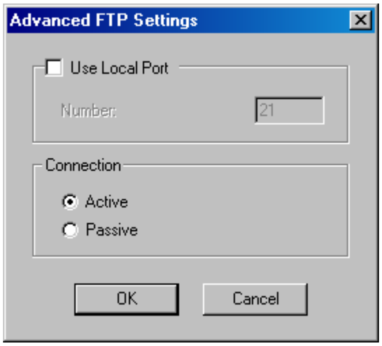
- *User Name* at the FTP site
- *Password* at the FTP site
- *Enable Mirroring* – The following happens if this option is selected: If any files or subfolders do not exist anymore on the local source folder, they are deleted as well on the remote ftp site, independent on the file mask configured in the FTPMirror module. By default the option is not selected. In this case, existing files on the FTP site persist until you delete them manually there.
- The *Update* group includes the settings for the file transfer to the FTP site:
  - *Every*: The transfer interval (update rate) for data transfer: Select the unit (*Minutes*, *Hours*, *Days*) and enter a value in the *Every* edit field. The default transfer interval is every (1) hour.
  - *Offset*: An offset in minutes to the full hour. The default value is 30 minutes (i.e., data transfer starts at half past ...).

- *File Age* >: A minimum file age in minutes for files to be transferred to the FTP server. Files with a time difference of file date and current date less than the value given here, are not transferred. The default value is 2 minutes.
- *File Age* <: A maximum file age in days for files to be transferred to the FTP server. Files with a time difference of file date and current date greater than the value given here, are not transferred. The default value is 30 days.

***Note** – Increasing the maximum file age after uploads to the FTP server have already been performed resets the* Last Uploaded File Time *entry for this connection relatively to the* Next Update *entry, since some files may not have been copied yet. For example: If the next upload is due at Dec, 12th and you increase the maximum file age to 10 days, the* Last Uploaded File Time *entry will be reset to Dec, 2nd.*

The *Files* browser button opens the *File Selection* dialog. By default, files of all types will be transferred from the selected folder to the FTP site. To make a selection of files, select the *User defined* option, and then select from the list of file extensions. Only files with that extension will be transferred: By default, the list contains the files of the type which are created by GPSBase (i.e. .org, .??n, .??g, .??a, .??o). You may modify this list to fit your needs: Highlight the respective extension and click the little cross shaped **Delete** button. To add a file type to that list, click the rectangle-shaped **Add** button and then enter the file type into the now displayed edit field.

Based on the FTP Server configuration settings, you may customize the port number and the connection mode for your FTP client session. Click **Advanced** from the *Connection Settings* dialog. The *Advanced FTP Settings* dialog appears.



The default command port number for FTP sessions is the port number 21. Select the *Use Local Port* check box to edit the *Number* field to define a different port number.

If a FTP server is configured as a default FTP, you should enable the *Connection* option *Active* for your FTP client session in the FTPMirror module. If the FTP server is configured for passive mode only, configure the FTP client session accordingly: Select the *Passive* option. You will find detailed information on the connection modes in the following section. Click **OK** to activate the updated connection.

Default (active) and passive mode FTP

When dealing with firewalls and their configuration, the most commonly seen question is with respect to FTP, if we are using a passive mode FTP connection or not. If there is no firewall between the FTP server and its clients, the server actually makes the connection to the client. This is the default (active) mode. In passive mode, the FTP server provides a data connection through a firewall and listens to a connection from the client.

The following figure shows the difference between these two modes.

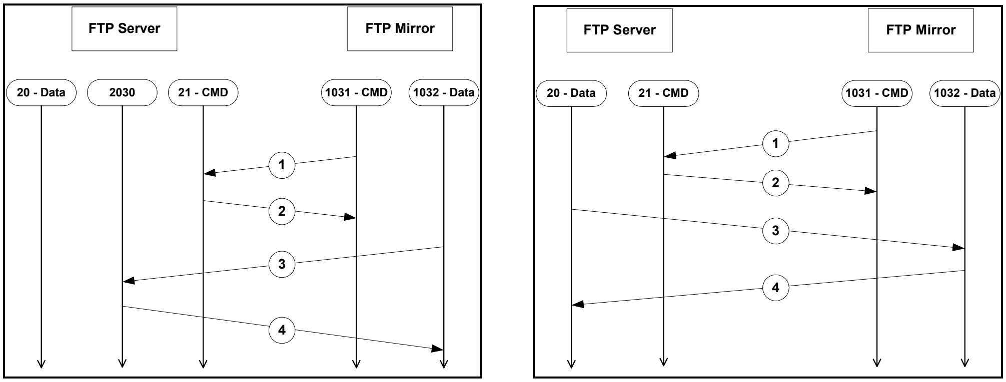


Figure 9.1 FTP connection in default (active) mode (left) and passive mode (right)

Watchdog

As the whole reference station system is a complete conglomerate of so different software and hardware spread over large areas, it is useful to be able to automatically re-start modules in case of failure.

Monitoring computer activity

The Watchdog functionality can be used for the supervision of GPSBase activity. If GPSBase does not react anymore, the watchdog hardware toggles one or two relays. These may, for example, restart the computer or disconnect an external modem based on the configuration.

If Watchdog is activated, GPSBase constantly triggers a counter on the watchdog. If GPSBase runs properly, the program resets the timer. If GPSBase does not react any more due to, for example, operating system failure, it will not reset the counter. In this case, the watchdog waits for a predefined time and then switches a relay (watchdog event) to reset the computer or to trigger an alarm. At present time, three watchdog devices are supported by the Watchdog module:

- QUANCOM PWDOG 1 (PCI slot card)

- QUANCOM WATCHDOG 2 (ISA slot card)
- TimeOut 2400 (external).

The internal Quancom cards must be connected to the computer's internal reset button.

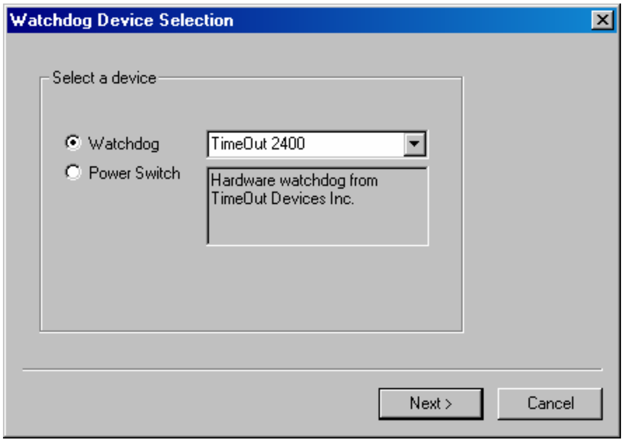
The external TimeOut 2400 device interrupts power supply of the connected computer. In addition, the TimeOut device can be accessed and controlled using a separate telephone line. For detailed description on the installation and features of each watchdog, refer to its user manual.

Besides the watchdog cards, you can attach and connect external multiple relay (power switch) devices like

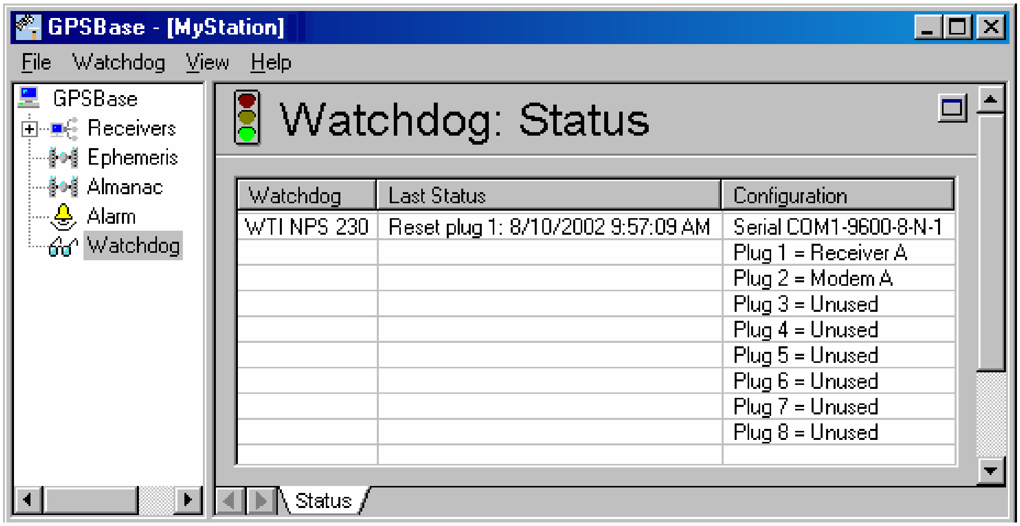
- Black Box Pow-R-Boot 5
- Black Box Pow-R-Boot 5+.
- WTI NPS 230

These devices allow you to control external components like receivers or modems – you may boot the power supply and turn the devices on or off.

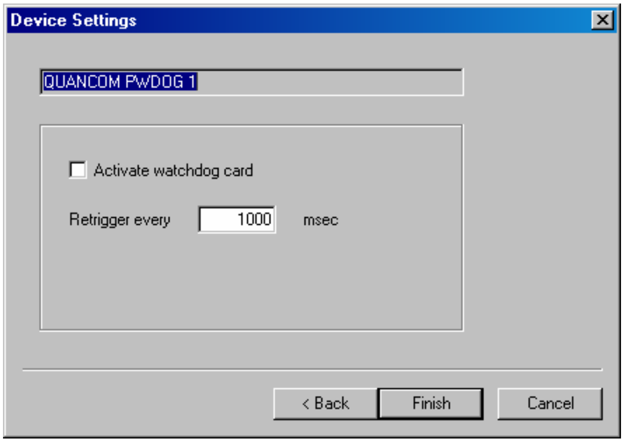
The Watchdog module is available under the GPSBase root module by selecting *Insert Modules*, selecting *Watchdog* from the *Module Selector* dialog and choosing the hardware used in your setup from the *Watchdog Device Selection* dialog. If the *Watchdog* option is selected, the list lets you select from watchdog devices; if you select the *Power Switch* option, the multiple relay devices become available for selection from the list. What happens then depends on your selection. See the following sections for each hardware component.



After you have clicked **Finish**, the Watchdog module appears in the navigator. Its single information page *Status* displays the triggering and configuration parameters of all attached devices.



QUANCOM Watchdog cards



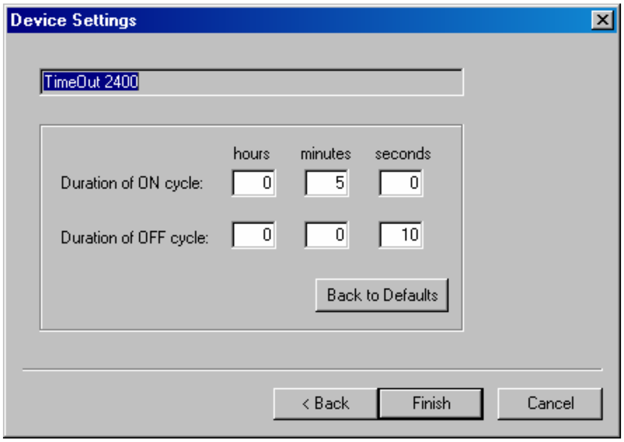
If you have successfully installed one of the QUANCOM PWDog 1 (PCI) or QUANCOM Watchdog 2 (ISA) cards, you can choose and pick the device from the list. Click **Next**. The *Device Settings* dialog appears. Only if the *Activate watchdog card* check box is selected, your Watchdog card is active and will perform system monitoring. If monitoring is disabled, the Watchdog card will not be operating although the module is loaded. In addition make sure that the triggering interval (milliseconds) matches and is identical to the interval set on the Watchdog card. The default value is 1000 milliseconds.

TimeOut 2400

If the TimeOut device was installed successfully, you can now configure the Watchdog module for TimeOut 2400 in GPSBase. Click **Next**. The *Device Settings* dialog appears.

TimeOut sends a request to GPSBase in specified time intervals (for example, every 5 minutes) and expects within short time (for example, 10 seconds) a reply (break) from GPSBase. If GPSBase does not answer within the time specified the TimeOut device disconnects/connects power, which forces the server to reboot.

The *Device Settings* dialog lets you specify the time values: the time interval between two requests (*duration of ON cycle*, by default 5 min) and the maximum time for GPSBase to reply to a request (*duration of OFF cycle*, by default 10 sec). For each value edit the *hours*, *minutes* and *seconds* edit fields. To return to the default settings for both time values, click **Back to Defaults**.



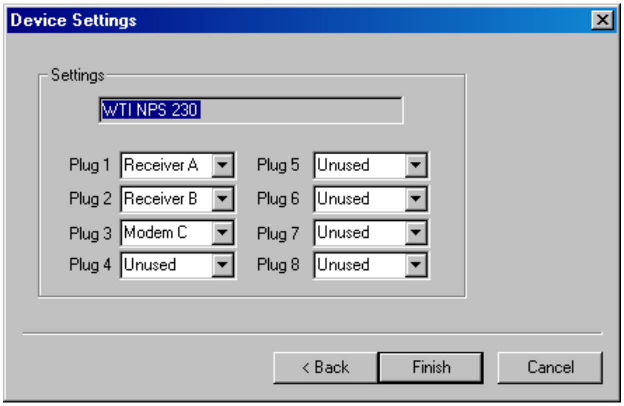
After you have clicked **Finish**, the well-known *Connection Wizard* appears that lets you define new connections and select the port the device is connected to.

A message window will pop up confirming that the device is recognized. For detailed information on the *Connection Wizard*, see Chapter 5, Communication Control.

Power Switch devices

Note that power switch devices WTI NPS 230, Black Box Power Boot 5 and 5+ are no watchdogs in terms of the classical definition of a watchdog since they do not get triggered from the system. However, in combination with the GPSBase Alarm module, they can be configured to reboot external devices. Use one of the action types *Boot command to power switch* or *Send modem command.* For more details, see Section Alarm System.

From the *Watchdog Device Selection* dialog, pick the WTI NPS 230 or one of the Black Box power components depending on the installed device. Click **Next**. The *Device Settings* dialog appears. The device has to be configured, so name the plugs where the external devices are connected to. For a used plug, select the type of instrument that is connected to it. Instruments may be a computer, receivers, modems or a radio. Then you have to configure the port your power boot device is attached to.



After you have clicked **Finish**, a Connection Wizard appears that lets you select or define new connections and lets you select the port the device is connected to. A message will appear confirming that the device is recognized. For detailed information on the Connection Wizard, see Chapter 5, Communication Control.

Watchdog properties

One page of settings will be available, if you select the command *Properties* from the Watchdog module's shortcut menu. The contents of the *Device Settings* tab depend on the hardware that is selected to monitor GPSBase. See the above sections for more information on the settings.

CHAPTER

10

Other Modules

In this chapter:

- Introduction
- Splitter
- Single Point Position
- Analysis Tools

Introduction

Besides the main functionality a variety of other modules is supported by the platform. In the following you can get an idea of enhancing your setup by base station relevant analyzing tools.

Splitter

While Receiver modules provide the incoming receiver data to other internal GPSBase modules, such as the RTCM Generator or the analysis tools, you may want to pass on the data also to an external user. In this case, use the Splitter module. It duplicates any data to any other communication line. The split line can be configured as unidirectional (passive) or as bi-directional (active) line.

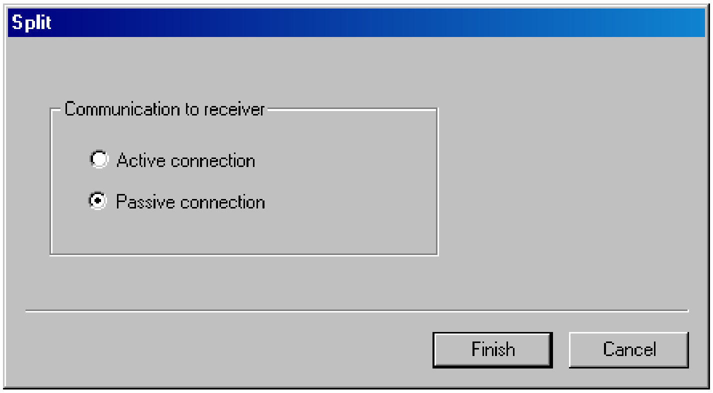
Adding a Splitter module

The Splitter module is available for several modules, such as the Receiver module and the RTCM Generator module.

To add the module to the system, right-click the respective navigator item to open its shortcut menu. Select *Insert Module*. From the *Module Selector* dialog, select the Splitter TAM module. The Connection Wizard appears. Add a new connection or select one from already defined connections (see Chapter 5, Communication Control, for more information on connections.). Click **Finish**. The *Split* dialog appears.

If you want to allow the user of the outgoing data to control the reference receiver by sending commands to it, select the *Active connection* option.

Warning – An active, bi-directional connection allows the user of the outgoing data to interfere with the system!



With the unidirectional *Passive connection* selected, the user can receive reference receiver data, but is not allowed to send commands to the respective receiver.

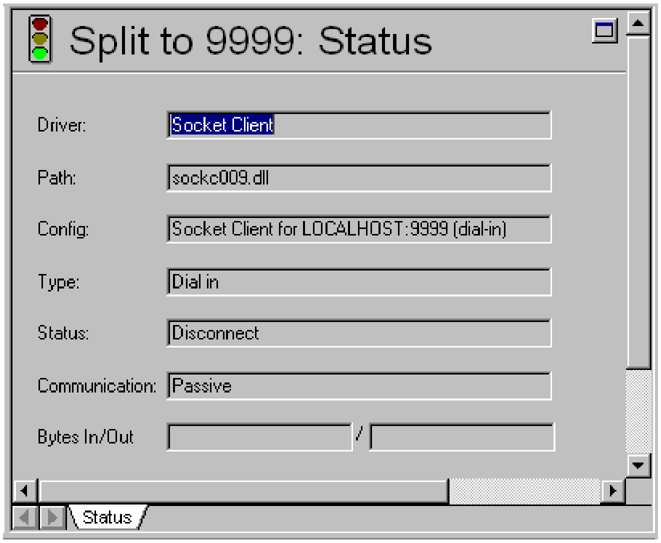
Getting information on the Splitter

When the Splitter module is added to GPSBase, the module shows up in the navigator. Its icon symbolizes the split line (black line) to the outgoing port (dark gray triangle). The connection port is surrounded by a background circle, whose color depends on the current connection status. See Table 10.1 for a detailed description of the colors.

Table 10.1 Icon colors and states.

Icon	Background Color	Description
	Gray	Connection status unknown: This may happen if the Socket connection is configured not in a modem-like way.
	White – no background color	Connection status known: Port ***is not*** connected to a receiving device.
	Green	Connection status known: Port ***is*** connected to a receiving device.

The information view of the Splitter module consists of the single page *Status*. *Status* displays in its heading the name of the selected connection. The connection information follows: The driver type (*Driver*) and DLL (*Path*), the configuration of the driver (*Config*) and its type (*Type*), as well as its current state (*Status*). *Status* indicates whether a user is currently connected to the Splitter. If communication errors occur, error messages will show up here. Since the time the module has been started, the *Bytes In / Out* fields accumulate the received (in) or transferred (out) bytes. Use these fields to see whether data is currently transmitted.



You may add further modules, if you select *Insert Module* from the module's shortcut menu. The following modules are currently available for a Splitter module:

- RAW Storage (See Chapter 7)
- Splitter

You may remove any module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

Single Point Position

You may control the resulting single point position of the reference station observations using the Single Point Position module. This module is available for the reference receiver and for the Raw Data Analysis module. In the latter case, the raw data analysis will be respected for the calculation of the single point position.

To add the module to the system, select the respective navigator item (right mouse button) to open the shortcut menu. Select *Insert Module*. From the *Module Selector* dialog, select the Single Point Position TAM module.

You may add further modules, if you select *Insert Module* from the instrument's shortcut menu. The following modules are currently available for a Single Point Position module:

- Point Position Analysis (See Section Point Position Analysis)

You may remove any module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

Single Point Position – Information page

For the Single Point Position module, one page of information exists in the information pane.

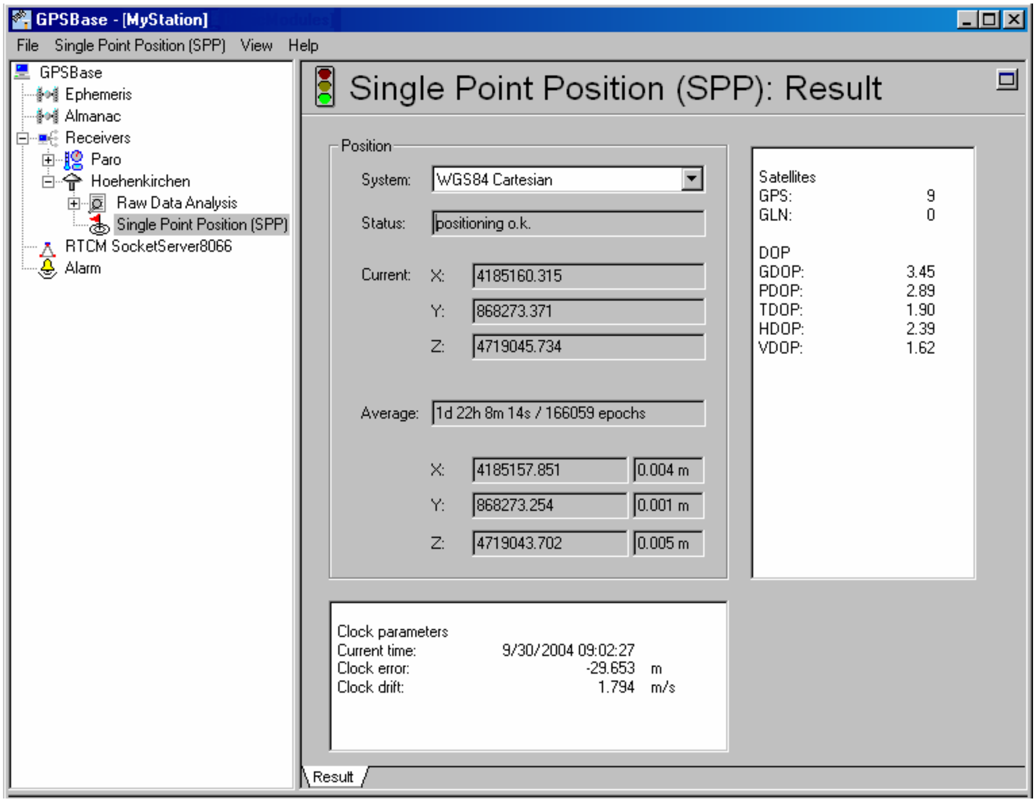
The *Result* page gives a short overview on the most important positioning results. The *Position* group gives the current coordinates in the selected system (either Cartesian or geographical), the averaged position, and the *Status* of positioning. If one of the analyzed modules is not working OK, the *Status* field will indicate where to find the error.

The number of satellites of either system, on which the position is founded, is given in the *Satellites* group. The current DOP values are updated below, where

- GDOP Geometric Dilution of Precision
- PDOP DOP for Position

- TDOP DOP for Time
- HDOP Horizontal DOP
- VDOP Vertical DOP

For the receiver clock, the *Clock Parameters* group gives the current time, the error in meters and the drift in m/s.



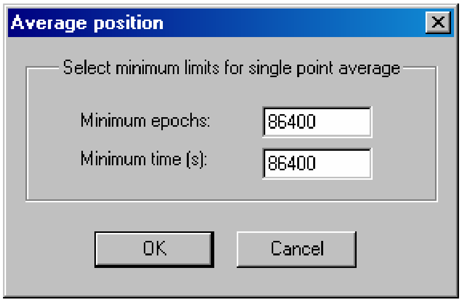
Single Point Position averages

The Single Point Position module automatically computes position averages and their standard deviations from the receiver raw data. The *Result* information page displays the time and the number of epochs, for which an average is currently computed, together with the current average values for X, Y, Z. These averaged positions are purely informational, if you don't activate auto averaging. The Single Point Position continuously calculates averages from the raw data.

You may ***restart*** the average computation at any time: Right-click the Single Point Position module in the navigator to open its shortcut menu and select *Reset Average*.

The averaged positions can be used as known coordinates for the reference station receiver. To ***manually update the position*** in the Receiver module, select the Single Point Position module's shortcut menu command *Accept as Reference*.

If ***auto averaging*** is selected, the Single Point Position module waits for a minimum of epochs and time, then calculates the respective averaged position and passes it on to the Receiver module. To start auto averaging, select the module's shortcut menu command *Start Auto Average*. The *Average position* dialog appears. Use it to start automatic average positioning and to define the minimum thresholds for it.



The dialog displays and lets you edit threshold values. Both limits must be passed, before the average position is used. *Minimum epochs* defines the minimum number of collected epochs necessary before the averaged SPP replaces the SPP solution. *Minimum time* gives the minimum time of data collection.

After you have accepted auto averaging, the information pane displays the information *Auto-averaging active*, with an information on the time and number of epochs to elapse before the averaged position becomes valid. As soon as the thresholds are passed, the computed average overwrites the SPP positions.

The module’s shortcut menu command *Stop Auto Average* stops auto averaging.

Analysis Tools

The analysis package of GPSBase lets you analyze many effects from the Global Positioning System and GLONASS signals. These effects are either system related or atmosphere related.

To activate an analysis module, add it to that module you want to be analyzed. This may be a Receiver module, a Single Point Position module or a Raw Data Analysis module: select the respective navigator item (right mouse button) to open its shortcut menu. Select *Insert Module*. From the *Module Selector* dialog, select one of the following Analysis Tools:

- Raw Data Analysis (See Section Raw Data Analysis)
- Point Position Analysis (See Section Point Position Analysis)

You may remove any module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

A traffic light in the upper left corner of each module’s information pane indicates the general status:

- Green: working correctly
- Red: errors occurred

Tip – The icon  in the upper right corner lets you undock the currently activated information pane. The undocked child window will then stay permanently in front of the main window to be always at your hands.

Raw Data Analysis

You may add the Raw Data Analysis module to the Receiver module.

The Raw Data Analysis module analyses the consistency of dual-frequency data for each satellite. It detects receiver errors, such as data drifts, outliers or cycle-slips, and generates pseudo-range and range rate corrections. If a cycle slip has been detected, the module tries to correct it. Data, which can not be corrected, is removed from the data set, before it is passed on to other modules.

***Note** – The Raw Data Analysis module respects a minimum cutoff elevation angle of 5°, even if the respective parameter at the* Receiver Data *property dialog of the Receiver module is set to a lower value.*

If the module detects that data is drifting, it generates an alarm. For how to set up the alarming functionality, see Chapter 9, Section Alarm System.

If you have activated Reporting (see Chapter 3, Reporting), the module generates three types of error reports. You may view the reports using your Internet Explorer or any other browser which can parse and display XML documents. For more information on the reports, see Appendix G.

- A summary report for each day may be generated from Raw Data Analysis [<station>] DailyErrorReport.xml.
- A detailed error report is available from Raw Data Analysis [<station>] IndividualErrorLog.xml .
- A detailed report on cycle slips (fixed and not fixed) can be viewed from Raw Data Analysis [<station>] Cycle-SlipLog.xml.

Use the right mouse button to have IE's options at your disposal.

For analyzing your observations, it is especially useful, to eliminate these receiver errors before further analyses are made. Therefore, it is advisable to first add the Raw Data Analysis module to the receiver, then to add the further analysis tools and the Single Point Position module to the Raw Data Analysis module.

You may add further modules, if you select *Insert Module* from the module's shortcut menu. The following modules are currently available for a Raw Data Analysis module:

- Single Point Position Analysis (See Section Single Point Position)
- RINEX Storage (see Chapter 7, Data Storage)
- DAT Storage
- RTCM (Single Station) Generator (See Chapter 8, Section RTCM Generators)

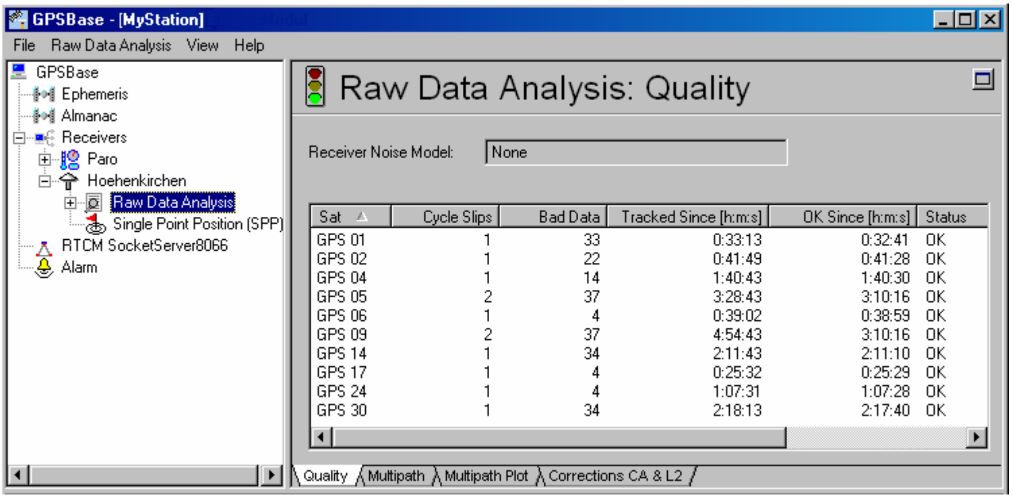
For the Raw Data Analysis module*,* four pages of information exist in the information pane.

- *Quality*
- *Multipath*
- *Multipath Plot*
- *Corrections CA and L2*

Raw Data Analysis – Quality

The list on the *Quality* page displays the current epoch data:

Column…	displays…
Sat	Satellite System and PRN number
Cycle Slips	Occurrences of cycles slips during the tracking time
Bad Data	Epochs that are marked "BAD" during the tracking time
Tracked Since [h:m:s]	Tracking time since start of this module
OK Since [h:m:s]	No error reported for this satellite since x seconds
Status	Status of error, according to the following list



The *Status* column may display one of the following messages:

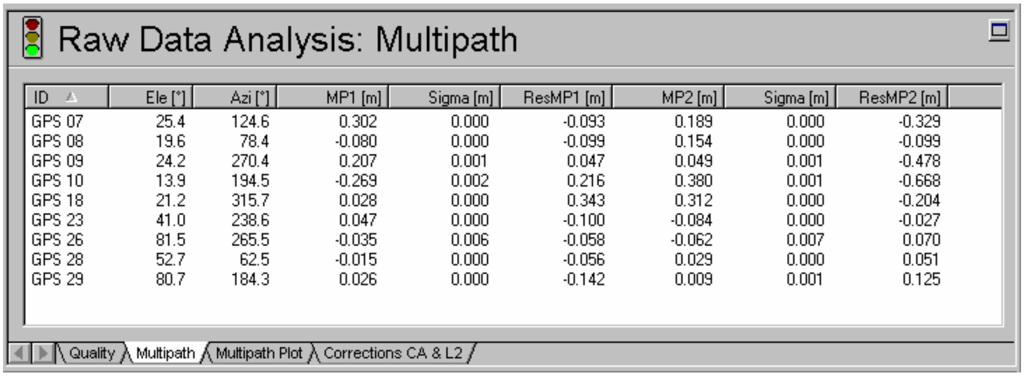
- OK
- Too many satellites
- Bad satellite ID
- Bad SNR L1
- Bad SNR L2
- LLI data bad on L1
- LLI data bad on L2
- L1-phase bad
- L2-phase bad
- L1-code bad
- L2-code bad
- Code difference bad
- No ephemeris
- SPP residual bad
- SPP position bad
- No GLONASS frequency
- No reference data
- Data gap too long
- Too few data

- Unresolved cycle slip
- Resolved cycle slip
- Continued cycle slip
- Cycle slip new arc
- Unknown Error

You may remove any module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

Raw Data Analysis – Multipath

The *Multipath* information page lists estimates of the L1 and L2 code multipath for each satellite. The first three columns (*ID*, *Ele* and *Azi*) list the satellite ID and the current elevation and azimuth of the satellite. The next three columns list the L1 code multipath model estimate (*MP1*), its expected error (*Sigma*) and the difference between the observed L1 code multipath and the model (*ResMP1*). The final three columns list the L2 code multipath model estimate (*MP2*), its expected error (*Sigma*) and the difference between the observed L2 code multipath and the model (*ResMP2*).



ID	Ele [°]	Azi [°]	MP1 [m]	Sigma [m]	ResMP1 [m]	MP2 [m]	Sigma [m]	ResMP2 [m]
GPS 07	25.4	124.6	0.302	0.000	-0.093	0.189	0.000	-0.329
GPS 08	19.6	78.4	-0.080	0.000	-0.099	0.154	0.000	-0.099
GPS 09	24.2	270.4	0.207	0.001	0.047	0.049	0.001	-0.478
GPS 10	13.9	194.5	-0.269	0.002	0.216	0.380	0.001	-0.668
GPS 18	21.2	315.7	0.028	0.000	0.343	0.312	0.000	-0.204
GPS 23	41.0	238.6	0.047	0.000	-0.100	-0.084	0.000	-0.027
GPS 26	81.5	265.5	-0.035	0.006	-0.058	-0.062	0.007	0.070
GPS 28	52.7	62.5	-0.015	0.000	-0.056	0.029	0.000	0.051
GPS 29	80.7	184.3	0.026	0.000	-0.142	0.009	0.001	0.125

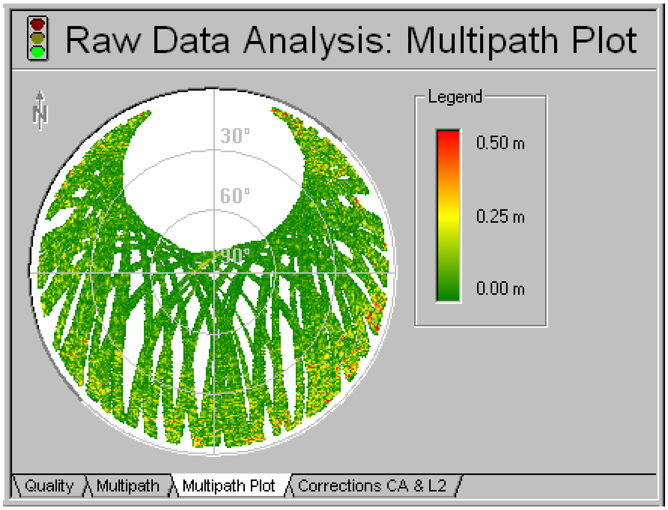
Raw Data Analysis – Multipath Plot

The plot on the *Multipath Plot* information page displays the multipath for given elevation and azimuth in colors from green (zero multipath) over yellow to red (high multipath). The legend gives the signal errors for different colors.

This plot is generated from the MPM file stored in \<installdir> \Multipath Reduction. The contents of these files are updated as long as the station configuration is known to the system and, therefore, contains information from several days.

Use the plot to detect interferences and obstructions.

You can reset the multipath model using the module's shortcut command *Reset Multipath Model*. Its MPM file is deleted.



Raw Data Analysis – Corrections CA and L2

The list on the *Corrections CA and L2* page displays the current epoch data:

Column…	displays…
Sat	Satellite System and PRN number
CA PRC [m]	Pseudo range correction [m] on CA
CA RRC [m/s]	Range rate correction [m/s] on CA
CA PHC [cy]	Phase corrections on CA
L2 PRC [m]	Pseudo range correction [m] on L2
L2 RRC [m/s]	Range rate correction [m/s] on L2
L2 PHC [cy]	Phase corrections on L2
IODE	Issue Of Data Ephemeris

Point Position Analysis

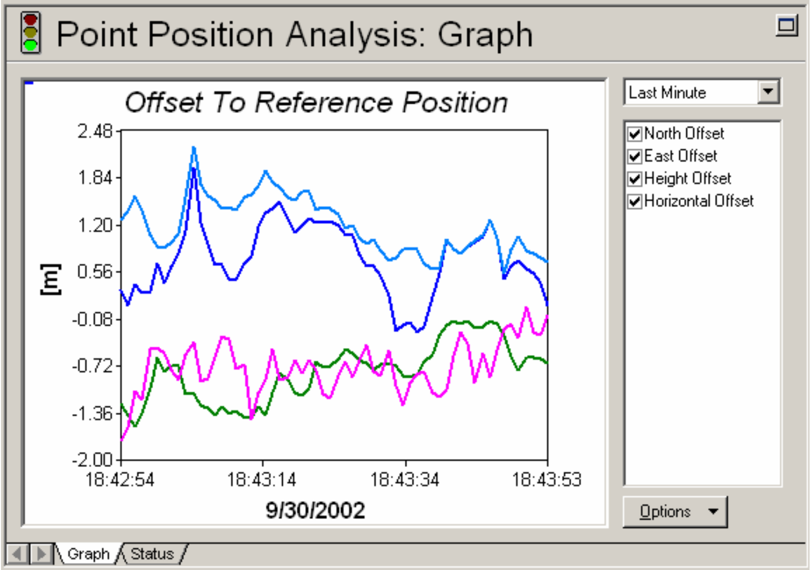
The Point Position Analysis module lets you analyze the position accuracy of the connected receiver at the current location. Depending on your selection, the module analyzes data either directly from the receiver, or from the Single Point solution.

You may remove the module at any time from GPSBase: Open its shortcut menu and select *Remove Module*.

For the Point Position Analysis module*,* two pages of information exist in the information pane. You can modify some limit parameters using the module's *Properties* dialog.

Point Position – Graph

The *Graph* page graphically displays up to four curves on position differences to the given reference position, depending on your curve selection. For a detailed general description of graphs, see the section on Graphs in Chapter 3, Section The Main GPSBase Window.

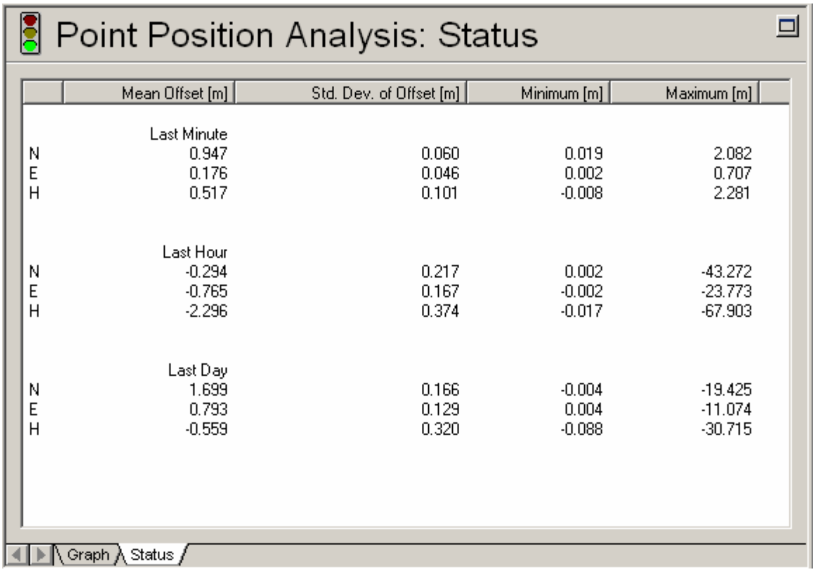


The graph displays, with respect to time, the north, east, height, and horizontal differences between the calculated and the known position in meters. The offsets are mainly influenced by multipath, noise, ephemeris and ionospheric errors. Discontinuities occur at satellite constellation changes.

Point Position – Status

The *Status* page shows offset values with respect to time. For each coordinate component (North, East, Height) the following values are listed for the last minute, hour and day:

- Mean offset [m]
- Standard deviation of Offset [m]
- Minimum during time range [m]
- Maximum during time range [m]



Point Position Analysis: Status

	Mean Offset [m]	Std. Dev. of Offset [m]	Minimum [m]	Maximum [m]
	Last Minute			
N	0.947	0.060	0.019	2.082
E	0.176	0.046	0.002	0.707
H	0.517	0.101	-0.008	2.281
	Last Hour			
N	-0.294	0.217	0.002	-43.272
E	-0.765	0.167	-0.002	-23.773
H	-2.296	0.374	-0.017	-67.903
	Last Day			
N	1.699	0.166	-0.004	-19.425
E	0.793	0.129	0.004	-11.074
H	-0.559	0.320	-0.088	-30.715

Point Position – Report

If you have activated Reporting (see the section on Reporting in Chapter 3, Section The Main GPSBase Window), you may view using your Internet Explorer, or any other browser, which can parse and display XML documents, the reports generated from Point Position Analysis [<station>] Statistic (from <module>).xml and Point Position Analysis [<station>] positionoutlierlog (from <module>).xml. The file names depend on the module, for which the analysis is done. For more information on the reports, see Appendix G.

APPENDIX

A

Supported Receiver Types

In this appendix:

- Introduction
- Decoders and Instrument Types

Introduction

When setting up connection profiles for receivers, you must select the matching decoder. This appendix gives you an overview on the supported receiver types and weather station types. There are further decoders that can be used for testing purposes.

Decoders and Instrument Types

Select the following decoders in the *Decoder* dialog for the given receiver types.

Table A.1 Decoders and receiver types

Decoder	Supported Receiver
Trimble (concise) concise: compressed format	MS 750 4000 SSE, 4000 SSi 4700 5700, 5700 L1 R7, NetRS, NetR5 SPS850
Trimble remote download	5700 R7, NetRS, NetR5 SPS850

To connect to a weather station, select one of the following decoders in the *Decoder* dialog.

Table A.2 Decoders and weather stations

Decoder	Supported Weather Station
Weather Station (NMEA output format)	Paroscientific MET3 Vaisala PTU 300
Weather Station Vaisala HMP243	Vaisala HMP243 Vaisala PTB220

APPENDIX

B

Testing Your Data Lines

In this appendix:

- Introduction
- Serial Communication
- Dial-In Connections via Modem

Introduction

Within your GPSBase system, you are dealing with a variety of different communication lines. This appendix shows some useful ways to test and verify the communication.

Serial Communication

Serial communication is established, if the reference station is connected to the control center using serial communication, i.e., you have a serial line from a receiver port to a COM-port of the control center computer, which runs GPSBase.

Direct serial connection

If the reference station is located at the same site (or close enough) as the control center computer, you will use a simple serial cable for the whole distance.

You should test the correct operation of the serial communication using the following steps:

1. Connect a computer, for example, a notebook computer, to each end of the serial cable. In order to connect two computers via a serial cable, use a NULL-Modem adapter, which twists the Transmit and Receive-lines of the serial cable. Then run a terminal program (for example, HyperTerminal) on each of the computers. Make sure that the keyboard input on both sides is correctly displayed on the other end of the line.

Tip – Very useful for testing a serial line is a “serial quick-tester”, a serial adapter, which displays the status of the serial lines and also allows switching the wire-connections via dipswitches. You can use this adapter to easily establish a serial line connection between two computers without a NULL-modem adapter. If you do not know how the serial cable is wired, you can experiment with the quick-tester until you have a correct connection between the two terminal programs.

2. Now connect the receiver at the reference-station end of the serial cable and either a terminal program or a receiver controller unit at the control center end of the cable. It should now be possible to configure the receiver via the serial line either using receiver-specific control commands on the terminal program or directly via the controller unit.
3. Now that you have made sure that the serial communication works correctly you can add a Receiver module for this reference-station to GPSBase and check if it recognizes the receiver correctly and if the receiver starts to send observations to the control center. Also try to reconfigure some receiver settings (for example, the elevation cutoff) and check if the receiver reacts accordingly.

Leased modem lines

Typically, you build up a continuously connected, leased modem line between a reference station receiver and the control center.

You should keep in mind that neither the reference station receiver nor the control center knows anything about the modem line. They both expect a connection, which is as transparent as a direct serial connection. (Note that this is different from the operation of RTCM Generators, which support modem functionality like accepting incoming calls and hanging up calls). Therefore, make sure that the modems do not disturb the data-stream. They ***must not*** alter the data on the line.

When you have set up the modem line, follow the same procedure as for Direct Serial Connection to ensure correct operation.

Dial-In Connections via Modem

RTCM Generators offer modem interfaces for rover systems dialing up to the control center. You should make sure that the communication between the rover’s modem and the dial-in modem at the control center is working correctly before you configure an RTCM Generator for that modem.

To set up a dial-in connection using a modem:

1. Configure the control-center modem to work correctly within your telephone environment.
2. Check the correct operation of the modem by running a simple terminal program on the COM port the modem is connected to. You should be able to enter *AT* commands and get correct "*OK*" replies from the modem.
3. Set up another computer with one of the rover-modems and run a terminal program on that computer, which simulates the rover. Then call up the modem using the rover modem and make sure that the connection is established correctly, when you accept the incoming call at the control center with command *ATA*. You should see keyboard inputs correctly on the remote terminal programs. If not, you probably have a problem with the different baudrates used on the three lines remote-computer to its modem, modem to modem, center modem to center computer.
4. If that works correctly, attach the rover receiver to the rover modem, configure it to send out the NMEA record GGA every couple of seconds. Let the rover call up the center modem and accept the incoming call at the center again. You should now receive the GGA record at the control center nicely readable. If not, your receiver is probably using a different baud-rate than you have used in step 3).
5. Now that the communication works correctly, you can configure an RTCM Generator using the new modem.

APPENDIX

C

Antenna Corrections

In this appendix:

- Introduction
- Antenna Phase Center Offsets
- Antenna Files in GPSBase

Introduction

For the correction of the antenna phase center to the ground marker, GPSBase uses antenna phase center offsets to correct for the antenna in use and height offsets from the ground marker. For height offsets, the measurement method is respected.

This appendix shortly outlines the importance of antenna phase center offsets for results with high accuracy and then explains how corrections for the antenna in use are applied in GPSBase.

Antenna Phase Center Offsets

When processing data from different receiver or antenna types together, the antenna phase center offsets are very important. Different antennas may have antenna phase centers differing by several centimeters. In order to achieve results with millimeter accuracy these values must be considered carefully.

The U.S. National Geodetic Survey (Gerald L. Mader) gives the following information at its WWW home page:

“A GPS geodetic solution for a baseline fundamentally provides the vector between the phase centers of the antennas at either end of the baseline. However, a real antenna does not have a single well-defined phase center. Instead, the phase center is a function of the direction from which it receives a signal. Almost all GPS antennas currently in use are azimuthally symmetric and the dominant phase variation occurs with elevation. However, the local environment around the antenna can introduce both azimuth and elevation variations from the ideally measured phase patterns.

In the absence of any corrections for these phase variations, the antenna phase centers defining baseline vectors are actually weighted-average, phase center locations for the data used to produce that baseline vector. The consequence of this is the correlation of station height with elevation cutoff. This is especially noticeable for baselines using mixed antennas.

The NGS antenna calibration procedure (see also IGS and CORS antenna type summary) uses field measurements to determine the relative phase center position and phase variations of a series of test antennas with respect to a reference antenna."

Antenna Files in GPSBase

The default antenna information is stored in the Trimble Common Files \ Config folder (the default path is: C:\ Program Files \ Common Files \ Trimble \ Config). This folder contains a file called antenna.ini, which defines the antennas supported by Trimble hardware and software; and it contains files (.pct, .ngs, .ife, .atx), which contain the elevation (and possibly azimuth) dependent corrections.

Creating a customized antenna database

More and more customers have information about the calibration of their own antenna (depending on serial number), or an additional antenna type had been calibrated. The calibration can be available in different formats, for example in the common ANTEX format.

GPSBase lets you create a customized antenna database so that information from special calibrations can be used for processing.

The following sections contain information about the structure of the antenna database, how to fill in the customized antenna.ini file and the structure of the phase correction tables.

Structure of the antenna database

***Note** – We strongly recommend that you do not edit the files in the Config folder.*

Additionally, a folder called Trimble Common Files \ Custom Config (the default path is C:\ Program Files \ Common Files \ Trimble \ CustomConfig) is installed. As default, a second file called antenna.ini is installed in this folder. This file contains only a rough structure or subdivision, but no antenna information.

***Note** – During installation, GPSBase checks if this file already exists. If yes, the empty antenna.ini file is not installed so you will not lose your keyed in information after a new installation.*

Nevertheless, we recommend backing up your personally created antenna.ini file.

The empty antenna.ini file (see Figure C.1) contains the following information:

antenna.ini - Notepad

File Edit Format View Help

```
[AntDatabaseInfo]
Version=5.00
Language=ENG

; Instructions
;--------------------------------------------------------------------------
; - Use a unique [key] for each new antenna entry.
;   (If you have serial number dependent antenna calibrations this [key]
;   must be a combination of the [key] from the default antenna.ini
;   and the serial number.)
; - The Type number must be larger than 10000 and unique.
; - The Name must be followed by the serial number separated by a space
; - The following items must be unique:
;      [key]
;      Name
;      DCName     (not needed)
;      CharCode   (not needed)
;      Type

[PhaseCorrTables]
Set1=Trimble,PhaseCorrTable
Set2=NGS,NGSCorrTable
Set3=IFE,IFECorrTable
Active=Set1

[Trimble]
Description="Trimble Calibration"

[NGS]
Description="US National Geodetic Survey Calibration"

[IFE]
Description="Institute for Geodesy Absolute Calibration"

[AntennaGroup]
Group1=Custom
Group2=Survey

[Custom]
Name=Custom
ReadOnly=0

[Survey]
Name=Survey
ReadOnly=0
```

Figure C.1 Empty antenna.ini

Section [PhaseCorrTables]

This section contains a list of different phase correction tables. By default, you have the choice of three different phase correction tables:

- Trimble, default Trimble calibration table PCT
- NGS, US National Geodetic Survey Calibration (ant_info.003)
- IFE, Institute for Geodesy Absolute Calibration

Section [AntennaGroup]

This section contains the names of different antenna groups. As default, one group called *Custom* is defined.

Section [Custom]

This section contains the information about the antenna group *Custom*.

How to fill in the customized antenna.ini file

To make sure that the software offers your own antenna for processing, fill in the antenna.ini file.

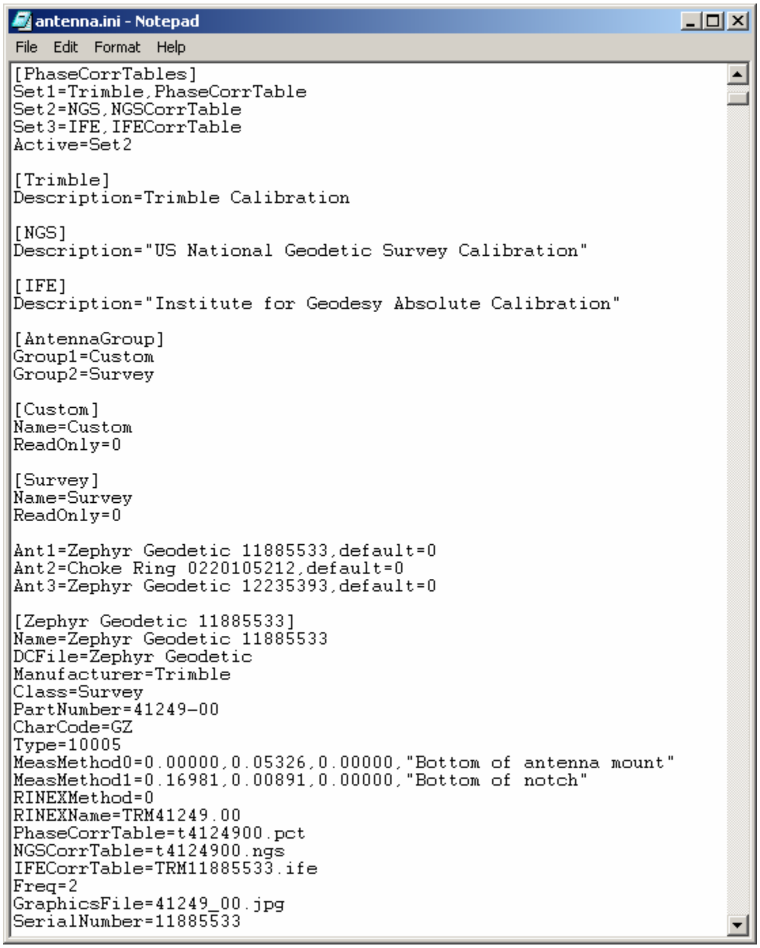
1. Define the type of phase correction table you want to use. If you want a different than the default ones, you can add a new type of phase correction table.
2. If you want to define an additional antenna group, add the information to section [Antenna Group]. Now introduce a new section with the name of your own antenna group.

   Define the antennas you want to use in the group, for example:

   Ant1 = Zephyr Geodetic 02204107, default = 0

Consecutive number Key Default measurement method

3. Define a new section for every antenna you want to add to the database. Start with the name of the antenna. Figure C.2 shows you the structure of such a newly defined section:




```
[PhaseCorrTables]
Set1=Trimble,PhaseCorrTable
Set2=NGS,NGSCorrTable
Set3=IFE,IFECorrTable
Active=Set2

[Trimble]
Description=Trimble Calibration

[NGS]
Description="US National Geodetic Survey Calibration"

[IFE]
Description="Institute for Geodesy Absolute Calibration"

[AntennaGroup]
Group1=Custom
Group2=Survey

[Custom]
Name=Custom
ReadOnly=0

[Survey]
Name=Survey
ReadOnly=0

Ant1=Zephyr Geodetic 11885533,default=0
Ant2=Choke Ring 0220105212,default=0
Ant3=Zephyr Geodetic 12235393,default=0

[Zephyr Geodetic 11885533]
Name=Zephyr Geodetic 11885533
DCFile=Zephyr Geodetic
Manufacturer=Trimble
Class=Survey
PartNumber=41249-00
CharCode=GZ
Type=10005
MeasMethod0=0.00000,0.05326,0.00000,"Bottom of antenna mount"
MeasMethod1=0.16981,0.00891,0.00000,"Bottom of notch"
RINEXMethod=0
RINEXName=TRM41249.00
PhaseCorrTable=t4124900.pct
NGSCorrTable=t4124900.ngs
IFECorrTable=TRM11885533.ife
Freq=2
GraphicsFile=41249_00.jpg
SerialNumber=11885533
```

Figure C.2 Customized antenna.ini

It is not necessary to key in all the information you see in Figure C.2. You should at least key in the following information:

[key]

Name

Manufacturer

Class

Type

MeasMethodX

RINEXMethod

RINEXName

Type of phase correction table

Serial number

Additional information/restrictions concerning the items:

- *[key]* - is a combination of the [key] from the default antenna.ini and the serial number.
- *Name* - key in the name of the antenna followed by a space and the serial number
- *Manufacturer* - key in the manufacturer of the antenna
- *Class* - key in the antenna group the antenna is defined in
- *Type* - key in a number > 10 000

  MeasMethodX - the measurement method defines eccentricities from an antenna reference point to the mechanical antenna phase center. X is a consecutive number, starting with 0 in each section. The eccentricities are defined by three values and information about the reference point at the antenna, for example:

  MeasMethod 0 = 0.00000, 0.0532b, 0.10107, "Bottom of antenna mount"

The first number defines the radius, the second one defines the height offset from the reference point to the mechanical L1 antenna phase center, the third value defines the tape correction factor for a 4000 ST internal antenna. For all other antennas, this value has to be set to zero.

- *RINEXMethod* - number corresponding to one of the measurement methods; defines the conversion of the coordinate during RINEX import.
- *RINEXName* - name of the antenna which is used in the header of a RINEX or ANTEX file. During the import of a RINEX file, this name is used. Select the antenna from the database. The length of the name has to fit into 20 characters.
- *Type of Phase Correction Table* - select one or several of the types defined in section [PhaseCorrTable], for example NGSCorrTable=t4124900-02204107.ngs. .ngs is a file which contains the elevation dependent corrections. To get more information, see the section *Structure of the Phase Corrections Tables* below. If the calibration is available in an ANTEX file use the ANTEX file name.
- *Serial number* - key in the serial number of your antenna if you have a serial number dependent calibration. If not, this information is not needed.

Structure of the Phase Correction Table

As you have seen, the antenna.ini file links to a file which contains the elevation dependent eccentricities (*.pct, *.ngs, *.ife). Figure C.3 shows you the structure of such a file:

The file contains the L1 Nominal Offset and L2 Nominal Offset.

***Note** – The up component in the L1 Nominal Offset and L2 Nominal Offset is the height difference between the L1 mechanical phase center and the L1/L2 electronic phase center.*

The elevation dependent corrections are listed in a table, starting with the value for 5 degrees, ending with 90 degrees (step 5 degree).

t4124900.ngs - Notepad

File Edit Format View Help

```
;PCT converted from ant_info.003 <MLM-01/04/11-94
;TRM41249.00          Trimble Zephyr Geodetic with GP          NGS (  4) 01/04/11
;
;Mean phase center (mm) North  East    Up
L1NominalOffset =          0.3   0.5  18.1
L2NominalOffset =         -0.4   0.1  14.9

;Elevation range (deg)   Start  Stop  Step
ElevationRange =             5    90     5

;Azimuth step size (deg)
AzimuthStep = 0

;Azimuth/elevation corrections (mm)

AZ=0

;L1
   0.0  -0.9   1.3   3.1   4.5   5.5   6.1   6.4   6.4   6.1
   5.6   4.9   4.1   3.2   2.3   1.4   0.6   0.0
;L2
   0.0  -0.8  -0.6  -0.2   0.2   0.6   0.9   1.0   1.1   1.0
   0.8   0.5   0.1  -0.2  -0.5  -0.6  -0.5   0.0
```

Figure C.3 Structure of a NGS phase correction file

Use of ANTEX files

ANTEX stands for Antenna Exchange Format and is an independent format to exchange antenna calibration information. The Trimble antenna database is able to support calibration information in the ANTEX format. To use it, the type of phase correction table needs to refer to the ANTEX file, containing the calibration for the antennae.

As an ANTEX file can contain multiple antenna entries, the search algorithm within the ANTEX file uses the RINEX Name and the serial number of the antenna. To get the antenna recognized, you need to make sure, that both entries are the same within the ANTEX file and the *Antenna* entry of the antenna.ini.

***Note** – The Trimble Antenna database does not support the history functionality of the ANTEX format. For the use in GPSBase, ANTEX .atx files must not contain more than one calibration per antenna.*

The ANTEX format does not distinguish between relative or absolute antenna calibrations. With relative antenna calibrations, we suggest to use the NGSCorrTable entry to refer to this calibration (e.g., NGSCorrTable=AAA1_1129.atx).
Having absolute calibration values you need to use the IfeCorrTable entry (e.g. IFECorrTable=AAA2_1129.atx).

***Note** – You may use relative and absolute calibrations of an antenna as well. However, they must reside in different files.*

APPENDIX

D

RTCM Messages

In this appendix:

- Introduction
- Standard RTCM v2.3 Messages
- Standard RTCM v3 Messages

Introduction

The Radio Technical Commission for Maritime Services has published the broadcast format called RTCM. This appendix lists all standard RTCM Messages (versions 2.3 and 3.1).

More detailed RTCM descriptions are available from:

Radio Technical Commission for Maritime Services
1800 Diagonal Road, Suite 600
Alexandria, Virginia 22314-2840 USA

www.rtcm.org

Standard RTCM v2.3 Messages

The format RTCM SC104 was developed by the Radio Technical Commission for Maritime Services, Special Committee No. 104. It is a standard for differential GNSS applications, which allows you to send out standardized differential messages to differentially correct mobile receivers.

The paper "RTCM Recommended Standards for Differential GNSS Service, Version 2.3" gives a detailed description of the RTCM format.

Table D.1 gives an overview of the available messages that can be created in the RTCM 2.3 format.

Table D.1 RTCM 2.3 messages

RTCM #	Current Status	Title
1	Fixed	Differential GPS Corrections
2	Fixed	Delta Differential GPS Corrections
3	Fixed	GPS Reference Station Parameters
4	Tentative	Reference Station Datum
5	Fixed	GPS Constellation Health
6	Fixed	GPS Null Frame
7	Fixed	DGPS Radiobeacon Almanac
8	Tentative	Pseudolite Almanac
9	Fixed	GPS Partial Correction Set
10	Reserved	P-Code Differential Correction
11	Reserved	C/A-Code L1, L2 Delta Corrections
12	Reserved	Pseudolite Station Parameter
13	Tentative	Ground Transmitter Parameters
14	Fixed	GPS Time of Week
15	Fixed	Ionospheric Delay Message
16	Fixed	GPS Special Message
17	Tentative	GPS Ephemerides
18	Fixed*	RTK Uncorrected Carrier Phases
19	Fixed*	RTK Uncorrected Pseudoranges
20	Fixed*	RTK Carrier Phase Corrections
21	Fixed*	RTK/Hi-Acc. Pseudorange Corrections
22	Tentative	Extended Reference Station Parameters
23 **	Tentative	Antenna Type Definition
24 **	Tentative	Reference Station: Antenna Reference Point (ARP) Parameter

RTCM #	Current Status	Title
25, 26		Undefined
27**	Tentative	Extended DGPS Radiobeacon Almanac
28…30		Undefined
31	Tentative	Differential GLONASS Corrections
32	Tentative	Differential GLONASS Reference Station Parameters
33	Tentative	GLONASS Constellation Health
34	Tentative	GONASS Partial Differential Correction Set (N>1) GLONASS Null Frame (N<=1)
35	Tentative	GLONASS Radiobeacon Almanac
36	Tentative	GLONASS Special Message
37	Tentative	GNSS System Time Offset
38…58	-	Undefined
59	Fixed	Proprietary Message
60…63	Reserved	Multipurpose Usage

* This message is considered fixed with respect to GPS, tentative with respect to GLONASS.

** RTCM message types that are new in Version 2.3 compared to version 2.2.

Standard RTCM v3 Messages

Since 2003, the RTCM Special Committee No. 104 has released the new RTCM SC 104 version 3.x standards, currently as version 3.1. The version 3.1 format is specifically designed to allow for modifications to the GPS and GLONASS systems (for example, new L2C and L5 signals), and to accommodate for new GNSS systems that are under development (for example, Galileo). In addition, augmentation systems that utilize geostationary satellites such as WAAS or EGNOS are respected.

Table D.2 gives an overview of the available messages that can be created in the RTCM 3.1 format.

Table D.2 RTCM 3.1 messages

RTCM #	Current Status	Title
1001	Fixed	L1-Only GPS RTK Observables
1002	Fixed	Extended L1-Only GPS RTK Observables
1003	Fixed	L1&L2 GPS RTK Observables
1004	Fixed	Extended L1&L2 GPS RTK Observables
1005	Fixed	Stationary RTK Reference Station ARP
1006	Fixed	Stationary RTK Reference Station ARP with Antenna Height
1007	Fixed	Antenna Descriptor
1008	Fixed	Antenna Descriptor & Serial Number
1009	Fixed	L1-Only GLONASS RTK Observables
1010	Fixed	Extended L1-Only GLONASS RTK Observables
1011	Fixed	L1&L2 GLONASS RTK Observables
1012	Fixed	Extended L1&L2 GLONASS RTK Observables
1013	Fixed	System Parameters
1014	Fixed	Network Auxiliary Station Data, Position
1015	Fixed	Network Auxiliary Station Data, Ionospheric Correction Differences
1016	Fixed	Network Auxiliary Station Data, Geometric Correction Differences
1017	Fixed	Network Auxiliary Station Data, Combined Geometric and Ionospheric Correction Differences

RTCM #	Current Status	Title
1019	Fixed	GPS Satellite Ephemeris
1020	Fixed	GLONASS Satellite Ephemeris
1021	Fixed	Helmert / abridged Molodenski Message
1022	Fixed	Molodenski-Badekas Transformation Message
1023	Fixed	Residual Message (ellipsoidal grid representation)
1024	Fixed	Residual Message (plane grid representation)
1025	Fixed	Projection Message (all projection types except LCC2SP and OM)
1026	Fixed	Projection Message (projection type LCC2SP)
1027	Fixed	Projection Message (projection type OM)
1028	Fixed	Local Transformation Message
1029	Fixed	Unicode Text String
1030	Fixed	GPS Network RTK Residual Message
1031	Fixed	GPS Network RTK Residual Message
1032	Fixed	Physical Reference Station Position Message
1033	Fixed	Receiver and Antenna Descriptors
4094	Fixed	Trimble proprietary message

The version 3.1 format lets you support RTK with considerable reduced bandwidths in comparison to the 2.x formats. One of the reasons is that Selective Availability is assumed to be permanently turned off.

The paper "RTCM Recommended Standards for Differential GNSS Service, Version 3.1" gives a detailed description of the RTCM format.

APPENDIX

E

NMEA Standard

In this appendix:

Introduction

The National Marine Electronics Association (NMEA) is dedicated to the education and advancement of the marine electronics industry and the market which it serves.

The NMEA standard defines an electrical interface and data protocol for communications between marine instrumentation.

Under the NMEA-0183 standard, all characters used are printable ASCII text (plus carriage return and line feed).

The data is transmitted in the form of “sentences”. Each sentence starts with a “$”, a two letter “talker ID”, a three letter “sentence ID”, followed by a number of data fields separated by commas, and terminated by an optional checksum, and a carriage return/line feed. A sentence may contain up to 82 characters including the “$” and CR/LF (Carriage return/Line feed).

If data for a field is not available, the field is omitted, but the commas that would delimit it are still sent, with no space between them. Since some fields are variable width, or may be omitted as above, the receiver locates desired data fields by counting commas, rather than by character position within the sentence.

The optional checksum field consists of a “*” and two hex digits representing the exclusive OR of all characters between, but not including, the “$” and “*”. A checksum is required on some sentences.

GPSBase supports the GGA code messages: - Latitude and Longitude, UTC of fix, Number of satellites, and Horizontal DOP, GNSS quality identifier. For accounting purposes, GPSBase supports UID messages.

For more information refer to the NMEA-0183 standard.

GGA – Global Positioning System Fix Data

Time, Position and fix related data for a GNSS receiver.

```
       1         2       3 4        5 6 7  8   9  10 11 12 13  14   15
       |         |       | |        | | |  |   |   | |   | |   |    |
$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
```

Table E.1 Fields of GGA message string

Field	Meaning
1	Universal Time Coordinated (UTC) [hhmmss.ss] of position fix
2	Latitude in [DDMM.MMMMMM]
3	Direction of latitude N: North S: South
4	Longitude in [DDDMM.MMMMMM]
5	Direction of longitude E: East W: West
6	GNSS Quality Indicator 0: fix not available 1: GNSS fix 2: Differential GNSS fix 4: Real-Time Kinematic, fixed integers 5: Real-Time Kinematic, float integers
7	Number of GNSS satellites being used [0 - 12]
8	HDOP of fix
9	Orthometric height (MSL reference)
10	M: orthometric height is measured in meters
11	Geoid separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), “-” means mean-sea-level below ellipsoid
12	M: geoid separation is measured in meters
13	Age of differential GNSS data, time in seconds since last SC104 type 1 or 9 update. Null field when DGPS is not used.

Field	Meaning
14	Differential reference station ID, [0000-1023]. A null field when any reference station is selected and no corrections are received.
15	Checksum [00 - FF]

***Note** – The latitude and longitude are in the datum and ellipsoid of WGS-84.*

APPENDIX

F

Trimble File Formats

In this appendix:

- Introduction
- Observation File
- Trimble Arc Inconsistency File

Introduction

GPSBase outputs data in various file formats. This appendix describes Trimble proprietary file formats.

Observation File

GPSBase allows using binary observation files for storing all data in a receiver independent format. The name of such a file typically contains the point number (SITE) and the observation day (DDD). A free variable S often describes the session number. The file has the extension .obs. Therefore, the typical observation file name is SITEddds.obs.

***Note** – SITE is not the real point number. The real point number is written within the .obs file*

These binary files consist of a header and a body.

Header

See Table F.1 for the data in the observation file header.

Table F.1 Data of the observation file header

Data	Format	Description
identification code	char id_code [8]	ASCII : set to "terraSat"
header length	unsigned int header_length and length	length of header including ic_code
file format version	int version	set to 1 for this version
receiver type	char rcv_type [20]	ASCII : specifying receiver type
receiver serial number	char rcv_serial [20]	ASCII : specifying serial number
receiver software version	char rcv_version [10]	ASCII : specifying receiver software
receiver channels	unsigned int num_rcv_channels	number of receiver channels
old point number	*char point_number [5]*	*should be binary zeros*
Point code	char point_code [17]	ASCII : description of point
Point info	char info [16]	ASCII : Additional Information
Position	double pos [3]	approximate WGS84 position

Data	Format	Description
Instrument eccentricities	float hen [3]	height, east and north eccentricity
Geoidal Height	float geoid_height	Geoidal height information : initial 0
GPS week	int week	GPS week for start of dataset
start time	double t_start	seconds of week for start time
end time	double t_end	seconds of week for end time
time interval	float delta consecutive epochs	smallest time interval between
satellites tracked	unsigned int sats_tracked [64]	number of epochs a specific satellite was tracked (sats_tracked[0] gives the number of epochs for prn 1 etc., elements 32..63 reserved for GLONASS)
reference file	char ref_file [10]	ASCII : initial setting: "?????????"
reference satellite	int ref_sat	initial setting : 0
reference interval	float	initial setting : 0
number of codes	unsigned int num_cod	# of code obs. to single sat
code indicators	char code_ind [4]	C/A = 0 , P1=1, P2=2, P1-P2=3
number of carriers	unsigned int num_car	number of carrier obs. to single sat
carrier indicators	char carrier_ind [4]	C/A = 0 , P1=1, P2=2, P1-P2=3
number of Doppler	unsigned int num_dop	number of Doppler obs. to single sat
Doppler indicators	char doppler_ind [4]	C/A = 0 , P1=1, P2=2, P1-P2=3
L2 squared indicator	unisgned longint l2_squared	activated bits 0..31 show squaring for prn´s 1..32
additional identifiers	unsigned int ident	reserved for bit identification (def 0) bits 0 and 1 for mode indication bit 0 not/bit 1 not set : static bit 0 not/bit 1 set : kinematic bit 0 set/bit 1 not set : short-static bit 0 set/bit 1 set : stop & go bit 2 raw data without satellite clocks bit 3 external oscillator connected bit 4 receiver clock error stored bit 5 indicates that slope instr.height bit 6 indicates that GPS-UTC is stored bit 7 indicates that true vertical instr. height is entered (only if bit 5 zero)
antenna correction	int ant_corr [6]	height, east and north antenna corrections for L1 and L2 in 0.1 mm
original file name	char original_fname[14]	file in receiver specific format
reference elev cutoff	char elev_cutoff	elevation cutoff - required for multistation approach
reference frequency	char frequency	type of frequency used by lastbaseline estimator run - required for multistation approach
antenna number	char antenna_num[20]	serial number of antenna
antenna type	char antenna_type[20]	type of antenna used
CRC	unsigned longint	32 bit crc
point_number_16	***char point_num[17]***	***ASCII: long point number***
GPS-UTC	char gps_utc[1]	GPS-UTC in seconds
reserved	char reserved [2]	reserved for future use
Last access by	modified_by[4]	for example, ´A´,´D´,´1´,´0´
Last access at	unsigned long time	value of C time function (holds date and time) in DOS format

Body

The body of an OBS file consists of a sequence of observation records, navigation records and event records.

Table F.2 Data of the observation file body

Data	Format	Description
Observation Record (OR)		
body identification	int body_id	ASCII : set to "OR"
record length	int record_length	length of body record in bytes including body_id and record_length
receipt time	double rec_time	signal receipt time in seconds of week corresponding to start week in header (rec_time can be larger than 604800, no wrap around)
Kinematic Indicator	***char kin_indicator [5]***	***"????" when moving, last four characters of point number when static***
number of sats	unsigned char num_sats	number of satellites tracked in current epoch
measurements	MEAS_BLOCK meas[num_sats]	structure with observations
typedef {	int sv_id;	satellite identification
	double code [num_cod];	pseudorange measurements
	double phase [num_carr];	carrier phase measurements in cycles
	float doppler [num_dop];	doppler measurements
	char snr [num_car];	signal to noise ratio in dB
	char lli [num_car];	lost of lock indicator (bitwise settings) no bits set - data ok, no loss of lock bit 0 set - lost lock between previous and current observation : cycle slip possible bit 1 set - inverse wavelength factor to default (does not change default) bits 0 and 1 set - lost lock , inverse wlfact bit 2 set - indicates 1/2 cycle error possible
} MEAS_BLOCK;		
Navigation solution record (NR)		
body identification	int body_nr_id	ASCII : set to "NR"
record length	int record_length	length of body record in bytes including body_id and record_length
reference time	double ref_time	reference time for navigation solution in seconds of week corresponding to start week in header (rec_time can be larger than 604800, no wrap around)
position	double curr_pos [3]	cartesian position solution in WGS 84
receiver clock error	float rcv_clk_error	receiver clock error in seconds
HDOP	unsigned int hdop	horizontal DOP value - to be divided by 100
VDOP	unsigned int vdop	vertical DOP value - to be divided by 100

Data	Format	Description
Event record (ER)		
body identification	int body_nr_id	ASCII : set to "ER"
record length	int record_length	length of body record in bytes including body_id and record_length
event type	int event_type	type of event 0 external event 1 receiver time adjustment 2 manual event 3 external comment 4 RS232 event 5 new point number
reference time	double ref_time	time of event in seconds
For types 0,1,2,4:		
event id	unsigned int event_number	event number for types 0, 1, 2, 4 (not stored for other types)
For type 3:		
comment	char comment[length-14]	comment text
For type 5:		used in Stop & Go
init_type	int init_type	Type of initialization or point 0 Normal new point 1 Point with known baseline to the base station 2 New initial point 3 VSFB
point number	char point_number[5]	ASCII: specifying short point number
point code	char point_code[17]	ASCII: description of point
point info	char point_info[16]	ASCII: additional information
instrument ecc	float hen[3]	height, east and north eccentricities
comment	char comment[length-64]	comment text
For type 6		used in Stop & Go with extended point number
init_type	int init_type	Type of initialization or point 0 Normal new point 1 Point with known baseline to the base station 2 New initial point 3 VSFB
point number	char point_number[9]	ASCII: specifying short point number
spares	char spares [8]	reserved for future extensions
point code	char point_code[17]	ASCII: description of point
point info	char point_info[16]	ASCII: additional information
instrument ecc	float hen[3]	height, east and north eccentricities
comment	char comment[length-76]	comment text

In case of VSFB, baseline components are stored in height, east and north in vector "**hen**". The sign of the baseline is defined as **rover-reference**.

Trimble Arc Inconsistency File

DIS files are binary files with the file extension .dis. They are created monthly and list the calculated arc inconsistencies for GPS satellites. DIS files can be read by ArcViewer, an add-on to the former GPS-Base program.

Arc inconsistencies allow the analysis of the satellite position by comparing the current ephemeris information with the previous one. Only arcs with time stamps less than a given threshold (user definable; default = 21600 seconds, i.e. 6 hours) are considered in order to avoid large errors.

The DIS file name typically starts with a leading t and contains the Month and the Year of creation: for example, tMM-YY.dis. DIS files contain the following information:

Table F.3 DIS file information

Abbreviation	Format	Description
SATID	integer	satellite ID
GPSWEEK	integer	GPS week
TOE_OLD	double	reference time of old ephemeris in seconds
TOE_NEW	double	reference time of new ephemeris in seconds
TMID	double	mean reference time of ephemeris
DX	double	WGS84 X-coordinate difference of the satellite position (new-old) in meters
DY	double	WGS84 Y-coordinate difference of the satellite position (new-old) in meters
DZ	double	WGS84 Z-coordinate difference of the satellite position (new-old) in meters

APPENDIX

G

Reports

In this appendix:

Introduction

Data may be output in the form of formatted text, called reports. GPSBase typically generates text in the XML format.

***Note** - Some modules create simple log files in text format, if you have activated logging in the registry. See the section on Log Files.*

GPSBase uses Windows Internet Explorer (IE) 6.0 to parse and display reports (or any other browser that can parse and display XML documents).

The XML file names typically follow the following formatting convention:

<module> [< source>] <task> $<sessionID>.xml

Table G.1 Components of the XML file names

Component	Description
<module>	The name of the module type that writes information into the report.
<source>	The name identifying the individual module. Your system may contain multiple modules of the same type, such as the RTCM Generator modules. If no additional information is needed, the brackets are empty. For example: For a Raw Data Analysis module, the brackets contain the name of the Receiver module the Raw Data Analysis module is added to.
<task>	Identifying the specific task of the report, if modules create multiple reports. For example: The SA Analysis module creates both a report on SA amplitudes and one on Daily SA periods.
$<sessionID>	Session identifier, where <sessionID> is replaced by one or several capital letters. Typically, per day one report of a type is written. Additional reports of the same type may occur after a restart of the system.

To start the reporting, select the main menu command *File / Reporting* and edit the *Reporting* dialog. See Chapter 3, Getting Started, Section Reporting. For information on the occasions when reports are generated, see Table G.2.

Table G.2 Report generation times

This report is generated after…	… this action by generating module:	…change of hour (H), … change of day (D)	…reporting enabled or Write Report clicked (E)	… this other event occurs:
Alarm Settings		D	E	Change of settings
Alarms Received	On alarm			
Alarms Issued	On alarm, if an action has been defined			
Almanac Satellite Status	- At start-up - On activation of "Store almanac"; updates on new almanac (10 sec. delay) and every hour after activation time		E	
Raw Data Analysis. Daily	- On first new data - Update every 15 minutes - On close	D	E	
Raw Data Analysis. Cycle Slips	If error occurred: - Update every 15 minutes - On close	D	E	

This report is generated after…	… this action by generating module:	…change of hour (H), … change of day (D)	…reporting enabled or Write Report clicked (E)	… this other event occurs:
Raw Data Analysis. Individual Error Report	If error occurred: - Update every 15 minutes - On close	D	E	
Point Position Analysis – Statistics	- Update every 6 minutes - On close	D	E	
Point Position Analysis – Position Outlier	- On first new data - Update every 15 minutes - On close	D	E	
Storage Report	- Update after a file was written - On close			At start-up the report files of the same day are loaded.
Storage Report – Summary	- Update after a file was written (delay of 20 seconds) - On close			
RTCM Generator Session Logfile	New report file with new connection. New header entry when output configuration changes.	D		
Overview of Connected Receivers	After instrument has been connected or removed (delay of 5 seconds)	D	E	

Log Files

The following modules create log files in text format, if you have activated logging:

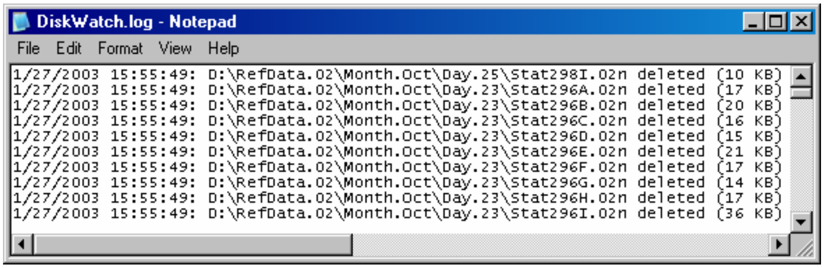
- Disk Watch module
- FTPMirror module

To activate logging, select the *Use Logfile* option from the module's short-cut menu.

If logging is activated, the logging modules write text files with the extension .log into the folder <installdir>/LogFiles. New information will be appended to these files. Thus, log files may get considerably big. Therefore, Trimble recommends you to check (and empty) the LogFiles folder once in a while.

The Disk Watch module writes data, time and path to deleted files into the log file.

The FTPMirror module writes detailed information on the current state of file transfer to the FTP server into the log file FTPMirror.log. You may also view the information at the *File Transmission Status* page of the FTPMirror information pane.

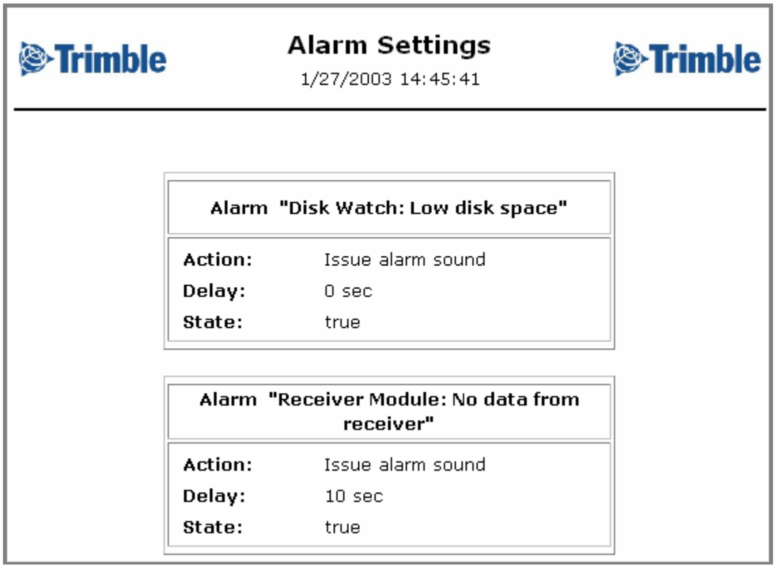



```
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.25\Stat298I.02n deleted (10 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296A.02n deleted (17 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296B.02n deleted (20 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296C.02n deleted (16 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296D.02n deleted (15 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296E.02n deleted (21 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296F.02n deleted (17 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296G.02n deleted (14 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296H.02n deleted (17 KB)
1/27/2003 15:55:49: D:\RefData.02\Month.Oct\Day.23\Stat296I.02n deleted (36 KB)
```

Alarm Reports

The Alarm module generates three reports:

- The report Alarm Settings is generated from Alarm [] Settings $<sessionID>.xml. This report lists for each alarm set the settings: alarm condition, action, time delay, status.


Alarm Settings
1/27/2003 14:45:41

Alarm "Disk Watch: Low disk space"	
Action:	Issue alarm sound
Delay:	0 sec
State:	true

Alarm "Receiver Module: No data from receiver"	
Action:	Issue alarm sound
Delay:	10 sec
State:	true

- The report Received Alarm Messages is generated from Alarm [] Received $<sessionID>.xml. It is a log of all alarm messages received. If alarming is activated, this applies to all modules that are able to create an alarm. (However, only those modules ***issue*** an alarm that you have configured using the alarm settings functionality.) If the alarm condition becomes true, each module writes this event into the Received Alarm Messages report using the default or the last saved settings, even if no alarm was issued. Listed are the time of sending the alarm message, the status of the condition (alarm or fixed) and the alarm condition.

Received Alarm Messages

1/27/2003 14:17:35

Send Time	State	Alarm
02.12.2004 14:40:20	Alarm	Hoehenkirchen: Receiver running on low voltage 18.1 V (Limit 33 V) 100 % (Limit 0 %)
02.12.2004 14:44:20	Fixed	Hoehenkirchen: Receiver running on low voltage 18.1 V (Limit 0 V) 100 % (Limit 0 %)
02.12.2004 14:44:50	Alarm	Hoehenkirchen: Receiver running on low voltage 18.0 V (Limit 33 V) 100 % (Limit 0 %)

- The Issued Alarm report is generated from Alarm [] Issued $<sessionID>.xml. It is a log of all alarm messages issued according to the settings. Listed are the issue time of alarm message, the status of the condition (alarm or fixed), the alarm condition and the action taken.

Issued Alarms

1/27/2003 15:34:50

Time	State	Alarm	Action
1/27/2003 15:32:31	Alarm	Receiver: No data from receiver Hoehenkirchen	Issue alarm sound
1/27/2003 15:42:31	Alarm	Receiver: No data from receiver Hoehenkirchen	Issue alarm sound
1/27/2003 15:52:31	Alarm	Receiver: No data from receiver Hoehenkirchen	Issue alarm sound

Almanac Reports

For almanac data one report is available:

- Satellite Status from Almanac: Almanac.xml.

This report summarizes the health indicators of the almanac for each satellite according to the satellite PRN and system. Possible almanac states are the following:

- all data ok
- parity failure some or all parity bad
- tlm/how format problem
- z-count in how bad
- subframes 1,2,3 - one or more subframes are bad
- subframes 4,5 - one or more subframes are bad
- all uploaded data bad
- all data bad

The almanac states are also indicated in the *Health* information page of the Availability module.

Satellite Status from Almanac

1/22/2003 13:34:07

PRN	System	Time	Almanac Status
1	GPS	1/24/2003 19:56:48	All data OK
2	GPS	1/24/2003 19:56:48	All data OK
3	GPS	1/24/2003 19:56:48	All data OK
4	GPS	1/24/2003 19:56:48	All data OK
5	GPS	1/24/2003 19:56:48	All data OK

Raw Data Analysis Reports

For raw data analysis, three reports are available:

- Raw Data Analysis Report: Daily. You can generate the report from Raw Data Analysis [<receiver>] Daily error report $<sessionID>.xml.
- Cycle-Slip Report. It is available from Raw Data Analysis [<receiver>] Cycle slip $<sessionID>.xml.
- Individual Error Report of Raw Data Analysis. It can be derived from Raw Data Analysis [<receiver>] Individual error $<sessionID>.xml.

The daily Raw Data Analysis Report counts for each satellite the errors which occurred during the day and sorts them according to the error type.

Raw-Data-Analysis Report Augsburg

1/27/2003 16:47:22

PRN	System	Error Statistics of Raw Data Type of Error	Count
1	GPS	L2-phase bad	58
		SPP residual bad	1
		Unresolved cycle slip	3
		Resolved cycle slip	12
		Continued cycle slip	3
		Unknown error	12

The Cycle Slip report shows for each occurrence of a cycle slip the reference time, the satellite PRN and system, its elevation and azimuth. A cycle slip may be *resolved*, *unresolved* or *continued*.

GPS-Time	Detected Cycle-Slips				
	Sat	System	Cycle Slip	Elev	Azi
1/13/01 11:33:50 PM	13	GPS	unresolved	11.2	208.5
1/13/01 11:55:20 PM	4	GPS	unresolved	10.8	308.5
1/14/01 12:01:50 AM	7	GPS	unresolved	5.1	278.9
1/14/01 12:41:45 AM	19	GPS	unresolved	11.2	171.9
1/14/01 12:46:52 AM	1	GPS	resolved	7.2	197.0
	4	GPS	resolved	31.5	309.6
	7	GPS	resolved	27.7	256.5

The Individual Error Report of Raw Data Analysis gives full detail on detected errors.

The *Type of Error* column may display one of the following status messages:

- OK
- Too many satellites
- Bad satellite ID
- Bad SNR L1
- Bad SNR L2
- LLI data bad on L1
- LLI data bad on L2
- L1-phase bad
- L2-phase bad
- L1-code bad
- L2-code bad
- Code difference bad
- No ephemeris
- SPP residual bad
- SPP position bad
- No GLONASS frequency

- No reference data
- Data gap too long
- Too few data
- Unresolved cycle slip
- Resolved cycle slip
- Continued cycle slip
- Cycle slip new arc
- Unknown Error

Individual Error Report of Raw Data Analysis Trimble 38400 Baud

1/14/01 12:03:29 AM

Event	PRN	System	Type of Error	Azi	Ele
1/13/01 11:00:58 PM	1	GPS	Data gap too big	194.8	21.8
			Too few data	194.8	21.8
	7	GPS	Data gap too big	308.0	28.6
			Too few data	308.0	28.6
	11	GPS	Data gap too big	132.1	71.5
			Too few data	132.1	71.5
	20	GPS	Data gap too big	264.6	59.7

Point Position Analysis Reports

For point position analysis, two reports are available:

- Point Position Analysis - Statistics from Point Position Analysis [<receiver>] Statistics (from <module>) $<sessionID>.xml.
- Point Position Analysis - Outliers from Point Position Analysis [<receiver>] Position outlier (from <module>) $<sessionID>.xml.

Since you may have added the Point Position Analysis module either directly below the Receiver module or below the Single Point

Position module of a Receiver module, the name of the XML file indicates the location of the data source. For example: "… (from Single Point Position) …".

The Statistics report gives a short summary on the point position analysis. For the current receiver module the data source (for example, the Single Point Position module) and the observation period is given. The reference position follows in XYZ coordinates.

For NEH then follow the mean difference, the mean standard and minimum and maximum difference values to the reference position.

Point Position Analysis
Statistics Rosenheim
1/27/2003 16:47:21

Receiver:	Rosenheim
Source:	Single Point Position (SPP)
Observation Time (GPS):	1/27/2003 13:18:00 - 1/27/2003 15:45:00
Reference Position:	X = 4191647.006 m Y = 899148.668 m Z = 4707396.743 m

	Mean Diff	Mean Std.	Min	Max
N	-1.733 m	0.198 m	-0.181 m	8.317 m
E	-0.781 m	0.121 m	-0.080 m	6.084 m
H	-3.330 m	0.302 m	0.019 m	-7.147 m

The Position Outlier Report lists all epochs with horizontal or vertical position differences to the known coordinates that are larger than the limits. The report gives the observation time span from the first epoch to the last epoch with outliers detected.

The horizontal and vertical limits are user-defined at the *Properties* dialog of the Point Position Analysis module.

Point Position Analysis
Outliers Rosenheim
1/15/2003 10:58:54

Receiver:	Rosenheim
Source:	Single Point Position (SPP)
Observation Time (GPS):	1/15/2003 09:55:36 - 1/15/2003 10:19:48
Reference Position:	X = 4191647.006 m Y = 899148.668 m Z = 4707396.743 m
Horizontal Limit:	1.000 m
Vertical Limit:	1.000 m

GPS-Time	dN [m]	dE [m]	dH [m]	dV [m]
1/15/2003 09:55:36	2.405	0.680	2.499	0.627
1/15/2003 09:55:37	2.399	0.728	2.507	1.039

Data Storage Reports

The following data writer modules generate summary and log reports.

- The DAT Storage module generates:
  - the DAT Report from the file DAT Storage [<receiver>] Station <ID> $<sessionID>.xml.
  - the DAT Report – Summary from the file DAT Storage [] Overview $<sessionID>.xml.
- The RINEX Storage module generates:
  - the RINEX Report from the file RINEX Storage [<receiver>] Station <ID> $<sessionID>.xml.
  - the RINEX Report – Summary from the file RINEX Storage [] Overview $<sessionID>.xml.

Typically, both types of reports are created as soon as the first data file has been written completely.

The three data storage modules write the same type of information into the two types of reports. The following subsection describes the contents of the log reports (DAT Report and RINEX Report). A comprehensive description of the respective summary reports for these data storage modules follows.

Note *- The data storage modules internally store their information. After a system re-start, they each add new information to the previous reports, such creating per day just one report file of a type.*

The <data type> Report

The daily DAT Report and RINEX Report log for the specified station and specified data type the data files that have been stored into the specified folder. The leading section of the report gives the Station ID, the date and the day of year, the tracking rate and the time offset of the local time to UTC time.

The following list logs for each data file

- A file status identifying icon
- The first epoch written into the data file
- The file name
- Epochs with status OK
- Missing Epochs
- Availability
- Mean number of satellites within the period
- Path to the data file

At the end of the list you find a legend for the icon colors.

Trimble **DAT Report** Trimble

1/22/2003 00:01:54

Station Rosenheim

ID:	272
Date:	1/21/2003
Day of Year:	21
Tracking Rate:	1.0 s
Local Time Offset:	+1 h

Start (Local Time)	Filename	Epochs OK	Epochs Missing	Availability	Satellites	Path
00:00:00	Rose021A.DAT	3600	0	100 %	8.3	D:\RefStations\\Month.Jan\Day.21\
01:00:00	Rose021B.DAT	3598	2	100 %	8.6	D:\RefStations\\Month.Jan\Day.21\
02:00:00	Rose021C.DAT	3600	0	100 %	8.4	D:\RefStations\\Month.Jan\Day.21\
03:00:00	Rose021D.DAT	3343	257	93 %	8.1	D:\RefStations\\Month.Jan\Day.21\
04:00:00	Rose021E.DAT	3598	2	100 %	9.9	D:\RefStations\\Month.Jan\Day.21\
05:00:00	Rose021F.DAT	3597	3	100 %	10.5	D:\RefStations\\Month.Jan\Day.21\
06:00:00	Rose021G.DAT	3600	0	100 %	9.5	D:\RefStations\\Month.Jan\Day.21\

LEGEND:

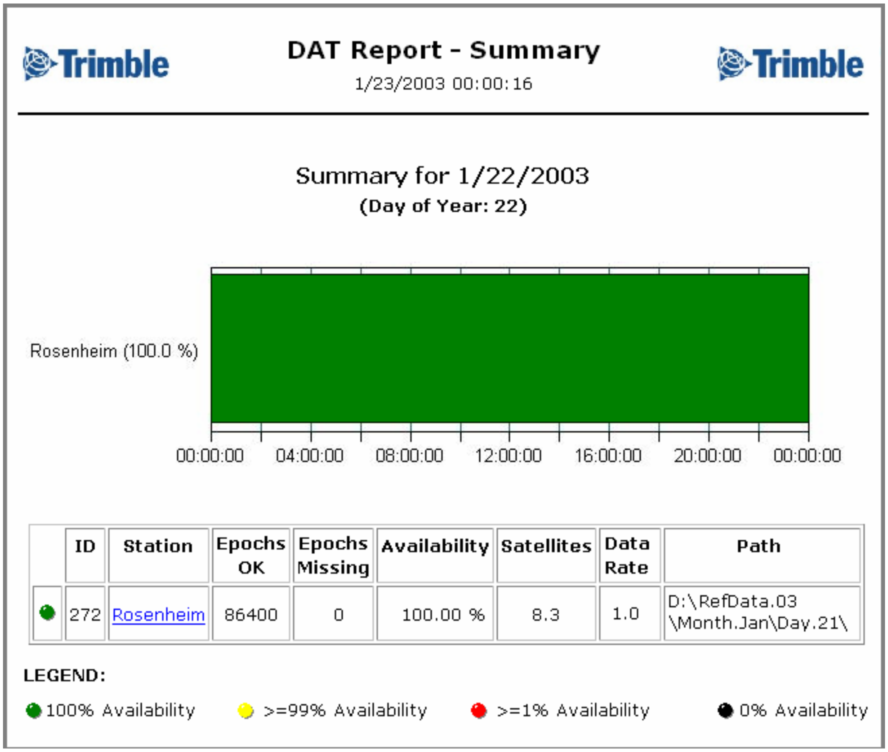
from "RINEX Storage"

from "Storage Integrity"

Availability: =100% >=99% >=1% >=0%

The <data type> Summary report

The daily summary reports give an overview for the station that creates the data reports. A bar graph shows the continuousness of data logging over time. The color of the bar represents the availability of data for the day. If data is missing, the bar is discontinued during the respective time span.



	ID	Station	Epochs OK	Epochs Missing	Availability	Satellites	Data Rate	Path
	272	Rosenheim	86400	0	100.00 %	8.3	1.0	D:\RefData.03 \Month.Jan\Day.21\

Besides an availability-status identifying icon and its ID you find for the station the summed-up numbers of good and missing epochs, the availability of epochs in percent, the data rate used for data storage, and the path to the file storage folder. The station name offers a hyperlink to the <data type> Report.

The status icon uses the same color code as the graph bar. See the legend for the icon status colors.

RTCM Generator Reports

All RTCM Generator modules start generating a log report, when a rover calls in. The report is closed when the connection is stopped.

- Rtcm Generator: Session Logfile. The report is generated from the file RTCM [<rtcm generator name>] YYMMDD HHMMSS <UserName> $<sessionID>.xml. The date and time in the file name refer to the start time of the connection; the user name section of the file name only applies if the user is identified.

The header of the report includes its start and close time.

RTCM Generator: Session Logfile

from 12/5/2002 8:45:53 AM until 12/5/2002 9:01:48 AM

User Name:	John Doe
Phone Number:	0123456789
RTCM Generator:	Single Station RTCM at 8000
Port:	Socket Server Port 8000 (Dial-In)
RTCM configuration:	OBS RTCM 2.3: 18/19(1), 23(17), 24(17)
RTCM position:	WGS84: X 4099564.067 m Y 881540.679 m Z 4790348.760 m WGS84: Lat N 48° 59' 35.06424" Lon E 12° 08' 08.43223" h 391.467 m
Distance to real reference station:	0.00 m

GPS-Time	Mode	Base station ID	Satellites	Rover solution
8:46:23 AM	RAW	278	9	SPP
8:46:40 AM	RAW	278	9	DGPS
8:48:09 AM	RAW	278	8	RTK
8:49:02 AM	RAW	278	9	RTK
8:49:38 AM	RAW	278	8	RTK

The RTCM Generator report consists of an extensive header part that gives you full information on the RTCM settings and parameters. If any changes to one of these parameters have occurred, this header part is repeated.

The following list logs the time-stamped activities. New entries will be added to the file each time one of the values changes: RTCM Generator mode (*Mode*), ID of nearest reference station (*Base station ID*), number of satellites (*Satellites*), quality of the rover solution (SPP, DGPS or RTK).

Table G.3 Parameters of the RTCM Generator reports

Line	Description
User Name	User Name of caller. This line is only displayed, if you have enabled the accounting functionality.
Phone Number	Phone number of the caller. This line is only displayed, if you have enabled the accounting functionality.
RTCM Generator	RTCM Single Station Generator name.
Port	Connection configuration of the RTCM Generator
RTCM configuration	Displays, how the RTCM Generator is configured in its *Properties* pages. Output type and output format; a comma separated list of the RTCM message types and (in brackets) their update rates in units of seconds follow after the colon. This is a copy of the line *RTCM-Config* of the RTCM Generator's *Status* information page.
RTCM position	The position sent as RTCM #3, #22, or #24 message, or as CMR type 1 message, depending on the data format chosen. Coordinates are given in X, Y, Z coordinates and ellipsoidal Lat, Lon, height. This is a copy of the line *RTCM-Position* of the RTCM Generator's *Status* information page.
Distance to real reference station	Distance between the selected reference station and the transmitted position.

Receivers Report

A report generated by the Receivers module gives an overview of the connected receiver’s main parameters:

- Overview of Connected Receivers. You can generate the report from the file Receivers []status $<sessionID>.xml.

Overview of Connected Receivers

1/17/2003 00:01:54

Connection: Hoehenkirchen

Receiver:	Trimble 4700 (SN: 20220117, FW: Nav 1.40 / Boot 1.00)
Station-ID:	304
Point Number:	Hoehenkirchen
Configuration:	Socket Client for DET-YBLVA, port 12304
Reference Position:	X = 4185157.392 m Y = 868272.672 m Z = 4719042.709 m
Antenna:	Compact L1/L2 w/GP and Dome (Trimble)
Antenna Height:	Antenna Phase Center h = 0.000 m
Elevation Cutoff:	5°
Tracking Rate:	1.0 sec

This report summarizes for the connection the most important information. It displays the following parameters:

- Receiver type. With an active receiver, you can also find the serial number and firmware.
- Station ID
- Point number
- Configuration type and detailed information
- Reference position in X, Y, Z coordinates

- Antenna brand
- Antenna height and measurement method
- Elevation cutoff
- Tracking rate

Abbreviations

This section explains some of the terms and abbreviations used in this manual.

AdV	Standard of the German Arbeitsgemeinschaft deutscher Vermessungsingenieure (AdV)
ANTEX	ANTenna EXchange independent format. Used for relative or absolute calibrations of antennas.
APC	Antenna phase center: The electronic center of the antenna. The APC often does not correspond to the physical center of the antenna. The radio signal is measured at the APC.
ARP	Antenna reference point.
ASCII	American Standard Code for Information Interchange. An eight-bit code for character representation, (seven bits plus parity), used for serial communication. Generally the data in this format can be read.
C/A code	Coarse Acquisition code.
CMR	Compact Measurement Record. The format was designed by Trimble and is supported by all Trimble RTK products. CMR messages require at least a 2400 baud data link.
DB	Database
DGPS	Differential GPS

DOP	Dilution of Precision
EGNOS	European Geostationary Navigation Overlay Service. Terrestrial regional augmentation network, under development
FKP	German area correction parameters, defined by AdV
FTP	File Transfer Protocol
GGA	NMEA record: Global Position System Fix Data
GLONASS	The Russian equivalent to GPS
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GSM	Global System for Mobile communication
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
ID	Identification
IE	Microsoft Internet Explorer
IGS	International GNSS Service (formerly the International GPS Service), federation of more than 200 worldwide agencies generating precise GPS & GLONASS products.
IODE	Issue Of Data (Ephemeris)
IP	Internet Protocol
ISDN	Integrated Services Digital Network
L2C	Civilian signal on the L2 frequency
LAN	Local Area Network

LLI	Loss of lock indicator
NMEA	National Marine Electronics Association
Ntrip	Network Transport of RTCM via Internet Protocol. RTCM standard; open, non-proprietary protocol based on HTTP/ 1.1; originally proposed by the German Federal Agency for Cartography and Geodesy (BKG)
OBS	Trimble Terrasat's Observation File Format
ODBC	Open Database Connectivity
PDF	Portable Document Format
PRC	Pseudo Range Corrections
PRN	Pseudo Random Noise, identifies the satellite
RINEX	Receiver Independent Exchange Format
RPC	Remote Procedure Call, technology for distributed client / server programs
RTCM	Radio Technical Commission For Maritime Services
RTCM Protocol	Internationally standardized data format for the broadcast of corrective data for DGPS
RTK	Real-Time Kinematic
SMTP	Send Mail Transfer Protocol
SNR	Signal to Noise Ratio
TAM	Trimble Application Model
TAPI	Telephone Application Programming Interface
TCP/IP	Transfer Control Protocol/Internet Protocol

TEC	Total Electron Content. 1 Tecu = 10^{16} electrons per square meter
TGD	Offset between L1 and L2 in the receiver or the satellite
TOW	Time of Week
TZD	Total Zenith Delay. Tropospheric error.
UMTS	Universal Mobile Telecommunication Service
URA	User Range Accuracy
USB	Universal Serial Bus
UTC	Universal Time Coordinated (world time)
VRS	Virtual Reference Station
WAAS	Wide Area Augmentation System
WAN	Wide Area Network

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