MAGELLAN®
PROFESSIONAL

ProMark™ 500

Reference Manual

Includes Serial Commands
Supplement

Copyright Notice

Trademarks

FCC Notice

ProMark 500 Receiver complies with the limits for a Class B digital device, pursuant to the Part 15 of the FCC rules when it is used in Portable Mode. See Note below related to Class B device.

Class B digital devices NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or locate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

When ProMark 500 is used with an external power supply or connected to an external device using the USB port, it complies with the limits for a Class A digital device, pursuant to the Part 15 of the FCC rules. See Note below related to Class A device.

Class A digital devices NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Remark: Any changes or modifications not expressly approved by Magellan Navigation, could void the right for user to operate the equipment.

RF Safety Exposure To Radio Frequency Energy (SAR)

Radio transmitting devices radiate Radio Frequency (RF) energy during its operation. RF energy can be absorbed into the human body and potentially can cause adverse health effects if excessive levels are absorbed. The unit of measurement for human exposure to RF energy is "Specific Absorption Rate" (SAR).

The Federal Communications Commission (FCC), Industrie Canada (IC), and other agencies around the world have established limits that incorporate a substantial safety margin designed to assure the safety of all persons using this equipment. In order to certify this unit for sale in the US, Canada and Europe this unit has been tested for RF exposure compliance at a qualified test laboratory and found to comply with the regulations regarding exposure to RF Energy. SAR was measured with the unit (GSM Module) transmitting at its maximum certified RF power. Often, however, during normal operation the unit (GSM Module) will transmit much less than maximum power. Transmit power is controlled automatically and, in general is reduced as you get closer to a cellular base station. This reduction in transmit power will result in a lower RF energy exposure and resulting SAR value.

FCC and CE UHF Safety Statement

The different versions of the UHF Transmitters are FCC and CE compliant.

In order to comply with FCC and CE RF exposure safety guidelines as body-worn, normal use of unit, the following must be followed:

A distance of AT LEAST 10 feet (3 m) of separation between the users body and the unit (UHF Transmitter). This distance has been defined taken into account the FCC and CE Requirements and the worst output power configuration.

Do NOT use the device in a manner such that it is in direct contact with the body (e.g. on the lap). Such use will likely exceed FCC RF safety exposure limits. See www.fcc.gov/oet/rfsafety/ for more information on RF exposure safety.

Replacing the Magellan U-Link Transmitter Power Fuse

The Magellan U-Link transmitter is protected by a 4-A fuse inserted in the data/power cable. This Y-shaped cable is used to connect the U-Link transmitter to the ProMark 500 receiver via a 7-pin connector, and to the power battery.

Should you have to replace this fuse, please get a spare fuse, 4 A, fast acting, ATO type, and then do the following:

- Unplug the battery end of the data/power cable
- Open the fuse holder located along the data/power cable
- Extract the damaged fuse
- Insert the new fuse and then push the holder lid back into place
- Connect the data/power cable back to the battery.

Magellan Professional Products - Limited Warranty (North, Central and South America)

Magellan Navigation warrants their GPS receivers and hardware accessories to be free of defects in material and workmanship and will conform to our published specifications for the product for a period of one year from the date of original purchase. THIS WARRANTY APPLIES ONLY TO THE ORIGINAL PURCHASER OF THIS PRODUCT.

In the event of a defect, Magellan Navigation will, at its option, repair or replace the hardware product with no charge to the purchaser for parts or labor. The repaired or replaced product will be warranted for 90 days from the date of return shipment, or for the balance of the original warranty, whichever is longer. Magellan Navigation warrants that software products or software included in hardware products will be free from defects in the media for a period of 30 days from the date of shipment and will substantially conform to the then-current user documentation provided with the software (including updates thereto). Magellan Navigation's sole obligation shall be the correction or replacement of the media or the software so that it will substantially conform to the then-current user documentation. Magellan Navigation does not warrant the software will meet purchaser's requirements or that its operation will be uninterrupted, error-free or virus-free. Purchaser assumes the entire risk of using the software.

PURCHASER'S EXCLUSIVE REMEDY UNDER THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT, AT MAGELLAN NAVIGATION'S OPTION, OF ANY DEFECTIVE PART OF THE RECEIVER OR ACCESSORIES WHICH ARE COVERED BY THIS WARRANTY. REPAIRS UNDER THIS WARRANTY SHALL ONLY BE MADE AT AN AUTHORIZED MAGELLAN NAVIGATION SERVICE CENTER. ANY REPAIRS BY A SERVICE CENTER NOT AUTHORIZED BY MAGELLAN NAVIGATION WILL VOID THIS WARRANTY.

To obtain warranty service the purchaser must obtain a Return Materials Authorization (RMA) number prior to shipping by calling 1-800-229-2400 (press option #1) (U.S.) or 1-408-615-3981 (International), or by submitting a repair request on-line at: http://professional.magellangps.com/en/support/rma.asp. The purchaser must return the product postpaid with a copy of the original sales receipt to the address provided by Magellan Navigation with the RMA number. Purchaser's return address and the RMA number must be clearly printed on the outside of the package.

Magellan Navigation reserves the right to refuse to provide service free-of-charge if the sales receipt is not provided or if the information contained in it is incomplete or illegible or if the serial number is altered or removed. Magellan Navigation will not be responsible for any losses or damage to the product incurred while the product is in transit or is being shipped for repair. Insurance is recommended. Magellan Navigation suggests using a trackable shipping method such as UPS or FedEx when returning a product for service.

EXCEPT AS SET FORTH IN THIS LIMITED WARRANTY, ALL OTHER EXPRESSED OR IMPLIED WARRANTIES, INCLUDING THOSE OF FITNESS FOR ANY PARTICULAR PURPOSE, MERCHANTABILITY OR NON-INFRINGEMENT, ARE HEREBY DISCLAIMED AND IF APPLICABLE, IMPLIED WARRANTIES UNDER ARTICLE 35 OF THE UNITED NATIONS CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS. Some national, state, or local laws do not allow limitations on implied warranty or how long an implied warranty lasts, so the above limitation may not apply to you.

The following are excluded from the warranty coverage: (1) periodic maintenance and repair or replacement of parts due to normal wear and tear; (2) batteries and finishes; (3) installations or defects resulting from installation; (4) any damage caused by (i) shipping, misuse, abuse, negligence, tampering, or improper use; (ii) disasters such as fire, flood, wind, and lightning; (iii) unauthorized attachments or modification; (5) service performed or attempted by anyone other than an authorized Magellan Navigations Service Center; (6) any product, components or parts not manufactured by Magellan Navigation; (7) that the receiver will be free from any claim for infringement of any patent, trademark, copyright or other proprietary right, including trade secrets; and (8) any damage due to accident, resulting from inaccurate satellite transmissions. Inaccurate transmissions can occur due to changes in the position, health or geometry of a satellite or modifications to the receiver that may be required due to any change in the GPS. (Note: Magellan Navigation GPS receivers use GPS or GPS+GLONASS to obtain position, velocity and time information. GPS is operated by the U.S. Government and GLONASS is the Global Navigation Satellite System of the Russian Federation, which are solely responsible for the accuracy and maintenance of their systems. Certain conditions can cause inaccuracies which could require modifications to the receiver. Examples of such conditions include but are not limited to changes in the GPS or GLONASS transmission.) Opening, dismantling or repairing of this product by anyone other than an authorized Magellan Navigation Service Center will void this warranty.

MAGELLAN NAVIGATION SHALL NOT BE LIABLE TO PURCHASER OR ANY OTHER PERSON FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DAMAGES RESULTING FROM DELAY OR LOSS OF USE, LOSS OF OR DAMAGES ARISING OUT OF BREACH OF THIS WARRANTY OR ANY IMPLIED WARRANTY EVEN THOUGH CAUSED BY NEGLIGENCE OR OTHER FAULT OFMAGELLAN NAVIGATION OR NEGLIGENT USAGE OF THE PRODUCT. IN NO EVENT WILL MAGELLAN NAVIGATION BE RESPONSIBLE FOR SUCH DAMAGES, EVEN IF MAGELLAN NAVIGATION HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

This written warranty is the complete, final and exclusive agreement between Magellan Navigation and the purchaser with respect to the quality of performance of the goods and any and all warranties and representations. This warranty sets forth all of Magellan Navigation's responsibilities regarding this product. This limited warranty is governed by the laws of the State of California, without reference to its conflict of law provisions or the U.N. Convention on Contracts for the International Sale of Goods, and shall benefit Magellan Navigation, its successors and assigns.

This warranty gives the purchaser specific rights. The purchaser may have other rights which vary from locality to locality (including Directive 1999/44/EC in the EC Member States) and certain limitations contained in this warranty, including the exclusion or limitation of incidental or consequential damages may not apply.

For further information concerning this limited warranty, please call or write:

Magellan Navigation, Inc., 471 El Camino Real, Santa Clara, CA 95050-4300, Phone: +1 408 615 5100, Fax: + +1 408 615 5200 or

Magellan Navigation SAS - ZAC La Fleuriaye - BP 433 - 44474 Carquefou Cedex - France Phone: +33 (0)2 28 09 38 00, Fax: +33 (0)2 28 09 39 39.

Magellan Professional Products Limited Warranty (Europe, Middle East, Africa)

All Magellan Navigation global positioning system (GPS) receivers are navigation aids, and are not intended to replace other methods of navigation. Purchaser is advised to perform careful position charting and use good judgment. READ THE USER GUIDE CAREFULLY BEFORE USING THE PRODUCT.

1. MAGELLAN NAVIGATION WARRANTY

Magellan Navigation warrants their GPS receivers and hardware accessories to be free of defects in material and workmanship and will conform to our published specifications for the product for a period of one year from the date of original purchase or such longer period as required by law. THIS WARRANTY APPLIES ONLY TO THE ORIGINAL PURCHASER OF THIS PRODUCT.

In the event of a defect, Magellan Navigation will, at its option, repair or replace the hardware product with no charge to the purchaser for parts or labor. The repaired or replaced product will be warranted for 90 days from the date of return shipment, or for the balance of the original warranty, whichever is longer. Magellan Navigation warrants that software products or software included in hardware products will be free from defects in the media for a period of 30 days from the date of shipment and will substantially conform to the then-current user documentation provided with the software (including updates thereto). Magellan Navigation's sole obligation shall be the correction or replacement of the media or the software so that it will substantially conform to the then-current user documentation. Magellan Navigation does not warrant the software will meet purchaser's requirements or that its operation will be uninterrupted, error-free or virus-free. Purchaser assumes the entire risk of using the software.

2. PURCHASER'S REMEDY

PURCHASER'S EXCLUSIVE REMEDY UNDER THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT, AT MAGELLAN NAVIGATION'S OPTION, OF ANY DEFECTIVE PART OF THE RECEIVER OR ACCESSORIES WHICH ARE COVERED BY THIS WARRANTY. REPAIRS UNDER THIS WARRANTY SHALL ONLY BE MADE AT AN AUTHORIZED MAGELLAN NAVIGATION SERVICE CENTER. ANY REPAIRS BY A SERVICE CENTER NOT AUTHORIZED BY MAGELLAN NAVIGATION WILL VOID THIS WARRANTY.

3. PURCHASER'S DUTIES

To obtain service, contact and return the product with a copy of the original sales receipt to the dealer from whom you purchased the product.

Magellan Navigation reserves the right to refuse to provide service free-of-charge if the sales receipt is not provided or if the information contained in it is incomplete or illegible or if the serial number is altered or removed. Magellan Navigation will not be responsible for any losses or damage to the product incurred while the product is in transit or is being shipped for repair. Insurance is recommended. Magellan Navigation suggests using a trackable shipping method such as UPS or FedEx when returning a product for service.

4. LIMITATION OF IMPLIED WARRANTIES

EXCEPT AS SET FORTH IN ITEM 1 ABOVE, ALL OTHER EXPRESSED OR IMPLIED WARRANTIES, INCLUDING THOSE OF FITNESS FOR ANY PARTICULAR PURPOSE OR MERCHANTABILITY, ARE HEREBY DISCLAIMED AND IF APPLICABLE, IMPLIED WARRANTIES UNDER ARTICLE 35 OF THE UNITED NATIONS CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS.

Some national, state, or local laws do not allow limitations on implied warranty or how long an implied warranty lasts, so the above limitation may not apply to you.

5. EXCLUSIONS

The following are excluded from the warranty coverage:

(1) periodic maintenance and repair or replacement of parts due to normal wear and tear;

(2) batteries;

(3) finishes;

(4) installations or defects resulting from installation;

(5) any damage caused by (i) shipping, misuse, abuse, negligence, tampering, or improper use; (ii) disasters such as fire, flood, wind, and lightning; (iii) unauthorized attachments or modification;

(6) service performed or attempted by anyone other than an authorized Magellan Navigations Service Center;

(7) any product, components or parts not manufactured by Magellan Navigation,

(8) that the receiver will be free from any claim for infringement of any patent, trademark, copyright or other proprietary right, including trade secrets

(9) any damage due to accident, resulting from inaccurate satellite transmissions. Inaccurate transmissions can occur due to changes in the position, health or geometry of a satellite or modifications to the receiver that may be required due to any change in the GPS. (Note: Magellan Navigation GPS receivers use GPS or GPS+GLONASS to obtain position, velocity and time information. GPS is operated by the U.S. Government and GLONASS is the Global Navigation Satellite System of the Russian Federation, which are solely responsible for the accuracy and maintenance of their systems. Certain conditions can cause inaccuracies which could require modifications to the receiver. Examples of such conditions include but are not limited to changes in the GPS or GLONASS transmission.).

Opening, dismantling or repairing of this product by anyone other than an authorized Magellan Navigation Service Center will void this warranty.

6. EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES

MAGELLAN NAVIGATION SHALL NOT BE LIABLE TO PURCHASER OR ANY OTHER PERSON FOR ANY INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DAMAGES RESULT-

ING FROM DELAY OR LOSS OF USE, LOSS OF OR DAMAGES ARISING OUT OF BREACH OF THIS WARRANTY OR ANY IMPLIED WARRANTY EVEN THOUGH CAUSED BY NEGLIGENCE OR OTHER FAULT OFMAGELLAN NAVIGATION OR NEGLIGENT USAGE OF THE PRODUCT. IN NO EVENT WILL MAGELLAN NAVIGATION BE RESPONSIBLE FOR SUCH DAMAGES, EVEN IF MAGELLAN NAVIGATION HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Some national, state, or local laws do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

7. COMPLETE AGREEMENT

This written warranty is the complete, final and exclusive agreement between Magellan Navigation and the purchaser with respect to the quality of performance of the goods and any and all warranties and representations. THIS WARRANTY SETS FORTH ALL OF MAGELLAN NAVIGATION'S RESPONSIBILITIES REGARDING THIS PRODUCT.

THIS WARRANTY GIVES YOU SPECIFIC RIGHTS. YOU MAY HAVE OTHER RIGHTS WHICH VARY FROM LOCALITY TO LOCALITY (including Directive 1999/44/EC in the EC Member States) AND CERTAIN LIMITATIONS CONTAINED IN THIS WARRANTY MAY NOT APPLY TO YOU.

8. CHOICE OF LAW.

This limited warranty is governed by the laws of France, without reference to its conflict of law provisions or the U.N. Convention on Contracts for the International Sale of Goods, and shall benefit Magellan Navigation, its successors and assigns.

THIS WARRANTY DOES NOT AFFECT THE CUSTOMER'S STATUTORY RIGHTS UNDER APPLICABLE LAWS IN FORCE IN THEIR LOCALITY, NOR THE CUSTOMER'S RIGHTS AGAINST THE DEALER ARISING FROM THEIR SALES/PURCHASE CONTRACT (such as the guarantees in France for latent defects in accordance with Article 1641 et seq of the French Civil Code).

For further information concerning this limited warranty, please call or write:

Magellan Navigation SAS - ZAC La Fleuriaye - BP 433 - 44474 Carquefou Cedex - France.

Phone: +33 (0)2 28 09 38 00, Fax: +33 (0)2 28 09 39 39.

NOTICE:

The FCC (Federal Communications Commission) requests that equipment manufacturers take every step to increase user awareness about the responsibilities inherent in being an FCC licensee on shared channels.

Users are indeed requested to obtain a FCC license before operating their RTK equipment on the US territory. Once a license has been granted, users should observe all the FCC regulations (see http://wireless.fcc.gov/). Licensees are encouraged to avoid any use of voice frequencies in the 450-470 MHz band.

How To Use this Documentation

Please read this section to understand the organization of the present manual. This will help you navigate more easily through the pages and find more quickly the information you are looking for.

Of the 28 sections included in **Chapters 1 through 4**, 20 are shared by the Getting Started Guide and the present manual. When Magellan revises any of the 20 sections, the two manuals will be updated automatically.

Chapter 1 provides a full description of the ProMark 500 (front panel display screens, connectors, accessories, batteries, etc.). Compared to the Getting Started Guide, this chapter provides four additional sections: Using the Carrying Case, Specifications, Firmware Options and Port Pinouts.

Chapter 2 is an introduction to FAST Survey. Compared to the Getting Started Guide, this chapter provides an additional section about software installation.

Chapter 3 provides step-by-step procedures to perform RTK surveying with ProMark 500 and FAST Survey. Compared to the Getting Started Guide, this chapter includes three additional sections: Network Connections, Localization and Logging Points in Continuous Mode.

Chapter 4 deals with raw data logging, also described in the Getting Started Guide. Compared to this Guide, Chapter 4 does not include any additional section.

Chapter 5 provides all the instructions required to run post-processed surveys. This chapter is somewhat redundant with Chapter 4. However, whereas Chapter 4 is more focused on describing the receiver's raw data logging capabilities and all the functions attached to it, Chapter 5 is more survey-oriented, focusing on field instructions when the equipment is used with FAST Survey for post-processed surveys exclusively.

Chapters 6 through 8 give in-depth information on GNSS surveying techniques, seen from both the theoretical and practical point of view. Key terms and expressions are also introduced at the beginning of each of the sections. The purpose is that you not only become familiar with these techniques, but also make them yours.

Note that these chapters refer to GNSS equipment in general, including Magellan equipment, and so are not specific to the ProMark 500 only. If in doubt with what the ProMark 500 really does in such or such circumstance, please refer to the *Specifications* section in chapter 1 of this manual.

Chapter 6 gives information on surveying techniques for both real-time and post-processed surveys. It includes separate sections on such particular topics as base position, initialization, antenna heights, accuracy, elevation vs. height and localization.

Chapter 7 deals more specifically with RTK surveying, introducing hardware means and data formats that exist today to implement the data link. (Through the data link, the rover receives the data it needs to operate in this mode.) Chapter 7 also introduces the two position output modes available in RTK and helps surveyors choose the one that's best for their applications.

Chapter 8 explains how to perform a large-scale static survey using GNSS equipment, emphasizing the difference between conventional and GNSS systems.

Chapter 9 is a collection of first-level maintenance instructions you may have to refer to, should you encounter problems with your equipment.

Chapter 10 is an appendix gathering various procedures and memo pages (list of alarms, file naming conventions, button combinations, etc.).

As a supplement to the ProMark 500 Reference Manual, three additional appendices are provided describing all serial commands applicable to the receiver.

Appendix A is an introduction to the $PASH proprietary commands. It introduces the two categories of commands, tells you how to apply them, describes the conventions used in their description and provides an alphabetical list, combining set and query commands in a single table.

Appendix B provides a full description of all the set commands.

Appendix C provides a full description of all the query commands.

Table of Contents

ProMark 500 Serial Commands Supplement

Chapter 1. Introduction

What is ProMark 500?

Congratulations! You have just acquired the latest dual-frequency ProMark 500 GNSS Surveying System from Magellan!

GNSS has revolutionized control surveys, topographic data collection and construction surveying. Purchasing the right tools for a professional job is essential in today's competitive business environment. Learning to put these tools to work quickly and efficiently will be the focus of the present manual.

Compared to its predecessors, ProMark 500 is more compact and lightweight while integrating more technology, such as the exclusive Magellan BLADE™ algorithms and multi-constellation (GPS+GLONASS+SBAS) capabilities.

In addition, because it’s easy to use, you will be able to focus on your job and forget almost everything about the technical aspects of your equipment. No more cables, no more clip-on modules: ProMark 500 will be the reliable tool you are expecting for all your GNSS survey operations!

System Components Overview

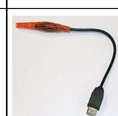
The tables below provide an overview of the different key items composing the ProMark 500.

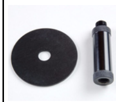
Depending on your purchase and based on the type of survey you wish to perform, you may only have some of the listed items. Please refer to the packing list for an accurate description of the equipment that has been delivered to you.

Basic Supply

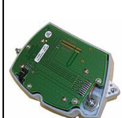
Item	Part Number	Picture
ProMark 500 GNSS Receiver: - Alone: - With standard accessories:	 802063 990596	
7.4 V-4.4 Ah Li-ion Battery Pack (rechargeable)	111374	
ProMark500 User Documentation CD	501503	

Accessories, General Purpose

Item	Part Number	Picture
AC/DC Power Supply Kit (includes external AC adapter, battery charger and cable extension for powering ProMark 500 directly from the AC adapter)	802064	
USB Device Cable (short). Makes ProMark 500 a USB host.	702103	
USB Host Cable (long) Makes ProMark 500 a USB device.	702104	
HI Measurement Tool	111146	

Item	Part Number	Picture
Vertical Antenna Extension	103717	
Field bag	205923	
Optional carrying case, rigid, for base/rover system	206215	 

Communication Modules and Associated Antennas

Item	Part Number	Picture
Magellan U-Link Transmitter, 12.5-kHz channel bandwidth	800986-10 (0.5/4 W, 410-430 MHz) 800986-30 (0.5/4 W, 430-450 MHz) 800986-50 (0.5/4 W, 450-470 MHz) Ech P/N includes a whip antenna, an antenna bracket, a Y-shaped data/power cable (P/N 730476) and a receiver power cable (P/N 730477).	 Picture of transmitter alone
Pacific Crest Transmitter, 25-kHz channel bandwidth	110972-10 (35 W, 410-430 MHz) 110972-30 (35 W, 430-450 MHz) 110972-50 (35 W, 450-470 MHz) Each P/N includes a whip antenna, an antenna bracket, an OEM Y-shaped data/power cable and a receiver power cable (P/N 730477)	 Picture of transmitter alone
Radio receiver kit (includes radio module, whip antenna and small parts)	802068-10 (410-430 MHz, 12.5 kHz) 802068-15 (410-430 MHz, 25 kHz) 802068-30 (430-450 MHz, 12.5 kHz) 802068-35 (430-450 MHz, 25 kHz) 802068-50 (450-470 MHz, 12.5 kHz) 802068-55 (450-470 MHz, 25 kHz)	
Quad-band GSM antenna	111397	

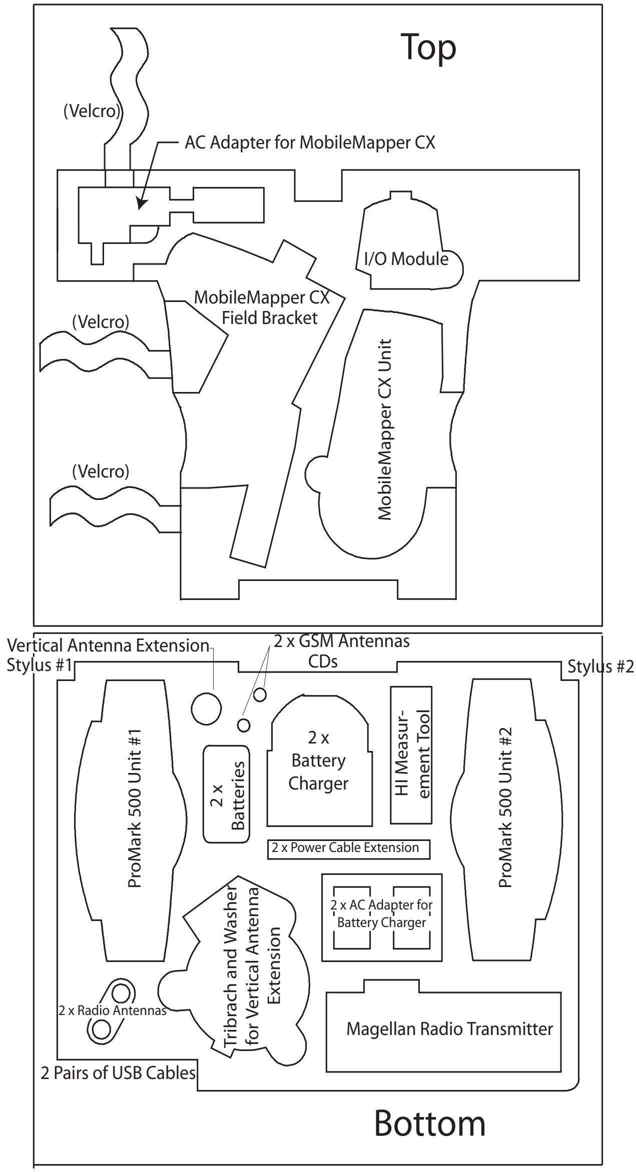
Base Accessories

Item	Part Number	Picture
External DC Power Cable for Receiver	730477	
Magellan Transmitter Data/Power Cable	730476	

Using the ProMark 500 Carrying Case

This section explains how to arrange the different pieces of equipment in the ProMark 500 carrying case.

Layout Diagram

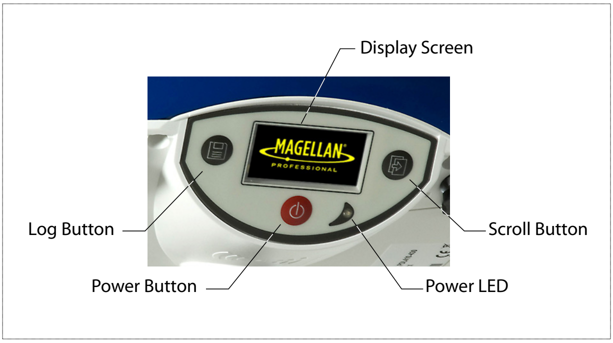


Packing a ProMark 500 System in the Carrying Case

Below is a picture of an open carrying case showing how to place the different ProMark 500 items in the case.

Equipment Description & Basic Functions

Front Panel View



Indicators & Controls

Power button

To turn on the ProMark 500, hold the Power button pressed until the power LED lights up.

To turn off the ProMark 500, hold the Power button pressed until the "Magellan Professional" screen is displayed. Then release the button and wait until the ProMark 500 shuts down.

Power LED

This indicator is on when the ProMark 500 is on, and off when it is off.

Display Screen

The display consists of a 128 x 64-pixel, 1.5-inch monochrome yellow screen using organic LED technology (OLED). It is oriented slightly downwards so the screen can easily be read when the ProMark 500 is installed on top of a range pole.

Used in conjunction with the Scroll button, the display screen allows you to view different pages of information. See *Display Screens on page 12* for a detailed description of the information available from this screen.

After a few seconds of inactivity (i.e. Scroll button idle), screen luminosity turns from high to low level.

Scroll button

Press this button shortly to scroll through the different pages of information viewed on the screen.

If an alarm is reported on the display screen, a short press on the Scroll button will acknowledge the alarm. The Scroll button will recover its display scrolling function only after all the alarms have been acknowledged this way.

Another function of the Scroll button is to re-activate the screen backlight after the latter has automatically been turned off. The Scroll button is also used in the firmware update procedure.

Log Button

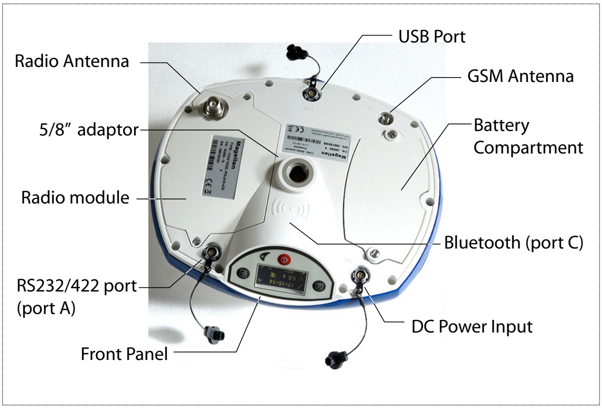
Press this button briefly to start recording raw data on the selected storage medium.

Another short press on this button will immediately stop raw data recording.

Buzzer

The internal buzzer will sound an alarm whenever a warning message is reported on the screen. The buzzer will beep until you acknowledge the warning message by pressing the Scroll button. The buzzer can be deactivated permanently using the $PASHS,BEEP command. See *BEEP: Beeper Setup on page 177*.

Bottom View



Battery, Connectors & Module

Battery Model & Battery Compartment

The battery used in the ProMark500 is a 7.4-V DC - 4400 mAh rechargeable battery. It is a standard model used in many camcorders.

The battery is housed in a battery compartment accessible from underneath the ProMark 500. The compartment door can be removed using a coin to release the two quarter-turn screws.

DC Power Input

A three-contact, female connector (Fischer type) allowing the ProMark500 to be powered from either the provided AC adapter (connect the cable extension between ProMark 500 and the end of the AC adapter output cable), or an external 9- to 28-V DC battery through cable P/N 730477 (cf. base configuration with radio).

GSM Antenna

A coaxial female connector (SMA type) allowing you to connect a GSM whip antenna to the ProMark 500.

Radio Antenna

A coaxial female connector (TNC type) allowing you to connect a radio whip antenna to the ProMark 500. This connector is available only if the ProMark 500 has been fitted with a radio module.

Radio Module

A module allowing ProMark 500 to receive and process corrections from a base. When a radio module is used, a radio antenna must be connected (see above). When no radio receiver kit is delivered, a single compartment door is provided instead, with no connector on it.

USB Port

A nine-contact female connector (Fischer type). Depending on how it is configured, the USB port can be used in two different ways:

1. For a USB host such as a mass storage device. In this case, you should use the special adaptor cable provided (P/N 702103) to attach the USB key to the ProMark 500. This configuration can be used to log raw data on the USB key or upgrade the ProMark 500 firmware from the files stored on the key.
2. For a USB device allowing ProMark 500 to be seen as a disk from the computer connected to this port. In this configuration, files can be transferred between the ProMark500's internal memory and the computer using the USB cable provided (P/N 702104).

RS232/422 Serial Port

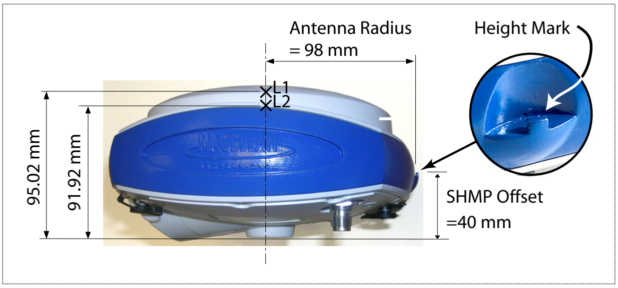
A seven-contact female connector (Fischer type) allowing you to connect the ProMark 500 to an external device via an RS232 or RS422 serial line (default: RS232). Changing the configuration of the port can be done from the field terminal using the $PASHS,MDP serial command. See *MDP: Setting Port A to RS232 or RS422 on page 201*.

Bluetooth Device

An integrated Bluetooth module allowing the ProMark 500 to communicate with a Bluetooth-enabled field terminal through a wireless connection.

Antenna Characteristics

The diagram below gives the dimensional parameters of the ProMark 500 antenna required for the system to determine the true height of the antenna from the measured value obtained using one of the standard height measurement methods, i.e. slant or vertical. These are still **preliminary values**.



The height mark allows you to hook the measure tape onto it so you can unroll the tape down to the survey mark and read the slant height measurement directly on the tape.

Special Button Combinations

- With the ProMark 500 OFF, pressing the Power, Log and Scroll buttons simultaneously for a few seconds will restore all the factory settings. **Always use this combination after changing the radio module**. This allows the receiver to recognize the new module.
- With the ProMark 500 OFF and a USB key connected, pressing the Power and Scroll buttons simultaneously for a few seconds will cause the ProMark 500 to start a firmware upload process. If there is no USB key connected or the key does not contain a firmware upgrade, then the process will abort after a few seconds.

  Because data has to be decompressed on the USB key during upgrades, the USB key must be unlocked, with at least 10 MBytes of free memory, before starting the upgrade.

These button combinations are summarized in the table below:

Button Combination	ProMark 500 State	Function
Power+Log+Scroll	OFF	Restores Factory Settings.
Power+Scroll	OFF	Initiates firmware update from USB key.

Display Screens

If you press the Scroll button several times, you will see the following displays successively.

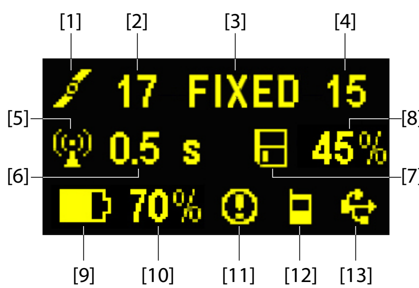
Power-On Screen

When you power on the ProMark 500, the Magellan Professional logo appears on the screen. It is displayed until the ProMark 500 has completed its auto-test (this takes about 30 seconds).

Then the General Status screen is displayed.

General Status Screen

An example of General Status screen is shown below.



This screen displays the following information:

- : Satellite icon **[1]** (always displayed).
- Number of satellites tracked **[2]**.
- Position solution status **[3]**:
  - NONE: Position not available
  - AUTO: Autonomous GPS position
  - DGPS: Differential GPS position
  - FLOAT: Float solution
  - FIXED: Fixed solution (RTK is operational)
  - BASE: This ProMark 500 is configured as a base.

- Number of satellites used **[4]**: Number of satellites involved in the position processing, regardless of the current position solution status.
- : Data link icon **[5]**. This icon is displayed only when corrections are received and at least a float solution is available.
- Age of corrections **[6]**, in seconds. This value is displayed only when corrections are received.
- : Raw data logging icon **[7]**:
  – Animated: Raw data logging in progress
  – Fixed: No raw data logging in progress.
- Percentage of free memory in the storage medium used **[8]**.
- : Battery icon **[9]** with visual indication of remaining charge. If an external power source is used (AC adapter or external battery), the battery icon will be animated to indicate battery charging in progress.

   is displayed when there is no battery in the compartment and the ProMark 500 is operated from an external power source.
- Power status **[10]**.

Icon	Definition
Percent value	Percentage of remaining battery. This indication will flash when the remaining energy drops below 5%.
	Replaces percentage when an external power source is used.

- Alarm status **[11]**.

Icon	Definition
	Alarm detected. Press the Scroll button to view the alarm type. Press it again to acknowledge the alarm, which then disappears from the list. Unless there is another alarm in the queue, in which case you will have to resume the acknowledge sequence, the screen then displays the memory screens.
None	No alarm detected

- GSM status **[12]**. This may be one of the following icons:

Icon	Definition
Blank	GSM module turned off.

Icon	Definition
	Blinking icon: GSM module turned on. Indicates signal strength received at current location. The higher the number of bars, the better the signal. Fixed icon: GSM module turned on and initialized (ready for a connection). Indicates signal strength received at current location.
	GSM module on line.

- [**13**]: USB status and/or Bluetooth status.

Icon	Definition
	USB port connected to active device
	Bluetooth active
 / 	These two icons will appear successively when both the USB port and Bluetooth are active.
Blank	USB port unconnected and Bluetooth inactive.

Memory Screens

From the General Status screen, press the Scroll button to access the Memory screens. Memory screens appear successively (see examples) at a display rate of about five seconds:

Left screen:

- First line: Percentage of free space in the internal memory.
- Second line: Number of files currently stored in the internal memory.
- Third line: Percentage of free space on the USB mass storage device.
- Fourth line: Number of files currently stored on the USB mass storage device.

Right screen:

- First line: Total space occupied by the files currently stored in the internal memory.
- Second line: Nominal size of the internal memory.

- Third line: Total space occupied by the files currently stored on the USB mass storage device.
- Fourth line: Nominal size of the USB mass storage device.

About the “*” symbol:

- It can only appear at the end of the first or third line.
- Where placed, it indicates that this storage medium is used for data logging.

What if there is no USB mass storage device connected to ProMark 500?

- Parameters relevant to the USB key size and space used and available are void (three dots displayed instead).
- Number of files is forced to “0”.

Receiver Identification Screen

From any of the two Memory screens, press the Scroll button to access the Receiver Identification screen. See example below.

- Receiver Serial Number
- Firmware Version
- Receiver Bluetooth Identifier

A new press on the Scroll button will take you back to the General Status screen.

Screen Backlight

The screen backlight is automatically turned off if no key is pressed for 1 minute. When the backlight is off, a short press on the Scroll button will turn it back on. The Scroll button will then recover its usual functions.

Data Transfer Screen

For more information on the screen displayed when downloading files, refer to *Downloading Raw Data on page 57*.

Charging Batteries Before Use

Make sure the battery is fully charged for each ProMark 500 you will be using in the field. Follow the instructions below to charge a battery.

Removing the Battery from the ProMark 500

Unless the battery has already been taken out, do the following:

- Put the ProMark 500 upside down.
- Remove the battery door, accessible from underneath the ProMark 500, by loosening the two quarter-turn screws (see picture) using a coin.

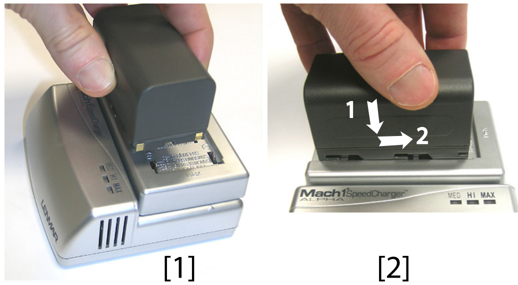
- Keeping one hand on the battery still in its compartment, put the ProMark 500 the right way up. The battery will then easily slide out of the battery compartment.

Charging the Battery

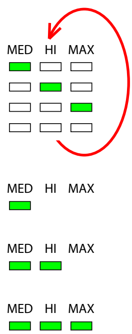
The battery charger comes with a separate universal AC adapter fitted with a 1.5-m output cable. The AC adapter includes a choice of four different, detachable plug types. Follow the instructions below to operate the charger.

- Choose the plug type that is suitable for your country.
- Secure that plug on the AC adapter by giving the plug the right orientation with respect to the adapter, then pushing and rotating it by about 10 degrees clockwise until you hear a “click”.
- Connect the cable from the AC adapter to the battery charger.
- Give the battery the right orientation with respect to the charger **[1]** (the battery terminals should come into contact with the two sets of connectors on the charger),

then push the battery against the plate and slide it forward **[2]** until it locks into place.



[1] [2]



[3]
[4]
[5]
[6]

- Plug the adapter into an AC outlet. Battery charging starts immediately.

  For a low battery that's being charged, you will first see the three LEDs switch on and off, one after the other, followed by a short period of time when none of the LEDs is on (see **[3])**.

  After about two hours of charging, the MED LED will stay on **[4]**. A few minutes later, the HI LED **[5]**, and then the MAX LED **[6]** will also stay on.
- When the three LEDs are on, this means the battery is fully charged and can be disconnected from the charger.

Inserting the Battery in the ProMark 500

- With the ProMark 500 upside down, insert the battery into the compartment making sure the battery has the right orientation (the battery terminals should come into contact with the two sets of connectors located at the bottom of the compartment).
- Place the battery door over the battery and tighten the two screws, using a coin. Note that, once it is properly secured, the battery door pushes the battery against the bottom of the compartment to ensure electrical connection of the battery to the ProMark 500.

Specifications

GNSS Characteristics

- 75 channels:
  – GPS L1 C/A L1/L2 P-code, L1/L2 full wavelength carrier

- GLONASS L1 C/A L1/L2 P-code, L1/L2 full wavelength carrier
- SBAS code & carrier (WAAS/EGNOS/MSAS)
- Low-signal acquisition and tracking engines for signal detection in difficult environments

- Fully independent code and phase measurements
- Magellan BLADE™ technology for optimal performance
- Advanced multipath mitigation
- Update rate: 10 Hz

Real-Time Accuracy (RMS)

SBAS (WAAS/EGNOS/MSAS)
- Horizontal: < 3 m (10 ft)

Real-Time DGPS Position
- Horizontal: < 0.8 m (2.62 ft)

Real-Time Kinematic Position (Fine Mode)
- Horizontal: 10 mm (0.033 ft) + 1.0 ppm
- Vertical: 20 mm (0.065 ft) + 1.0 ppm

See also notes 1 and 2.

Real-Time Performance

Instant-RTK® Initialization
- Typically 2-second initialization for baselines < 20 km
- 99.9% reliability

RTK initialization range
- > 40 km

Post-Processing Accuracy (RMS)

Static, Rapid Static
- Horizontal: 5 mm (0.016 ft) + 0.5 ppm
- Vertical: 10 mm (0.033 ft) + 1.0 ppm

Post-Processed Kinematic
- Horizontal: 10 mm (0.033 ft) + 1.0 ppm

---

1. Performance values assume minimum of five satellites, following the procedures recommended in the product manual. High-multipath areas, high PDOP values and periods of severe atmospheric conditions may degrade performance.
2. Accuracy and TTFF specifications based on tests conducted in Nantes, France, and Moscow. Tests in different locations under different conditions may produce different results.

- Vertical: 20 mm (0.065 ft) + 1.0 ppm

See also notes 1 and 2.

Data Logging Characteristics

Recording Interval:
- 0.1 to 999 seconds

Physical Characteristics

- Size: 22.8 x 18.8 x 8.4 cm (9 x 7.4 x 3.3 “)
- Weight: 1.4 kg (3.1 lb)

Monitoring Screen

- Graphic OLED display

Memory

- 128-MByte internal memory (expandable through USB)
- Up to 400 hours of 15-s GNSS raw data from 18 satellites

I/O Interface

- RS232, RS422, USB 2.0 (full speed), Bluetooth
- External event input

Data Format

- RTCM 2.3, RTCM 3.1
- CMR, CMR+
- Magellan ATOM™
- NMEA 0183
- NTRIP

Operation

- RTK rover/base, post-processing
- RTK network rover: VRS, FKP, MAC

Environmental Characteristics

- Operating temperature: -30° to +55°C (-22° to +131°F)
- Storage temperature: -40° to +85°C (-40° to +158°F)
- Humidity: 100% condensing
- Waterproof
- Shock: ETS300 0.19, 2 m (6.56 ft) pole drop

---

1. Performance values assume minimum of five satellites, following the procedures recommended in the product manual. High-multipath areas, high PDOP values and periods of severe atmospheric conditions may degrade performance.

2. Accuracy and TTFF specifications based on tests conducted in Nantes, France, and Moscow. Tests in different locations under different conditions may produce different results.

- Vibration: EN60945

Power Characteristics

- Li-ion battery, 4400 mAh
- Battery life time > 6 hrs (UHF rover at 20°C)
- 6-28 VDC input
- Power drain (typical, at 25°C, with GLONASS enabled):
  - Receiver alone: 3.7 W
  - Receiver + modem on-line: 5.4 W
  - Receiver + radio module: 4.4 W

Optional System Components

- Rover Communication Module:
  - Magellan UHF
  - Pacific Crest UHF
  - GSM/GPRS/EDGE (class 10) Quad-band
- Transmitter Kits
  - Magellan UHF
  - Pacific Crest UHF
- Rechargeable battery kit
- Field terminal kit with FAST Survey
  - Magellan MobileMapper CX
  - Juniper Allegro CX

Office Software Suite - GNSS Solutions

Key software functions include:

- Network post-processing
- Integrated transformation and grid system computations
- Pre-defined datums along with user-defined capabilities
- Precise ephemeris data
- Survey mission planning
- Automatic vector processing
- Least-square network adjustment
- Data analysis and quality control tools
- Coordinate transformations
- Reporting
- Exporting
- Geoid03
- Languages: English, Spanish, French, German, Portuguese, Italian, Russian

System Requirements:

- Windows 2000 / XP / Vista

- Pentium® 133 or higher
- 32-MB RAM
- 90-MB disk space required for installation

Field Software Suite - FAST Survey

Key software functions include:

- ProMark 500 GNSS support: configuration, monitoring and control
- Volume computation
- Background raster image
- Network connectivity
- Coordinate system support: predefined grid systems, predefined datums, projections, geoids, local grid
- Map view with colored lines
- Geodetic geometry: intersection, azimuth/distance, offsetting, polyline, curve, area
- Data import/export: DXF, SHP, RW5, LandXML, etc.
- Survey utilities: calculator, RW5 file viewing
- Optical Surveying Instruments (optional)
- Road construction (optional)
- Robotic total stations (optional)

Supported hardware [1]:

– Magellan MobileMapper CX
– Juniper Allegro CX

1. Other field software & controllers are also compatible with ProMark 500.

Firmware Options

Four firmware options are available as summarized in the table below.

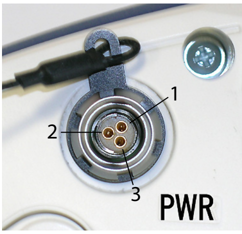
ID	Label	Description	Part Number
K	RTK	Allows a base to generate and send RTK correction data. Allows a rover to compute RTK position solutions using corrections received from a base.	680502
F	FASTOUTPUT10	Allows position output at a rate of 10 Hz instead of 5 Hz	680527
Z	MODEM	Enables the use of the internal GSM/GPRS modem	680528
S	GLONASS	Enables the use of signals from the GLONASS constellation	680500

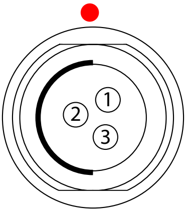
Enabling a firmware option purchased separately from the system relies on the use of the $PASHS,OPTION serial command. For more information on how to enable an option, refer to *OPTION: Receiver Firmware Options on page 211*.

Port Pinouts

NOTE: All illustrations below show connectors seen from outside the receiver case.

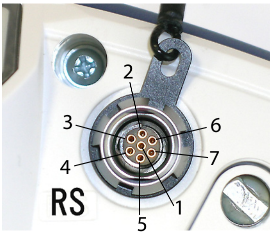
Power 3-C Connector, Type: Fischer DBPU 102 A052-139

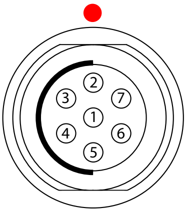




Pin	Signal Name	Description
1	GND	External Power Ground
2	PWR	External Power Input (10-28 V DC)
3	-	**Mandatory! Leave this pin unconnected.**

RS Port (Port A) 7-C Connector, Type: Fischer DBPU 102 A056-139





RS232 Configuration:

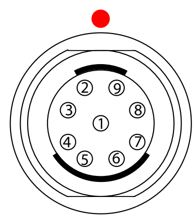
Pin	Signal Name	Description
1	+ 16 V Output	+16 V DC regulated output voltage
2	GND	Ground
3	CTS	Clear To Send
4	RTS	Request To Send
5	RXD	Receive Data
6	TXD	Transmit Data
7	EVENT	Event marker input

RS422 Configuration:

Pin	Signal Name	Description
1	+ 16 V Output	+16 V DC regulated output voltage
2	GND	Ground
3	RXD-	Receive Data-
4	TXD+	Transmit Data+
5	RXD+	Receive Data+
6	TXD-	Transmit Data-
7	EVENT	Event marker input

USB Port USB 2.0, full speed.

9-C Connector, Type: Fischer DBPU 102 A059-139



Pin	Signal Name
1	NC
2	GND
3	Device (D+)
4	Device (D-)
5	Host (VBus)
6	Host (D+)
7	Host (D-)
8	Device Detection
9	NC

Chapter 2. FAST Survey Field Software

Installing FAST Survey

This section describes how to install FAST Survey from the CD provided, using an office computer. The FAST Survey software can also be downloaded from the Magellan FTP server.

If Windows XP (or older OS version) is used on your computer, you first need to install Microsoft Active Sync on your office computer.

If Vista is used, you don't normally need to install an additional program on your computer. However, if the installation of FAST Survey fails, you will have first to install Windows Mobile Device Center and then resume the installation of FAST Survey.

The latest versions of ActiveSync and Device Center can be downloaded from http://www.microsoft.com/windowsmobile/activesync/default.mspx at no cost. ActiveSync 4.5 can be installed directly from your FAST Survey CD.

Installation Procedure

- Connect the field terminal to your office computer using the USB data cable provided.
- Turn on the field terminal.
- Insert the FAST Survey CD in your office computer. This automatically starts the setup file stored on the CD.
- Click on the **Install FAST Survey for ProMark500 and Z-Max** option then on the **Install FAST Survey 2.3 for MobileMapper CX** option. This starts the FAST Survey Setup Wizard.
- Click **Next>**.
- Check on the **I accept the terms in the License Agreement** option and then click **Install**.
- Confirm installation in the default folder by clicking **Yes**. The wizard starts copying the installation files to the field terminal. At the end of this phase, a message window appears asking you to check the field terminal screen to

see if additional steps are needed to complete the installation.

- Click **OK**, then **Finish** to complete installation on computer side.
- On the field terminal the installation phase has automatically started. When the progress bar disappears from the screen, this means installation is complete. The FAST Survey icon can then be seen on the screen.

Registering as a FAST Survey User

The first time you start FAST Survey, you will be prompted to register your license of the software. If you do not register, FAST Survey will remain in demo mode, limiting each job file to a maximum of 30 points.

How to Register

FAST Survey registration is done via the Internet at the following address: Magellan FAST Survey Registration

Choose Yes to start the registration process. You will be required to enter the following information:

- User Name
- Company Name
- Serial Number*
- Email Address
- Phone Number
- Fax Number
- Hardware ID#1*
- Hardware ID#2*
- Reason for Install
- Registration Code*

*: Select **Equip>About Magellan Fast Survey>Change Registration** in FAST Survey to read this information.

After you submit this information, your change key will be displayed and emailed to the address that you submit. Keep this for your permanent records. You may then enter the manufacturer and model of your equipment.

If you do not have access to the Internet, you may fax the above information to (+1) 606-564-9525. Your registration information will be faxed back to you within 48 hours. During this time, you may continue to use the program without restriction. After you receive your Change Key, enter it and tap

OK. You can then create a new FAST Survey job, as explained further.

Saving your registration in the Field Terminal

When you register FAST Survey in a Magellan MobileMapper CX, the code is automatically and safely saved at the end of the registration procedure.

With a Juniper Allegro CX, you need to perform a RAM backup or a System Save to be sure your authorization code will not be lost when you next reboot your Allegro CX. If you cannot find this option on the Allegro CX Start menu, then open the Control Panel and choose RAM backup.

Creating a New FAST Survey Job

1. Turn on the field terminal and wait until the boot sequence is complete.
2. Make sure the clock is set properly before starting FAST Survey.
3. Double-tap Fast Survey to launch FAST Survey.
4. Tap the **Select New/Existing** Job button. This opens the Coordinate Files window.
5. Tap on the highlighted “crd” file name located at the bottom of the screen. This opens FAST Survey’s virtual keyboard with the file name now appearing above.
6. Using the keyboard, type in the name of the “crd” file in which FAST Survey will store the data you will collect during your job.
7. Tap . This takes you back to the Coordinate Files window where your file name now appears in the **Name** field.
8. Tap again. This opens the Job Settings window, which consists of five different tabs on which you can set a large number of parameters pertaining to the job (or future jobs).

   Only the parameters that make sense with a GNSS system such as the ProMark 500 are presented below. All other parameters should be kept with their default settings.

   On the **System** tab:

   – **Distance**: Choose the unit in which all measured distances will be expressed (US Survey Feet, Metric or International Feet). Unless “Metric” is selected, you can also choose the units in which distances will be displayed ("Decimal feet" or "Feet and Inches"). **Warning! You cannot change this setting after creating the file!**

- **Angle**: Choose the unit in which all measured angles will be expressed (degrees, minutes, seconds or grads)
- **Zero Azimuth Setting**: Choose the direction for which azimuth is arbitrarily set to 0° (North or South)
- **Projection**: Choose a projection from the combo box. To select a different projection, tap the **Edit Projection List** button. The **Add Predefined** button allows you to select an existing projection. The **Add User Defined** button allows you to create an entirely new projection. The selected or created projection will then be selectable from the combo box.

On the **Stake** tab:

- **Precision**: Choose the number of decimal places (0 to 5) used to express the three coordinates of any stakeout point. "0.000" (3 decimal places) is the best setting to fully benefit from the precision offered by ProMark 500.

On the **Format** tab:

- **Coordinate Display Order**: Choose the order in which you want FAST Survey to display East and North coordinates (East,North or North,East).
- **Angle Entry and Display**: Choose the type of angle FAST Survey will display (Azimuth or Bearing).

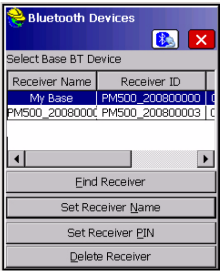
9. Tap ✅. This creates the file, closes the Job Settings window and takes you to the FAST Survey menu.

How FAST Survey Interfaces with ProMark 500 Via Bluetooth

First-Time Use

Right after you start FAST Survey and create or open your first job, FAST Survey will try to activate the preset connection (default: "Cable") to the receiver. Because no cable is connected to the field terminal, a message will be displayed informing you that the connection failed.

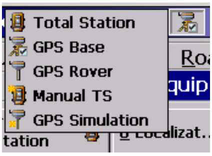
Assuming your base and rover are nearby and powered on, follow the procedure below to perform a Bluetooth connection with the base.



- Tap **Equip>GPS Base**.
- Tap on the **Comms** tab.
- Select "Bluetooth" from the **Type** field and "Magellan BT" from the **Device** field.
- Tap on the **Configure** button. This opens the Bluetooth Devices window.
- Tap **Find Receiver**. Wait until FAST Survey lists the Bluetooth identifiers of your base and rover. The list appears in a new window.
- Highlight the Bluetooth identifier corresponding to the base. To make sure you select the right identifier, press the Scroll button on the base until you display the Receiver Identification screen. The identifier is in the lower line (after the "BT:" prefix).
- Tap . This takes you back to the previous screen where the selected Bluetooth identifier remains highlighted in the list. The following actions may be performed on the selected receiver using the following buttons:
  - **Set Receiver Name**: By default, the "Receiver Bluetooth Identifier" of the detected receiver is assigned to this parameter. You may use a more self-explanatory name to identify your base (e.g.: "MyBase").
  - **Set Receiver PIN**: Do not use this button. In its default configuration, ProMark 500 does not request a PIN code to allow a peripheral device to connect to it via Bluetooth.
  - **Delete Receiver**: Removes the selected receiver from the list of remote receivers detected by Bluetooth.
- Tap to connect the field terminal to the base via Bluetooth and then configure the base according to your needs (see *RTK Base Configuration on page 34)*.
- Later, you will establish a Bluetooth connection with the rover. The process will start when you tap **Equip**>**GPS Rover** to configure the rover. From the **Comms** tab, you will be able to access the Bluetooth Devices window and select the rover receiver from the list of remote receivers detected by Bluetooth, in the same way as you did for the base.

Switching Between Base and Rover

During a FAST Survey session, you can quickly change the receiver you are communicating with (provided the receiver you want to communicate with is within Bluetooth range).



The  icon located in the upper-right corner of the FAST Survey window allows you to change receivers. Tap on this icon and then:

- Select **GPS Base** to switch to the base,
- Or select **GPS Rover** to switch to the rover.

NOTE: If you examine more carefully this icon, you will see that it changes aspect (base or rover icon) depending on which receiver is currently communicating with FAST Survey.

In addition, on the **Equip** menu, a small check box appears in the icon inside either the **GPS Rover** or **GPS Base** button to indicate which connection is active.

Subsequent Uses

In the next sessions of FAST Survey, the software will prompt you to re-activate the Bluetooth connection you last established in the previous session, or simply work without a connection. If you choose the first option, FAST Survey will automatically re-establish the connection, provided the concerned receiver is still on and within Bluetooth range.

Chapter 3. RTK Surveying

RTK Base Setup

Prerequisites

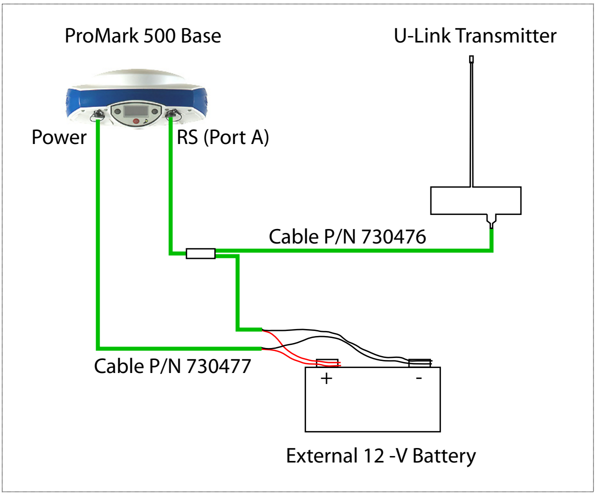
- You will need a tripod and a tribrach (not provided) to install the base. The provided antenna extension pole fitted with a 5/8” male adaptor is also required in this configuration.
- For a long-range radio link, i.e. more than 1 mile or 1.6 km, for which the radio antenna should be placed as high as possible, Magellan recommends you install the antenna on top of an antenna pole secured on a tripod (neither of these items is provided).
- To power the radio, you need an external 9- to 28-V DC power source such as a standard 12-V DC battery (optional accessory). In this configuration, the ProMark 500 can be powered either from the same power source (recommended), using cable P/N 730477, or from its internal battery.

  Powering the ProMark 500 from the external battery offers two advantages:

  1. Operating sessions can be extended significantly.
  2. The external battery operates as a trickle charger for the ProMark 500’s internal battery.

Magellan Radio Link

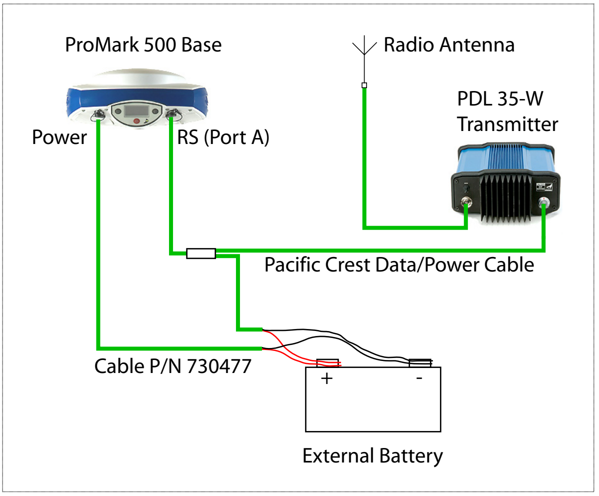
eThe connection diagram is as follows.



Mount the different items as shown on the picture.

PacCrest Radio Link

The connection diagram is as follows.



Mount the different items as shown on the picture.

RTK Base Configuration

Prerequisites

- Your base is properly set up and powered on. It is on its definitive location for the survey and the field terminal is located at less than 10 metres from the base.
- Your field terminal is on, FAST Survey is running, a Bluetooth connection has already been configured (with the base; see *How FAST Survey Interfaces with ProMark 500 Via Bluetooth on page28*) and a job file is open.
- In FAST Survey, tap on the **Equip** tab and then the **GPS Base** button. A message may appear asking you to confirm your choice of configuring a base. Tap **Yes**. This opens the **Current** tab of the GPS Base window.

Set Manufacturer & Model

- Set the **Manufacturer** (“Magellan Navigation”) and **Model** (“ProMark 500”) of the equipment used as the base.

Check/Change Bluetooth Connection

- Tap on the **Comms** tab. Since the Bluetooth connection was performed earlier, just check that FAST Survey is properly configured to communicate with the base. You should read:
  - **Type** = “Bluetooth”
  - **Device** = “Magellan BT”
  - **Instr** = should be set to the name you gave earlier to the base, as seen from FAST Survey Bluetooth.

  Note that the **Configure** button next to the **Device** field allows you to return to the Bluetooth Devices window through which you earlier configured the Bluetooth connection to the base (see *How FAST Survey Interfaces with ProMark 500 Via Bluetooth on page28*). Changes can be made now if necessary.

Set Receiver Parameters

- Using the HI measurement tool provided, perform a slant measurement of the antenna height (recommended).
- On the field terminal, tap on the **Receiver** tab.

- Select the **Slant** option for the antenna height measurement.
- Tap within the **Antenna Height** field and enter the value you have just measured.
- Choose your preferred settings for **Elevation Mask**, **Use SBAS Satellites** and **Use GLONASS Satellites**.Using SBAS and/or GLONASS satellites will help the rover maintain the availability of fixed positions in those difficult environments where GPS alone would fail to do so.

Set Radio Link & Transmitter

- Tap on the **RTK** tab and set the radio link according to the table below.

Field	Magellan	Pacific Crest
Device	Magellan Radio	Pacific Crest
Baud	(forced to 19200 Bd)	“38400 Bd” (default)
Message Type	RTCM V3.0 recommended.	RTCM V3.0 recommended.
Base ID	Choose any number at your convenience between 0 and 4095.	Choose any number at your convenience between 0 and 4095.

- Tap on the **Config** button to set the radio transmitter:

Field	Magellan	Pacific Crest
Protocol	-	“Transparent” recommended
Channel	Choose channel used (channel No. - Frequency)	Choose channel used (channel No. - Frequency)
Over the Air Baud	-	“9600 Bd” recommended

- Tap to load the settings to the radio. This may take a few seconds. FAST Survey then returns to the GPS Base configuration window.

Load Configuration to the Base

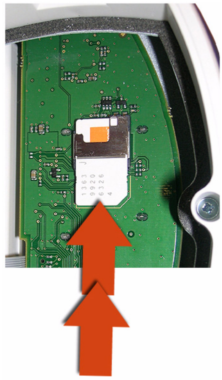
Now that you have browsed all the tabs in the Base Configuration window and set all the parameters, just tap to connect and load the configuration to the base. This may take a few seconds.

Set Base Position

FAST Survey then asks you to set the base position. Depending on the chosen method, follow the instructions displayed on the screen to define this position. This completes the base configuration phase.

RTK Rover Setup

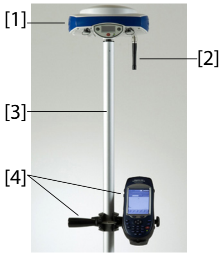
Prerequisites



- Use a range pole fitted with a 5/8" male adaptor at the upper end (not provided).
- If a radio link is used with the base, your rover should normally have been fitted with the radio module that matches the reception band covered by the radio transmitter used at the base.
- If a GPRS connection is used, your rover should normally have been fitted with the SIM card that will allow it to perform a network connection.

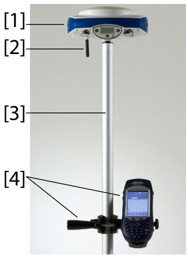
  To connect the SIM card, first use a flat screwdriver to loosen the two quarter-turn screws securing the radio module. Remove the module. This gives access to an electronic card on which you can insert the SIM card as shown on the picture.

Radio Link



Mount the different items as shown on the picture, including the ProMark 500 **[1]**, the radio antenna **[2]**, the range pole **[3]** and the field terminal with its mounting bracket **[4]**.

GSM/GPRS Connection



As a standard feature, the ProMark 500 incorporates a built-in GSM modem, which means you only have to connect the GSM antenna if you have paid for activation of the hardware. Mount the different items as shown on the picture, including the ProMark 500 [1], the GSM antenna [2], the range pole [3] and the field terminal with its mounting bracket [4].

RTK Rover Configuration

Prerequisites

- Your rover is properly set up and powered on.
- Your field terminal is on, FAST Survey is running and a job file is open.
- In FAST Survey, tap on the **Equip** tab and then the **GPS Rover** button. A message may appear asking you to confirm your choice of configuring a rover. Tap **Yes**. This opens the **Current** tab of the GPS Rover window.

Set Manufacturer & Model

- Set the **Manufacturer** (“Magellan Navigation”) and **Model** (“ProMark 500”) of the equipment used as the rover.

Set Bluetooth Connection

- Tap on the **Comms** tab.
- In the **Type field**, select “Bluetooth”.
- In the **Device** field, select “Magellan BT”.
- Tap on the **Configure** button to access the Bluetooth Devices window. The window lists Bluetooth identifiers that correspond to the receivers found in the vicinity.
- Select the rover’s Bluetooth identifier from the list. To make sure you are making the right selection, press the Scroll button on your rover until you display the Receiver Identification screen. The Bluetooth identifier is shown in the lower line. This is the parameter you must select from the list.

  You may give the rover a more familiar name (e.g. “MyRover”) using the **Set Receiver Name** button.

- Tap  to connect the field terminal to the rover via Bluetooth. FAST Survey then returns to the GPS Rover configuration window.
- Check that the rover name is now selected in the **Instr** field.

Set Receiver Parameters

- Measure or read the length of the range pole on top of which the ProMark 500 is mounted.
- On the field terminal, tap on the **Receiver** tab.
- Select the **Vertical** option for the antenna height measurement.
- Tap within the **Antenna Height** field and enter the value you have just measured or read for the range pole length.
- Choose your preferred settings for **Elevation Mask**, **Ambiguity Fixing** (see also table below), **Use SBAS Satellites** and **Use GLONASS Satellites**.Using SBAS and/or GLONASS satellites helps to maintain the availability of fixed positions in those difficult environments where GPS alone would fail to do so.

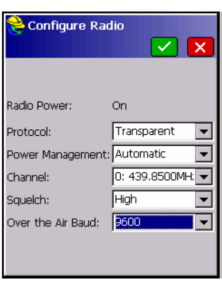
Choice	Definition
Float	Choose this option if you only need decimeter accuracy (position status will never go to "Fixed").
95.0	95% confidence level
99.0	99% confidence level (default and recommended setting)
99.9	99.9 confidence level

Set RTK Mode

- Tap on the **RTK** tab and set the radio link according to the table below.

Field	Radio	GSM/GPRS/Network
Device	Pacific Crest	Internal GSM
Network	-	Choose the RTK mode that suits your application (TCP/IP Direct, UDP/IP Direct, NTRIP, SpiderNet or Direct Dial)
Send Rover Position to Network	Disable this option.	Enable this option if TCP/IPDirect IP is used. In NTRIP, this option is automatically enabled.

- If you choose "Pacific Crest", tap on the **Config** button next to the **Device** field to set the radio receiver:



Field	Setting
Protocol	Select "Magellan" if base radio is a Magellan radio. Select "Transparent" if base radio is a Pacific Crest radio.
Power Management	"Automatic" recommended. In Automatic, the radio module is automatically powered when you turn on the receiver and will only be turned off when you turn off the receiver. In Manual, the module will be powered on only when you configure the rover.
Channel	Choose channel used (Channel No. - Frequency)

Field	Setting
Squelch	The factory default setting of “High” provides maximum effective sensitivity to incoming signals.This is the preferred setting. “Medium” and “Low” sensitivity settings are available for use if local electrical noise or distant radio signals falsely activate the radio receiver. Use of these settings may reduce the radio range.
Over the Air Baud	“9600 Bd” recommended

Then tap to load the settings to the radio. This may take a few seconds. FAST Survey then returns to the GPS Rover configuration window.

- If you choose “Internal GSM”, tap on the **Config** button next to the **Device** field to set the internal modem. Then tap on the **Config** button next to the **Network** field to set the GSM/GPRS connection. The table lists all the parameters that need to be defined.

Parameter	TCP/IP UDP/IP	NTRIP	SpiderNet	Direct Dial
Name	•	•	•	•
IP Address	•	•	•	
Port	•	•	•	
User Name		•	•	
Password		•	•	
Phone Number				•

For more information on the modem and network connections, see *Network Connection on page 41*.

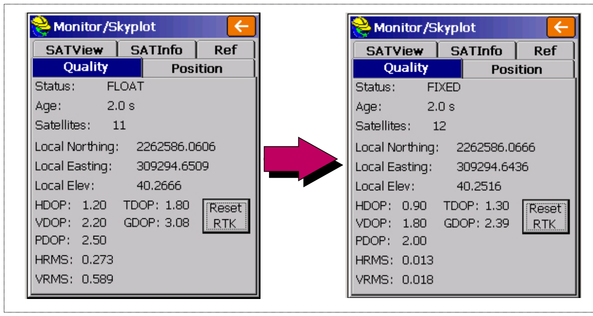
Load Configuration to the Rover

Now that you have browsed all the tabs in the Rover Configuration window and set all the parameters, just tap to connect and load the configuration to the rover.

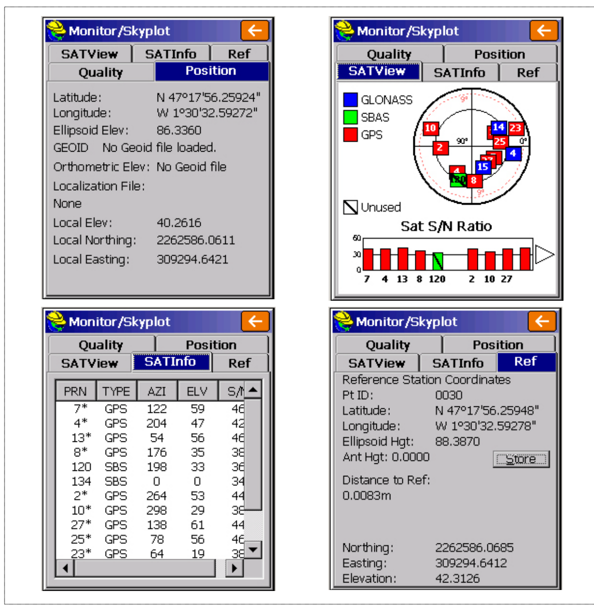
Check that a “Fixed” Solution is Now Available

The rover then starts acquiring corrections data from the selected base. Note that the rover will automatically recognize the format of the received data (RTCM, CMR, etc.). Do the following before starting your survey:

- In the **Equip** menu, tap on the **Monitor/Skyplot** button
- Read the different parameters displayed on the screen. You should see the HRMS and VRMS rapidly decrease from a few meters to less than 10 to 20 mm, while the position status switches from “AUTO” to “FLOAT” and finally “FIXED”.



Other screens are available from within the **Monitor/Skyplot** function showing the details of the constellation, of the base position and of the RTK position solution:



In NTRIP and Direct IP modes, a **Disconnect/Connect** button is available on the **Ref** tab to easily control the network connection. There is also a horizontal bar showing the GSM signal level until the modem is on-line. The bar disappears when the modem is online.

- Tap after you have made sure the FIXED position status is settled. This takes you back to the FAST Survey menu from which you can start your survey.

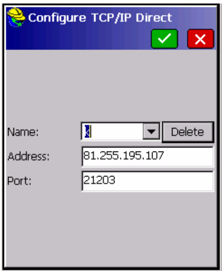
Network Connection

From the GPS Rover's **RTK** tab, do the following to first configure the internal modem and then choose, set and activate a network connection.

Configuring the Modem

1. Select "Internal GSM" from the **Device** field.
2. Tap on the **Config** button next to the **Device** field to set the modem:
   - **Power Management**: "Automatic" or "Manual". In Automatic, the modem is automatically powered when you turn on the receiver and will only be turned off when you turn off the receiver. In Manual, the modem will be powered on only if this is requested by the configuration you load to the rover.
   - **Band**: 900/1800 (Europe), 850/1900 or 900/1900, depending on the band used by the provider (North America).
   - **Provider**. This drop-down menu offers preset providers (Cingular, T-Mobile, etc.). Selecting one of them automatically sets the next parameters. If you select "Other", you must define the next parameters manually.
   - **Pin**. Pin number giving access to the SIM card. Leave this field blank if your GPRS provider lets you access the SIM card without a pin code.
   - Access Point Name (APN) definition (**APN Server**, **APN User Name** and **APN Password**).
3. Tap . The "Device Configured" message is displayed briefly. FAST Survey takes you back to the **RTK** tab where you can now set the type of network connection you wish to use.

TCP/IP Direct Connection

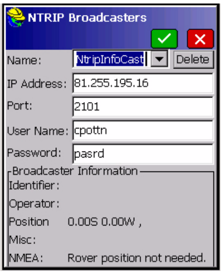


1. Select "TCP/IP Direct" from the **Network** field.
2. Tap on the **Config** button next to the **Network** field to set the connection:
   - **Name**: Select <New> from this field and then, in the same field, enter a name for the file in which the properties of the TCP/IP Direct connection you are now creating will be saved.
   - **Address**: IP address of the Direct IP server.
   - **Port**. Port number.
3. Tap . This takes you back to the **RTK** tab.
4. Tap  again to configure the rover and establish the connection to the network.

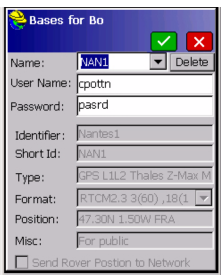
UDP/IP Direct Connection

1. Select "UDP/IP Direct" from the **Network** field.
2. Tap on the **Config** button next to the **Network** field to set the connection:
   - **Name**: Select <New> from this field and then, in the same field, enter a name for the file in which the properties of the UDP/IP Direct connection you are now creating will be saved.
   - **Address**: IP address of the Direct IP server.
   - **Port**. Port number.
3. Tap . This takes you back to the **RTK** tab.
4. Tap  again to configure the rover and establish the connection to the network.

NTRIP Network Connection



1. Select “NTRIP” from the **Network** field.
2. Tap on the **Config** button next to the **Network** field to set the connection:
   - **Name**: Select <New> from this field and then, in the same field, enter a name for the file in which the properties of the NTRIP connection you are now creating will be saved.
   - **Address**: IP address of the NTRIP server.
   - **Port**. Port number.
   - **User Name**. Enter your user name (provided by the NTRIP provider).
   - **Password**. Enter your password (provided by the NTRIP provider).
3. Tap ✓. This initializes the modem, saves the NTRIP configuration under the specified name, and finally downloads and displays the source table. This table lists all the stations made available by your provider for use in RTK mode.



4. Select the station you want to receive data from.
5. Tap ✓ to confirm your choice and return to the **RTK** tab.
6. Tap ✓ again to activate the NTRIP connection.

SpiderNet Connection

1. Select “SpiderNet” from the **Network** field.
2. Tap on the **Config** button next to the **Network** field to set the connection:
   - **Name**: Select <New> from this field and then, in the same field, enter a name for the file in which the properties of the SpiderNet connection you are now creating will be saved.
   - **Address**: IP address of the SpiderNet server.
   - **Port**. Port number.
   - **User Name**. Enter your user name (provided by SpiderNet).
   - **Password**. Enter your password (provided by SpiderNet).

3. Tap . This takes you back to the **RTK** tab.
4. Tap  again to activate the SpiderNet connection.

Uploading Stakeout Points to the Field Terminal

In your office, do the following:

- Connect the field terminal to your office computer using the USB data cable.
- Make sure ActiveSync is installed on your computer and is allowed to perform USB connections. If you do not have ActiveSync installed, download the latest version from the following web page:

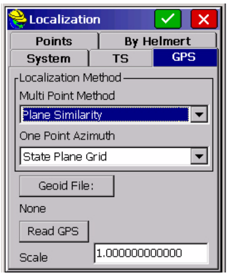
  hhttp://www.microsoft.com/windowsmobile/activesync/default.mspx
- Run GNSS Solutions on your office computer.
- Open the project containing the stakeout points you want to transfer to the field terminal as your job.
- On the project map view, select all the reference and target points making up your job.
- Select **Project>Upload Positions to External Device..**
- Select **RTK Job** and **FAST Survey data collector**.
- Click **OK**.
- Name the job (e.g. MYJOB). Keep the **Selected Targets and References** option selected and click **OK**. This opens the Data Transfer dialog box.
- In the combo box, select **Active Sync** and keep **Automatic transfer** enabled.
- Click **OK** to establish the connection with the field terminal and upload the job (to \MyDevice\FAST Survey\Data\).
- After the job has been uploaded, turn off the field terminal, disconnect the USB cable and go to the field with your surveying equipment to stake out your points.

Running Localization

Choosing the Localization Method

- With your job open in FAST Survey, click on the **Equip** tab and then on the **Localization** button. This opens the Localization window with the **System** tab shown first.

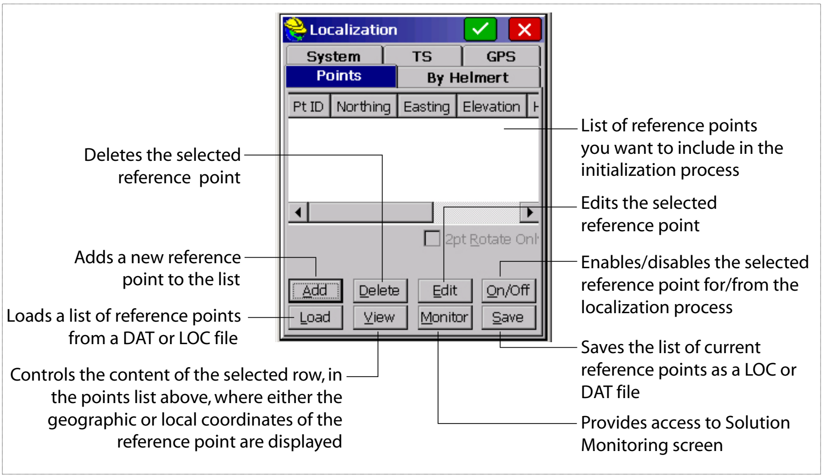
  For your information, this tab shows the name of the projection selected earlier for the project (see **File>Job Settings>System**). Choosing another projection here would change the projection used in the job. It is your responsibility to have the right projection selected on which the localization process is going to be run.



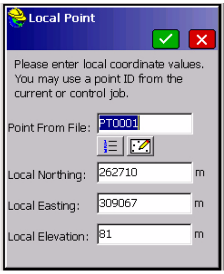
- Tap on the **GPS** tab and select your localization methods for multi-point and one-point localizations. If you choose "Helmert" as the localization method, the one-point method selection is grayed.

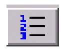
One-Point or Multi-Point Localization

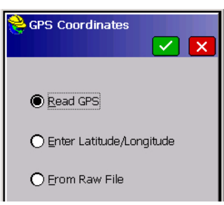
1. Tap on the **Points** tab. This tab allows you to define the reference points used as the input to the localization process.

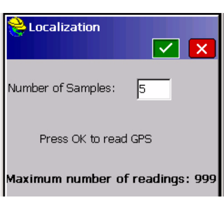


For each of the available reference points, you need to enter the local coordinates and then the WGS84 coordinates, as measured by your equipment.

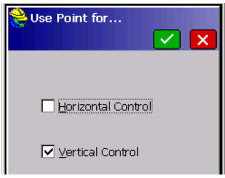


2. Click **Add** to define the first reference point. A new window (Local Point) is displayed allowing you to do that. For a brand new reference point, simply name the point and type in its known local coordinates. To add a reference point that already exists in the job, do one of the following:
   - Type its name in the **Point From File** field. This automatically updates the window with the point's local coordinates.
   - Or tap on the  button to access the list of points available. Choose one and tap the green button to return to the Local Point window.
   - Or tap on the  button to select the point directly on the map of the working area.
3. Tap on the green button () to enter the name and local coordinates of the reference point.
   FAST Survey then asks you to enter the WGS84 coordinates of the point. Choose one of the following methods:
   - **Read GPS**. Choosing this method means your equipment should be placed exactly over the reference point. Then enter a number of samples required before the equipment delivers an averaged WGS84 solution for the point (5 minimum recommended). Tap on the green button to let the equipment take the required readings and return a result (averaged position + residuals). Then validate the result.
   - **Enter latitude/Longitude**. Enter the three WGS84 coordinates of the point, using the "dd.mmssss" format, for latitude and longitude. Elevation should be entered in the distance unit chosen for the job. Enter the orthometric elevation if a geoid file is used otherwise enter the ellipsoid elevation.
   - **From Raw File**: Select a point from the job holding the WGS84 coordinates of the reference point. This point should have been surveyed earlier by the system in the same measurement conditions (same base setup, etc.) as now.



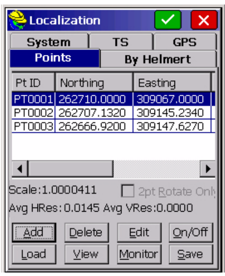


Once both the local and WGS84 coordinates have been entered, the reference point appears in the list of points used in the localization process.



4. With the point selected in the list, tap on the **On/Off** button to tell FAST Survey how the point should be used in the localization process.

   You can force the local grid to pass through its horizontal position by checking the **Horizontal Control** button and/or its vertical position by checking the **Vertical Control** button. Clearing the two options means the point is not involved at all in the localization process. Tap on the green button to validate your choices.



5. Resume the previous three steps until all your reference points have been added to the list.

   As you add new points, check the amount of residual for each reference point involved in the localization (residuals are displayed in the lower part of the screen). The lower these values, the better the consistency of your set of reference points.

   Should some residuals be abnormally high, the relevant point(s) should be deleted using the **Delete** button, or its contribution to the localization process changed by editing its control settings through the **On/Off** button.

   If you enter only two reference points, the **2 pt Rotate Only** button is made available. This option allows you to use the second point for direction but not for scaling.

6. Tap when you are satisfied with the level of residuals. FAST Survey then asks you to save your list of points as a LOC or DAT localization file.

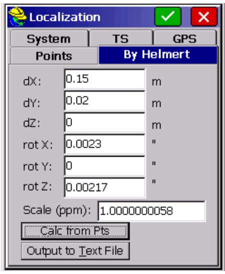
7. Name the file and tap . **The localization process is now complete and active. This means every new point you will now survey will be expressed on the local grid**.

   If points have been surveyed in the job prior to the localization process, FAST Survey will prompt you to convert their coordinates to the new local grid. If you accept, FAST Survey will open the Process Raw File window.

   Simply tap to re-process the coordinates of these points. FAST Survey will return the list of converted coordinates.

   NOTE: Tapping from the Localization screen is mandatory to activate the new localization file. Using the **Save** button saves the localization file but does not make it active.

Helmert Localization



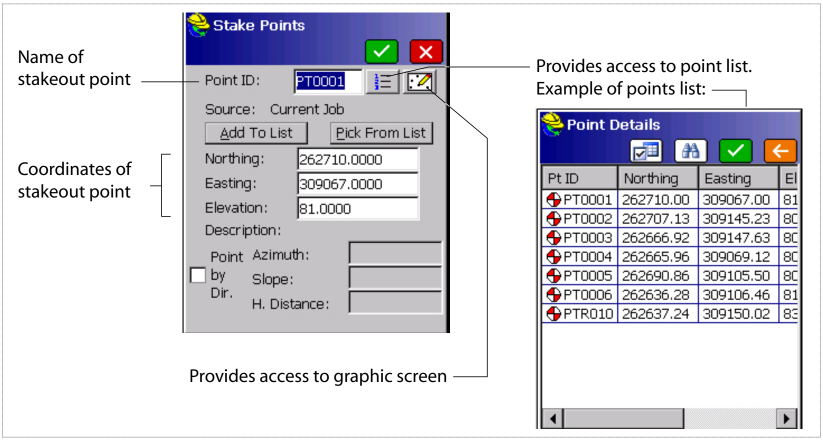
1. With your job open in FAST Survey, click on the **Equip** tab and then on the **Localization** button.
2. Tap on the **GPS** tab and select "Helmert" from the **Multi Point Method** field.
3. Tap on the **By Helmert** tab and then enter the seven parameters defining the new datum of the local grid.
4. Tap . **The localization process is now complete and active**. This means every new point you will now survey will be expressed on the local grid.

Computing Helmert Parameters from a Multi-Point Localization File

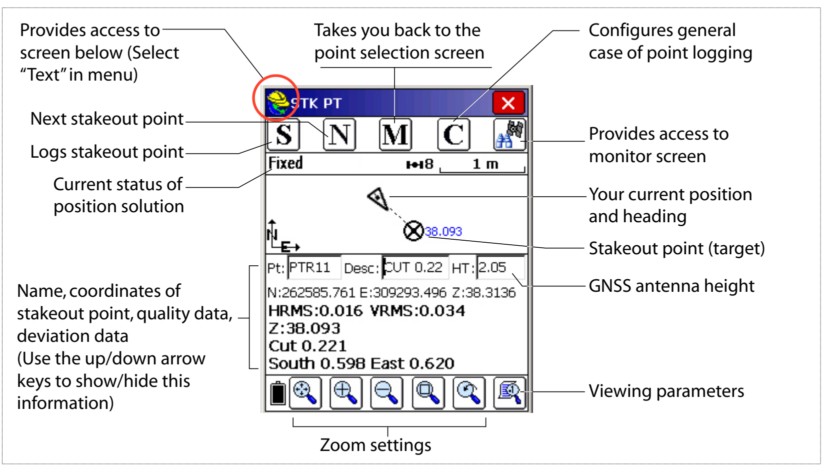
- Follow the instructions to perform a multi-point localization.
- After all the points have been defined, tap on the **By Helmert** tab.
- Tap on the **Calc from Pts** button. FAST Survey computes the seven Helmert parameters and displays the result in the corresponding fields.
- To save the seven parameters as a TXT file, tap on the Output to Text File button and name the file.

Staking Out Points

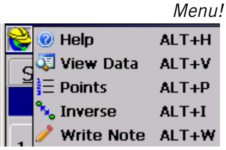
1. Run FAST Survey and open the job containing the points you want to stake out.
2. Tap on the **Survey** tab and then select **Stake Points**. The screen now displayed allows you to stake out points.
3. On this screen, FAST Survey asks you to choose the point you want to stake out. You can either type in its coordinates in the **Northing**, **Easting** and **Elevation** fields, or select a pre-defined point from the points list (see **File>List Points**). You can also define graphically the point by tapping on the point on the graphic screen, or define the point according to azimuth, slope and horizontal distance.



4. Once you have chosen a point, tap . A graphic screen is now displayed to help you head for the point.

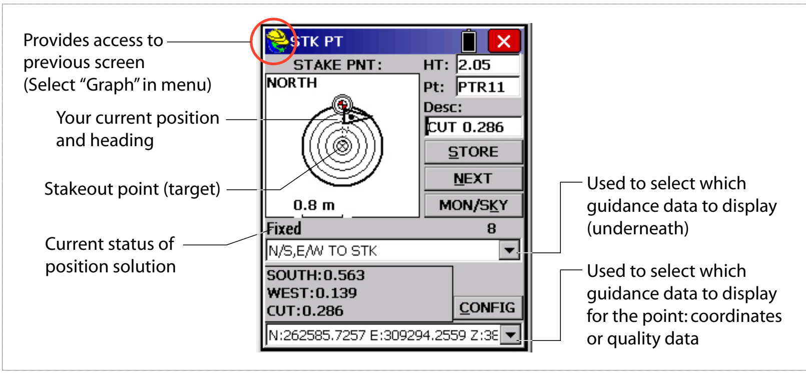


Yellow helmet gives access to Function Menu!



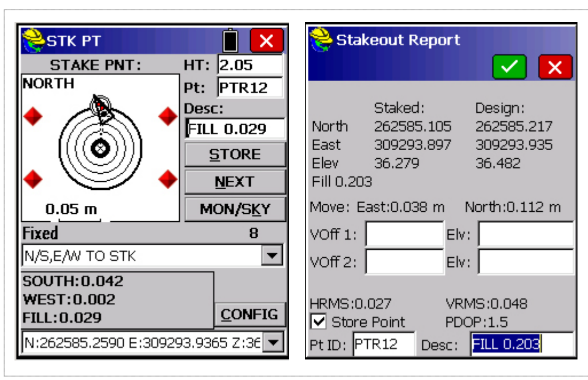
5. When the distance to the stakeout point is too small to be clearly seen on this screen, tap on the surveyor's helmet in the upper-left corner and select **Text** from the menu that pops up.

   A new screen appears giving a more accurate view of the remaining distance to the stakeout point. (If you want to return to the previous screen, just select **Graph** in the same menu.)



When the remaining distance is within the stakeout tolerance (this parameter can be changed in **Equip**>**Tolerances**), markers appear in the four corners of the target. You can now set a stake on this point.

6. Tap on the **STORE** button if you want to store the position of this point. You will be notified if the values of HRMS and VRMS exceed the tolerances set for these two parameters in **Equip**>**Tolerances**. A new screen is then displayed showing the coordinates of both the staked and design points.



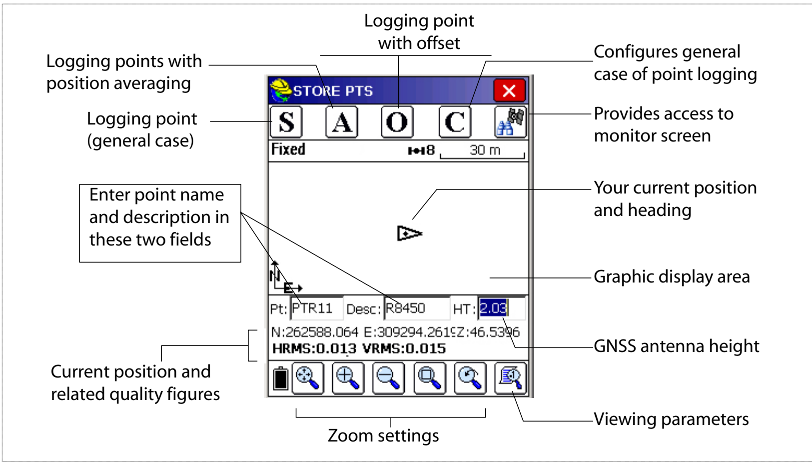
7. Tap ✓ if you agree. The "**Point Stored**" message appears briefly. The screen then comes back to the Stake Points screen where you can choose the next point to be staked.

8. After staking out all your points, tap ✕ in the upper-right corner of the screen to return to the menu.

Logging Points

1. Tap on the **Survey** tab and then on **Store Points**. The screen now displayed allows you to log all your points.

   The figure below summarizes all the functions available from that screen.

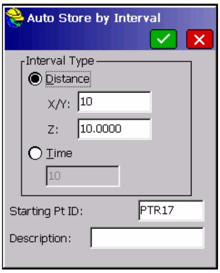


2. Type in the point name and description in the corresponding two fields (see above)
3. Tap on the “**A**” button
4. Enter the number of readings you want before FAST Survey is allowed to compute an average position for this point.

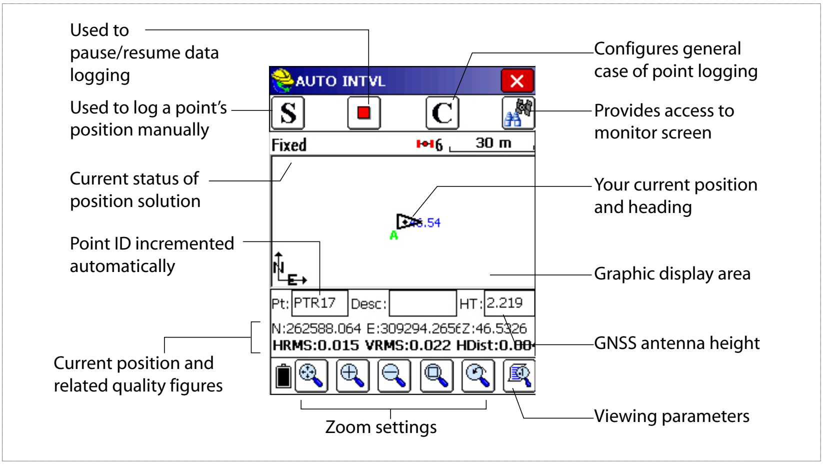
   For example, type in “5” and tap .

   Messages follow successively indicating that the system is taking the five requested readings. Then FAST Survey displays the average coordinates it has determined for the point.
5. Tap  if you agree. The “**Point Stored**” message appears briefly. The screen then shows the location of the point together with its name and description.
6. After logging all your points, tap  in the upper-right corner of the screen to return to the menu.

Logging Points in Continuous Mode



1. On the **Survey** tab, select the **Auto by Interval** function. Two different modes are possible: Time or Distance.
2. If you choose **Distance**, enter the horizontal and vertical increment value respectively in the **X/Y** and **Z** fields, according to the chosen unit. If you choose **Time**, enter the increment value, in seconds.
3. Enter a point Id. for the start point in the **Starting Pt ID** field. This field will be incremented by one after each point logging. You do not need to define a name finishing with a figure. FAST Survey will place one anyway when incrementing this field.
4. Tap to switch to the graphic screen (see figure below) and start logging the first point.



The **S** button lets you instantly log the position of a point.

The pause button allows you to pause data logging in continuous mode.

If data logging in continuous mode is paused, you can still continue to log points in manual mode using the **S** button.

Tap the pause button again to resume data logging in continuous mode.

If you directly tap to come back to the main menu, data logging in continuous mode is automatically stopped.

Downloading RTK Points to GNSS Solutions

- Go back to your office and connect the field terminal to your office computer using the USB data cable.
- Run GNSS Solutions on your office computer.
- Open the project in which to add the points from the field.
- Select **Project>Download Positions from External Device..**
- Select **RTK Results** and **FAST Survey data collector**.
- Click **OK**. This opens the Data Transfer dialog box.
- In the combo box, select **ActiveSync**, enable **Automatic Transfer** and click **OK**. This opens a new window listing all the jobs stored in the field terminal.
- Select the job you want to download (e.g. “MYJOB”) and click OK. This starts the download process.

Chapter 4. Logging Raw Data

Introduction

ProMark 500 allows you to log raw data in two different ways:

- Standalone: You simply need to use the Log button to start and stop raw data logging.

  Later, you will however need to do the following manually:

  1. Downloading phase: Rename the raw data files collected on each site.
  2. Post-processing phase: Manually correct all computed elevations for the antenna height.

- Using FAST Survey: The **Survey**>**Log Raw GPS** function allows you to fully control raw data logging. Using this method offers three advantages:.

  1. *Antenna reduction* is automatically performed during post-processing because of the antenna height value (from the receiver properties) stored in the raw data files.
  2. Ability to name the raw data file and insert time tags.
  3. Ability to pause/resume data logging.

By default, raw data is logged to the ProMark 500's internal memory.

Using FAST Survey, you can change the storage medium (internal memory or USB memory stick).

The choice of storage medium is then valid for both data logging methods (standalone and using FAST Survey). If "USB memory stick" is selected and no USB stick is connected to the ProMark 500, then no data logging will take place.

In both data logging methods, the Raw Data Logging icon on the General Status screen will start flashing when a raw data file is open for logging.

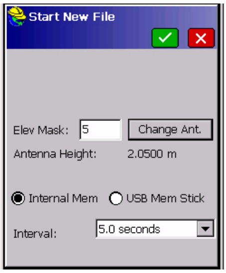
Raw Data Logging Methods

Standalone

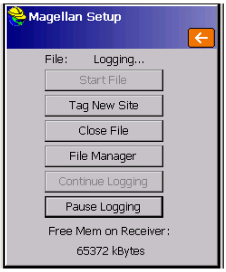
- Press the Log button to start data logging.
- Press the Log button again when it's time to stop data logging.

Using FAST Survey

- Tap **Survey**>**Log Raw GPS**.
- Tap **Start File**.
- Set the following parameters:



  - Elevation Mask in degrees.
  - Check the antenna height value. If it's wrong, tap the **Change Ant.** button to set the new value.
  - Storage medium (internal or USB memory stick). Choosing the internal memory is recommended. The use of a memory stick should be restricted to downloading raw data files.
  - Logging interval in seconds.



- Tap ✓. This starts data logging. From the screen then displayed, you can do the following:
  - Name the raw data file, mark a particular point or event (**Tag New Site**).
  - Stop data logging (**Close File**).
  - Access the File Manager window in read-only mode (**File Manager**).
  - **Continue Logging** / **Pause Logging**. Pausing data logging means closing the currently open file. Continuing data logging means opening a new file. Data logging will start immediately based on the parameters set for the previous file.

Combining the two Methods

Combining the two methods is possible.

For example, you can start data logging using FAST Survey. Then you can quit FAST Survey and turn off the field terminal without disturbing data logging. Later, you will be allowed to stop data logging by simply pressing the Log button on the ProMark 500 front panel.

Downloading Raw Data

Use a USB mass storage device as a transit storage medium to download raw data files from the ProMark 500's internal memory to your office computer.

Important! During a download operation, files are not deleted from the receiver but simply copied to the USB mass storage device.

After downloading the files to this device, connect the USB device to your computer and use your usual browser to copy the files to the project folder.

Using a USB Mass Storage Device

- Connect the USB mass storage device to the ProMark 500 via the short USB Device cable provided (P/N 702103).

  If raw data files are present in the ProMark 500's internal memory, the following icons will automatically appear on the display screen:

- To confirm the file transfer, press the Log button. The General status screen will re-appear after the file transfer is complete.
- To cancel the file transfer, press the Scroll button.
- If you do not press any button within the next 10 seconds, the download procedure will be canceled automatically and the screen will come back to the previous display.

Using the USB Cable Provided

- Connect the USB cable provided (P/N 702104) between the office computer and ProMark 500's USB port. The receiver is then seen as a USB device from the office computer
- Using Windows Explorer on your office computer, browse the ProMark 500's internal memory for the raw data files.
- Copy/paste the files to your project folder. Note that raw data files can directly be deleted from the receiver's internal memory through this connection.

Case of Static Survey in Standalone

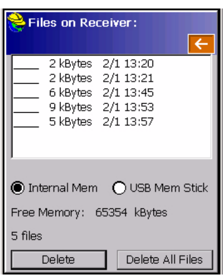
When static surveys are performed without the field terminal and FAST Survey, you must be careful with raw data file names. In view of the ATOM naming conventions used and the system's default settings, there is indeed every chance that the base file and the rover file have the same name. Magellan then recommends you follow this procedure:

1. Download the raw data file from one of the receivers to the USB device.
2. Plug the USB device to the office computer, copy the raw data file to the project folder and rename the file to reflect the site where the static occupation took place (e.g. replace "G____" with "GPREF")
3. Repeat the previous two steps with the other receiver, using a different name for the file (e.g. replace "G____" with "GP100").

Deleting Raw Data Files

Use FAST Survey to delete raw data files from the ProMark 500 internal memory.

1. Tap on the **Survey** tab and then on **Log Raw GPS**.
2. Tap on **File Manager**. The screen displays the following parameters:
   - List of raw data filenames.
   - Selected storage medium.
   - Free memory available.
   - Current number of raw data files in memory.



3. Unless already done, select **Internal Mem** to list the files stored in the internal memory.
4. To delete one file, highlight its name in the list and tap the **Delete** button. To delete all the files, tap **Delete All Files**.

   Important! When the receiver is logging raw data, the file being logged cannot be deleted. The file is protected from deletion until you close it.

Chapter 5. Post-Processed Surveying

System Setup

Base Setup

This setup should always be used for a base and may also be used for a rover having to run a static survey.

Prerequisites:

- You need accessories to install the base, such as a tripod, a tribrach and an antenna pole.
- Allow for an external DC power source if this is how you want the base to be powered. Connect the power source to the DC Power Input located underneath the unit.

Step-by-step Procedure:

1. Set up the tripod and tribrach over the point chosen for the base.
2. Screw the ProMark 500 on top of the pole.
3. Insert the antenna pole into the tribrach.
4. Perform a slant height measurement. Keep the measured value in your mind or write it down.

Rover Setup

This setup is intended for rovers having to run continuous or stop&go kinematic surveys.

Prerequisites:

- Use a range pole fitted with a 5/8" male adaptor at the upper end (not provided).

Step-by-step Procedure:

1. Screw the ProMark 500 on top of the range pole.
2. Perform a vertical height measurement, which consists in measuring the length of the range pole or reading the graduation on the pole. Keep the measured value in your mind or write it down.
3. Fasten the field terminal and its bracket further down on the pole so you can easily use the field terminal.

System Configuration

Foreword

Please read the following before going any further:

- System configuration for post-processed surveys is required only when FAST Survey is used to control your system. Configuring the system then only consists in activating a Bluetooth connection between the field terminal and the desired receiver.
- The FAST Survey field software is required to perform stop&go or continuous kinematic surveys, but it is optional for static surveys. Static surveys may indeed be run either with or without FAST Survey.
- When a static survey is run without FAST Survey, data collection is started/stopped directly from the receiver by pressing the Log button (see *Logging Raw Data on page 55*).

  In this case however, because the antenna height will be missing from the raw data file, you will have to measure and remember the antenna height, and later enter this information, for antenna reduction, when post-processing the static raw data file with GNSS Solutions.
- Opening a job file is mandatory when running FAST Survey but is in fact useless in the case of post-processed surveys. In addition, the notion of “base” and “rover” as presented in FAST Survey’s **Equip** menu is irrelevant for post-processed surveys in the sense that you don’t need to upload a “base” or rover” configuration to your receiver (except for changing the GLONASS or SBAS setting). So consider creating a job just as a means to access the FAST Survey main menu, with the following objectives:
  1. Allow a Bluetooth connection to be established with your base and rover through the **Equip>GPS Base** or **GPS Rover** button.
  2. Check communication between the field terminal and the receiver using the Monitor/Skyplot function.
  3. Access the **Survey>Log Raw GPS** function to perform your survey.

Prerequisites

- Your base and rover are properly set up and powered on.
- Your field terminal is on and within Bluetooth range of the base and afterwards, of the rover.

Establishing Bluetooth Connection with the Base

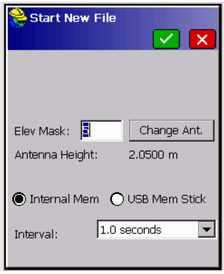
1. Run FAST Survey on your field terminal and create a new job.
2. Tap on the **Equip** tab and then on the **GPS Base** or **GPS Rover** button, whichever is the currently active button (for more convenience).

   NOTE: If a Bluetooth connection was established previously with your base, you just have to tap on the **Connect to last bluetooth device** button to restore the Bluetooth connection with the base (this would end the current procedure).
3. Tap on the **Comms** tab.
4. Select ‘Bluetooth” in the **Type** field and “Magellan BT” in the **Device** field.
5. Tap on the **Configure** button next to the **Device** field.
6. In the Bluetooth Devices window that opens, tap on the **Find Receiver** button. After a few seconds, the window lists the Bluetooth identifiers of your base and rover.
7. Select the base’s Bluetooth identifier from the list.
8. Tap  to connect the field terminal to the base. Then FAST survey takes you back to the **Comms** tab.
9. Tap  to return to the FAST Survey **Equip** menu.

Starting Base Data Collection, Naming the Base Raw Data File, Programming the End of Base Data Collection

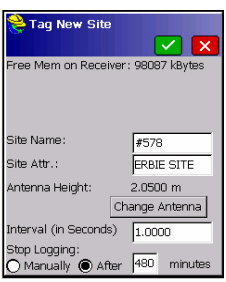
Before starting base data collection, you need to define the elevation mask, the base antenna height, the storage medium used in the receiver and the raw data recording rate. Follow the instructions below.

1. Tap on the **Survey** tab and then on **Log Raw GPS**.
2. Tap on **Start File**. The screen lists the currently used settings.
3. Keep or edit these settings, depending on the specific requirements of your survey:
   - **Elev Mask**: Elevation mask, in degrees (default: 5 degrees)

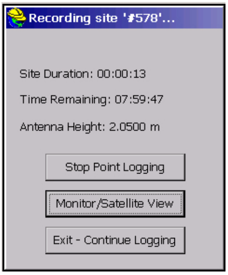


- **Antenna Height**: Current value of antenna height, expressed in the chosen unit. Use the **Change Ant.** button to change the antenna height. Choose the measurement type first (**Vertical** or **Slant**) and then enter the measured value.
- Choose the storage medium where to store the file (**Internal Mem** or **USB Mem Stick**).
- **Interval**: Raw data recording rate, in seconds (possible range: 0.1 to 999 seconds)

4. Tap . On top of the screen now appears the **Logging...** message indicating raw data recording in progress. A default name is given to the open raw data file, based on the naming conventions described in *ATOM File Naming Conventions on page 151*.
5. Name the site where data collection is taking place. According to the same ATOM file naming conventions, naming this site will impact the raw data filename. To name the site, tap on the **Tag New Site** button. This opens a new window on which you can enter the following parameters:
   - **Site Name**: Enter a name for the base location. A four-character name is recommended so that the entire name, and not a truncated name, appears later in the raw data file name. Longer names will not be truncated however in GNSS Solutions.
   - **Site Attr.**: Enter an optional description of the base location.
   - [The antenna height and raw data recording rate (interval) are recalled on this screen. You can still change them if necessary.]
   - **Stop Logging**: FAST Survey allows you to stop data collection automatically by selecting **After** and entering the duration, in minutes, of data collection. If you wish data collection to be stopped by an operator, select **Manually**.



6. Tap . A new screen is displayed summarizing all your settings.

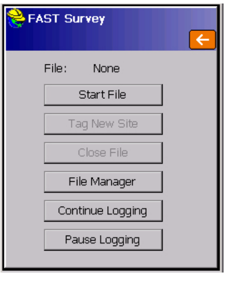


7. Tap on the **Monitor/Satellite View** button to make sure GNSS reception is good at the base location (enough satellites are received, DOP values low). Ignore all RTK-related indicators.
8. Tap to return to the previous screen.
9. Tap on the **Exit-Continue Logging** button.
10. Tap **Yes** to confirm that you want to exit the Log Raw GPS function but you want data logging to continue.
11. Tap to return to the main menu.
12. Tap **Yes** twice to continue data logging at the base location. You can now let the base operate on its own and switch to the rover.

Establishing Bluetooth Connection with the Rover

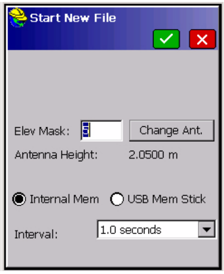
1. Tap on the **Equip** tab and then on the **GPS Base** or **GPS Rover** button, whichever is the currently active button.
2. Tap on the **Comms** tab.
3. Tap on the **Configure** button next to the **Device** field. This opens the Bluetooth Devices window.
4. Select the rover Bluetooth identifier from the list.
5. Tap to connect the field terminal to the rover. Then FAST survey takes you back to the **Comms** tab.
6. Tap to return to the FAST Survey Equip menu. The field terminal now communicates with the rover. Move both the rover and field terminal to the working area so you can start your static, stop & go or kinematic survey. See next sections.

Static Survey



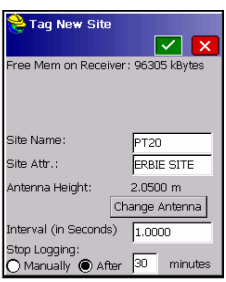
The rover has been installed on the survey point and will stay there throughout the static survey. What you will have to do now with your rover is much similar to what you've just done for the base. Follow the instructions below to run the survey:

1. Tap on the **Survey** tab and then on **Log Raw GPS**.
2. Tap on **Start File**. The screen lists the currently used settings.
3. Keep or edit these settings, depending on the specific requirements of your survey:
   - **Elev Mask**: Elevation mask, in degrees (default: 5 degrees)

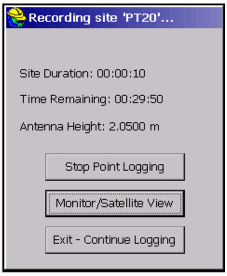


- **Antenna Height**: Current value of antenna height, expressed in the chosen unit. Use the **Change Ant.** button to change the antenna height. Choose the measurement type first (**Vertical** or **Slant**) and then enter the measured value.
- Choose the storage medium where to store the file (**Internal Mem** or **USB Mem Stick**).
- **Interval**: Raw data recording rate, in seconds. Use the same recording rate as the base.

4. Tap . On top of the screen now appears the **Logging...** message indicating raw data recording in progress. A default name is given to the open raw data file, based on the naming conventions described in *ATOM File Naming Conventions on page 151*.
5. Name the point where data collection is taking place. According to the same ATOM file naming conventions, naming this point will impact the raw data filename. To name the point, tap on the **Tag New Site** button. This opens a new window on which you can enter the following parameters:
   - **Site Name**: Enter a name for the survey point. A four-character name is recommended so that the entire name, and not a truncated name, appears later in the raw data file name. Longer site names will not be truncated however in GNSS Solutions.
   - **Site Attr.**: Enter an optional description for the survey point.
   - [The antenna height and raw data recording rate (interval) are recalled on this screen. You can still change them if necessary.]
   - **Stop Logging**: FAST Survey allows you to stop data collection automatically (recommended) by selecting **After** and entering the duration, in minutes, of data collection (typically 5 to 30 minutes). You may also want to stop data collection by yourself. In this case, select **Manually**.

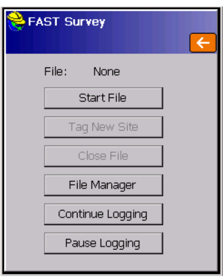


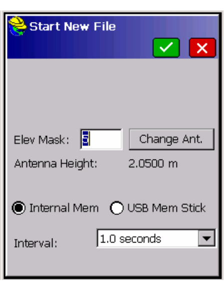
6. Tap . A new screen is displayed summarizing all your settings.



7. Tap on the **Monitor/Satellite View** button to make sure GNSS reception is good at the survey point (enough satellites are received, DOP values low). Ignore all RTK-related indicators.
8. Tap to return to the previous screen.
9. Wait until the end of the countdown. A message then informs you that the programmed time of data collection has elapsed.
10. Tap **OK** to acknowledge the message.
11. Tap on the **Close File** button to end data collection and close the raw data file.
12. Tap on the File Manager button. You should recognize the last file in the list as the file you have just closed (the file is identified by the point name).

"Stop & Go" Kinematic Survey

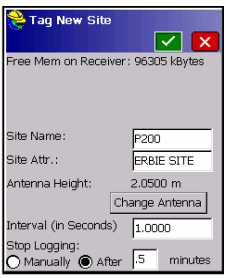




The rover is located on the first survey point. Follow the instructions below to run the survey:

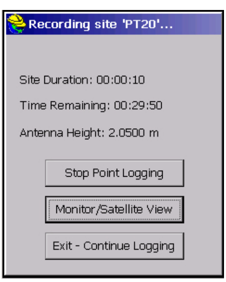
1. Tap on the **Survey** tab and then on **Log Raw GPS**.
2. Tap on **Start File**. The screen lists the currently used settings.
3. Keep or edit these settings, depending on the specific requirements of your survey:
   - **Elev Mask**: Elevation mask, in degrees (default: 5 degrees)
   - **Antenna Height**: Current value of antenna height, expressed in the chosen unit. Use the **Change Ant.** button to change the antenna height. Choose the measurement type first (**Vertical** or **Slant**) and then enter the measured value.
   - Choose the storage medium where to store the file (**Internal Mem** or **USB Mem Stick**).
   - **Interval**: Raw data recording rate, in seconds. Use the same recording rate as the base.
4. Tap . On top of the screen now appears the **Logging...** message indicating raw data recording in progress. A default name is given to the open raw data file, based on the naming conventions described in *ATOM File Naming Conventions on page 151*.
5. Name the point where data collection is taking place. According to the same ATOM file naming conventions,

naming this point will impact the raw data filename. To name the point, tap on the **Tag New Site** button. This opens a new window on which you can enter the following parameters:



- **Site Name**: Enter a name for the survey point. A four-character name is recommended so that the entire name, and not a truncated name, appears later in the raw data file name. Longer site names will not be truncated however in GNSS Solutions. In stop & go the filename will pick up the name of the last surveyed point.
- **Site Attr.**: Enter an optional description for the survey point.
- [The antenna height and raw data recording rate (interval) are recalled on this screen. You can still change them if necessary.]
- **Stop Logging**: FAST Survey allows you to stop data collection automatically (recommended) by selecting **After** and entering the duration, in minutes, of data collection (typically 1 minute). You may also want to stop data collection by yourself. In this case, select **Manually**.

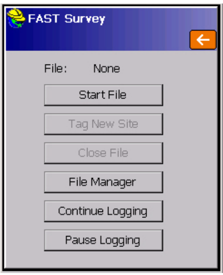
6. Tap . A new screen is displayed summarizing all your settings.



7. Tap on the **Monitor/Satellite View** button to make sure GNSS reception is good at the survey point (enough satellites are received, DOP values low). Ignore all RTK-related indicators.
8. Tap to return to the previous screen.
9. Wait until the end of the countdown. A message then informs you that the programmed time of data collection on the point has elapsed.
10. Tap **OK** to acknowledge the message.
11. Move the rover to the next point. Remember data logging continues so you should not mask the antenna while walking to this point.
12. Resume the previous seven steps (5 to 11) until all the points have been visited. In the Tag New Site window, you just need to enter a new point name. All other parameters may be kept unchanged.
13. At the end of the survey, tap **Close File** to end data collection.

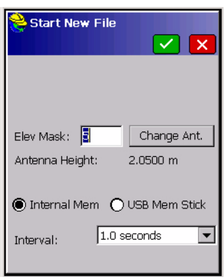
14. Tap on the **File Manager** button. You should recognize the last file in the list as the file you have just closed (the file is identified by the point name you last entered).

Continuous Kinematic Survey

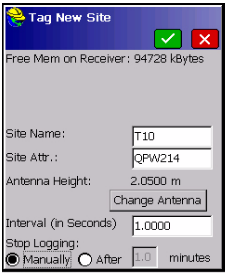


Your rover is located at the beginning of the trajectory. Do the following to run the survey:

1. Tap on the **Survey** tab and then on **Log Raw GPS**.
2. Tap on **Start File**. The screen lists the currently used settings.
3. Keep or edit these settings, depending on the specific requirements of your survey:
   - **Elev Mask**: Elevation mask, in degrees (default: 5 degrees)

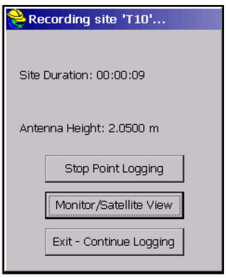


   - **Antenna Height**: Current value of antenna height, expressed in the chosen unit. Use the **Change Ant.** button to change the antenna height. Choose the measurement type first (**Vertical** or **Slant**) and then enter the measured value.
   - Choose the storage medium where to store the file (**Internal Mem** or **USB Mem Stick**).
   - **Interval**: Raw data recording rate, in seconds. Use the same recording rate as the base.
4. Tap . On top of the screen now appears the **Logging...** message indicating raw data recording in progress. A default name is given to the open raw data file, based on the naming conventions described in *ATOM File Naming Conventions on page 151*.
5. As you start walking along the trajectory, you can name it. According to the same ATOM file naming conventions, naming this trajectory will impact the raw data filename. To name the trajectory, tap on the **Tag New Site** button. This opens a new window on which you can enter the following parameters:
   - **Site Name**: Enter a name for the trajectory. A four-character name is recommended so that the entire name, and not a truncated name, appears later in the raw data file name. Longer site names will not be truncated however in GNSS Solutions.



- **Site Attr.**: Enter an optional description for the trajectory.
- [The antenna height and raw data recording rate (interval) are recalled on this screen. You can still change them if necessary.]
- **Stop Logging**: Select **Manually**.

6. Tap . A new screen is displayed summarizing all your settings.



7. Tap on the **Monitor/Satellite View** button to make sure GNSS reception is good at the survey point (enough satellites are received, DOP values low). Ignore all RTK-related indicators.
8. Tap to return to the previous screen.
9. When you arrive at the end of your trajectory, tap on the Stop Point Logging button.
10. Tap OK twice to confirm the end of data collection.

Chapter 6. Precise Surveying - Field Applications & Concepts

Introduction to Precise Surveying

GNSS precise surveying relies on the use of specific algorithms involved in the processing of carrier phase measurements. Centimeter precision obtained in precise surveying results from the successful processing of these measurements.

Carrier phase measurements are derived from the signals the surveying equipment receives and decodes from the visible GNSS + SBAS constellations.

There are two different ways of implementing the processing algorithms, each of them defining a specific family of surveying method:

- *RTK* real-time surveying.
- *Post-processed* surveying

This chapter introduces the basics of the two surveying methods.

Note that all Magellan RTK-capable receivers can intrinsically be used for post-processed surveys. With these receivers, post-processed surveying can be used either as a backup method or as an excellent source of comparison for checking your real-time survey results.

Key Terms and Expressions

Carrier: Refers to the electromagnetic wave carrying signals transmitted by satellites (cf. L1 and L2 carriers).

Carrier phase measurements: Refers to measurements performed by a receiver from the received signals to determine the phase of the carrier at the receiver location.

CPD: Carrier-Phase Differential. An acronym that refers to the processing of carrier phase measurements.

Fixed (solution): Status of the position solution once RTK operation is effective and centimeter-level precision is assumed to be achieved.

GNSS: Global Navigation Satellite System. GPS, GLONASS and the future Galileo are each a GNSS.

SBAS: Satellite Based Augmentation System. A wide-area or regional system composed of geostationary satellites providing GNSS augmentation, that is a method of improving locally the performance (i.e. accuracy, reliability, availability, etc.) of a GNSS.

RTK Surveying

RTK (for *Real-Time Kinematic*) is a surveying method through which you ask the rover equipment to quasi-instantly determine the coordinates of your current location with centimeter precision.

This section describes the implementation rules common to all surveys performed with the RTK method and presents the three basic field applications:

- Logging points.
- Logging points in continuous mode (trajectory).
- Staking out.

Depending on the software application installed in the field terminal, more field functions may be available, like for example for road construction or civil engineering. These additional functions are all derived from the capability of the system to perform one of the three basic functions described in this section.

Key Terms and Expressions

Baseline: Distance between the base antenna phase center and the rover antenna phase center (see also *GNSS Antennas and Antenna Heights on page 91*). Fundamentally, the surveying system is used to determine all the components of the vector formed by the baseline.

Base/rover configuration: Refers to an RTK surveying system consisting of a base and a rover. As opposed to a rover-only configuration, this system is autonomous in the sense that the surveyor has full control over the base data sent to the rover.

Constellation: Set of GNSS satellites visible from a given observation point on the Earth.

Data Link: Communication means allowing transfer of RTK correction data from a base to a rover.

Occupation Time: Time spent on a survey point without moving (“static” occupation) the antenna pole and keeping it vertical. Irrelevant to logging points in continuous mode.

Position Averaging: Process run in a rover during an occupation time consisting in collecting all the position solutions delivered over this period and computing an average position from all these solutions. The resulting solution, which is statistically more accurate than each of the individual solutions from which it proceeds, is assigned to the point on which the occupation time took place.

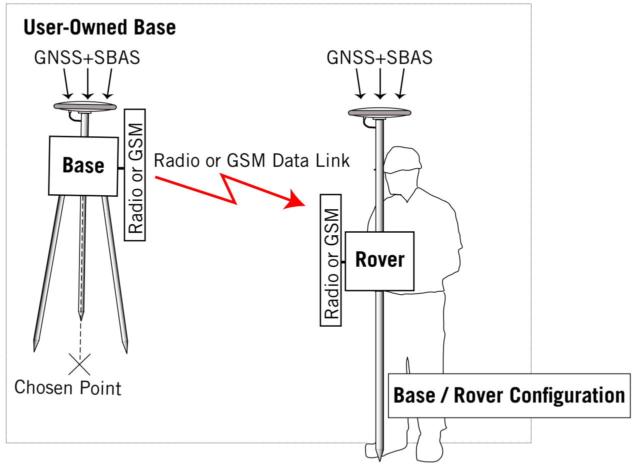
Rover-Only Configuration: Refers to an RTK surveying system only consisting of a rover, which uses data from a third-party base to deliver centimeter-accurate positions.

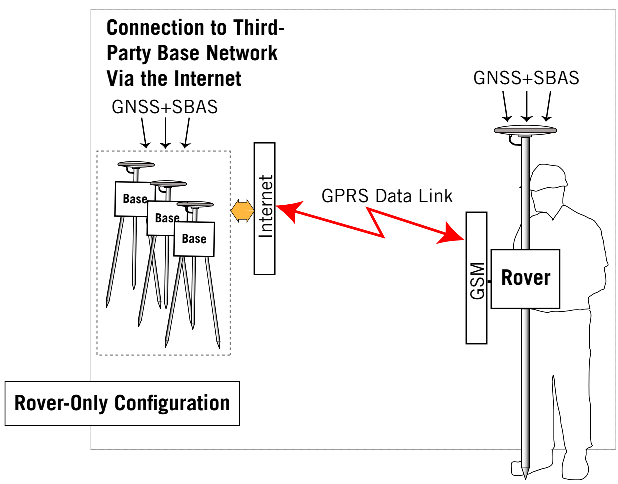
RTK Correction Data or *base data*: Differential data generated by a base allowing a rover processing this data to deliver centimeter-accurate positions. For each received satellite, this data basically consists of a delta time corresponding to the variations of the carrier phase with time.

TTFF: Time To First Fix. The time required for an RTK system to get initialized, i.e. the time elapsed since power up before it can deliver a “fixed” RTK position.

Implementation Rules

1. Two systems are used: one (the base) is operated on a chosen point while the other (the rover) is used in the working area for the survey.
2. The base will be either:
   – A user-owned base fitted with a UHF radio, a GSM modem or any other capable external device. To choose a reference location for the base, see *Choosing a Location for the Base on page 82*.
   – A third-party operated base (Direct IP) or base network (NTRIP) that delivers its data to the rover via a GSM/GPRS modem.



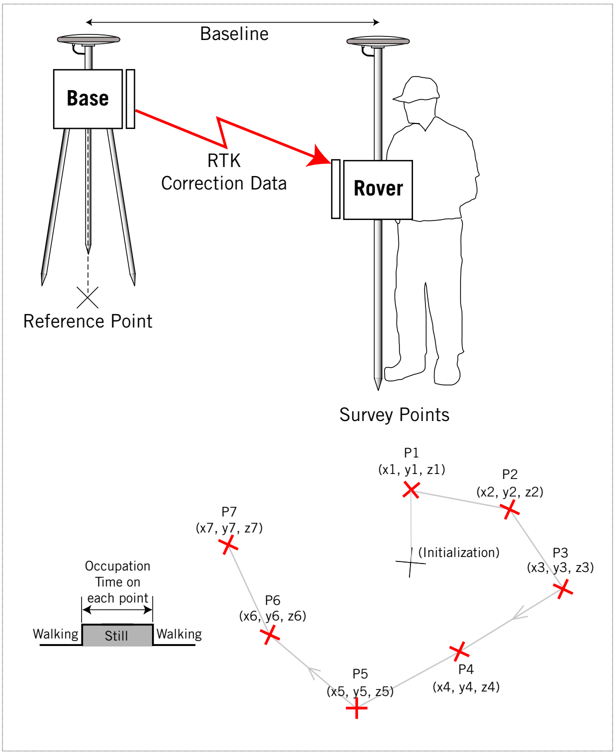


3. A data link must be established to transfer the base's RTK correction data to the rover. This data link can be implemented in several ways:
   – UHF radio
   – GSM cellular modem (GSM or GPRS)
   – Other external device.
4. Successful survey requires getting the system initialized and preserving initialization throughout the survey. See *Initialization on page 84*.
5. There can be several rovers working together at the same time, receiving RTK correction data from the same base.

Logging Points

Typical Use

Determining and logging the coordinates of points in a chosen coordinate system. The points are located within a relatively small area.



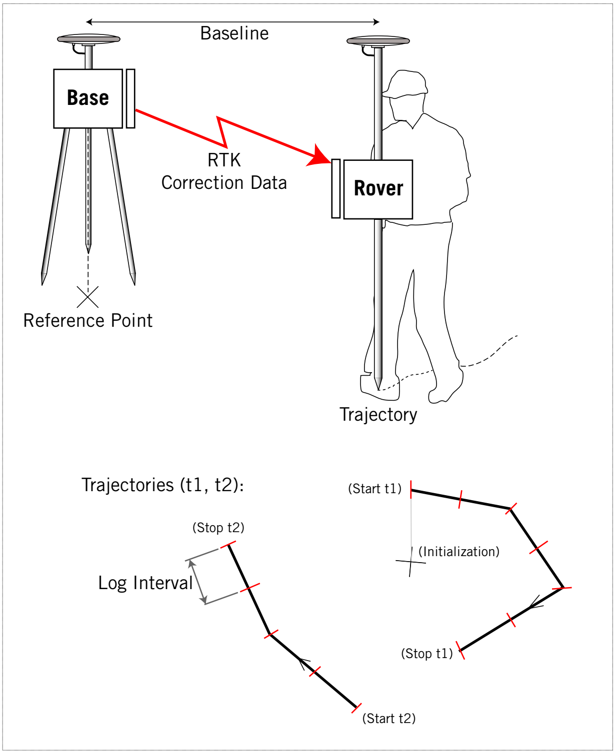
Key Points

- Make sure the rover delivers RTK positions before starting the job. (Initialization must be achieved and maintained.)
- Hold the antenna pole still and vertical over each survey point.
- Occupation time on each point is user-presettable. A countdown routine tells you when the receiver has finished logging the position of the point.
- During the countdown, the rover averages the successive positions it computes.
- With minimum countdown, the rover just logs the first position it computes on that point (no position averaging).

Logging Points in Continuous Mode

Typical Use

Determining and logging the coordinates of points along the trajectory followed by the rover.



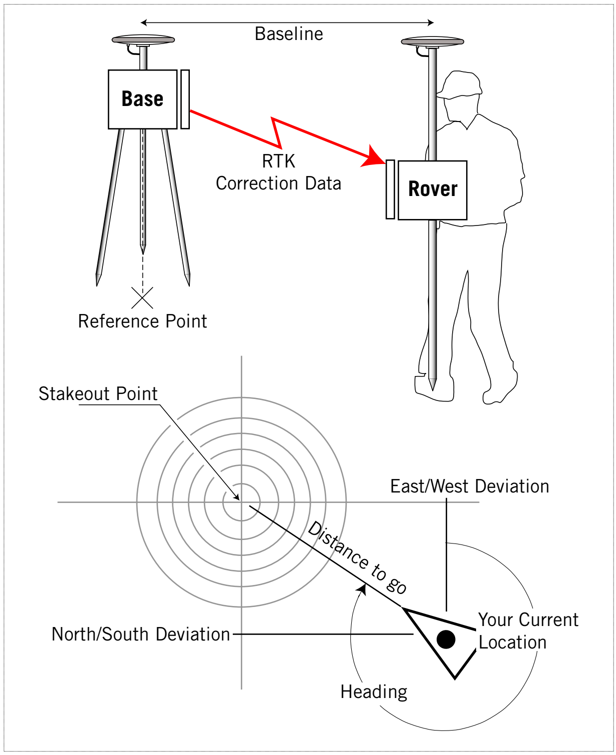
Key Points

- Make sure the rover delivers RTK positions before starting the job. (Initialization must be achieved and maintained.)
- Hold the antenna pole vertical all along the trajectory.
- Points are automatically logged at regular intervals of time or distance. You set the log interval before starting the survey.
- Because you will be steadily walking along the surveyed trajectory, all logged points will necessarily be "one-shot" points, i.e. the first position solution available at the time of point logging will be saved (no position averaging is possible in this case).

Staking Out

Typical Use

Going to the field to accurately locate points, marking them with appropriate means and logging their positions, as determined by the rover. Stakeout points are typically a project's input data.



Key Points

- Make sure the rover delivers RTK positions before starting the job. (Initialization must be achieved and maintained.)
- You choose the point you want to go to from a list of points previously uploaded to your field terminal. The terminal screen will then guide you to the point.
- Hold the antenna pole vertical as you let your system guide you to the point. The screen switches to a more accurate view as you approach the point. The system tells you when you are over the point.

- When you are over the point, mark its location on the ground. You can save the coordinates of the stakeout point with or without a position averaging period.
- The rover will then automatically prompt you to walk to the next point from the list and will guide you to this point.

Post-Processed Surveying

In post-processed surveying, the field equipment is only used to record *GPS/GNSS raw data* from which the post-processing software will be able to output centimeter-accurate positions.

This section describes the implementation rules common to all surveys performed with the post-processing method and presents the possible three field applications:

- Static survey.
- Stop & Go Kinematic survey.
- Continuous Kinematic survey.

Key Terms and Expressions

Baseline: Distance between the base antenna phase center and the rover antenna phase center (see also *GNSS Antennas and Antenna Heights on page 91*). Fundamentally, the surveying system is used to determine all the components of the vector formed by the baseline.

GPS/GNSS Raw Data or *Raw Data* for short: Data delivered by a GNSS receiver including code and carrier phase measurements and other satellite-related data such as almanacs and ephemerides.

Log Interval: Parameter used by some receivers in Continuous Kinematic survey to define the time elapsed, in seconds, or the distance traveled, in meters, between any two successive markers inserted into the logged raw data file.

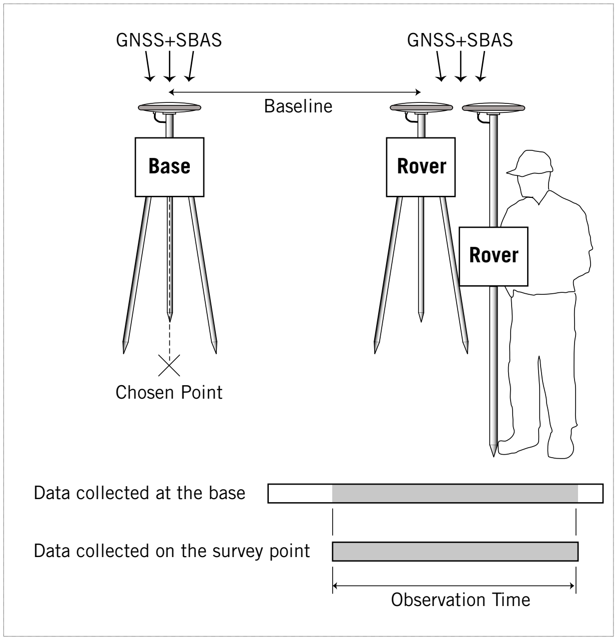
NOTE: Log Interval vs. Raw Data Recording Rate. The Log Interval should not be less than the Raw Data Recording Rate. For example, if Raw Data Recording Rate=1 second, then Log Interval should be at least 1 second (or 2 meters if your walking speed is 5 km/hr)

Observation Time: Time during which a base and rover simultaneously log GNSS raw data. The flow of collected data will be entirely usable if it's continuous from start to end of the observation.

Occupation Time: Time spent on a survey point without moving ("static" occupation). In static survey, Occupation time= Observation time because only one point is surveyed. Occupation time is irrelevant to Continuous Kinematic.

Raw Data Recording Rate: Rate, expressed in seconds, at which the field equipment records the raw data received from the GNSS constellation.

Implementation Rules



1. Two systems are used: one (the base) is operated on a chosen point while the other (the rover) is used in the working area for the survey.

   The base may be either a user-owned base, in which case you need to properly locate your base (see *Choosing a Location for the Base on page 82*), or a third-party operated base.

   With a third-party base, base data for your observation times can be downloaded through the Internet (cf. CORS, RGP) for post-processing. Rover data can also be uploaded to the base (cf. OPUS), which will in return provide centimeter-accurate position results.
2. Data must be collected simultaneously by the base and the rover. **Always use the same raw data recording rate on both units**.
3. Successful survey requires proper initialization of the system. See *Initialization on page 84*.

To maintain initialization throughout the survey, and especially in kinematic surveys, be careful at all times not to mask the rover's GNSS antenna.

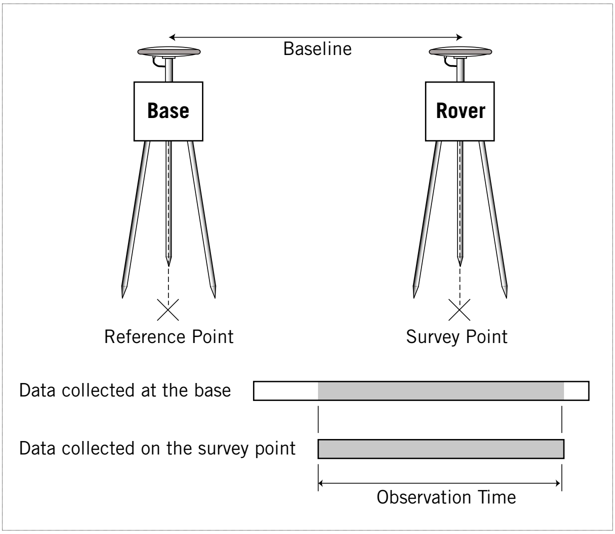
For some Magellan receivers such as the ProMark3, and in case of poor reception or complete loss of satellite signals, a message will prompt you to resume initialization.

4. The observation time is determined by the last unit set up (start) and the first unit turned off (end). It is advisable to start the base first and turn it off last.
5. The required observation time mainly depends on the baseline length, the reception conditions and the initialization method used. See *Initialization on page 84*.
6. Remember the rover will always collect data **continuously** throughout the survey, whether you are performing a static, continuous kinematic or Stop & Go kinematic survey. That is why you must continually keep the GNSS antenna clear of any obstructions.
7. There can be several rovers logging data at the same time.

Static Survey

Typical Use

Surveying a New Control Point.



Key Points

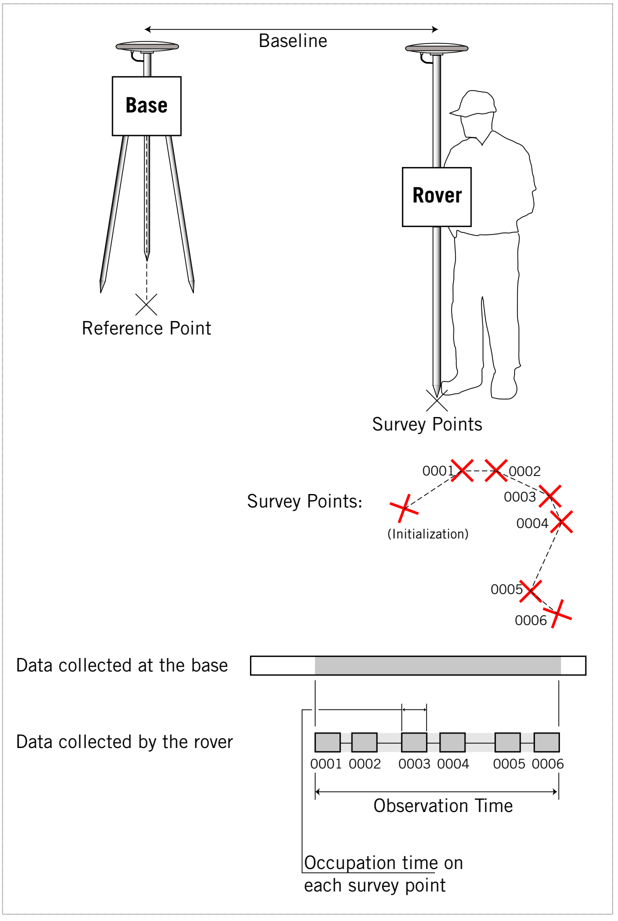
1. Same system setup for the base and the rover.

2. The rover is stationary throughout the survey.
3. Occupation time=Observation time
4. Initialization and masking problems minimized as the rover is stationary.

"Stop & Go" Kinematic Survey

Typical Use

Surveying Several Points within a Relatively Small Area.



Key Points

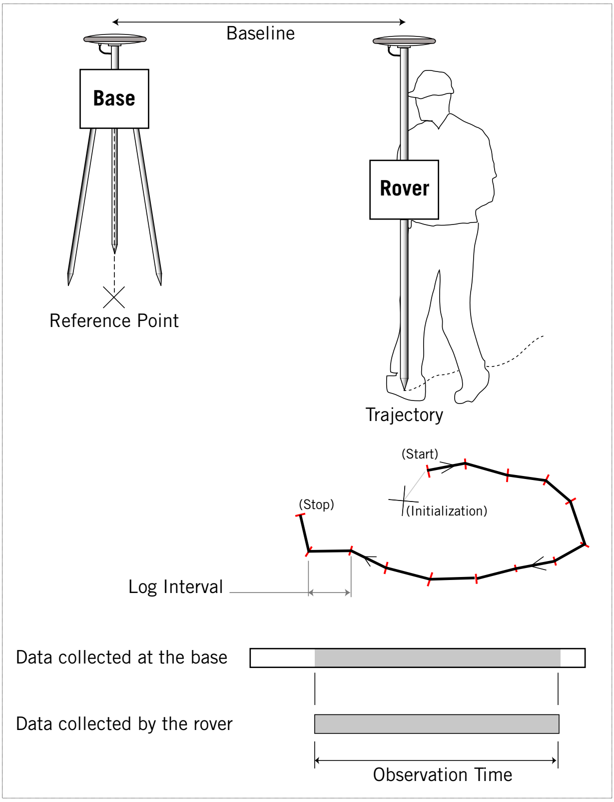
1. The rover is moved successively onto each of the survey points. The rover antenna pole should be kept still and vertical over each survey point for a given occupation time.

2. Occupation time on each surveyed point is user-preset. A countdown routine tells you when to move to the next point.
3. In the rover, "surveying a point" in Stop & Go mode simply consists of inserting start and end markers into the logged raw data file. Each point is in fact delimited in the raw data file by a pair of start and end markers.
4. Points are automatically named (numeral suffix automatically incremented) unless you wish to give a particular name for each point.
5. Occupation time in fact defines the period of time for which the post-processing software will average the successive positions it will determine over this period of time. The resulting averaged position will be assigned to the point.

Continuous Kinematic Survey

Typical Use

Surveying Trajectories.



Key Points

1. The rover is moved along the trajectory while raw data is being logged. The rover antenna pole should be held continually vertical througout the observation.
2. Contrary to Stop & Go survey, there is no occupation time on a particular point. Data logging should be started at the beginning of the trajectory and stopped at the end.
3. *Log interval*. For some receivers, such as the ProMark 500, the log interval can only be equal to the raw data recording rate, meaning that the trajectory is necessarily surveyed in time mode.

   For other receivers, such as the ProMark3, the log interval is distinct from the raw data recording rate. With these receivers, you can log your trajectories either in distance or time mode and you set the log interval independently.

In distance mode, a new marker is created every x meters. In time mode, a new marker is created every x seconds, where ”x” is the log interval.

While you are walking along the trajectory, the rover inserts new markers into the logged raw data file according to the chosen log interval. Each marker is named as a point. The name includes a numeral suffix that is automatically incremented for each new logged marker. You must take care however to use a log interval that is compatible with the raw data recording rate:

In time mode:
log interval (s) >2 x raw data recording rate (s)
In distance mode:
log interval (m) > 2 x walking speed (m/s) x raw data recording rate (s)

4. *Number of trajectories in a single file*. Some receivers, such as the ProMark 500, allow you to log a single trajectory into a raw data file. Some others, like the ProMark3, allow you to enter several start/stop markers in the same file meaning that several trajectories can be logged in the same file.

Choosing a Location for the Base

The location of the base is fundamental for the success of your survey. Whether you are in post-processing or real-time mode and your receivers are single- or dual-frequency, remember the rover position will always be computed relative to the base position. Any inaccuracy in the base position will inevitably be transferred to the position computed by the rover.

This section discusses the two basic criteria to be taken into account when installing a base:

1. GNSS reception conditions
2. Base position known or unknown?

When a base radio is used, there is a third criterion to be taken into account in the choice of the base location, which is the ability to install the radio antenna as high as possible, with a minimum of obstructions to the working area, so that the radio range can be as good as expected.

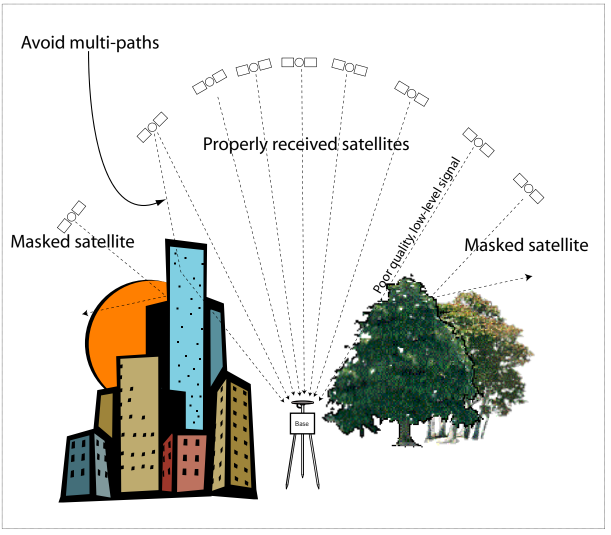
First Criterion: GNSS Reception Conditions

Make sure the base is sited in a clear area giving the best possible view of the sky.

When this is possible, avoid trees, buildings or any high obstacles in the vicinity of the base.

Having a clear view of the sky will allow the base to collect data from a maximum of visible satellites, which is highly recommended to perform a successful, accurate and fast survey.

You should pay attention to low-level satellite signals coming through trees, which may have a more adverse effect upon system performance than those completely masked.



Second Criterion: Base Position Known or Unknown?

In addition to the good reception conditions required at the base, you must also think about whether the base position should be known with great precision or not. The explanations below will help you understand what you need in terms of base position accuracy.

1. **If you want to obtain absolute, centimeter-accurate positions** attached to a particular coordinate system for all your surveyed points, then the base position must be known with the same centimeter accuracy.

   If the chosen position for the base is unknown whereas you need centimeter accuracy for this point in the coordinate system used, you can determine it through a static post-processing survey. You will however need a reference position to determine this point.

2. **If you are only interested in performing relative measurements** (i.e. positions of points relatively to other points), then the base can be installed on an unknown point meeting the reception requirements. In this case, the position to be entered in the base can be accurate only to within a few meters.

   Caution! In this case, keep in mind that you will not be able to attach your points to a known coordinate system unless later you accurately determine one of these points in the desired coordinate system. If you are using field software such as Magellan FAST Survey, you can also use the Localization function to attach your job to a local system.

   There are some disadvantages that you should be aware of when installing a base on an unknown point. For every 15 meters of error between the estimated base coordinates and the true base coordinates, one part-per-million (ppm) of relative error will be introduced into the computed vector between base and rover, plus the absolute difference between the computed base position and the real base position.

   For example, assume that the coordinates assigned to the base point are 30 meters off the true base position. This 30-meter offset from truth will produce 2 ppm (0.002 m per kilometer or 0.010 ft per mile) of error in the vector between base and rover.

   If the rover is 5 kilometers (3 miles) from the base, this will produce 0.010 m (0.030 ft) of error in the vector. In most cases, the base receiver will estimate its position to better than 30 meters (probably closer to 10-20 meters), but an error of 50 meters is possible.

   If you plan to use an estimated position for the base, keep the vector lengths between the base and rover short and ensure the added error is not significant for the survey you are performing.

Initialization

Preamble

Initialization is the process through which your real-time receiver or post-processing software can solve the integer ambiguity inherent in the carrier phase processing.

Solving integer ambiguity is a prerequisite for the receiver or software to be able to deliver centimeter-accurate positions.

For this reason, initialization is a requirement you should constantly keep in mind.

NOTE: This initialization process should not be confused with the initialization of a GNSS receiver, corresponding to the start sequence during which the receiver searches for the visible satellites in order to be able to compute its first 5-to 10-meter accurate position.

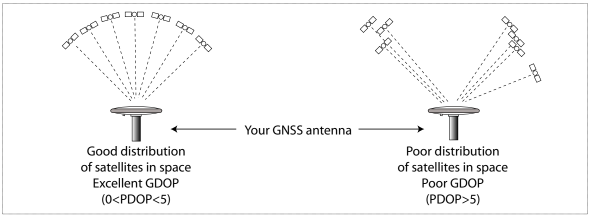
Importance of Baseline Length

The amount of data required to initialize the position computation process in the software (post-processing) or the rover (RTK real-time) is proportional to the baseline length.

In other words, the longer the baseline length, the longer the time required to achieve initialization.

Key Terms and Expressions

DOP: Dilution of Precision. A factor computed by the equipment that describes satellite distribution in space. The lower the DOP, the better the distribution in space and the better the probability of a successful survey. Several DOP values exist, such as the GDOP, HDOP, VDOP, TDOP, but the most frequently used one is the PDOP (for Position Dilution of Precision).



Integer Ambiguity: “Integer” refers to the number of entire wavelengths of signal carrier separating a satellite from a receiver. “Ambiguity” refers to the fact that this number is unknown at the beginning of a survey. Solving integer ambiguity therefore means determining the exact number of entire wavelengths.

Other General Considerations

RTK Real-Time vs. Post-Processing

In real-time surveys, system initialization is achieved when the system has been able to fix an RTK solution for any new position it computes. You just have to make sure this operating status is maintained until the end of the survey. In real time, it is therefore quite naturally that you make sure the initialization process has been successful. Should you lose the “RTK” position status, then this would mean the system has lost initialization and you should act to restore it.

In post-processed surveys, there is the same need for initialization except that the system is not always able to inform you, in real time, that this requirement is met. Remember that in this type of survey, your system is just a raw data collector.

It is only subsequently, when back at the office to post-process the raw data that you will see if the complete set of collected data results in successful and sustained initialization.

Kinematic vs. Static

In static surveys, the risk of unsuccessful initialization is significantly lessened by the fact that the GNSS antenna is motionless and the system is operated for relatively long recording sessions with the best possible view of the sky.

This may not be true for kinematic surveys during which the rover is moved from place to place, with real risks of:

- Masking the GNSS antenna causing lock on satellites to be lost.
- Stopping recording sessions before enough data has been collected to guarantee initialization.

For this reason, you should be aware of the initialization issue and so take all the necessary steps to make sure initialization will not only be achieved but also preserved until the end of your kinematic surveys.

Single-Frequency vs. Dual-Frequency

GNSS dual-frequency receivers need less data and time to get initialized. However, recent developments have allowed single-frequency receivers to significantly improve their performance on that particular point and so to reduce the gap that separate them from dual-frequency systems.

Strategies for Securing Initialization

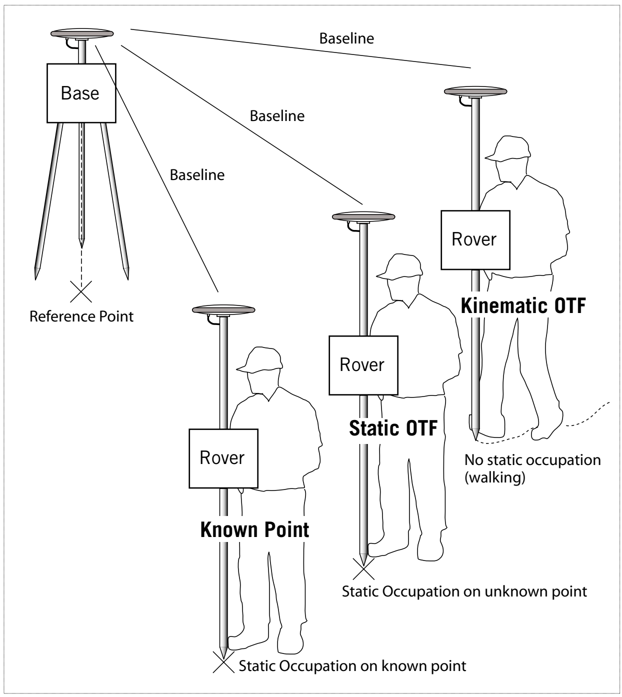
When starting a survey, you will sometimes be asked to choose an initialization method (more particularly if you are using a single-frequency receiver). The selected method tells the system how it should deal with initialization. Some of these methods can make initialization easier and faster, resulting in the following:

- Reduction of the observation time in post-processing.
- Reduction of the TTFF in RTK real-time.

This section describes the different initialization methods available with Magellan receivers:

- Kinematic OTF.
- Static OTF (for RTK real-time surveying only).
- Known Point.
- Initializer Bar (with some single-frequency receivers only).

OTF and “Known Point” Methods



Kinematic OTF. For both post-processing and RTK real-time, this method does not make initialization faster but is the less constraining method in the field (although it does not release you from being careful on the operating conditions). Kinematic OTF should be used by default when there is nothing in the working area that can help secure the initialization.

Static OTF. An initialization method usable in RTK real-time surveying only. The rover asks you to stay still on an unknown point until initialization is achieved (i.e. RTK position fixed).

The declared static occupation time helps the rover initialize more quickly.

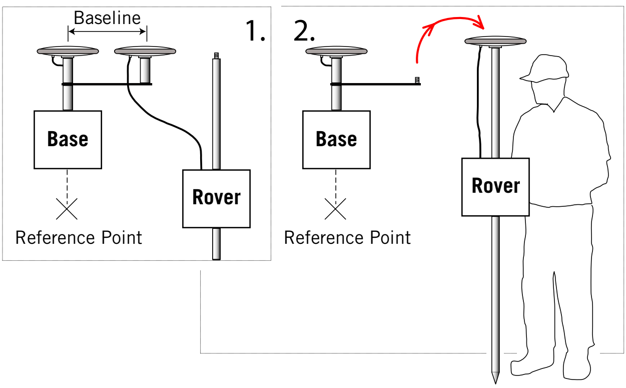
Known Point. In RTK surveying, the rover asks you to stay still on a known point until initialization is achieved (i.e. RTK position fixed). The declared static occupation time helps the rover initialize more quickly. This is a statistically faster initialization method than Static OTF for a given baseline length in the same reception conditions.

In post-processed surveying, the rover asks you to stay still on the known point for a preset occupation time. This particular event in the logged raw data file will help the post-processing software initialize more quickly.

The known point can be a point previously surveyed in post-processing static mode.

Initializer Bar

This method may be used with some Magellan single-frequency receivers, such as the ProMark3.



The Initializer Bar method can be used more especially when the survey takes place in the vicinity of the base (short baseline). It makes use of an initializer bar, also called “kinematic bar”, mounted at the base. The bar receives the antenna base and, for a limited time, the rover antenna as well.

The bar in fact defines a short 20-centimeter, known baseline length. After a preset occupation time, the rover antenna is moved to the rover pole, taking care not to obstruct the antenna during this action.

Initialization in RTK Real-Time Surveying

Field Approach

In real-time surveys, the position status will at all times inform you of the real status of initialization. At power up, the time required to get a fixed solution, i.e. the time for the rover to get initialized is called TTFF (time To First Fix).

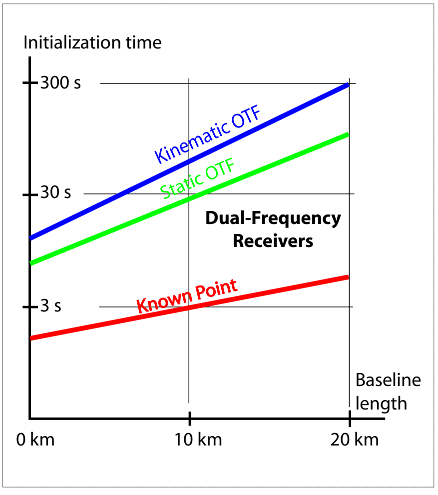
Obviously, for a given baseline length, the better the operating conditions (low DOP, large number of received satellites, open sky conditions), the easier the initialization, and therefore the shorter the TTFF.

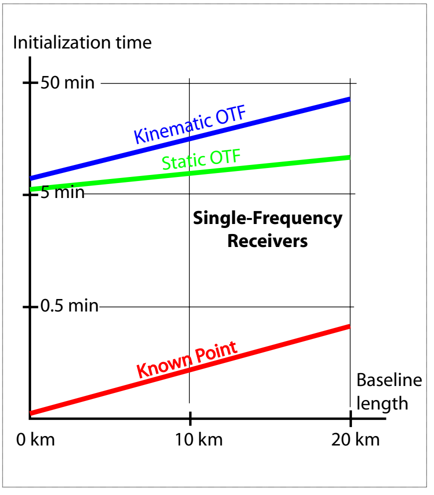
The initialization can even be faster if there is a possibility for you to use the "Known Point" initialization method, or, if your receiver is a ProMark3, the "Initializer Bar" method.

Typical Initialization Times (TTFF)

The charts below show the variations of the TTFF obtained with Magellan receivers, as a function of baseline length, initialization method and receiver type, for normal operating conditions (open sky, 8 satellites, PDOP<3).

TTFF Charts:





For single-frequency receivers using the initializer bar (baseline length: 20 cm), the TTFF is less than 60 seconds.

Initialization in Post-Processed Surveys

Field Approach

In post-processed surveys, reckoning that the collected data will result in successful initialization when later post-processing the raw data is not as easy as in RTK. Below are a few recommendations to help you perform successful initializations:

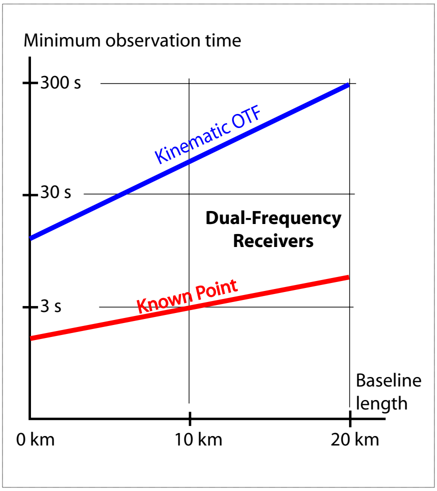
- The observation time is an important factor for successful initialization. The longer the baseline length, the larger the required amount of data and so the longer the required observation time. Such indicators as the "Observation Timer" or "Observation Range" available on some Magellan receivers will help you take a decision on when to stop data collection.
- The lower the DOP, the larger the number of received satellites and the more open the sky, the better the chances for successful initialization. Such indicators as DOP, number of satellites received, sky quality (presence/absence of obstructions) will indirectly help you get a good idea of whether initialization will be achieved or not. Interpreting these environmental parameters will be easier as you become an experimented operator.
- In kinematic surveys, it is a good practice to deal with initialization at the beginning of a survey and then make sure you won't lose it until the end of the survey.

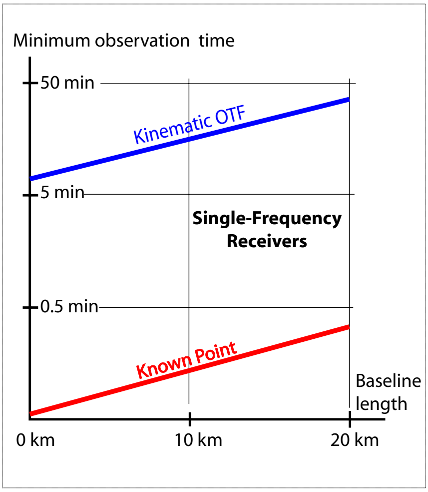
  However you should be aware that, whether you are performing a kinematic or static survey and regardless of the method used to help secure initialization, the only thing that counts for a successful initialization is **the amount, quality and continuity of the collected data**. This means **all** the logged data, and not only those logged at the beginning of the survey, can contribute to successful initialization.
- Choose the initialization method that is best appropriate to your survey. The Initializer Bar method (for ProMark3 users) and the "Known Point" method should be preferred whenever possible.

Required Observation Times

The charts below show the minimum observation times required with Magellan receivers, as a function of baseline length, initialization method and receiver type for normal operating conditions (open sky, 8 satellites received, PDOP<3 and 1-second raw data recording rate).

Observation Time Charts:





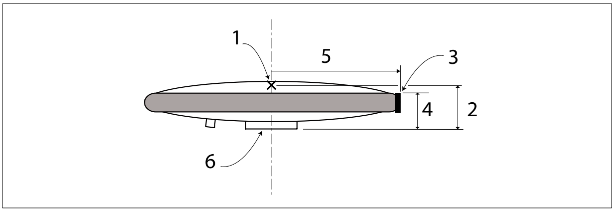
Not surprisingly, the minimum observation times in post-processed surveys are roughly equal to the TTFF's in real-time surveys, for the same type of equipment, baseline and initialization methods.

For single-frequency receivers using the initializer bar (baseline length: 20 cm), the minimum observation time is about 60 seconds.

GNSS Antennas and Antenna Heights

GNSS Antenna Features

The figure below represents a generic GNSS antenna showing the features that are critical to precise surveying.



Phase Center Location (1)

This is a virtual point that represents the spatio-temporal origin of the antenna. It is usually inside the antenna and often on, or close to, the vertical axis of the antenna.

The phase center location is accurately determined by the antenna manufacturer after a long series of tests. The location of the phase center is usually indicated on the antenna itself (see also 4. below).

A dual-frequency antenna usually has two different phase centers instead of one. In this case, the antenna manufacturer should mention the exact locations of the two phase centers.

Phase Center Offset (2)

Vertical distance that separates the phase center from the bottom of the antenna (see also ARP below).

SHMP (3)

(SHMP=Slant Height Measurement Point) Point located on the edge of the antenna radome into which a tape measure can be inserted to perform a slant measurement.

SHMP Offset (4)

Vertical distance that separates the SHMP from the base of the antenna. This parameter is needed by the system to determine the real height of the antenna over the landmark after a slant measurement has been entered into the system.

Antenna Radius (5)

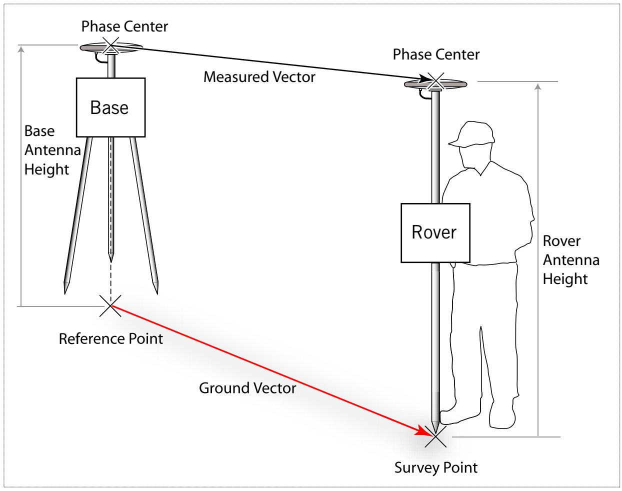
Horizontal distance from the geometrical center to the edge of the antenna. This parameter is needed by the system to determine the real height of the antenna over the landmark after a slant measurement has been entered into the system.

ARP (6)

Antenna Reference Point located at the bottom of the antenna receiving the 5/8” adaptor of the antenna pole.

Why is GNSS Antenna Height so Important

The basic measurement giving centimeter accuracy is the vector from the phase center of the base antenna to the phase center of the rover antenna. Usually, the real position of interest is not the phase center of the antenna, but the survey mark (or other landmark) over which the antenna is set up.



To compute the position of the mark instead of the antenna, it is necessary to instruct the rover to perform an *antenna reduction*. In an antenna reduction, the antenna heights are taken into account when computing the rover position.

Whether you are performing an RTK real-time or post-processing survey, the antenna heights of both the base and the rover should be entered in the system so the correct ground positions can be determined.

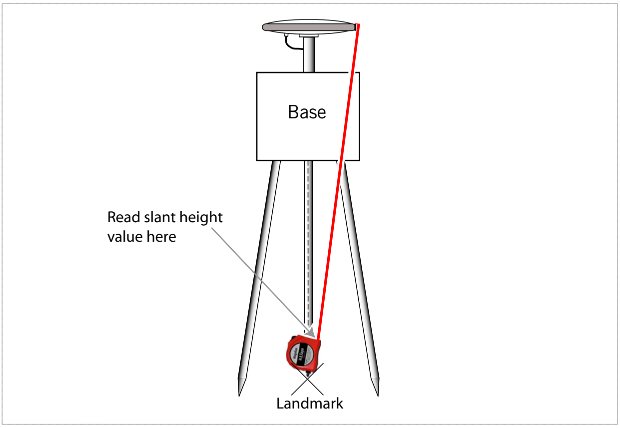
There are two different ways of measuring the antenna height:

- Slant height measurement
- Vertical height measurement.

Slant Height Measurement

Slant measurement is typically performed at the base because the classical vertical measurement is not possible owing to accessories (tripod, tribrach, etc.) usually in the way of the vertical path from the antenna to the landmark.

Rather than performing a bad vertical measurement, it is a better idea to resort to a slant measurement, which is much more accurate, provided the antenna parameters are also accurately known and the specific Magellan measurement tape is used for this purpose.



- Position the base system exactly over the landmark.
- Insert the end of the Magellan measurement tape into the slot representing the SHMP.
- Unroll the tap toward the landmark and position the tip of the measurement tape onto the landmark.
- Block the tape and read the value indicated by the measurement tape: this is the slant height.
- Enter this value into the base system as a slant measurement.

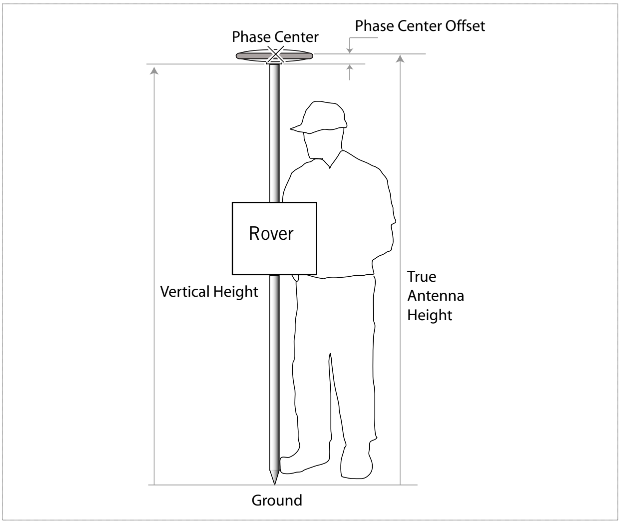
  If a Magellan antenna is used, the system will automatically determine the true antenna height because it has got all the antenna parameters in its memory to perform the conversion.

  For another antenna however, you will first have to create a new antenna type in the system and enter its parameters (see *GNSS Antenna Features on page 91*) in order to be sure the system can accurately convert the slant measurement into real height.

Vertical Height Measurement

This is a more straightforward method for measuring the antenna height. It is generally used on rover side.

The vertical height represents the distance from the bottom of the GNSS antenna to the ground.



The real height of the antenna is therefore the sum of the vertical height and the phase center offset.

Measuring the vertical height only consists in measuring the length of the range pole used to support the GNSS antenna and the rover unit. As most range poles are height-adjustable and have a graduation to set this height, measuring the vertical height only consists in reading the graduation on the pole.

If a Magellan antenna is used, the system will automatically determine the true antenna height because it has got all the antenna parameters in its memory to perform the conversion.

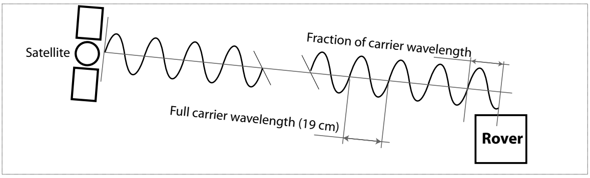
For another antenna however, you will first have to create a new antenna type in the system and enter its parameters (see *GNSS Antenna Features on page 91*) in order to be sure the system can accurately convert the vertical measurement into real height.

General Considerations on Accuracy

What Accuracy Mainly Depends On

In precise surveying, accuracy is primarily tied to the capacity of a system to detect the finest variation in the portion of carrier wavelength arriving at the surveyed point, assuming the number of complete carrier cycles has been determined successfully (cf. integer ambiguity in *Initialization on page 84*).

Knowing that the carrier wavelength of the L1 signal used in the processing is equal to 19 cm, this gives an idea of the processing step the system has to go through to achieve centimeter accuracy.



In practice, accuracy will first depend on the following parameters:

- Quality of the carrier phase measurements, i.e. quality of the receiver (noise level) and environmental conditions (number of received satellites, presence or absence of multipaths).
- Intrinsic quality of the processing algorithms used.

Accuracy will also depend on the RTK correction data received from the base:

- The further the distance between the surveyed point and the base, i.e. the longer the baseline length, the higher the theoretical uncertainty affecting the position result.
- The lower the reception level of the received RTK correction data, the noisier the data involved in the processing and the higher the measurement uncertainty affecting the position result.

Accuracy will also depend on whether the survey is run in real time (RTK) or post-processing. In post-processing, because the system processes the collected raw data as a whole, accuracies are better than in real time, provided the observation times are long enough.

Expression of Accuracy

For all Magellan precise surveying systems, the expression of the global accuracy on position is the sum of a constant term and a variable term, as expressed in the equation below.

$$Accuracy = Xcm + Yppm$$

Where:

- **X** is the constant term, in centimeters, indicating the global uncertainty on position measurements (an rms value, see *Accuracy Measures on page 97*). X qualifies the intrinsic quality of the receiver and its algorithms under nominal receptions conditions (i.e. open sky, a minimum number of satellites is received and good GDOP). It may be different for the vertical and horizontal components of position.

- **Y** is the variable term, expressed in parts per million (ppm) of baseline length. For example, if Y=1 and the baseline length in your survey is about 8 km, then Y brings about an additional, and nominal, 8 millimeters uncertainty on all positions. The value of Y also reflects the quality of the receiver and the algorithms used. Like X, Y may be different for the vertical and horizontal components of position.

For your information, usual figures of accuracy for fixed RTK positions are given in the table below for nominal reception conditions (open sky, good GDOP, 5 to 7 satellites received). But remember these values are specific to each model. Please refer to the specifications sheet of the model you are using for more information.

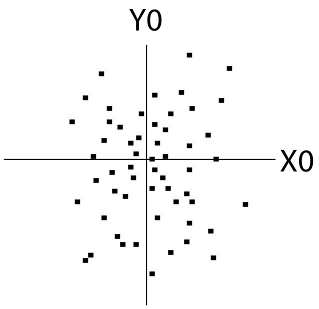
Accuracy (rms)	RTK	Post-Processing
Horizontal	1 cm + 1 ppm	0.5 cm + 1 ppm
Vertical	2 cm + 1 ppm	1 cm + 2 ppm

Obviously, accuracy figures deteriorate when the system fails to fix the position.

Accuracy Measures

Errors on coordinates determined with GNSS systems are not constant (the solution varies statistically).

If you plot the horizontal coordinates of a reference point (X0, Y0) computed by a GNSS system over a significant period of time (static survey), you will obtain a scatter plot such as the one below.



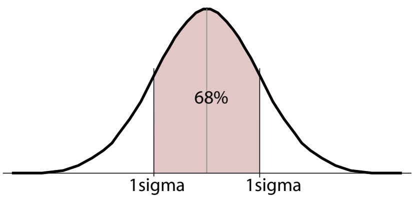
The origin of the (X0, Y0) axis system is the true position of the reference point. Each dot represents a position solution delivered by the GNSS System for this point.

How you analyze the scatter of solutions results in a different accuracy figure characterizing the performance of the system.

The main accuracy measures used by GNSS manufacturers are the following:

1. *rms* (root mean square): accuracy is obtained by computing the square root of the average of the squared errors (a statistical method).

   If error distribution along each axis is Gaussian (it is in general), i.e. the mean error converges to zero, or close to zero, then an error probability may be associated with the rms accuracy. This probability is about 68%, which means the computed position will be within the announced accuracy about 68% of the time. This percentage corresponds to the 1-sigma width on the Gaussian curve.

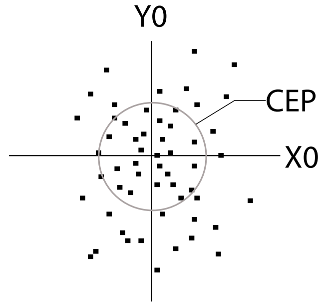


2. Some manufacturers use the “2drms” measure, which is derived from the rms measure on the horizontal plane, using the following formula:

   Accuracy (2 drms)= 2 x Accuracy (rms)

3. CEP (Circular Error Probable): accuracy is equal to the circle's radius, centered at the true position, containing

50% of the points in the horizontal scatter plot (see chart below). This means the computed position will be within the announced accuracy 50% of the time.



Ellipsoidal Height and Elevation

The vertical coordinate measured by GNSS systems is worth an explanation. Behind this coordinate in fact lies the specificity of GNSS systems compared to conventional surveying systems.

Basically, all positions delivered by GNSS systems consist of *geographic coordinates* (latitude, longitude, height) referenced to an ellipsoid, called *reference ellipsoid*, which is a simple and accurate model to describe the shape and surface of our planet.

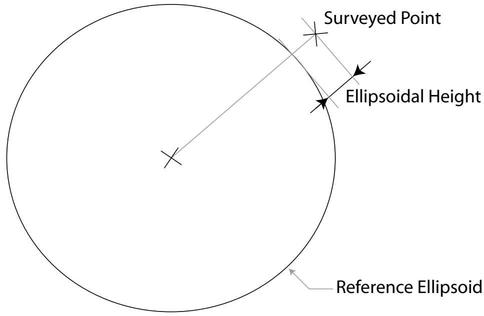
The reference ellipsoid refers to the WGS84, or better the ITRF00.

The center of this reference ellipsoid coincides with the center of the mass of the Earth, which is also the origin point of the Earth-Centered Earth-Fixed (ECEF) X, Y, Z Cartesian coordinate system.

As far as horizontal coordinates are concerned, the reference ellipsoid gives full satisfaction. Converting geographic coordinates to any projection system does not raise any particular problem.

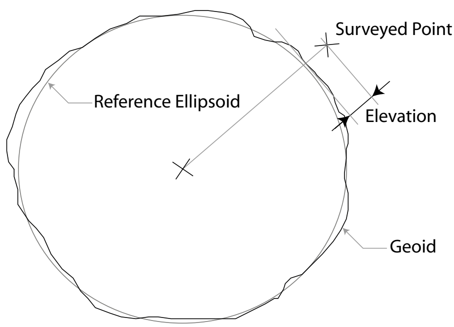
Things are a bit more complicated though when dealing with vertical coordinates because surveyors need to define very precisely which type of vertical coordinates they wish to measure.

The vertical coordinate provided by GNSS systems basically is the height of the surveyed point over the reference ellipsoid. We call it the *ellipsoidal height*.



For a long time, surveyors have used the concept of "mean sea level" to measure the *elevations* of their points. The mean sea level was the common "zero" elevation. But this concept has shown some limitations.

Today, a much better model of vertical reference system, called *geoid*, is used. This model is defined as a surface on which the pull of gravity is constant.



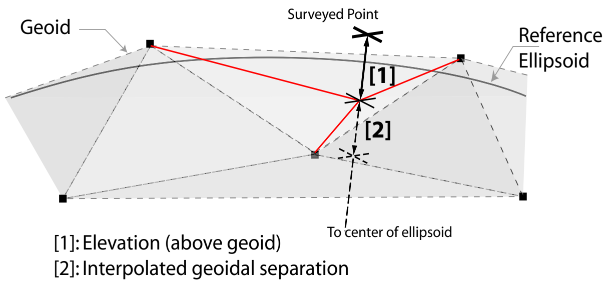
This surface is irregular depending on the density and distribution of materials on the surface of the Earth, which means the geoid may not exactly follow the natural features on the Earth's surface. (The geoid is a fictitious surface that can't be seen).

This is a bit sarcastic but using the geoid as vertical reference, one can be sure water will always flow downhill, from lower to higher gravity level, which was not always the case when using the too approximative mean sea level!!

So the question is now, "*How can we convert an ellipsoidal height provided by our GNSS system into an elevation?*"

In practical terms, a geoid model used in a GNSS system is a file containing a more or less dense array of points evenly distributed across the surface of the geoid. For each point, the file provides the horizontal geographic coordinates and the separation (geoidal separation) between the reference ellipsoid and the geoid. The extent of the geoid file may be worldwide or limited to a particular area.

Providing an accurate modelling of the undulations of the geoid surface, the geoid file is used by the GNSS system to interpolate the separation between this surface and the surface of the reference ellipsoid for the point surveyed.



From this interpolation the system can derive elevation from ellipsoidal height using the following formula:

Elevation [1] = Ellipsoidal Height - Interpolated geoidal separation

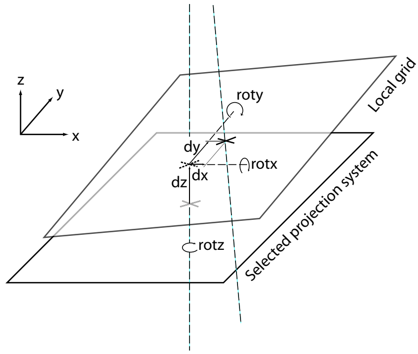
Localization

What is Localization?

Localization, also known as "calibration" or "determining the local grid", consists of accurately determining a local grid that fits in with the job you want to perform. The localization process performs a rotation and translation of the plane defined by the projection system chosen for the job.

After localization has been run, your equipment provides the coordinates of every point, including new surveyed points, on this local grid.

Typically through localization, your equipment determines the new local grid (a plane) by comparing the known local coordinates of one or more reference points with the corresponding geographic coordinates entered or measured for these points.



NOTICE: Not all the existing field software applications have the capability to run localization in real time. Magellan FAST Survey is one of those applications that allows you to do that.

When is Localization Needed?

Performing localization is required in the following cases:

- Your job requires that a given standard projection be used but you realize that your equipment does not deliver exactly the expected coordinates when placed over existing reference points.
- Your job requires that a local projection be used but none of the parameters of this projection are known.
- The base is operated on a reference point whose position was only determined in autonomous GPS mode.

Localization Methods

Several localization methods exist. The choice of a method depends on the nature of the problem you have to solve and the number of available reference points. The most commonly used localization methods are listed below:

- *Plane Similarity*: In this method, the user should provide three or more reference points among which at least two of them should be held horizontally. A least-square transformation is performed to determine the local grid. The transformation includes rotation and translation of the plane defined by the standard projection system used, as well as scale factor change. The use of three reference points or more is highly recommended to achieve accurate localization on the horizontal plane. This number should be raised up to four, or more, to ensure vertical localization.
- *Rigid Body*: Same as plane similarity except that the scale factor is held fixed throughout the localization process.

- *Helmert*: With this method, the user provides the seven parameters modifying the projection system currently used in the job. These parameters (dX, dY, dZ, rot X, rot Y, rot Z and scale factor) may be the result of a multi-point localization performed earlier.
- *One-Point Azimuth*: This method is used when only one reference point is available to determine the local grid. In this case, the user should specify the orientation of the North direction of the local grid (geographic or true).

  A typical application of this method is to use the point where the base is installed at the origin (0, 0, 0), or on a singular point (e.g. 100, 1000, 0) of the local grid. In this case, the geographic coordinates of the base position may feature only several meter accuracy since the surveyor is only interested in collecting local coordinates for the job. It will therefore be the surveyor's responsibility to make sure the geographic coordinates of the base (typically determined through the autonomous GPS mode) can be fed into the localization process.

A geoid model can be included in the localization process. In this case, all elevations provided for the reference points used should be orthometric instead of ellipsoidal.

Typical Instructions to Complete a Localization Process

Localization based on the use of reference points is typically achieved through the following steps:

1. Make sure the right projection system is selected in your job. What does that mean? Here are the two cases to consider:
   - Some reference points that you will hold horizontally or vertically fixed in the localization process may have their coordinates expressed in a known projection system. We recommend you select this projection as the job's initial projection system.
   - If the local coordinates of your reference points do not refer to any known projection system, then we recommend you choose a projection system that is standard in your working area.
2. Enter the local coordinates of the first reference point.
3. Enter the latitude, longitude and ellipsoidal height of the first reference point.
4. Set horizontal or/and vertical control for the first reference point. This means requiring that the local grid pass through respectively the horizontal or/and vertical position of the point.

5. Resume the previous three steps until all the reference points have been defined.
6. Run the localization process and make sure the local grid is now the new projection system used in the job.

Chapter 7. RTK Implementation

Data Link

In an RTK surveying system, the data link is used to transfer RTK correction data from the base to the rover.

The data link may be one of the following two types:

- *Standalone*: You will have full control over the generation and transmission of RTK correction data (Magellan equipment used in base/rover configuration).
- *Network-based*: You will be resorting to a third-party, network-based provider for the generation and delivery of RTK correction data (Magellan equipment used in rover-only configuration)

This section introduces the two basic transmission means available in Magellan surveying systems for setting up this data link:

- Radio (standalone)
- GSM.

For GSM, this section describes the different operating modes available:

- CSD (standalone)
- NTRIP (network-based)
- Direct IP (network-based).

Key Terms and Expressions

Age of Corrections: The age of corrections is measured as the time elapsed between the time corrections are generated in a base and the time when they are effectively used to yield an RTK position in a rover. Generally speaking, the quality of corrections decreases as their age increases.

CSD: Circuit Switched Data. is the original form of data transmission developed for the time division multiple access (TDMA)-based mobile phone systems like GSM.

Direct IP: (IP=Internet Protocol). A way of acquiring base data from the Internet via a network connection.

GPRS: General Packet Radio Service. A mobile data service available to GSM modem users such as cell phone users. GPRS data transfer is typically charged per megabyte of transferred data, while data communication via traditional circuit switching is billed per minute of connection time, independent of whether the user has actually transferred data or has been in an idle state.

GSM: Global System for Mobile communications. The most popular standard for mobile communications.

Modem: A device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.

NTRIP: Networked Transport of RTCM via Internet Protocol. A protocol used by GNSS service providers to deliver corrections from their networks of reference stations (bases). Among well known providers using the NTRIP protocol are VRS, MAC, FKP, etc.

NTRIP Caster: A piece of software in charge of collecting data from a network of Internet-connected bases using the NTRIP protocol and responding to a rover request by routing RTK correction data from the desired base to the calling rover. Rover requests are addressed to the caster via a network connection.

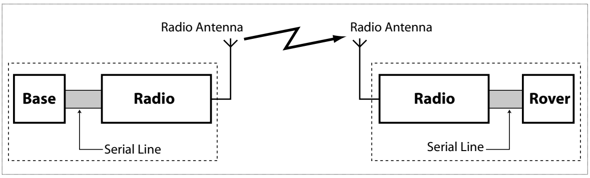
Source Table: Refers to a caster. The source table lists the characteristics of all the bases managed by the caster.

Transfer Rate: The rate at which a base is set to transmit its RTK correction data. Usually expressed in seconds.

Radio Implementation

Radios can only be used in surveying systems used in base/rover configuration.

Radios are usually operated in pairs (one at the base, used as a transmitter, and the other in the rover, used as a receiver), but an unlimited number of rovers can receive RTK correction data from the same base.



An important factor is the radio range. It should be equal to or greater than the maximum baseline length you need to survey.

Internal vs. External Radios

Depending on the model of Magellan receiver used, the pair of radios can be:

- Incorporated into the Magellan receiver. Only the radio antenna is visible from outside. The modem is connected to the system via a serial line.
- External to the Magellan receiver and connected to it via a power/serial data cable.

License-Free vs. Non License-Free Radios

In almost all countries, radio systems are submitted to laws regulating their use. Regulations are more especially about transmission power, frequency band and channel bandwidth. They may differ from one country to the other.

In most countries however, radios used under a certain level of radiated power in dedicated frequency bands do not require a certification (or license) to be operated freely. For this reason, Magellan offers two types of radios:

- License-free, low-power radios (short range) (available for some models of Magellan receivers)(not available with ProMark 500).
- Non license-free, medium-power radios (longer range). For this type of equipment, Magellan will help you get the certification required for use of the radio in your country. But remember the right to operate a radio is *your* responsibility.

Features

The main features of a radio are the following:

- UHF Frequency band: Range of UHF frequencies on which the radio transmits or receives data (license-free radios operate in the 850-930 MHz band, other radios in the 410-470 MHz band).
- Channel spacing or channel bandwidth: Space occupied by one channel (in kHz).
- Radiated power: Transmission power, in watts (W) radiated by the radio used at the base.
- Channel number: Corresponds to a specific carrier frequency within the band. In theory, the number of available channels is equal to the ratio between the whole frequency band and the one-channel bandwidth.

- Modulation type: A parameter that defines the technique used to modulate the carrier with RTK correction data (GMSK or FSK)
- Radio data rate: Speed at which the carrier frequency is modulated with RTK correction data. Expressed in kbits/second. Not to be confused with the baud rate of the serial line connecting the radio to the rest of the equipment.
- Frequency hopping: A process through which the radio regularly changes the carrier frequency. The radio usually loops on several preset channel numbers. In some countries, regulations exist that require the implementation of this technique.
- Duty Cycle: Ratio between the time period a radio is on (i.e. is transmitting) and a full cycle of radio on/off periods. In some countries, regulations exist to maintain this parameter under a certain threshold.
- Operation indicator: The ability for a radio to inform users in real time of the quality and strength of the signal transmitted or received.

Activating a Radio Data Link

Some radios are plug-and-play units, some others need a few preliminary settings (channel number, data rate + internal port settings).

Pros and Cons

With radios, you are independent of any third-party data provider. Your base can on its own generate and transfer RTK correction data via the radio. This is possible any time, from any place. In addition, several rovers can work in RTK from the same base (multi-point mode).

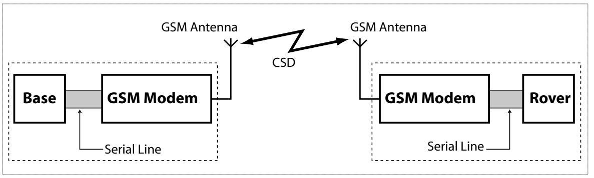
However, wave propagation in the UHF band is sometimes difficult. The radio range can dramatically be reduced if obstructions exist between the base and the rover. As a general rule, radio antennas should be raised as high as possible.

GSM Modem

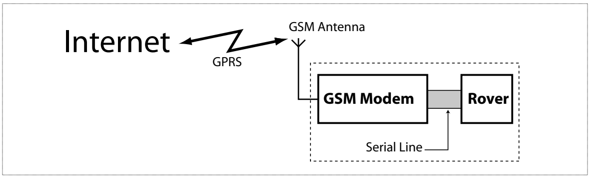
Implementation

GSM modems can be used for the data link in one of the following two configurations:

- A pair of GSM modems operating in CSD mode. One is used at the base and the other at the rover. The data link operates like a phone link, the rover being the caller. This configuration is well suited to surveying systems used in base/rover configuration.



- One GSM modem operating in GPRS mode. The modem is used on the rover side to establish a connection to the Internet, either in Direct IP or NTRIP mode. The rover will then receive RTK correction data from the selected base. This type of data link is well suited to surveying systems used in rover-only configuration.



Internal vs. External GSM Modems

Depending on the model of Magellan receiver used, GSM modems can be:

- Incorporated into the Magellan receiver. Only the GSM antenna is visible from outside.
- External to the Magellan receiver and connected to it via a power/serial data cable or a Bluetooth connection (cf. ProMark3 RTK).

Activating a GSM Data Link in CSD Mode

In this mode, you will have to:

- Make sure the base and its GSM modem have been set up properly, and are operating.
- Choose the GSM band (according to country).
- Dial the phone number of the base modem.

if set accordingly, the following parameters will facilitate the activation and deactivation of the data link:

- Auto-dial: The phone number will automatically be dialed right after the rover modem has been initialized.
- Number of re-dials: In case of unsuccessful connection, the rover will automatically re-dial the base phone number until the data link is established. After “x” unsuccessful

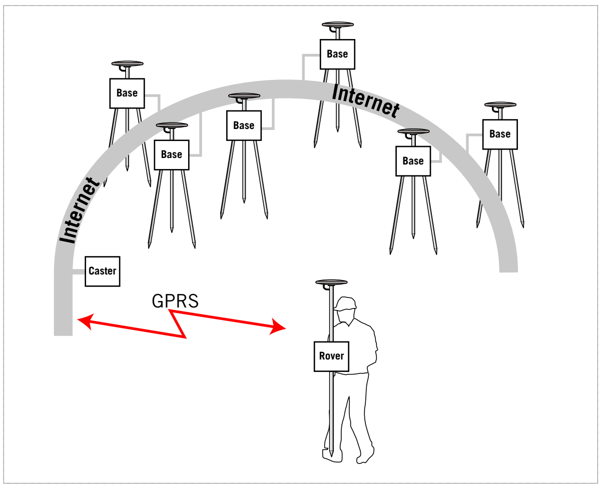
re-dials, the modem will automatically switch to the idle state.

- Time out: The rover modem will automatically hang up if no data is received via the data link for the specified time. (This parameter can also be set on the base to deactivate its modem if no data is transmitted for the specified time.)

An alarm will go off in the following cases:

- No phone number dialed
- Invalid phone number
- Line engaged
- All re-dials failed.

Activating a GSM Data Link in NTRIP Mode



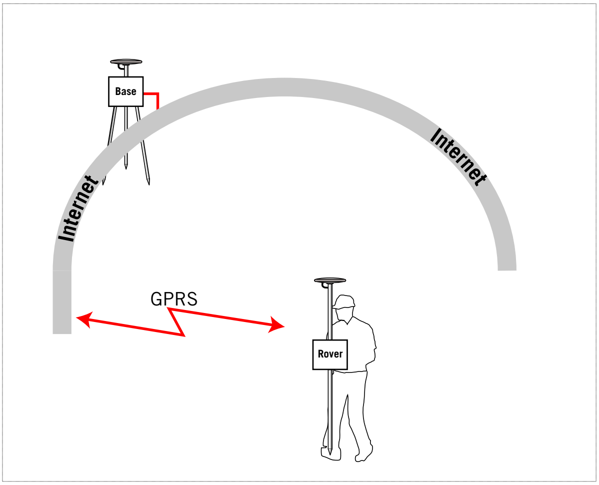
In this mode, you will have to:

- Enter the five identification parameters of the caster, i.e.:
  1. IP address
  2. Mount point
  3. Port number
  4. Login
  5. Password

- The caster will return the source table from which you will be able to select which base from the caster you would like the rover to work with. The nearest base will be prompted as the default setting.

At this stage, and only if this choice is available from the selected base, you can specify whether you wish the base to send its own RTK correction data or instead, RTK correction data computed from the base network for a virtual base that would be located at the rover's location (VRS).

Activating a GSM Data Link in Direct IP Mode



In this mode, you will have to:

- Enter the three identification parameters of the RTK correction data provider, i.e. IP address (xxx.xxx.xxx.xxx) or host name (a URL name), and port number.
- Wait until the data link is active and RTK correction data is received.

Monitoring the Data Link

Making sure the data link is operational at all times is essential to successful field operations. A good indicator to monitor the data link is the *age of corrections*. This parameter is clearly highlighted on the display screens of all Magellan receivers or field terminals.

When the data link operates normally, the age of corrections is continuously equal to the transfer rate set at the base for transmitting RTK correction data. If for any reason, a correction data set is not received or the rover fails to decode and use it, then the age of corrections will start increasing.

If the increase is only temporary, then you should not care too much about the data link as long as the rover continues to provide “fixed” positions.

But if the age of corrections keeps on increasing, then the problem is more serious as it can only result in a rover losing the “fixed” status for all the positions it delivers. In this case, you should figure out why the data link fails and take the necessary steps to bring it back to work.

So the recommendation is to constantly keep an eye on the age of corrections as you progress in your field operations.

In some of the available Magellan receivers, you can set a parameter, called “maximum age of corrections” defining an upper limit for the age of corrections. If for any reason the age of corrections reaches this limit, a warning message will alert you. There is no such possibility in the ProMark 500.

RTK Correction Data Formats

This section describes the different data formats that can be used by Magellan receivers to transport RTK correction data from a base to a rover.

One of the preliminary settings you will have to do before using your equipment is to choose one these data formats and set the output rate. This choice should be done in conjunction with that of the data link (see the *"Data Link" section*).

Key Terms and Expressions

Observable: Is another name for the data being collected (observed) by a receiver.

Proprietary Formats

DBEN

DBEN is the Magellan proprietary format (not supported in ProMark 500). It is a compressed format that includes pseudo-range and carrier phase measurements. The DBEN format consists of two different messages as described in the table below.

Message Type	Transfer Rate (default)	Range
Code and phase measurements	1 second	Less than 1 second up to 300 seconds
Base position	30 seconds	1 to 300 seconds

Standard Formats

CMR, CMR+

CMR (for *Compact Measurement Record*) is a non-proprietary RTK format that uses data compression techniques to reduce the bandwidth required to transmit the RTK data. In other words, the amount of data to be transmitted on the data link is less with CMR than with other formats.

There is also an enhanced version of this format called CMR+.

Message Type	Transfer Rate (default)	Range
Observables	1 second	Less than 1 second up to 300 seconds
Coordinates of base position	30 seconds	1 to 300 seconds
Base description	30 seconds	1 to 300 seconds

RTCM

RTCM (for *Radio Technical Commission for Maritime Services*) is the most widespread standard format for transporting RTK correction data. As listed below, there are several versions of the RTCM format available in Magellan receivers:

RTCM2.3. The message types that exist in this version are numbered from 1 to 34. The most important ones are listed below:

Message Type	Description	Default Transfer Rate
1	Differential GPS Corrections	
3	ECEF XYZ base coordinates	30 seconds
16	GPS special message	
18	Uncorrected carrier phase	1 second
19	Uncorrected pseudo-ranges	1 second
20	RTK carrier phase corrections	
21	RTK high-accuracy, pseudorange corrections	
22	Extended base parameter	30 seconds
23	Antenna type definition	
24	Antenna reference point	
31	Differential GLONASS corrections	
32	GLONASS Reference Stations Parameters	

RTCM3.0 and 3.1. The message types that exist in these versions are numbered from 1001 to 1029. The most important ones are listed below.

Message Type	Description	Default Transfer Rate
1001	L1 only GPS RTK observables	
1002	Extended L1 only GPS RTK observables	
1003	L1 & L2 GPS RTK observables	
1004	Extended L1&L2 GPS observables	1 second
1005	Stationary RTK reference station ARP	
1006	Base ARP with antenna height	13 seconds
1007	Antenna descriptor	
1008	Antenna descriptor and serial number	
1009	L1 only GLONASS RTK observables	
1010	Extended L1 only GLONASS RTK observables	
1011	L1&L2 GLONASS observables	
1012	Extended L1&L2 GLONASS observables	1 second
1013	System parameter	
1019	GPS ephemeris data	

Message Type	Description	Default Transfer Rate
1020	GLONASS ephemeris data	
1029	Unicode text string	
1033	Receiver and antenna descriptors	31 seconds

RTK Position Output

RTK Position Output Mode

Definition

Some field applications require the fastest possible position output rate whereas some others can do with a slower output rate provided the position accuracy is maximum.

Setting the RTK position output mode allows you to choose the position output that is right for your application.

Magellan receivers offer two different RTK position output modes:

- *Time-tagged RTK* mode, also called “Synchronized RTK” mode.
- *Fast RTK* mode.

Key Terms and Expressions

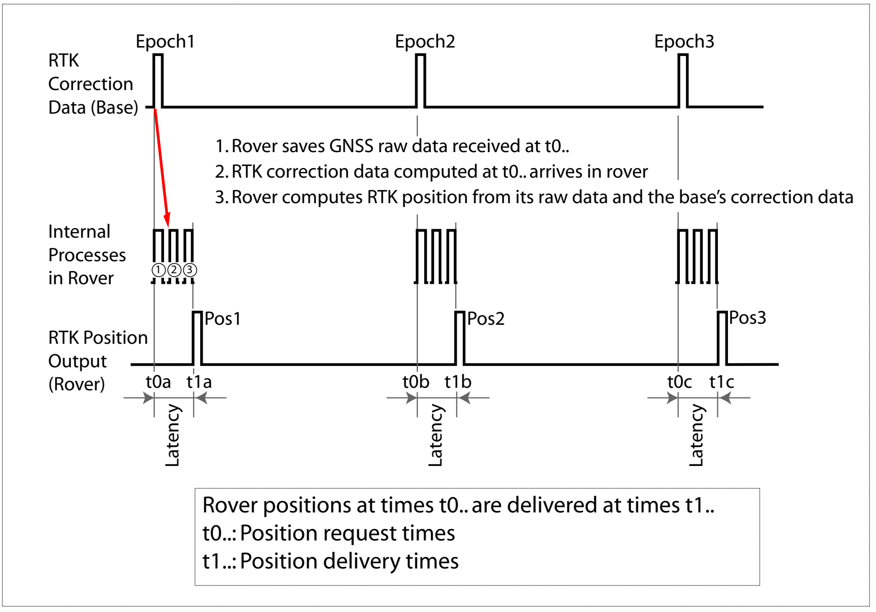
Latency: Delay between the time (t0) for which an RTK position is requested and the time (t1) when the rover starts delivering that position. More precisely, t1 represents the time when the rover outputs the position data’s first character. **Caution!** At time t1, the rover will start delivering the position it occupied at time t0, and not the position it is occupying at time t1. This is true for the two output modes presented in this section.

Epoch: Relevant to a particular time at which a full set of RTK correction data is generated by the base. As this time of data availability is cyclical, each occurrence of this particular time is called an epoch.

Extrapolation: A process through which the rover can continue to compute accurate positions by extrapolating the RTK correction data last received from the base. Generally speaking, in an extrapolation process, a system tries to predict with the best possible accuracy the most likely value of a quantity in a very near future.

Time-Tagged RTK Output Mode

Principle. In Time-tagged RTK, the rover will compute and output a single RTK position for each epoch of RTK correction data it receives.



The time when position is requested is t0 and the time when the rover starts providing the position for time t0 is t1. Times t0 in the base and the rover are synchronous because they originate from the same clock which is the GNSS time.

Here the latency (t1 – t0) is caused by data processing times in both the base and the rover as well as the base-rover propagation time, the latter being negligible compared to the former. In this configuration, a typical latency time in Magellan receivers is about 100 ms.

Use Context. Time-tagged RTK should be used when consistent accuracy is more important than the position output rate and when a relatively long latency is acceptable.

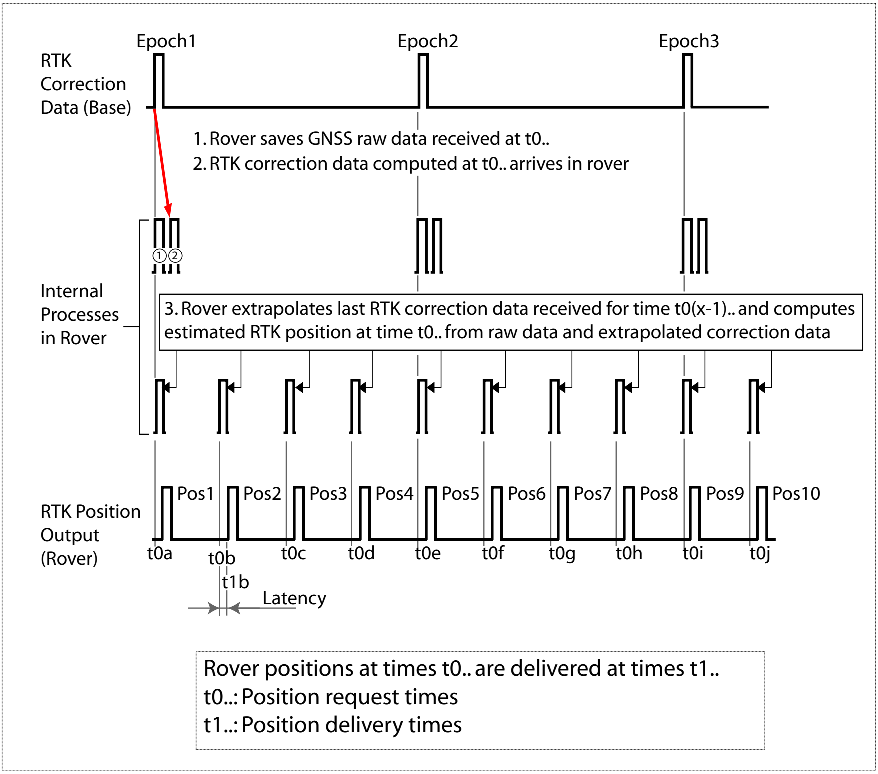
Benefit. RTK positions are consistently accurate.

Drawback. Time-tagged RTK is less consistent in its output because any interruption in the flow of RTK correction data will cause the rover to cease outputting positions. An interruption could be caused by a problem at the base or interference in the data link between the base and the rover. Regardless of the cause, the rover will only provide an RTK position when it receives data from the base.

Fast RTK Output Mode

Principle. In Fast RTK, the rover uses the RTK correction data from a single epoch to compute multiple RTK positions.

For example, if the base is transmitting RTK correction data every second (1 Hz), the rover can output four RTK positions at intervals of 0.25 second.



The time when position is requested is t0 and the time when the rover starts providing the position for time t0 is t1. Times t0a, t0e and t0j in the base and the rover are synchronous because they originate from the same clock which is the GNSS time.

Here the latency (t1 – t0) is caused by the extrapolation and position processing times in the sole rover. In this configuration, a typical latency time in Magellan receivers is 15 ms.

Use Context. Fast RTK should be used when consistent and high-rate position updates are required, such as in machine control or field operator guidance, and when consistent position accuracy is not the highest priority.

Benefits. The position output rate is less sensitive to the rate at which the rover receives RTK correction data.

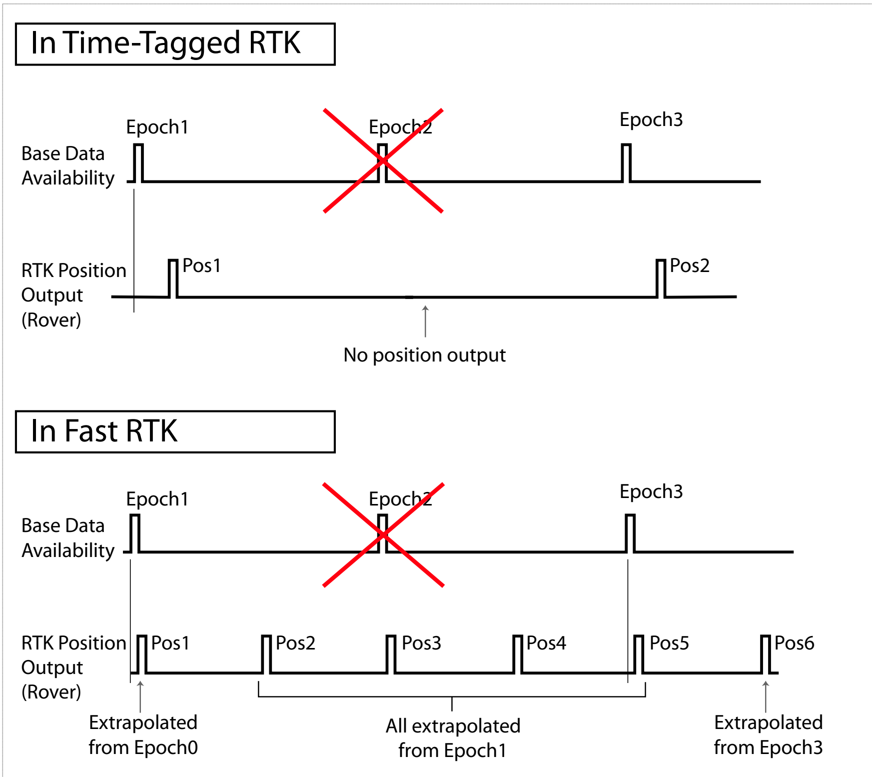
The latency is shorter than in time-tagged mode thanks to the extrapolation process.

The rover will continue to compute positions even if there is a minor interruption in the RTK correction data. Under good conditions, centimeter-level accuracy can be maintained in the rover even if no RTK correction data is received for several seconds.

Drawback. Accuracy is slightly degraded with extrapolated solutions because the noise level on these solutions is higher.

Insensitivity of the Fast RTK Mode to Missing Base Epochs

The diagram below shows how the two output modes react when an epoch of RTK correction data is missing.



In the above Fast RTK mode example, the output rate has been set to twice the base data output rate.

Whereas the Time-Tagged mode can only stick to the base data output rate, the Fast RTK mode on the other hand can continue to deliver its positions at an unaffected output rate. The only difference, when a base data epoch is missing, is that the last received RTK correction data is extrapolated for a longer time to produce up to four positions (instead of two).

RTK Position Output Rate

In Time-tagged RTK mode, clearly the rover's position output rate is equal to the RTK correction data output rate set at the base. It will also depend on the installed firmware options, if applicable to the Magellan equipment used.

In Fast RTK mode, the rover's position output rate can be a multiple of the RTK correction data output rate. It is controlled by a specific user-settable parameter and will also depend on the installed firmware options, if applicable to the Magellan equipment used.

Chapter 8. Planning a Large-Scale Post-Processed Static Survey

Large-scale static survey planning consists of two primary steps:

- *Network design*
- O*bservation plan*

Following these two steps will greatly increase your chances of success. Each of these steps is discussed below.

Network Design

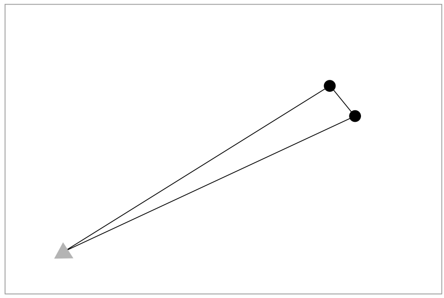
Whether the number of control points to be established in your static survey is 2 or 20, you should design a network defining the number and location of observations that will be required to effectively position the new points.

As an illustration, consider an example where two new intervisible points are to be established on a project site for use as control for a boundary survey (see *Fig. 1*). The two new points need to be tied to an existing control point three kilometers (1.9 miles) away.

Fig. 1. Three-Point Control Survey Example

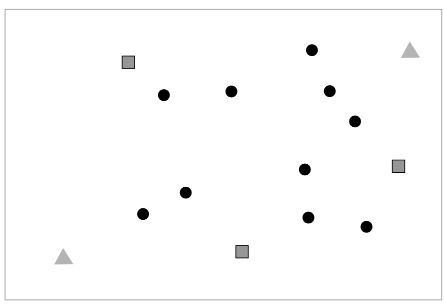
If you were to perform this survey with a conventional total station, you would probably plan on running a closed-loop traverse from the existing control point through the two new points (see *Fig. 2*). The same philosophy can be used for GNSS surveys. The figure below is your network design for this survey

Fig. 2. Closed-Loop Traverse Design



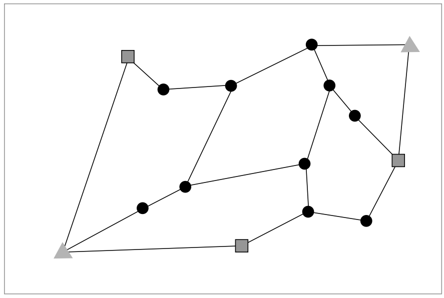
The previous example resulted in a very simple network design. *Fig. 3* represents a more complex control survey where 10 new points are to be established based on two existing horizontal and three existing vertical control points.

Fig. 3. 15-Point Control Survey Example



Again, if you were to perform this survey with a conventional total station, you would design a traverse plan which produced a strong looking network of closed-loop traverses through the points of the survey. *Fig. 4* shows one possible network design.

Fig. 4. Network Design for 15-Point Control Survey



Although this network design was produced with conventional traversing in mind, this same design can also be used if performing the survey with GNSS equipment.

When designing your network, keep the following principles in mind:

- Design loops through the network points which resemble a square or circle. Avoid loops that are long and skinny. Circular or square shaped loops are stronger geometrically.
- Keep the number of points in each loop fewer than 10.
- Always include a direct link between intervisible points, i.e. points which may be used as a pair for orientation of a conventional traverse. Since in most instances, intervisible points are relatively close to each other, it is important to get a direct observation between them.

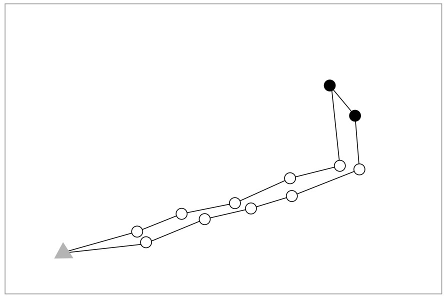
Observation Plan

With the network design completed, the next step is to determine how and when data collection will be performed to produce the desired network.

How to Organize Data Collection

If you were to use a conventional total station to perform our three-point survey example, your resulting traverse would probably look like *Fig. 5*.

Fig. 5. Closed-Loop Traverse of 3-Point Control Survey

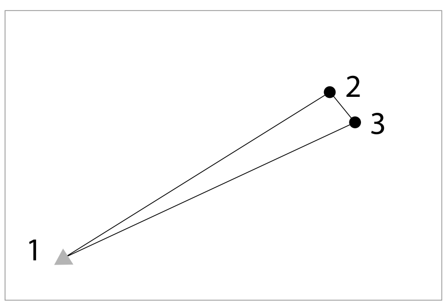


The number of traverse legs required to traverse between each point in the network will depend upon the conditions on the ground between the points.

If you are in luck, the area is relatively flat and there is a straight road running from the existing control point to the two new points to be established, thus minimizing the number of legs required to complete the loop.

Surveying with GNSS has the advantage of not requiring line-of-sight between the points surveyed. This allows for direct observations between the points. To illustrate this, let's take our three-point control survey network design (see *Fig. 6*).

Fig. 6. Network Design for 3-Point Control Survey

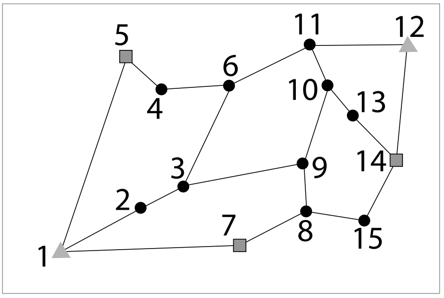


Assume that a two-receiver system will be used to perform the above survey. To produce the link between the existing control point 1 and the new point 2, simply place one receiver system on point 1, place the other receiver on point 2 and simultaneously collect data between the two points. When the observation is complete, move the receiver from point 2 to point 3. Perform another observation, simultaneously collecting data on points 1 and 3. When completed, move the receiver from point 1 to point 2. Perform the final observation between points 3 and 2. When this data is downloaded and processed, the result will be three vectors (delta positions) forming the network design shown in *Fig. 6*.

Now consider the situation where a three-receiver system is used. By placing one receiver on each of the three points in our network, the data for all three vectors can be collected in one observation, rather than the three separate observations required with using a two-receiver system.

Now consider the observation plan for the more complex 15-point survey (*Fig. 7*).

Fig. 7. Network Design for 15-Point Control Survey



To execute this network design, you must perform a direct GNSS observation between all points directly linked. Each link can be viewed as a required vector. Counting the links in this network design, you will find that 19 vectors are required to execute this design.

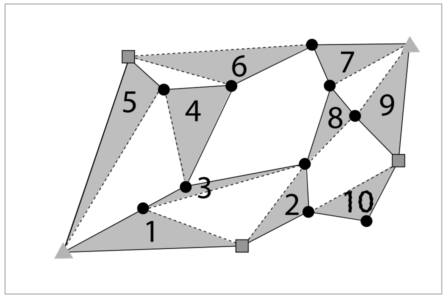
If the survey was to be performed using a two-receiver system, 19 separate data collection sessions (observations) would be required. For example, you can start with a receiver on point 1 and another on point 2. After this observation, you would move the receiver from point 1 to point 3 to perform an observation between points 2 and 3, and so on until all vectors were observed.

Now consider the situation where the 15-point control survey above is to be performed using a three-receiver system. With three receivers, each observation session will produce two vectors from the network design. For example, you may start by placing one receiver on point 1, the second on point 2, and the third on point 7. These three receivers would simultaneously collect data on these three points, resulting in the vectors between points 1 and 2, and points 1 and 7. In addition to these two vectors, a third vector is produced between points 2 and 7. At the end of this first observation, you could move the receiver from point 2 to point 9 and the receiver from point 1 to point 8.

The receiver at point 7 would remain as the pivot point, connecting the first observation to the second. This would continue until all vectors were observed.

Fig. 8 shows what the observation plan might look like with a three-receiver system.

Fig. 8. Receiver Observation Plan for 15-Point Control Survey



The observation plan shows that it will take 10 separate observation sessions to complete the survey based on the network design shown in *Fig. 4*.

Notice that all observation sessions, except for session 6, produce two vectors required from the network design. Observation 6 produces only one since there were an odd number of required vectors (19).

When to Perform Data Collection

The best time to perform surveys is determined by an examination of the constellation of satellites at your location for a given time of day. The number and distribution of visible satellites are important factors impacting the observation time required to produce quality vectors.

Times when the number of visible satellites is low or the distribution is poor will require extended data collection periods to ensure quality results. In rare instances, availability and distribution may be so poor that you are better off not performing your survey during these periods.

Included in the Magellan post-processing office software is a module called Mission Planning. The Mission Planning software provides you with the tools to examine the constellation of satellites. Using satellite almanac information, which predicts the location of the satellites into the future, you can examine satellite availability and distribution for the day(s) when you wish to perform your survey to isolate any time periods were observation times may need to be extended or periods where it is best not to collect data.

You provide the software with your current location and the date when you wish to perform your survey. The software then provides you with multiple ways of examining the satellite constellation at your location for the given time. Pay particular attention to satellite availability (number of satellites in view) and the satellite distribution.

To assist in analyzing the quality of satellite distribution, Dilution of Precision (DOP) values are presented. DOP is a quality analysis value for satellite distribution. The most popular DOP value is PDOP, which stands for Position Dilution of Precision. The PDOP value estimates the impact on the precision of your observations due to satellite geometry. The smaller the PDOP value the better the satellite distribution (geometry) and therefore the better the precision of your observations.

Chapter 9. Troubleshooting

Bluetooth Connection Failed

	RTK Base	RTK Rover	PP Base	PP Rover
Relevant to	•	•	•	•

Your field terminal typically uses a wireless link (Bluetooth type) to communicate with the ProMark 500 receiver.

To ask for a Bluetooth connection with a receiver, you have to select “Bluetooth” and “Magellan BT” on the **Comms** tab when setting your base or rover. Using the **Configure** button, you can then search for remote Bluetooth-enabled devices, select the one corresponding to your receiver and finally ask for a Bluetooth connection to be established between FAST Survey and your receiver.

In the next sessions, FAST Survey will automatically restore the connection if you ask it to do so, provided the same receiver is still close by and powered on.

Bluetooth Icon::

When the Bluetooth connection is active, the Bluetooth icon is displayed in the lower-right corner of the screen.

After examining the screen, you determine that FAST Survey is not communicating with the receiver via Bluetooth. Follow the steps below to try to resolve the problem.

Step 1. Has your Receiver Booted Normally?

When you turn on your receiver, it may fail to complete the boot sequence.

1. **If your receiver has completed the boot sequence normally** (the General Status screen is displayed after the “Starting...” message), go to Step 2.
2. **If your receiver fails to complete the boot sequence**:
   - Make sure the battery is charged. A too-low battery will prevent the receiver from powering up normally.
   - If there is still enough energy in the battery, your receiver may be malfunctioning. Try to turn it on again.

In case of a new failure, call your local dealer or email Magellan technical support for assistance.

Step 2.Does FAST Survey Ask for a Bluetooth Connection?

When using FAST Survey for the first time, you will need to run a search phase to list the Bluetooth devices present in the vicinity.

After opening a job in FAST Survey, the software will prompt you to re-activate the connection with the last receiver used.

1. **If no receiver is detected the first time you use FAST Survey**, go to Step 3.
2. I**f FAST Survey fails to restore the connection to the last receiver used**, make sure the nearby receiver is the expected one (check its Bluetooth identifier on the Receiver Identification screen). The Bluetooth connection will fail if it's not the right receiver.

Step 3. Is the Receiver Close Enough to You?

FAST Survey was unable to detect the receiver. Do the following to resolve the problem.

1. Move the field terminal closer to the receiver (1 meter typical) and resume the search using the **Find Receiver** button in the Bluetooth Devices window. If after several attempts, no receiver is detected, then either the field terminal or the ProMark 500 has a faulty Bluetooth device.
2. You may try to isolate the problem by turning on another ProMark 500 receiver and resuming the search phase. If it's successful, then it means the first ProMark 500 is malfunctioning. Call your local dealer or email Magellan technical support for assistance. Conversely, you may try another field terminal to see if the Bluetooth problem is in the first field terminal.

Receiver is Not Tracking Satellites

	RTK Base	RTK Rover	PP Base	PP Rover
Relevant to	•	•	•	•

Step 1. Has the Receiver Been Powered Up?

To determine if the receiver is powered up, examine the power LED on the front panel of the receiver. If the LED is on, the receiver is on.

1. **If the receiver is not powered up**, turn on the receiver by pressing and holding the power key on the front panel. The button must be held for a few seconds since there is a

delay in power on. You will see the power LED turn on and the display will show the Magellan logo followed by the message “Starting...”.

2. **If the receiver does not power up**, check the power source. The receiver supports both internal (battery) and external power sources.

   If using the internal power source, make sure the internal battery has been fully charged before it was inserted in the receiver. A too low battery will prevent the receiver from powering up.

   If using external power, check to ensure the power cable is properly connected to both the external battery and the receiver.

   - If the cable is properly connected, check the power level of the external power source. If low, replace the battery with a charged battery and turn on the receiver.
   - If the external power source is good and the cable is connected to both the receiver and the power source, there may be a problem with the cable. If available, try a different power cable. If the new cable works, the old cable is malfunctioning. Call your local dealer or email Magellan technical support to have the cable repaired.

3. **If the receiver is now powered up**, go to step 2.

Step 2. Does the Number of Tracked Satellites Stay Abnormally Low?

1. **Check the information displayed on the receiver front panel**. In the upper line, starting from the left, the first number displayed should gradually rise from 0 to 8 or more. This information represents the number of tracked satellites. In the same time, the last number in the same line should increase as well, in the same proportion. This information represents the number of satellites actually used by the receiver, and should be equal to, or slightly less than, the first number in the line.
2. **If the receiver fails to track any satellites** after a few minutes of operation, see if you can improve this by moving the receiver to a better place (a more open-sky area) where there can’t be any doubt on the possibility for a receiver to track satellites.
3. If the receiver still fails to track any satellites, a component may be malfunctioning. Call your local dealer or email Magellan technical support for assistance.

Receiver is Not Logging Data

	RTK Base	RTK Rover	PP Base	PP Rover
Relevant to	•	•	•	•

Raw Data Logging Icon::

The Raw Data Logging icon on the front panel of the receiver will be animated when data logging is in progress.

Examining the General Status screen, you determine that the receiver is not logging data to memory. Follow the procedures below to determine the cause of this problem.

Step 1. Has Data Logging Been Started?

At receiver power up, data logging is disabled in the receiver (default setting). To start data logging, press the Log button on the front panel, or use FAST Survey's **Log Raw GPS** function from the **Survey** menu (tap the **Start File** button to start data logging). By default, raw data is written to the receiver's internal memory.

1. **If the Raw Data Logging icon starts blinking** (animated icon), then the problem is solved. **Warning!** The Raw Data Logging icon may blink throughout a logging session, but if not a single satellite is received during this time, then your raw data file will be empty.
2. **If the problem is not yet resolved**, go to step 2.

Step 2. Is the Currently Selected Memory Usable?

The receiver logs raw data to the internal memory (recommended) or to a USB stick. With the default settings, the selected memory is the internal memory. Changing the storage medium can only be made using FAST Survey. You can determine which memory is currently selected by reading the memory screens. The "*" symbol indicates the currently selected storage medium.

If the USB stick is the currently selected memory, there is no USB stick connected and you are using the receiver without FAST Survey, then the receiver won't start data logging when you press the Log button.

1. **If you are using the receiver alone** and the currently selected memory is the USB stick, do one of the following:
   - Connect a USB stick to the receiver through the USB device cable provided and press the Log button again.
   - Restore the default settings (by pressing the Log+Scroll+Power buttons simultaneously) in order to make the internal memory the active memory. Press the Log button again.

If neither of these two actions resolves your problem, go to step 3.

2. **If you are using FAST Survey to control the receiver**, select the **Survey** menu. Tap on the **Log Raw GPS** button and then on the **File Manager** button. Select the memory where you want the raw data file to be created (Internal Mem or USB Mem Stick). Come back to the previous screen and tap on the **Start File** button. If the problem is not yet resolved, go to step 3.

Step 3. Is the Currently Used Memory Full?

Data logging will stop automatically or won't start if the storage medium used (internal memory or USB stick) is full. On the General Status screen, read the remaining percentage of free memory (second line, last number in the line).

1. **If "0%" is displayed**, then the memory used is full. Do one of the following:
   - Change the storage medium
   - Using FAST Survey, empty the memory or delete the files you don't need anymore.

   If neither of these two actions resolves your problem, you may have a malfunctioning receiver. Contact your local dealer or email Magellan Technical Support for assistance.
2. If the memory is not full (>0%), you may have a malfunctioning receiver. Contact your local dealer or email Magellan Technical Support for assistance.

Radio Data Link Fails to Provide Base Corrections to Rover

	RTK Base	RTK Rover	PP Base	PP Rover
Relevant to		•		

The Data Link icon is displayed on the rover's General Status screen when base corrections are received and a float or fixed solution is available. Next to it is the age of corrections, a value which should not normally a few seconds when the data link operates smoothly.

After examining the General Status screen, you determine that the rover is not receiving data. Follow the outline below to troubleshoot this problem.

Step 1. Is the Receiver Fitted with the Appropriate Radio Module?

The radio module used should be compatible with the radio transmitter used at the base. Several sub-bands and channel bandwidths are available for the radio (see *Communication Modules and Associated Antennas on page 3*).

1. **If you are using the right module**, go to step 2.
2. **If you are not using the right module**, turn off the receiver and replace the module with the right one. You then need to restore the default settings in the receiver (by pressing the **Reset Factory Defaults** button in FAST Survey's **Equip>GPS Utilities** or pressing the Log+ Scroll+ Power buttons simultaneously on the front panel) so the receiver can recognize and use the new module. If using the right module does resolve the problem, go to step 2.

   NOTE: There is no particular action required to power up the radio module other than to power up the receiver. This automatically applies power to the radio module.

Step 2. Is the Radio Antenna Connected to the Radio Module?

The radio module cannot operate properly without an antenna. Make sure the antenna is connected to the radio module.

1. **If the antenna is not connected**, connect the radio antenna (provided in the radio receiver kit) to the radio module. Ensure that the connection is secure. If the problem is not yet resolved, go to step 3
2. **If the antenna is connected**, ensure the connection to the radio module is secure. If the problem is not yet resolved, go to step 3.

Step 3. Are the Rover Radio Settings Compatible with those of the Base Radio?

The rover radio must use settings that are compatible with those of the base radio, in order for the rover to receive corrections from the base. (This means you are supposed to know the currently used base radio settings.)

1. **Check the radio settings in the rover**:

   Use FAST Survey (**Equip** menu>**GPS Rover**>**RTK** Tab, **Device** field, **Config** button) to check the frequency, protocol and "Over the Air" baud rate used.
2. **If the rover radio is set properly**, go to step 4.

Step 4. Is the Line of Sight Between the Base and the Rover Antennas Obstructed?

Although radios are fairly robust, an excessive amount of obstructions can block out the signal.

1. **If the line of sight is not obstructed**, go to step 5 below.
2. **If the line of sight is obstructed**:
   - Move to a less obstructed location. In order to test if the system is functioning properly, move to a location

that does not have an obstructed view between the base and rover radio antennas.

- If this is not possible, move to higher ground or a location where there is less obstruction.
- If, after moving, the rover radio begins to receive data from the base, then the previous location is too obstructed from the base. You will need to either raise the base radio antenna higher, or move the base to a location with less obstruction between the base and rover radio antennas.

3. If the problem is not yet resolved, go to step 5.

Step 5. Are you Within Range Specifications of Your Radio System?

The range within which your radio system will function varies greatly with the conditions under which the system is being used. With clear line of sight between the base and rover radio antennas, and no interference on the frequencies you are working on, a UHF system can function with tens of miles of separation. Unfortunately, these are ideal situations seldom found. In most situations, the range of UHF radio will be between 5 and 10 miles.

1. **If you are not within range specifications**, move within range. Either move closer to the base, or move the base closer to you. If the problem is not yet resolved, go to step 6.
2. **If you are within range specifications**, move closer to the base to test the system. Since radio range is difficult to predict due the varying effects of local conditions, try moving closer to the base in an attempt to resolve the problem.

   If by moving closer you find that the rover radio begins to receive data, the previous location is out-of-range of the radio system. You will need to elevate the base radio antenna or move the base to a location closer to you to solve the problem. If the problem is not yet resolved, go to step 6.

Step 6. Is the Radio Being Jammed?

When working with UHF radios, it is possible that the frequency you are using is being shared with other people in your vicinity. Traffic on this frequency can interfere with the rover's ability to receive data from the base. The effect may be no reception of base data or intermittent reception of data. Both are detrimental to proper operation of the RTK system. Interference can be a problem with UHF radios.

There are two methods to determine if there is traffic on the frequencies you wish to use. The best method is to acquire a handheld scanner and to listen for traffic on the frequency you plan to use. The second method is to observe the Data Link icon the rover's General Status screen. The base and rover radio will receive any traffic on the frequency they are set to causing this icon to appear. This is best done before setting up the base to transmit data. Any appearance of the Data Link icon indicates some traffic on your frequency.

1. **If there is no jamming**, your radio module or radio antenna may be malfunctioning. There is no way to further isolate this problem unless you have spares for these components. Call your local dealer or email Magellan technical support for assistance.
2. **If there is jamming**:
   - Lower the sensitivity of the rover radio. FAST Survey lets you change the sensitivity of the rover radio, and you can also lower the sensitivity of the PDL radio via the front panel display.

     Lower the sensitivity of the rover to medium or low. If the traffic on your frequency is not strong in power, lowering the sensitivity of the rover radio may cause the radio to ignore the traffic. This will not help if the traffic is caused by a nearby or very high powered radio.

     The disadvantage of lowering the sensitivity is a reduction in the range of your radio system. A lower sensitivity at the rover may cause the rover to not hear the base transmissions as the rover moves farther away from the base.
   - Try another frequency. If you are licensed to operate on more than one frequency, move to a different frequency in hopes that the new frequency has less traffic.

     If you have a license for only one frequency, you may need to find another frequency in your area that is clear of traffic in order for the system to function reliably and acquire a license for this frequency if possible.

Data Link Okay but No Fixed Position Computed

	RTK Base	RTK Rover	PP Base	PP Rover
Relevant to		•		

Once the receiver is set to function in RTK (i.e. RTK firmware option has been enabled), it will compute RTK quality positions. In order to accomplish this, the rover must collect raw satellite data at its position and also receive RTK correction data transmitted by the base. Without these two components, the rover will not be able to fix RTK position solutions.

To determine if the rover is computing a fixed position, you can read the General Status screen (2nd parameter in upper line), or use FAST Survey (**Equip** tab, **Monitor Skyplot** function).

Using either the display screen or FAST Survey, you have determined that the rover system is not computing a “Fixed” position. Follow the steps outlined below to troubleshoot this problem.

Step 1. Is the Radio Receiving Base Data?

To determine if the rover is receiving base data, examine the 2nd line on the General Status screen. The Data Link icon should be visible. Refer to *Radio Data Link Fails to Provide Base Corrections to Rover on page 135* if you need to fix this problem, and then come back to this procedure.

Step 2. Is the Receiver Tracking satellites?

Use either the front panel of the receiver or FAST Survey running on the field terminal to determine if the rover is tracking satellites.

- **If the receiver is not tracking satellites**, refer to *Receiver is Not Tracking Satellites on page 132* and then come back to this procedure.
- **If the receiver is tracking satellites**, go to step 3 below.

Step 3. Are The Base and Rover Tracking at least 5 Common Satellites?

In order for the rover to compute an RTK position, the base and rover must observe data from at least 5 common healthy satellites simultaneously. Without this common data, the rover cannot compute an RTK position.

Use FAST Survey’s Monitor/Skyplot function or the receiver front panel to determine if the base and rover are indeed tracking at least 5 common healthy satellites.

1. **If the base and rover are not tracking at least 5 common satellites**:
   - Check satellite availability. Use the Mission Planning utility from GNSS Solutions to check satellite availability for your current location and time. Look for the number of satellites available higher than 5° above the horizon. Ensure at least 5 healthy satellites are available. If not, you will need to perform your survey at another time.

     If the problem is not yet resolved and at least 5 satellites are now tracked and used, your rover may be malfunctioning. Contact your local dealer or email Magellan technical support for assistance.
   - Move the base or rover if sites have satellite obstructions. If your base or rover site has any obstructions 5° above the horizon, the obstructions may be blocking essential satellites. If obstructions exist at the base or the rover, move the system to an open area.

     If the problem is not yet resolved and at least 5 satellites are now tracked and used, your rover may be malfunctioning. Contact your local dealer or email Magellan technical support for assistance.
2. If the base and rover are tracking at least 5 common satellites, your rover may be malfunctioning. Contact your local dealer or email Magellan technical support for assistance.

Rover is Computing Positions with High Uncertainties

	RTK Base	RTK Rover	PP Base	PP Rover
Relevant to		•		

Using FAST Survey, you find that the rover is computing a position but the uncertainties (HRMS, VRMS) assigned to the position are unacceptably high. Follow the steps outlined below to troubleshoot this problem.

Step 1. Is the Receiver Set to Function as an RTK Rover?

The rover must be set to function in RTK rover mode in order for it to compute accurate RTK positions. If the rover is not set in RTK rover mode, the receiver will compute autonomous positions which could contain about 10 meters or more of error. This is probably the problem if HRMS and VRMS values are in the 10s of meters. Use FAST Survey to determine if the system is configured as an RTK rover.

- **If the receiver is not set to function as an RTK rover**, go to the **Equip** menu>**GPS Rover**>**RTK** tab and set the different parameters to match your application.
- **If the receiver is set to function as an RTK rover**, go to step 2.

Step 2. Are the Base and Rover Tracking at least 5 common Satellites?

Although the rover is capable of computing a position with only 4 common healthy satellites with the base, the rover will not attempt to fix ambiguities unless 5 common healthy satellites are observed. Fixing ambiguities is a required process for the rover to compute highly precise RTK positions. FAST Survey and the receiver will inform you if you currently have a fixed ambiguity solution or a float ambiguity solution. Your field application software will also inform you which satellites are being tracked by the base and which are being tracked by the rover and whether or not these satellites are healthy. If you find that your solution will not fix, look to determine if the base and rover are indeed tracking at least 5 common healthy satellites.

1. **If the base and rover are not tracking at least 5 satellites**:
   - Check satellite availability. Use the Mission Planning utility from GNSS Solutions to check satellite availability for your current location and time. Look for the number of satellites higher than 5° above the horizon. Ensure at least 5 healthy satellites are available. If not, you will need to perform your survey at another time.

     Go to step 3 below if the problem is not yet resolved.
   - Move the base or rover if sites have satellite obstruction. If your base or rover site has any obstructions higher than 5° above the horizon, the obstructions may be blocking essential satellites. If obstructions exist at the base or rover, move the system to an open area.

     Go to step 3 below if the problem is not yet resolved.
2. **If the base and rover are tracking at least 5 satellites**, go to step 3 below.

Step 3. Are HDOP & VDOP Values Too High for Precision Requirements?

Dilution of Precision (DOP) values give a quality indication of the satellite geometry at any given time. Satellite geometry is important to the precision of an RTK solution.

In fact, the DOP value is used as a multiplier in the computation of position precision. For example, in the computation of horizontal RMS (HRMS), an estimated precision value is multiplied by the HDOP at that given time to produce HRMS. The larger the HDOP value, the larger the HRMS value. The same relationship holds for VDOP and VRMS.

Therefore, poor satellite geometry will result in poor solution precision. The smaller the DOP value, the better the geometry and solution precision.

FAST Survey can view current DOP values. If your precision estimates (HRMS, VRMS) do not meet expected values, use this feature to examine the current DOP values.

1. **If DOP values are too high**, look for a satellite window with more suitable DOP values to perform the survey:

   Use the Mission Planning utility from GNSS Solutions to examine expected DOP values for periods during which you would like to perform your survey. Avoid surveying during periods where DOP values are above 4. For the highest level of accuracy, limit surveying to periods where DOP values are between 1 and 2.

   Remember that obstructions to line of sight between the GPS antenna and the satellites will block out satellite signals. Every time a satellite is lost due to obstructions, DOP values will be adversely affected. An obstructed area may not be suitable to meet your precision needs due to the adverse effect on satellite geometry.
2. **If DOP values are not too high**, go to step 4 below.

Step 4. Are Precision Requirements Too Stringent for RTK?

If the RTK system is not delivering the precision requirements you need for your specific task, it is possible that your precision requirements are too stringent for the RTK system. Review your system documentation to determine the precision specifications for the RTK system.

- If the precision is not beyond capability, then the rover may be malfunctioning. Contact your local dealer or email Magellan technical support for assistance.
- If the precision is beyond capability, your precision requirements are not attainable through RTK surveying. You will need to find some other measurement system to perform your survey.

This concludes the troubleshooting section. If the tips given here did not help you to resolve your problem with your system, please call your local dealer or email Magellan Technical Support for assistance.

Chapter 10. Miscellaneous

List of Alarms

Alarms are reported on the ProMark 500 display screen. A blinking warning sign appears on the status screen prompting you to press the Scroll button so you can read the alarm label.

To acknowledge an alarm message once the alarm label is displayed on the screen, press the Scroll button again. If several alarm messages are reported, press the Scroll button as many times. This will acknowledge each message, one after the other.

If the reason for raising an alarm persists, you won't be able to acknowledge the alarm until you correct the problem.

Some of the alarms listed below can only be the result of a bad serial command submitted to the receiver (in command mode). Serial commands can be applied to the receiver from FAST Survey or GNSS Solutions' Wincomm Utility.

Alarm Number	Alarm Label	Symptoms & Remedies
0	Software error	Receiver detected an internal error due to software. If persisting, 2nd-level maintenance is required for the receiver.
1	Unknown command	Unknown serial command received. Correct syntax and re-send command.
2	Bad parameter format	Not well-formatted parameter in the command sent. Correct syntax and re-send command.
3	Bad command checksum	Serial command received with bad checksum. Correct checksum and re-send command.
4	File open error	Receiver failed to open the raw data file. Restart the receiver an try again. If error persists and selected storage medium is USB, change USB key and try again. If error persists and selected storage medium is internal memory, re-format internal memory using command $PASHS,INI,2 (configuration will be lost).
5	File close error	Receiver failed to close the raw data file. Try again. If still unsuccessful, turn off the receiver and try again.

Alarm Number	Alarm Label	Symptoms & Remedies
6	File write error	Receiver failed to write data into the raw data file.If the alarm persists, close the file and resume data logging. If error persists and selected storage medium is USB, check that it’s not in read-only (remove lock). Else, change USB key and try again. If error persists and selected storage medium is internal memory, re-format internal memory using command $PASHS,INI,2 (configuration will be lost).
7	File read error	Receiver failed to read the number of files in the selected storage medium.If error still occurs, change the USB key or re-format the internal memory (see Alarm 4).
8	File system mount error	Receiver failed to detect the USB key. Remove USB key and re-insert it. If still unsuccessful, use a new USB key.
12	GSM connection failed	GSM connection has been lost. Try again. Most of the time, the server ends the connection for one of the following reasons: - User name and/or password is incorrect (contact your provider) - Server is faulty (contact provider) - You are outside the area covered by the NTRIP or Direct IP server.
14	GSM initialization failed	Receiver failed to initialize GSM modem. Check the GSM status icon on the display screen (should indicate Modem is powered on). If error persists, contact your GPRS provider for assistance.
16	GSM data write error	Receiver failed to write data on the GSM port. Try again. If error persists, restart the receiver. If error persists, call your local dealer or email Magellan technical support for assistance.
17	GSM network error	GSM reception level too low. Check GSM antenna
18	GSM status error	Not used
19	GSM power error	Receiver failed to power on the modem or action required from modem while it is off. If error persists, call your local dealer or email Magellan technical support for assistance.
21	USB removed while file opened	User error. USB key should not be removed while data is being logged to this key. Data file in progress will be entirely lost.
22	File transfer Error	Receiver failed to transfer data from the internal memory to the USB key. Change the USB key and try again. If error persists, restart receiver. If error still persists, call your local dealer or email Magellan technical support for assistance.
23	Transfer to USB failed	Receiver failed to transfer data from the internal memory to the USB key because the key is full. Empty the key or insert a new one and then try again.
24	RTC send error	Receiver has detected a task not running properly. Restart receiver. If error still persists, call your local dealer or email Magellan technical support for assistance
25	Bad radio settings	Bad $PASHS,RDP,PAR command received. Consider the following: -Settings may be incompatible with the type of radio used -Settings may have been rejected by the radio Correct command syntax and/or parameters and re-send command.

Alarm Number	Alarm Label	Symptoms & Remedies
26	No radio detected	Receiver fails to communicate with the external or internal radio device, or radio does not respond to your command. Check to see if radio is present (internal radio) or connected and powered on (external radio). Then send your command again.
27	Radio settings corrupted	Receiver failed to interpret data received from Pacific Crest receiver or transmitter. Check baud rate and retry.
28	Bad radio response	Receiver failed to interpret data received from Magellan transmitter. Check baud rate and retry.
29	Bad radio channel	Bad $PASHS,RDP,PAR command received (contains invalid channel number). Consider the following: -Submitted channel number may be absent from channel table -Submitted channel number rejected by radio. Check channel table and send the command again.
30	No GNSS detected	GNSS board found missing. Restart receiver. If error persists, call your local dealer or email Magellan technical support for assistance.
31	Bad PVT received	Bad position data delivered by GNSS board. If error persists, call your local dealer or email Magellan technical support for assistance.
32	Bad PVT decoded	Bad position data delivered by GNSS board. If error persists, call your local dealer or email Magellan technical support for assistance.
33	PVT multiflag	If error persists, call your local dealer or email Magellan technical support for assistance.
34	Unknown option code	OPTION command received includes invalid option code. Check command syntax/parameters and send the command again.
35	C3 code checksum is bad	Option codes are corrupted at power-on. Re-install receiver options.
36	Option has expired	At receiver power-on, all installed firmware options are tested for validity. This alarm is activated if at least one option has expired. Need to purchase option if no longer available.
37	All attempts failed	Number of tries exceeded. Check phone number. Resume the connection procedure from the beginning. If error persists, call your local dealer or email Magellan technical support for assistance
38	Memory full	Data memory full. Data logging stopped or impossible. You need to empty memory partially or entirely before data logging can be resumed.
39	Spy too long	A Debug command. Apart from acknowledging the alarm, no particular action required.
40	GSM already in DIP Mode	Source table requested whereas GSM already used in DIP mode. End DIP connection before requesting the source table.
41	GSM currently in NTRIP Mode	Source table requested whereas GSM already used in NTRIP mode. End NTRIP connection before requesting the source table.
42	GSM currently in CSD Mode	Source table requested whereas GSM already used in CSD mode. End CSD connection before requesting the source table.
43	Invalid mount point	You are trying to connect the receiver to an invalid mount point. Correct mount point parameters and try again.
44	Input buffer full	If error persists, call your local dealer or email Magellan technical support for assistance.
45	GSM Pin code invalid	Correct pin code and try again. If error persists, contact GPRS provider to fix the problem.

Alarm Number	Alarm Label	Symptoms & Remedies
46	GSM band error	Correct GSM band and try again. If error persists, call your local dealer or email Magellan technical support for assistance.
47	GSM protocol error	Correct protocol used and try again. If error persists, call your local dealer or email Magellan technical support for assistance.
48	GSM CSD mode error	Problem configuring the modem in CSD mode. Try again. If error persists, call your local dealer or email Magellan technical support for assistance.
49	APN error	Problem configuring the APN. If error persists, contact GPRS provider to fix the problem.
51	GPRS login error	Check GPRS login. If error persists, contact GPRS provider to fix the problem.
53	GPRS password error	Check GPRS password. If error persists, contact GPRS provider to fix the problem.
54	GPRS connection failed	Receiver failed to connect to GPRS. Check GSM antenna. Check GPRS parameters and reception level and try again.
55	Connection to caster failed	Receiver failed to connect to Caster. Check NTRIP parameters and try again.
56	Invalid caster hostname	Correct caster hostname and try again.
57	Invalid caster port	Receiver failed to access the caster through the port mentioned. Check caster port number.
58	Disconnect. from IP failed	Receiver failed to disconnect from NTRIP or Direct IP. Try again. If still unsuccessful, shut down the receiver.
59	Connect. to mount point failed	Receiver failed to connect to the specified mount point. Check mount point name and access rights and try again.
60	Disconnect. from GPRS failed	Receiver failed to disconnect from GPRS. Try again. If still unsuccessful, shut down the receiver.
61	Connect. to DIP failed	Receiver failed to connect to the specified DIP address. Check DIP parameters and access rights and try again.
62	CSD dial error	Receiver failed to dial the specified phone number
63	CSD hangup error	Receiver failed to hang up. Shut down the receiver.
64	Auto dial error	Receiver failed to set “auto dial” in GSM modem
65	Redial number error	Receiver failed to set “auto dial” in GSM modem
66	Auto pickup error	Receiver failed to set “auto pickup” in GSM modem
67	No SIM card detected	Receiver needs SIM card to operate in requested mode. Install SIM card or check that the installed SIM card has been inserted correctly. If still unsuccessful, call your GPRS provider to make sure the SIM card holds the information to make it usable.
68	Incomplete srce table	Receiver failed to decode the whole source table. Resume the connection to the caster. If error persists, contact provider to fix the problem.
69	Too many files	26 files (index A to Z) can be logged per day, based on the same site name. To log more files on the same day, change the site name.

Special Button Combinations Summary

Button Combination	ProMark 500 State	Function
Power+Log+Scroll	OFF	Restores Factory Settings.
Power+Scroll	OFF	Initiates firmware update from USB key.

Refer to *Special Button Combinations on page 11* for more information.

Reset Procedure

The receiver may be reset to the default settings using the Log+Scroll+Power button combination. Release the three buttons only after the Magellan logo is displayed.

The reset procedure is also used to poll the radio module. If a new module is detected, the receiver will update its database so it can successfully communicate with the new module.

The default settings can also be restored using the $PASHS,INI command. With this command, you can ask more than a simple “restore default settings”. See *INI: Receiver Initialization on page 193*.

Firmware Upgrade Procedure

Firmware upgrades can be downloaded from the Magellan FTP server.

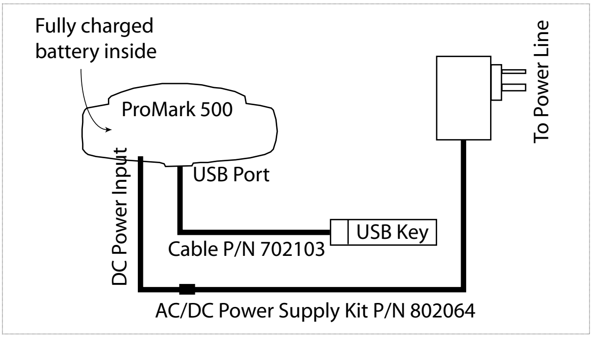
Completing a firmware upgrade procedure may take up to 15 minutes. For this reason, it must be run with the receiver powered from both a fully charged internal battery and the AC/DC power supply kit. You also need a USB key to make the upgrade files available to the receiver.

A firmware upgrade consists of the following files:

Filename	Refers to	File Size (approx.)
PM4_upgrade-PMU-<Version No.>.tar.bz2	PMU (Power unit)	15 kbytes
PM4_upgrade-GNSS-<Version No.>.tar.bz2	GNSS board	1 Mbyte
PM4_upgrade-dataflash-<Version No.>.tar.bz2	System board	4.6 Mbytes

Follow the instructions below to complete the upgrade of your receiver:

1. Check that the USB key used for the upgrade is not write-protected and then connect it to your computer.
2. Using Windows Explorer, copy the three files to the root directory of the USB key.
3. Check that there is at least 10 Mbytes of free memory left on the USB key. The free memory will be used during the upgrade for decompressing data.
4. Disconnect the USB key from the computer (after taking the usual safety precautions related to the USB standard).
5. Make sure the ProMark 500 you want to upgrade is OFF and ready for upgrade (i.e. internal battery present and external AC/DC power supply connected and on).



6. Connect the USB key now containing the upgrade files to the ProMark 500's USB connector through cable P/N 702103 (provided).
7. Hold down the Scroll button and then press the Power button until the "Upgrade" message is displayed on the receiver screen. This automatically starts the upgrade procedure.
8. Release the two buttons and let the receiver proceed with the upgrade. **Take care not to turn off the receiver while the upgrade is in progress**.
9. Wait until the upgrade is complete. The receiver is automatically turned off at the end of the procedure (following the upgrade of the PMU).
10. Disconnect the USB key and its cable from the receiver.
11. Perform a normal start of the receiver and check that the new firmware is installed (read the second line on the Receiver Identification Screen).

Time-tagged RTK vs. FAST RTK Position Output

The ProMark 500 can deliver RTK positions either in Time-Tagged or Fast RTK mode. The default mode is Fast RTK.

In this default mode, in fact the ProMark 500 automatically switches from Time-Tagged to Fast RTK depending on context:

- When assisting you in your navigation to a point, the receiver will operate in Fast RTK mode. In this case, all satellites received above the elevation mask, including those for which the base is unable to provide corrections, will be used in the position processing for best availability of an RTK position.
- When you are about to log a point, the ProMark 500 will automatically switch to Time-Tagged RTK for best accuracy. In this case, only those satellites above the elevation mask for which corrections are provided by the base will be used in the position processing.

If you wish your receiver to always operate in Time-Tagged mode, use the appropiate serial command to switch into that mode (see *CPD,FST: RTK Output Mode on page 181*).

In its standard version, the ProMark 500 features a Fast RTK mode with an output rate of 5 Hz. With the FASTOUTPUT10 firmware option, the output rate is 10 Hz. After purchasing this option, use the $PASHS,OPTION command to install it. See *OPTION: Receiver Firmware Options on page 211*).

ATOM File Naming Conventions

Raw data files in ATOM format are named using the following syntax:

G<Site><Index><Year>.<Day>

Where:

Item in Filename	Description
G	Header indicative of a file containing ATOM data.
<Site>	A 4-character string recalling the name of the site where data was collected (a point name in static, a trajectory name in kinematic, or name of last surveyed point in stop & go). The default string is four underscores (“____”).
<Index>	Order number of file being recorded (A.. Z, where “A” is used for the first file logged in current day).
<Year>	Last two figures of current year (e.g. “08” for 2008).

Item in Filename	Description
.<Day>	File extension: a three-figure number representing the current day number in year (1.. 365).

Example of first file logged on May 6th 2008 on point 584V:

G584VA08.127

Saving/Restoring Base and Rover Configurations

FAST Survey allows you to save into a file all the settings you have prepared for your base or rover.

This function is useful when you regularly have to switch between two or more configurations. By simply selecting the right configuration, you immediately restore all the settings FAST Survey needs to load to the receiver before the receiver/ field terminal system can operate as expected.

The table below summarizes the parameters held in a configuration file.

Parameters	Base	Rover
Equipment manufacturer	•	•
Equipment model	•	•
Communication Type (Bluetooth or other)	•	•
Antenna height measurement type and value	•	•
Elevation mask	•	•
Ambiguity fixing		•
Use SBAS satellites	•	•
Use GLONASS satellites	•	•
Device used in RTK data link and device settings	•	•

For network connections, the file includes the provider's connection parameters as well as, for NTRIP, the last reference station selected from the source table. Needless to say in these cases, you'll really save time when starting your system if you first take a couple of seconds to save your configurations.

FAST Survey manages base and rover configurations independently of job files. All saved configurations are potentially usable in all new jobs and whatever the existing jobs you re-open, provided the hardware available matches the configuration.

The two procedures described below apply to either a base or rover.

Saving a Configuration

- Tap **Equip** then **GPS Base** for a base, or **GPS Rover** for a rover.
- Enter all the parameters needed to set the equipment in the four tabs presented in this window.
- Before you tap to load the configuration to the receiver, come back to the **Current** tab.
- Tap on the **Save** button located in the lower part of the window and then name the configuration (e.g. “Radio” or “NTRIP”).
- Name the configuration file and tap . This takes you back to the current tab where the new configuration is now listed.

Making a Saved Configuration the Current Configuration

- Tap **Equip** then **GPS Base** for a base, or **GPS Rover** for a rover.
- Select the name of the desired configuration from the lower list.
- Tap on the **Load** button.
- Tap **Yes** to confirm your choice. This restores all the settings held in this configuration. You may check this by scrolling all the tabs in the window.
- Tap to load the configuration to the receiver.

Setting the Base Position With FAST Survey

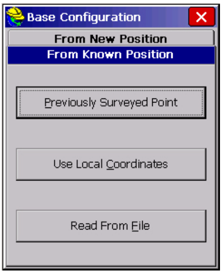
This section is a supplement to the section *Set Base Position on page 35* where the procedure is only outlined.

For theoretical aspects, see also *Choosing a Location for the Base on page 82*.

Depending on how you chose the base site (is its position known or unknown?), choose either **From Known Position**, for known position, or **From New Position**, for unknown position.

Then of the three possible choices, choose the one that suits your job.

Known Base Position



Choice	Case of Use
Previously Surveyed Point	Choose this option if the base is installed on a point you surveyed earlier and the latitude, longitude and ellipsoidal height of this point are saved in the open job. In this case, select this point from the job's point list or select it graphically on the map of the working area.
Use Local Coordinates	Choose this option if the coordinates of the point where the base is installed are known and expressed in the projection system used in the job. You can enter the local coordinates either manually or by choosing a point from the job's points list. In this case, and unlike the previous choice, the point from the points list is defined with local instead of geographical (lat, lon, height) coordinates.
Read from File	Choose this option if the geographical coordinates of the base were saved earlier to a REF file. Then select this file to load the position held in this file as the base position.

Unknown Base Position

Choice	Case of Use
Read from GPS	Choose this option if you want the base receiver to determine its own WGS84 coordinates. The coordinates will be determined to within 2-3 meters as the autonomous GPS mode is used in this case. To improve the accuracy of the computation, FAST Survey prompts you to take several readings (typically 10) so all the readings can be averaged to provide a more accurate position solution for the base.
Enter Lat/Lon	Choose this option if you know and want to enter manually the latitude, longitude and ellipsoidal height of the base location, rather than ask the receiver to compute them by itself. The coordinates should be entered in the “dd.mmssss” format for latitude and longitude.
Enter Grid System Coordinates	Choose this option to freely enter base coordinates expressed in the projection system used in the job. You may enter them manually or derive them from a point in the points list or a point you select on the map of the working area.

Changing the Radio Module or Using One for the First Time

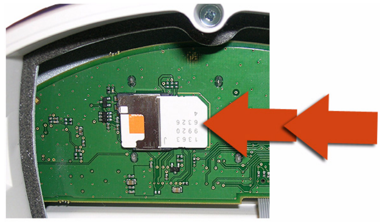
- Turn the ProMark 500 upside down.
- Using a flat screw driver, loosen the two quarter-turn screws of the radio module (or compartment door if your ProMark 500 was purchased without a radio module).

- Gently pull the module (or compartment door) out of the ProMark 500. The picture below shows a ProMark 500 from which a radio module was removed.

- Insert the new radio module. This should be done gently, taking care not to damage the 16-pin male connector, which connects to the bottom of the receiver. When the module is fully inserted, tighten the screws.
- When next turning on the ProMark 500, don’t forget to use the Power+Log+Scroll button combination. By restoring the factory settings, this procedure will allow the receiver to query, and so identify, the new radio module.

Installing a SIM Card

- Turn the ProMark 500 upside down.
- Using a flat screwdriver, loosen the two quarter-turn screws of the radio module (or compartment door if your ProMark 500 was purchased without a radio module).
- Pull the radio module or compartment door out of the ProMark 500. This unveils the printed circuit board located at the bottom of the case, on which you can insert your SIM card.
- Insert the SIM card as shown below.



- Put the radio module or compartment door back in place. Tighten the two screws.

Configuring the Serial Port

- Set up your equipment in such a way that it can successfully receive and process a serial command sent from outside the equipment. See *Applying Serial Commands on page 162* in this manual to know how this can be done.
- Use the $PASHS,MDP serial command to configure the serial port as an RS232 or RS422 port. Refer to *MDP: Setting Port A to RS232 or RS422 on page 201* in this manual to learn how to use this command.
- Use the $PASHS,CTS command to enable/disable hardware handshaking. Refer to *CTS: Handshaking on page 186*.

NOTE: A Bluetooth connection is also possible between a Bluetooth-enabled computer and the receiver.

Enabling a Firmware Option

- Set up your equipment in such a way that it can successfully receive and process a serial command sent from outside the equipment. See *Applying Serial Commands on page 162* in this manual to know how this can be done.
- Use the $PASHS,OPTION serial command to enable the firmware option. Refer to *OPTION: Receiver Firmware Options on page 211* in this manual to learn how to use this command.

  Through this command, you will enter the code provided by Magellan after you purchased the option. Entering this code into the receiver will unlock the option.

Using a Geoid File in the Localization Process

Uploading a Geoid File to the Field Terminal

Use GNSS Solutions' Geoids utility exclusively to upload a geoid file to the field terminal.

From a given geoid model, the Geoids utility allows you to extract part of the open geoid corresponding to your working area before uploading the data to the field terminal. This results in a smaller file in the field terminal. Follow the instructions below to upload a geoid file.

- Turn on your office computer and field terminal.
- Connect a USB cable between your office computer and field terminal.
- Run GNSS Solutions' Geoids utility on your office computer.
- In Geoids, use the **File>Open** command to open the geoid model you wish to use
- Use the **File>Extract as** command and define the limits of the geoid corresponding to your working area.
- Name the resulting geoid and click on the **Extract** button. A new window opens in Geoids showing the properties of your geoid extraction.
- Select **Transfer>Write.**
- Select "FAST Survey data collector" in the upper field and click **OK**.
- Select "ActiveSync" as the communication type between the computer and the field terminal and "Automatic Transfer".
- Click **OK**. This starts the data transfer. Wait until the "Transfer complete" message is displayed. The geoid file can now be found on the field terminal in \MyDevice\FAST Survey\Data\ as a *.GSF file.

Selecting a Geoid File for Use in FAST Survey's Localization Process

In FAST Survey, do the following:

- In the **Equip** menu, tap on the **Localization** button.
- Tap on the **GPS** tab.
- Tap on the **Geoid File:** button. This opens the \MyDevice\FAST Survey\Data\ folder from which you can now select the geoid file you have just uploaded.
- Select the file and tap . The name of the geoid file now appears underneath the Geoid File: button, meaning that from now on, it is used in the localization procedure for the processing of elevations.

Using a ProMark3 RTK Rover with a ProMark 500 RTK Base

The ProMark 500 can serve as a base for ProMark3 RTK rovers.

In this configuration, a radio link is used between the ProMark 500 and the ProMark3 RTK to transfer base corrections to rovers.

The ProMark 500 will use a Magellan or Pac Crest transmitter and the ProMark3 RTK a Pac Crest radio receiver (“stick” type).

The ProMark 500 should be set up to broadcast corrections in RTCM3.1 format.

The range of the radio link will be that of the ProMark 500 radio transmitter.

ProMark 500 Serial Commands Supplement

Appendix A. Using Serial Commands

Introduction to Serial Commands

Serial commands allow you to communicate directly with the receiver in machine language. Serial commands can be used for various purposes such as:

- Changing default settings
- Monitoring different receiver statuses (internal operation, constellations, etc.)
- Outputting messages on request
- Installing firmware options, etc.

Serial commands fall into two categories:

- *Set* commands ($PASHS,...), used to set or modify the receiver's internal parameters.
- *Query* commands ($PASHQ,...), used to interrogate the receiver.

The few conventions used to describe the serial commands in this manual are summarized in the table below.

String or sign	Description
$PASHS	Header for set commands (Whole line shown in bold characters)
$PASHQ	Header for query commands (Whole line shown in bold characters)
$PASHR	Receiver response line, in normal characters.
$--	Header prefix for all standard NMEA messages delivered by the receiver.
[ ]	Optional field or parameter
,	Field delimiter
.	Decimal point (used in f-type fields)
c..	One-character string
d..	Integer
f..	Real number, with decimal places
h..	Parameter in hexadecimal notation
m..	Denotes specific data format used, such as angles (e.g. ddmm.mmm) or time (e.g. hhmmss.sss)
s..	Character string
*cc	Checksum

Applying Serial Commands

From the Office Computer

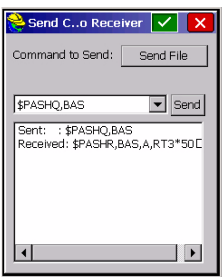
Connect serial port COM1 on your computer to a serial port on your receiver using the appropriate data cable.

Use GNSS Solutions' WinComm utility to send your serial commands. See *GNSS Solutions Reference Manual* or WinComm On-Line Help for more information on WinComm.

From FAST Survey

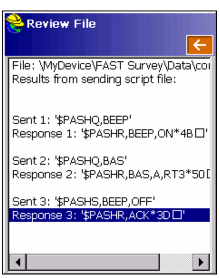
From the FAST Survey menu, tap on the **Equip** tab, then on the **GPS Utilities** button, and then on the **Send Command** button. It is assumed that the communication with the receiver has been established via Bluetooth or a serial cable.

Running a Single Command at a Time



- Tap your command directly in the combo box using FAST Survey's virtual keyboard. The keyboard appears automatically when you tap inside the box.
- Tap after you have typed the command line.
- Tap on the **Send** button to send the command to the receiver. The command line as well as the response line(s) then appear at the bottom of the screen.

Running a Series of Commands



First of all, you need to create a TXT file containing all the commands you want the receiver to run. Save the file to the "MyDevice/FAST Survey/Data/" folder. Then do the following:

- Use the **Send File** button in the upper part of the window to select the TXT file and send it to the receiver.
- Once the receiver has executed all the commands included in the file, a new window is displayed listing each of the commands run in the receiver as well the resulting receiver response line(s).
- Tapping will take you back to the command window.

List of Commands

The two categories of commands (set/query) are combined in a single table. Commands appear in alphabetical order. All pairs of related set and query commands (e.g. $PASHS,ANH and $PASHQ,ANH) always appear in the same row.

Set Command	Description	Query Command	Description
		$PASHQ,ALM	Almanac message
$PASHS,ANH	Antenna height	$PASHQ,ANH	Antenna height
$PASHS,ANR	Antenna reduction mode	$PASHQ,ANR	Antenna reduction mode
$PASHS,ATM	ATOM messages	$PASHQ,ATM	ATOM data parameters
$PASHS,ATM,ALL	Disable ATOM messages		
$PASHS,ATM,PER	ATOM output rate		
		$PASHQ,ATO	ATOM message parameters
$PASHS,BAS	Differential data type	$PASHQ,BAS	DIfferential data type
$PASHS,BEEP	Beeper	$PASHQ,BEEP	Beeper
		$PASHQ,BTH	Bluetooth settings
$PASHS,BTH,NAME	Bluetooth device name		
$PASHS,BTH,PIN	Bluetooth device pin code		
		$PASHQ,CMR,MSI	CMR message status
$PASHS,CMR,TYP	CMR message type & rate		
		$PASHQ,CPD,AFP	Ambiguity fixing parameter
		$PASHQ,CPD,ANT	Base antenna height
$PASHS,CPD,FST	RTK output mode	$PASHQ,CPD,FST	RTK output mode
$PASHS,CPD,MOD	Base/rover mode	$PASHQ,CPD,MOD	Base/rover mode
$PASHS,CPD,NET	Network corrections	$PASHQ,CPD,NET	Network operation mode
		$PASHQ,CPD,POS	Base position
$PASHS,CPD,REM	Differential data port	$PASHQ,CPD,REM	Differential data port
$PASHS,CPD,RST	RTK process reset		
		$PASHQ,CRT	Cartesian coordinates of position
$PASHS,CTS	Handshaking	$PASHQ,CTS	Handshaking
		$PASHQ,DCR	Cartesian coordinates of baseline
$PASHS,DIP		$PASHQ,DIP	Direct IP parameters
$PASHS,DIP,OFF	Direct IP connection		
		$PASHQ,DPO	Delta position
$PASHS,DRI	Raw data recording rate	$PASHQ,DRI	Raw data recording rate
$PASHS,DYN	Receiver dynamics	$PASHQ,DYN	Receiver dynamics
		$PASHQ,ELM	Elevation mask
$PASHS,FIL,D	Deleting files		
		$PASHQ,FLS	List of raw data files
		$PASHQ,GGA	GNSS position message
		$PASHQ,GLL	Geographic position-lat./long.
$PASHS,GLO	GLONASS tracking	$PASHQ,GLO	GLONASS tracking
		$PASHQ,GRS	GNSS range residuals
		$PASHQ,GSA	GNSS DOP & active satellites

Set Command	Description	Query Command	Description
		$PASHQ,GST	GNSS pseudorange error statistics
		$PASHQ,GSV	GNSS satellites in view
$PASHS,INI	Receiver initialization		
$PASHS,LTZ	Time zone		
		$PASHQ,MDM	Modem status and parameters
$PASHS,MDM,DAL	dialing and hanging up		
$PASHS,MDM,INI	Initializing the modem		
		$PASHQ,MDM,LVL	Modem signal level
$PASHS,MDM,OFF	Internal modem power off		
$PASHS,MDM,ON	Internal modem power on		
$PASHS,MDM,PAR	Setting modem parameters		
$PASHS,MDP	Port A setting	$PASHQ,MDP	Port A setting
$PASHS,MEM	Memory device used	$PASHQ,MEM	Memory device used
$PASHS,MWD	Modem timeout	$PASHQ,MWD	Modem timeout
$PASHS,NME	NMEA messages (ON/OFF)		
$PASHS,NME,PER	NMEA output rate		
		$PASHQ,NMO	NMEA output settings
		$PASHQ,NTR	NTRIP settings
$PASHS,NTR,LOD	Loading NTRIP source table		
$PASHS,NTR,MTP	Connect to NTRIP mount point		
$PASHS,NTR,PAR	NTRIP settings		
		$PASHQ,NTR,TBL	Source table
$PASHS,OCC	Writing occupation data	$PASHQ,OCC	Occupation state and parameters
$PASHS,OPTION	Receiver firmware options	$PASHQ,OPTION	Receiver firmware options
$PASHS,PEM	Position elevation mask	$PASHQ,PEM	Position elevation mask
$PASHS,POS	Antenna position	$PASHQ,POS	Computed position data
$PASHS,PRT	Baud rates	$PASHQ,PRT	Baud rates
$PASHS,PWR,OFF	Powering off the receiver		
$PASHS,PWR,PAR	Power management	$PASHQ,PWR,PAR	Power status
$PASHS,RAW	Raw data messages (ON/OFF)	$PASHQ,RAW	Raw data settings
$PASHS,RAW,PER	Raw data output rate		
		$PASHQ,RDP,CHT	Radio channel table
$PASHS,RDP,OFF	Powering off internal radio		
$PASHS,RDP,ON	Powering on internal radio		
$PASHS,RDP,PAR	Setting the radio	$PASHQ,RDP,PAR	Radio parameters
$PASHS,RDP,TYP	Radio type used	$PASHQ,RDP,TYP	Radio type used
$PASHS,REC	Raw data recording	$PASHQ,REC	Raw data recording
		$PASHQ,RID	Receiver identification
		$PASHQ,RMC	Recomm. min. specific GNSS data
		$PASHQ,RRE	Residual error
$PASHS,RST	Default settings		
		$PASHQ,RTC	RTCM status
$PASHS,RTC,MSG	User message		
		$PASHQ,RTC,MSI	RTCM messages status
$PASHS,RTC,TYP	RTCM message type		

Set Command	Description	Query Command	Description
		$PASHQ,RWO	Raw data output settings
		$PASHQ,SAT	Satellites status
$PASHS,SBA	SBAS tracking (ON/OFF)	$PASHQ,SBA	SBAS tracking status
$PASHS,SBA	SBAS messages (ON/OFF)		
$PASHS,SBA,ALL	Disabling all SBAS messages		
		$PASHQ,SBA,INF	SBAS info message output
		$PASHQ,SBO	SBAS message output settings
$PASHS,SIT	Site name	$PASHQ,SIT	Site name
$PASHS,STI	Station ID	$PASHQ,STI	Station ID
		$PASHQ,VEC	Vector & accuracy data
		$PASHQ,VERSION	Firmware version
		$PASHQ,VTG	COG and ground speed
$PASHS,WAK	Alarm acknowledgement		
		$PASHQ,WARN	Warning messages
$PASHS,ZDA	Time and date	$PASHQ,ZDA	Time and date

Default Settings

This section describes the factory settings saved in the ProMark 500’s permanent memory. (These default settings were pre-loaded into your receiver by running the appropriate set of serial commands.)

Wherever mentioned in this section, “M” and “U” ports refer to memories or files. “M” designates the internal memory, and “U” the external memory (USB mass storage device).

Serial Ports

Parameter	Range	Default
Port A baud rate	300 to 115200 Bd	19200 Bd
Port A RTS/CTS protocol	ON or OFF	ON
Port A mode	232, 422	232
Port D baud rate	300 to 115200	38400
Port E baud rate	300 to 115200	115200

Bluetooth

Parameter	Range	Default
Device name	64 characters max.	Serial number
PIN code	8 digits max.	-1 (no PIN code)

Modem

Parameter	Range	Default
Power management	Manual, Automatic	Manual
PIN code	8 digits max.	

Parameter	Range	Default
Protocol	CSD, GPRS	GPRS
CDS mode	V.32, V.110	V.32
GPRS access point name	32 characters max.	
GPRS login	32 characters max.	
GPRS password	32 characters max.	
Internet protocol	TCP, UDP	TCP
Phone number	20 digits max.	
Auto-dial mode	Yes, No	Yes
Number of re-dials	0-15	2
Watch dog	0-99	0
NTRIP IP address	xxx.xxx.xxx.xxx	
NTRIP host name	32 characters max.	
NTRIP port number	0-65535	2100
NTRIP login	32 characters max.	
NTRIP password	32 characters max.	
NTRIP type	Client, Server	Client
Direct IP address (or host name)	xxx.xxx.xxx.xxx	0.0.0.0
Direct IP port number	0-65535	2100

Internal Radio (Port D)

Parameter	Range	Default
Radio type	UNKNOWN, NONE, PDL	
Power management	Manual, Automatic	Automatic

NMEA Messages, Computed Data

Parameter	Range	Default
Output rate	0.05 s - 999 s	1 s
Port A - xxx	ON, OFF	OFF
Port A - xxx rate	0.05 s - 999 s	1 s
Port C - xxx	ON, OFF	OFF
Port C - xxx rate	0.05 s - 999 s	1 s
Port D - xxx	ON, OFF	OFF
Port D - xxx rate	0.05 s - 999 s	1 s
Port M - xxx	ON, OFF	OFF
Port M - xxx rate	0.05 s - 999 s	1 s
Port U - xxx	ON, OFF	OFF
Port U - xxx rate	0.05 s - 999 s	1 s

xxx: NMEA message type ALM, GGA, GLL, GRS, GSA, GST, GSV, RMC, VTG, ZDA, CRT, DCR, DPO, MSG, POS, RRE or SAT, VEC.

NMEA Messages, Raw Data

Parameter	Range	Default
Output rate	0.05 s - 999 s	1 s
Port A - xxx	ON, OFF	OFF
Port A - xxx rate	0.05 s - 999 s	1 s
Port C - xxx	ON, OFF	OFF
Port C - xxx rate	0.05 s - 999 s	1 s
Port D - xxx	ON, OFF	OFF
Port D - xxx rate	0.05 s - 999 s	1 s
Port M - xxx	ON, OFF	OFF
Port M - xxx rate	0.05 s - 999 s	1 s
Port U - xxx	ON, OFF	OFF
Port U - xxx rate	0.05 s - 999 s	1 s

xxx: NMEA message type MPC, SNV, SNG, SNW, SAG, SAL, SAW or ION.

NMEA Messages, SBAS Data

Parameter	Range	Default
Output rate	0.05 s - 999 s	1 s
Port A - xxx	ON, OFF	OFF
Port A - xxx rate	0.05 s - 999 s	1 s
Port C - xxx	ON, OFF	OFF
Port C - xxx rate	0.05 s - 999 s	1 s
Port D - xxx	ON, OFF	OFF
Port D - xxx rate	0.05 s - 999 s	1 s
Port M - xxx	ON, OFF	OFF
Port M - xxx rate	0.05 s - 999 s	1 s
Port U - xxx	ON, OFF	OFF
Port U - xxx rate	0.05 s - 999 s	1 s

xxx: NMEA message type DAT or INF.

Raw Data Logging

Parameter	Range	Default
Memory Storage location	Internal, External	Internal
Raw data recording mode	Yes, No	No
Raw data recording rate	0.05 s - 999 s	1 s
Site name	4 characters	four “underscores”

GNSS Reception

Parameter	Range	Default
SBAS use	ON, OFF	ON
GLONASS use	ON, OFF	ON

Antenna Parameters

Parameter	Range	Default
Antenna reduction mode	OFF, ON, ARP	ON
Antenna height	0-6.553 m	0
Type of antenna height	Vertical, slant	Vertical

Position Computation

Parameter	Range	Default
Receiver mode	Rover, Base	Rover
Ambiguity fixing parameter	95.0, 99.0, 99.9	99.0
Fast RTK output mode	OFF, ON	ON
Rover dynamics	1-8	8
RTK network operation mode	0-2	1
Position elevation mask	0-90°	5°
Incoming differential data	Automatic, Manual	Automatic
Incoming differential port 1	A, C, D, E	
Incoming differential port 2	A, C, D, E	

Base

Parameter	Range	Default
Differential data type 1	NONE, RT2 (RTCM2.3), RT3 (RTCM3.x), CMR, CMR+	RT3
Differential data port 1	A, D, E, M, U	A
Differential data type 2	NONE, RT2 (RTCM2.3), RT3 (RTCM3.0), DBN (DBEN), CMR, CMR+	NONE
Differential data port 2	A, D, E, M, U	A
RTCM 2.3 type xxx rate*	0-300 s	Type 3: 30 s Type 18: 1 s Type 19: 1 s Type 22: 30 s Other: 0
RTCM 3.x type xxx rate**	0-300 s	Type 1004: 1 s Type 1006: 13 s Type 1012: 1 s Type 1033: 13 s
CMR station ID	0-31	1
RTCM2.3 station ID	0-1023	1
RTCM3.x station ID	0-4095	1
CMR type 0 rate	0, 0.5 s, 1-300 s	1 s
CMR type 1 rate	0-300 s	30 s
CMR type 2 rate	0-300 s	30 s
Base position (lat, lon, height)		0°, 0°, 0 m
Elevation mask	0-90 degrees	5 degrees

*: Message type 1, 3, 16, 18, 20, 22, 23, 24, 31 or 32.

**: Message type 1001, 1002,.. 1013, 1019, 1020, 1029 or 1033.

Power

Parameter	Range	Default
Minimum battery level	6.7 - 8.4 V DC	6.8
Minimum external DC level	9.0 - 28.0 V DC	9.1

Time

Parameter	Range	Default
Local time zone, hours	-13 to +13	0
Local time zone, minutes	0-59	0

User Interface

Parameter	Range	Default
Beeper state	ON, OFF	ON

Appendix B. Set Command Library

ANH: Antenna Height

Function

This command allows you to enter the antenna height . If not specified, the height measurement type is set to “Vertical”.

Command Format

Syntax

$PASHS,ANH,f1[,c2][*cc]

Parameters

Parameter	Description	Range
f1	Antenna height.	0-6.553 m
c2	Antenna height measurement type: • V: Vertical measurement • S: Slant measurement	V, S
*cc	Optional checksum	*00-*FF

Examples

Entering the vertical measurement (2 m) of a rover antenna:

$PASHS,ANH,2.000

Entering the slant measurement (1.543 m) of a base antenna:

$PASHS,ANH,1.543,S

Relevant Query Command

$PASHQ,ANH

See also

$PASHS,ANR

ANR: Antenna Reduction Mode

Function

This command allows you to set the antenna reduction mode. The default value is ON.

Command Format

Syntax

$PASHS,ANR,s1[*cc]

Parameters

Parameter	Description	Range
s1	Antenna reduction mode: • OFF: No antenna reduction. It is therefore the location of the L1 phase center that is assumed to be the real location of the base, or the position to be determined (rover). • ON: Antenna reduction is active (default). From the parameters entered through the $PASHS,ANH command, the location of the L1 phase center is projected to the ground thus making this point the real location of the base, or the position to be determined (rover). • ARP: From the antenna parameters, the location of the L1 phase center is projected to the Antenna Reference Plane (ARP) thus making this point the real location of the base, or the position to be determined (rover). The $PASHS,ANH setting is ignored when s1=ARP. Obviously, the antenna reduction mode setting should be the same for the pair of base/rover receivers used.	OFF, ON, ARP
*cc	Optional checksum	*00-*FF

Example

Setting the antenna reduction mode to ON:

$PASHS,ANR,ON

Relevant Query Command

$PASHQ,ANR

See also

$PASHS,ANH

ATM: Enabling/Disabling ATOM Messages

Function

This command allows you to enable or disable ATOM messages on the specified port.

Command Format

Syntax

$PASHS,ATM,s1,c2,s3[,f4][*cc]

Parameters

Parameter	Description	Range
s1	ATOM message type	MES, PVT, ATR, NAV, DAT. See table below.
c2	Port routing the ATOM message: • A: Serial port • C: Bluetooth port • M: Internal memory • U: External memory (USB device)	A, C, M, U
s3	Enable (ON) or disable (OFF) this ATOM message type.	ON, OFF
f4	Output rate	0.1-0.9 s 1-999 s
*cc	Optional checksum	*00-*FF

ATOM Message types

Data	ATOM Message Number	Description
MES	4095,2	GNSS raw measurements
PVT	4095,3	Positioning resullts (2 Hz max.)
ATR	4095,4	Receiver attributes
NAV	4095,5	GNSS navigation data
DAT	4095,6	Raw navigation data

Example

Enabling ATOM message type “PVT”on serial port A at a 1-second output rate:

$PASHS,ATM,PVT,A,ON,1

Relevant Query Commands

$PASHQ,ATO
$PASHSQ,ATM

See also

$PASHS,ATM,PER
$PASHS,ATM,ALL

ATM,ALL: Disabling All ATOM Messages

Function

This command disables all ATOM messages currently enabled on the specified port.

Command Format

Syntax

$PASHS,ATM,ALL,c1,OFF[*cc]

Parameters

Parameter	Description	Range
c1	Port related to the ATOM message(s) you want to disable. • A: Serial port • C: Bluetooth port • M: Internal memory • U: External memory (USB device)	A, C, M, U
*cc	Optional checksum	*00-*FF

Example

Disabling all ATOM messages on port A:

$PASHS,ATM,ALL,A,OFF

Relevant Query Command

None.

See also

$PASHS,ATM

ATM,PER: Setting Unique Output Rate for all ATOM Messages

Function

This command is used to set the same output rate for all ATOM messages. This command will overwrite all the output rates set individually for each message type using $PASHS,ATM,xxx.

Command Format

Syntax

$PASHS,ATM,PER,f[*cc]

Parameters

Parameter	Description	Range
f	Output rate	0.1-0.9 s 1-999 s
*cc	Optional checksum	*00-*FF

Example

Setting the output rate to 1 second:

$PASHS,ATM,PER,1

Relevant Query Command

$PASHQ,ATM

See also

$PASHS,ATM

BAS: Differential Data Type

Function

This command is used in a base to select the type of differential data the base should generate and the port, or two ports, through which this data should be routed.

Command Format

Syntax

$PASHS,BAS,c1,s2[,c3,s4][*cc]

Parameters

Parameter	Description	Range
c1	First port ID: • A: Serial port (default) • C: Bluetooth port • D or E: Internal radio port/modem • M: Internal memory • U: External memory (USB device)	A, C, D, E, M, U
s2	Differential data type: • RT2: RTCM 2.3 messages • RT3: RTCM 3.0 & 3.1 messages (default) • CMR: CMR messages • CMP: CMR+ messages	RT2, RT3, CMR, CMP
c3	Second port ID: same as c1 above	A, C, D, E, M, U
s4	Differential data type: same as s2 above.	RT2, RT3, CMR, CMP
*cc	Optional checksum	*00-*FF

Examples

Sending RTCM 3.0 message to the external UHF transmitter via port A:

$PASHS,BAS,A,RT3

Sending RTCM 2.3 messages to the external UHF transmitter via port D and CMR+ messages to the GSM modem via port E:

$PASHS,BAS,D,RT2,E,CMP

Relevant Query Command

$PASHQ,BAS.

See also

$PASHS,CPD,MOD
$PASHS,RTC,TYP

BEEP: Beeper Setup

Function

This command enables or disables the internal beeper.

Command Format

Syntax

$PASHS,BEEP,s[*cc]

Parameters

Parameter	Description	Range
s	Enables (ON) or disables (OFF) the beeper.	ON, OFF
*cc	Optional checksum	*00-*FF

Example

Disabling the beeper:

$PASHS,BEEP,OFF

Relevant Query Command

$PASHQ,BEEP

BTH,NAME: Bluetooth Device Name

Function This command is used to name the Bluetooth device.

Command Format

Syntax

$PASHS,BTH,NAME,s1[*cc]

Parameters

Parameter	Description	Range
s1	Bluetooth device name	64 characters max.
*cc	Optional checksum	*00-*FF

Example

Naming the Bluetooth device as “My Surveying Unit”:

$PASHS,BTH,NAME,My Surveying Unit

Relevant Query Command $PASHQ,BTH

See also $PASHS,BTH,PIN

BTH,PIN: Bluetooth Device Pin Code

Function

This command is used to assign a PIN code to the Bluetooth device.

Command Format

Syntax

$PASHS,BTH,PIN,d1[*cc]

Parameters

Parameter	Description	Range
d1	Bluetooth PIN code	0-99999999 -1: no PIN code
*cc	Optional checksum	*00-*FF

Example

Assigning PIN code “02” to the Bluetooth device:

$PASHS,BTH,PIN,02

Relevant Query Command

$PASHQ,BTH

See also

$PASHS,BTH,NAME

CMR,TYP: CMR Message Type and Rate

Function

This command is used in a base to set the type and rate of CMR message the base will generate and deliver.

Command Format

Syntax

$PASHS,CMR,TYP,d1,d2[*cc]

Parameters

Parameter	Description	Range
d1	Message type	0, 1, 2 (See table below)
d2	Output rate in seconds	0, 0.5 or 1-300 (See table below)
*cc	Optional checksum	*00-*FF

Message Type	Description	Output Rate (Range)	Output Rate (Default)
0	Observables	0, 0.5 s or 1-300 s	1 s
1	Base coordinates	0-300 s	30 s
2	Base description	0-300 s	30 s

Examples

Setting a CMR message type 0 (observables) at a 1-second output rate:

$PASHS,CMR,TYP,0,1

Setting a CMR message type 1 (base coordinates) at a 30-second output rate:

$PASHS,CMR,TYP,1,30

Relevant Query Command

$PASHQ,CMR,MSI

See also

$PASHS,BAS

$PASHS,CPD,MOD,BAS.

CPD,FST: RTK Output Mode

Function

This command enables or disables the fast RTK output mode (Fast CPD mode).

Command Format

Syntax

$PASHS,CPD,FST,s[*cc]

Parameters

Parameter	Description	Range
s	Enables (ON) or disables (OFF) the fast RTK output mode	ON, OFF
*cc	Optional checksum	*00-*FF

Example

Enabling the fast RTK output mode:

$PASHS,CPD,FST,ON

Relevant Query Command

$PASHQ,CPD,FST

CPD,MOD: Base/Rover Mode

Function

This command is used to set the addressed receiver as a base or a rover, thus defining the operating mode for the receiver. In addition the command allows you to specify the satellite constellations that will be used effectively if the receiver is defined as a base.

Command Format

Syntax

$PASHS,CPD,MOD,s1[,c2][*cc]

Parameters

Parameter	Description	Range	Default
s1	CPD mode: • BAS: Base • ROV: Rover	BAS, ROV	ROV
d2	Constellations used in the base: • 0: GPS, GLONASS, SBAS (default) • 1: Only GPS and SBAS • 2: Only GPS and GLONASS • 3: Only GPS	0-3	0
*cc	Optional checksum	*00-*FF	

Examples

Setting the receiver as a base using all constellations:

$PASHS,CPD,MOD,BAS,0

Setting the receiver as a rover:

$PASHS,CPD,MOD,ROV

Relevant Query Command

$PASHQ,CPD,MOD

See also

$PASHS,BAS
$PASHS,CPD,REM

CPD,NET: Network Corrections

Function

This command sets the behavior of the receiver with respect to network corrections, i.e. RTK correction data delivered by a network.

Command Format

Syntax

$PASHS,CPD,NET,d[*cc]

Parameters

Parameter	Description	Range	Default
d	Possible values for d: • 0: Network corrections not processed • 1: Network corrections processed if available and healthy. The receiver will automatically switch to “standard” RTK mode if network corrections are no longer available or healthy. • 2: Network corrections are mandatory. Any satellite for which network corrections are not healthy will not be used.	0-2	1
*cc	Optional checksum	*00-*FF	

Example

Setting the receiver to not process network corrections:

$PASHS,CPD,NET,0

Relevant Query Command

$PASHQ,CPD,NET

CPD,REM: Differential Data Port

Function

This command sets the reception mode for all differential data.

If Automatic is chosen, all received differential data is processed whatever the input ports.

On the contrary, if Manual is chosen, only the data coming in through the specified ports (one or two ports) will be processed.

Command Format

Syntax

$PASHS,CPD,REM,s1[,c2][,c3][*cc]

Parameters

Parameter	Description	Range	Default
s1	Reception mode: • AUT: Automatic (default) • MAN: Manual	AUT, MAN	AUT
c2	Input port #1	A, C, D, E	
c3	Input port #2	A, C, D, E	
*cc	Optional checksum	*00-*FF	

Examples

Setting the receiver to receive and process differential data in Automatic mode:

$PASHS,CPD,REM,AUT

Setting the receiver to receive and process differential data in Manual mode with the data received on port D:

$PASHS,CPD,REM,MAN,D

See also

$PASHS,CPD,MOD

CPD,RST: RTK Process Reset

Function This command resets the RTK processing.

Command Format

Syntax

$PASHS,CPD,RST[*cc]

Parameters

None

Example

Resetting the RTK processing:

$PASHS,CPD,RST

Relevant Query Command None.

CTS: Handshaking

Function

This command enables or disables the RTS/CTS handshaking protocol for the specified port.

Command Format

Syntax

$PASHS,CTS,c1,s2[*cc]

Parameters

Parameter	Description	Range	Default
c1	Port ID	A	A
s2	RTS/CTS control (default: ON)	ON, OFF	ON
*cc	Optional checksum	*00-*FF	

Example

Disabling RTS/CTS on port A:

$PASHS,CTS,A,OFF

Relevant Query Command

$PASHQ,CTS

See also

$PASHS,PRT
$PASHS,MDP

DIP: Server Connection

Function

This command is used to connect the receiver to a base via the base's IP address or host name.

Command Format

Syntax

$PASHS,DIP,RIP,s1,PRT,d2[,LGN,s3,PWD,s4][*cc]

Parameters

Parameter	Description	Range
s1	IP address (xxx.xxx.xxx.xxx) or host name	32 char. max.
d2	Port number	0-65535
s3	User name (optional)	20 char. max.
s4	Password (optional)	20 char. max.
*cc	Optional checksum	*00-*FF

Comments

Optional fields s3 and s4 need to be specified when the base used requires a user name and password. In this case, the receiver sends the $GPUID,s2,s4 command to the base right after the IP connection has been established.

Examples

Connecting the receiver to IP address 134.20.2.100 and port number 6666:

$PASHS,DIP,RIP,134.20.2.100,PRT,6666

Connecting the receiver to www.magellangps.com through port 8080:

$PASHS,DIP,RIP,www.magellangps.com,PRT,8080

Relevant Query Commands

$PASHQ,MDM
$PASHQ,DIP

See also

$PASHS,MDM
$PASHS,DIP,OFF

DIP,OFF: Terminating Direct IP Connection

Function

This command is used to terminate the current connection to a base via the base's IP address or host name.

Command Format

Syntax

$PASHS,DIP,OFF[*cc]

Parameters

None.

Examples

Terminating the current connection:

$PASHS,DIP,OFF

Relevant Query Command

$PASHQ,MDM

See also

$PASHS,DIP

DRI: Raw Data Recording Rate

Function

This command sets the recording rate for all raw data logged in the internal or external memory.

Command Format

Syntax

$PASHS,DRI,f[*cc]

Parameters

Parameter	Description	Range	Default
s	Raw data recording rate	0.1-0.9 s 1-999 s	1 s
*cc	Optional checksum	*00-*FF	

Example

Setting the recording rate to 5 seconds:

$PASHS,DRI,5

Relevant Query Command

$PASHQ,DRI

See also

$PASHS,ATM
$PASHS,RAW
$PAHS,REC

DYN: Receiver Dynamics

Function

This command allows you to define the receiver dynamics.

Command Format

Syntax

$PASHS,DYN,d[*cc]

Parameters

Parameter	Description	Range	Default
d	Receiver dynamics: • 1: Static • 2: Quasi-static • 3: Walking • 4: Ship • 5: Automobile • 6: Aircraft • 7: Unlimited • 8: Adaptive	1-8	8
*cc	Optional checksum	*00-*FF	

Examples

Setting rover dynamics to “Walking”:

$PASHS,DYN,3

Setting base dynamics to “Static”:

$PASHS,DYN,1

Relevant Query Command

$PASHQ,DYN

FIL,D: Deleting Files

Function

This command allows you to delete files from whichever internal or external memory is selected.

Command Format

Syntax

$PASHS,FIL,D,d[*cc]

Parameters

Parameter	Description	Range
d	File index number: • In the range 0-99: With file index number=n, then file “n+1” will be deleted. Warning! If the deleted file is not the last one in memory, all the files that follow the deleted file will have their index number re-ordered after file deletion. • =999: All the files in memory, except for the file being used, will be deleted.	0-99, 999
*cc	Optional checksum	*00-*FF

Example

Deleting the 6th file from memory:

$PASHS,FIL,D,5

Comments

If the file you want to delete is the only file present in the selected memory and this file is currently being used, the “NAK” message is returned to inform you that the file cannot be deleted.

Relevant Query Command

None.

See also

$PASHQ,FLS

$PASHS,MEM to select the memory from which to delete files.

GLO: GLONASS Tracking

Function

This command is used to enable or disable GLONASS tracking. It is valid only if the GLONASS option has been activated in the receiver.

Command Format

Syntax

$PASHS,GLO,s[*cc]

Parameters

Parameter	Description	Range	Default
s	Enables (ON) or disables (OFF) GLONASS tracking.	ON, OFF	ON
*cc	Optional checksum	*00-*FF	

Example

Enabling GLONASS:

$PASHS,GLO,ON

Relevant Query Command

$PASHQ,GLO

See also

$PASHS,SBA

INI: Receiver Initialization

Function

This command resets the receiver memory and then restarts the receiver.

Command Format

Syntax

$PASHS,INI,d1[*cc]

Parameters

Parameter	Description	Range
d1	File index number: • 0: Restarts the receiver without memory reset. • 1: Resets user settings, clears ephemeris, almanac and latest position/time data, and re-starts the receiver. • 2: Resets user settings, formats internal memory and re-starts the receiver. • 3: Resets user settings, formats internal memory, clears ephemeris, almanac and latest position/time data, and re-starts the receiver.	0, 1, 2, 3
*cc	Optional checksum	*00-*FF

Example

Resetting all and restarting the receiver:

$PASHS,INI,1

Relevant Query Command

None.

See also

$PASHS,RST

LTZ: Time Zone

Function

This command is used to set the local time zone.

Command Format

Syntax

$PASHS,LTZ,d1,d2[*cc]

Parameters

Parameter	Description	Range	Default
d1	Local time zone (hours).	-13 to +13	0
d2	Local time zone (minutes)	0-59	0
*cc	Optional checksum	*00-*FF	

Example

Setting local time to UTC+2:

$PASHS,LTZ,2,0

Relevant Query Command

$PASHQ,ZDA

See also

$PASHS,ZDA

MDM,DAL: Dialing and Hanging up

Function

This command is used to dial the phone number stored in memory or to hang up.

Command Format

Syntax

$PASHS,MDM,DAL,d[*cc]

Parameters

Parameter	Description	Range
d	1: Dials the phone number. 0: Hangs up.	0-1
[*cc]	Optional checksum	*00-*FF

Examples

Dialing the stored phone number:

$PASHS,MDM,DAL,1

Hanging up:

$PASHS,MDM,DAL,0

Relevant Query Command

$PASHQ,MDM

See also

$PASHS,MDM,PAR
$PASHS,MDM,INI

MDM,INI: Initializing the Modem

Function

This command is used to initialize the modem.

Command Format

Syntax

$PASHS,MDM,INI[*cc]

Parameters

None.

Example

Initializing the modem:

$PASHS,MDM,INI

If modem initialization is successful, you will get the following answer:

$PASHR,MDM,INI,OK*7A

If modem initialization failed, you will get the following answer:

$PASHR,MDM,INI,FAIL*7C

Relevant Query Command

$PASHQ,MDM

See also

$PASHS,MDM,PAR

MDM,OFF: Powering Off the Internal Modem

Function

This command is used to power off the internal modem.

Command Format

Syntax

$PASHS,MDM,OFF[*cc]

Parameters

None.

Example

Turning off the internal modem:

$PASHS,MDM,OFF

Relevant Query Command

$PASHQ,MDM

See also

$PASHS,MDM,ON

MDM,ON: Powering On the Internal Modem

Function

This command is used to power on the internal modem.

Command Format

Syntax

$PASHS,MDM,ON[*cc]

Parameters

None.

Example

Turning on the internal modem:

$PASHS,MDM,ON

Relevant Query Command

$PASHQ,MDM

See also

$PASHS,MDM,OFF

MDM,PAR: Setting the Modem Parameters

Function

This command is used to set the modem parameters.

Command Format

Syntax

$PASHS,MDM,PAR[,PWR,s1][,PIN,s2][,BND,d3][,PTC,d4][,CBS,d5][,APN,s6][,LGN,s7][,PWD,s8][,IPT,d9][PHN,s10][,ADL,c11],[RNO,d12][*cc]

Parameters

Parameter	Description	Range	Default
PWR,s1	Power mode: • AUT: Automatic • MAN: Manual	AUT, MAN	MAN
PIN,s2	PIN code	4-8 digits	Empty
BND,d3	Band: • 0: 850/1900 (North America) • 1: 900/1800 (Europe) • 2: 900/1900	0-2	0
PTC,d4	Protocol: • 0: CSD • 1: GPRS	0-1	1
CBS,d5	CSD mode: • 0: V.32 9600 bauds • 1: V.110 9600 bauds ISDN	0-1	0
APN,s6	Access Point Name (GPRS)	32 char. max.	Empty
LGN,s7	Login (GPRS)	32 char. max.	Empty
PWD,s8	Password (GPRS)	32 char. max.	Empty
IPT,d9	Internet Protocol: • 0: TCP • 1: UDP	0-1	0
PHN,s10	Phone number (CSD)	20 digits max.	Empty
ADL,c11	Auto-dial mode (CSD)	Y, N	Y
RNO,d12	Maximum number of re-dials (CSD)	0-15	2
*cc	Optional checksum	*00-*FF	

Examples

Setting GPRS Configuration:

$PASHS,MDM,PAR,PWR,AUT,PIN,1234,BND,0,PTC,1,APN,orange.fr,LGN,orange,PWD,orange,IPT,0

Setting GSM data configuration:

$PASHS,MDM,PAR,PWR,AUT,PIN,1234,BND,1,PTC,0,CBS,1,PHN,0228093838,ADL,Y,RNO,5

Relevant Query Command $PASHQ,MDM

See also

$PASHS,DAL
$PASHS,DIP
$PASHS,NTR
$PASHS,MWD

MDP: Setting Port A to RS232 or RS422

Function

This command is used to set port A as an RS232 or RS422 serial port.

Command Format

Syntax

$PASHS,MDP,A,c[*cc]

Parameters

Parameter	Description	Range	Default
c	Port setting (RS232 or RS422)	232, 422	232
*cc	Optional checksum	*00-*FF	

Example

Setting port A to RS422:

$PASHS,MDP,A,422

Relevant Query Command

$PASHQ,MDP

See also

$PASHS,PRT
$PASHS,CTS

MEM: Selecting Memory Device Used

Function

This command is used to select the memory used by the receiver.

Command Format

Syntax

$PASHS,MEM,d[*cc]

Parameters

Parameter	Description	Range	Default
d	Memory used: • 0: Internal memory (NAND Flash) • 2: USB mass storage key	0, 2	0
*cc	Optional checksum	*00-*FF	

Example

Selecting internal memory as the memory used by the receiver:

$PASHS,MEM,0

Relevant Query Command

$PASHQ,MEM

See also

$PASHS,FIL,D
$PASHQ,FLS

MWD: Setting the Modem Timeout

Function

This command is used to set the modem watchdog timeout. This parameter refers to the time during which the modem connection is active but no data is sent or received through the modem port. In case of timeout, the modem will hang up automatically.

Command Format

Syntax

$PASHS,MWD,d[*cc]

Parameters

Parameter	Description	Range	Default
d	Timeout setting: • 1-99: Modem timeout in minutes. • 0: No timeout	0-99	0
*cc	Optional checksum	*00-*FF	

Example

Setting the timeout to 5 minutes:

$PASHS,MWD,5

Relevant Query Command

$PASHQ,MWD

See also

$PASHS,MDM,PAR
$PASHQ,FLS

NME: Enabling/Disabling NMEA Messages

Function

This command is used to enable or disable NMEA messages and Magellan NMEA-like messages.

Command Format

Syntax

$PASHS,NME,s1,c2,s3[,f4][*cc]

Parameters

Parameter	Description	Range
s1	Data message type	See tables below
c2	Port routing the message: • A: Serial port • D: Radio • E: Modem • C: Bluetooth • M, U: Memory	A, C, D, E, M, U
s3	Enables (ON) or disables (OFF) the message	ON, OFF
f4	Output rate: • 0.1-0.9 or 1-999: Output rate in seconds • Omitted: The message output rate will be as defined with $PASHS,NME,PER	0.1-0.9 s 1-999 s
*cc	Optional checksum	*00-*FF

NMEA messages:

Data	Description
ALM	GPS almanac data
GGA	GPS fix data
GLL	Geographic position - Latitude / longitude
GRS	GNSS range residual
GSA	GNSS DOP and active satellites
GST	GNSS pseudo-range error statistics
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed
ZDA	Time and date

Magellan NMEA-like messages:

Data	Description
CRT	Cartesian coordinates
DCR	Delta cartesian
DPO	Delta position
POS	Position
RRE	Residual error

Data	Description
SAT	Satellite status
VEC	Vector and accuracy

Example

Setting GGA message on Bluetooth port at 1-second output rate:

$PASHS,NME,GGA,C,ON,1

Relevant Query Command

$PASHQ,NMO

See also

$PASHS,NME,PER

NME,PER: Setting Unique Output Rate for all NMEA Messages

Function

This command is used to set the same output rate for all NMEA and Magellan NMEA-like messages. This command will overwrite all the output rates set individually for each message type using $PASHS,NME,xxx.

Command Format

Syntax

$PASHS,NME,PER,f[*cc]

Parameters

Parameter	Description	Range	Default
f	Output rate	0.1-0.9 s 1-999 s	1 s
*cc	Optional checksum	*00-*FF	

Example

Setting the output rate to 1 second:

$PASHS,NME,PER,1

Relevant Query Command

$PASHQ,NMO

See also

$PASHS,NME

NTR,LOD: Loading the NTRIP Caster Source Table

Function

This command is used to load the source table from the NTRIP caster.

Command Format

Syntax

$PASHS,NTR,LOD[*cc]

Parameters

None.

Example

Loading the source table:

$PASHS,NTR,LOD

If the source table is downloaded successfully, the following response line will be returned:

$PASHR,NTR,OK*cc

If the receiver fails to download the source table, the following response line will be returned:

$PASHR,NTR,FAIL*12

Relevant Query Command

None.

See also

$PASHQ,NTR,TBL

NTR,MTP: Connecting Receiver to NTRIP Caster Mount Point

Function

This command allows you to connect the receiver to a NTRIP caster mount point.

Command Format

Syntax

$PASHS,NTR,MTP,s[*cc]

Parameters

Parameter	Description	Range
s	NTRIP mount point or OFF command	100 characters max or "OFF"
*cc	Optional checksum	*00-*FF

Example

Connecting to mount point MUWF0:

$PASHS,NTR,MTP,MUWF0

If the connection is successful, the following response line will be returned:

$PASHR,NTR,OK*cc

If the connection failed, the following response line will be returned:

$PASHR,NTR,FAIL*12

Relevant Query Command

None.

See also

$PASHQ,NTR,TBL

NTR,PAR: NTRIP Settings

Function

This command allows you to set all the NTRIP parameters.

Command Format

Syntax

$PASHS,NTR,PAR[,ADD,s1][,PRT,d2][,LGN,s3][,PWD,s4][,TYP,d5][*cc]

Parameters

Parameter	Description	Range
ADD,s1	Caster IP address	000.000.000.000-255.255.255.255
PRT,d2	Caster port number	0-65535
LGN,s3	Login	32 characters max.
PWD,s4	Password	32 characters max.
TYP,d5	Caster type: • 0: Client • 1: Server	0-1
*cc	Optional checksum	*00-*FF

Example

Entering NTRIP settings for a client caster by specifying its IP address, port number, login and password:

$PASHS,NTR,PAR,ADD,192.34.76.1,PRT,2100,LGN,Magellan,PWD,u6huz8,TYP,0

Relevant Query Command

$PASHQ,NTR

OCC: Writing Occupation Data to Raw Data File

Function

This command is used to write information about the current occupation to the raw data file being logged.

Command Format

Syntax

$PASHS,OCC,d1,d2,s3[,s4][*cc]

Parameters

Parameter	Description	Range
d1	Occupation type: • 0: Static • 1: Quasi-static • 2: Dynamic • 3: Event	0-3
d2	Occupation event: • 0: Begin • 1: End	0-1
s3	Occupation name	255 characters max.
s4	Occupation description	255 characters max.
*cc	Optional checksum	*00-*FF

Examples

Starting a static occupation on point “SITE01”:

$PASHS,OCC,0,0,SITE01,Park_Entrance

Ending the static occupation on point “SITE01”:

$PASHS,OCC,0,1,SITE01,Park_Entrance

Relevant Query Command

$PASHQ,OCC

See also

$PASHS,REC
$PASHS,ATM

OPTION: Receiver Firmware Options

Function

This command is used to install receiver firmware options.

Command Format

Syntax

$PASHS,OPTION,c1,h2[*cc]

Parameters

Parameter	Description	Range
c1	Option ID	K, F, Z, S (See table below)
h2	Hexadecimal unlock code	13 characters max.
*cc	Optional checksum	*00-*FF

Option ID	Label	Description
K	RTK	Enables RTK processing. Corrections generated in RTCM2.3, RTCM3.0, CMR or CMR+ format.
F	FASTOUTPUT	Enables data output at 10 or 20 Hz
Z	MODEM	Enables the GSM/GPRS modem
S	GLONASS	Enables GLONASS

Example

Enabling the RTK option:

$PASHS,OPTION,K,878A8874

Setting a CMR message type 1 (base coordinates) at a 30-second ouptut rate:

$PASHS,CMR,TYP,1,30

Relevant Query Command

$PASHQ,OPTION

See also

$PASHQ,RID

PEM: Setting the Position Elevation Mask

Function

This command is used to set the elevation mask used in the position processing.

Command Format

Syntax

$PASHS,PEM,d1[*cc]

Parameters

Parameter	Description	Range	Default
d1	Elevation mask angle	0-90°	5°
*cc	Optional checksum	*00-*FF	

Example

Setting the elevation mask to 15 degrees:

$PASHS,PEM,15

Relevant Query Command

$PASHQ,PEM

See also

$PASHS,ELM

POS: Setting the Antenna Position

Function

This command allows you to enter the geographic coordinates of a GNSS antenna. It is more particularly used to enter the position of a base.

Depending on the last $PASHS,ANR command applied to the receiver, the antenna position you enter will be either that of the phase center, the ARP or the ground mark.

Command Format

Syntax

$PASHS,POS,m1,c2,m3,c4,f5[*cc]

Parameters

Parameter	Description	Range
m1	Latitude in degrees and minutes with 7 decimal places (ddmm.mmmmmmm)	0-90
c2	North (N) or South (S)	N, S
m3	Longitude in degrees, minutes with 7 decimal places (ddmm.mmmmmmm)	0-180
c4	West (W) or East (E)	W, E
f5	Height in meters	+ or -9999.9999
*cc	Optional checksum	*00-*FF

Example

Setting the antenna position to 37°22.2912313’N, 121°59.7998217’W and 15.25 m:

$PASHS,POS,3722.2912313,N,12159.7998217,W,15.25

Relevant Query Command

$PASHQ,CPD,POS

See also

$PASHS,CPD,MOD,BAS
$PASHS,RT3
$PASHS,ANH
$PASHS,ANR

PRT: Setting Baud Rates

Function

This command is used to set the baud rate of each of the serial ports used in the receiver.

Command Format

Syntax

$PASHS,CRT,c1,d2[*cc]

Parameters

Parameter	Description	Range
c1	Port ID	A, D, E
d2	Baud rate	0-9 (see table below)
*cc	Optional checksum	*00-*FF

Code	Baud Rate	Code	Baud Rate
0	300	5	9600
1	600	6	19200
2	1200	7	38400
3	2400	8	57600
4	4800	9	115200

Example

Setting port A to 19200 Bd:

$PASHS,PRT,A,6

Relevant Query Command

$PASHQ,PRT

See also

$PASHS,CTS
$PASHS,MDP

PWR,OFF: Powering Off the Receiver

Function

This command is used to power off the receiver.

Command Format

Syntax

$PASHS,PWR,OFF[*cc]

Parameters

None.

Example

Turning off the receiver:

$PASHS,PWR,OFF

Relevant Query Command

None.

PWR,PAR: Power Management

Function

This command is used to set the voltage thresholds triggering low-power alarms.

Command Format

Syntax

$PASHS,PWR,PAR,f1,f2[*cc]

Parameters

Parameter	Description	Range
f1	Battery voltage threshold, in volts, triggering a low-battery alarm	6.7-8.4
f2	External power voltage threshold, in volts, triggering a low-power alarm	9.0-28.0
*cc	Optional checksum	*00-*FF

Example

Setting the thresholds to respectively 7 and 9 V:

$PASHS,PWR,PAR,7,9

Relevant Query Command

$PASHQ,PWR

RAW: Enabling/Disabling Raw Data Messages in Ashtech Format

Function

This command is used to enable or disable the standard, continuous output of raw data in Ashtech format.

NOTE: The ATOM format, instead of the Ashtech format, should be activated in ProMark 500 if you want the raw data collected by this system to be further processed in GNSS Solutions.

Command Format

Syntax

$PASHS,RAW,s1,c2,s3[,f4][*cc]

Parameters

Parameter	Description	Range	Default
s1	Raw data message type	MPC, SNV, SNG, SNW, SAL, SAG, SAW, ION (see table below)	
c2	Port routing the raw data message: • A: Serial port • C: Bluetooth port • M: Internal memory • U: External memory (USB)	A, C, M, U	
s3	Enables (ON) or disables (OFF) the raw data message	ON, OFF	OFF
f4	Output rate	1-999 s	1 s
*cc	Optional checksum	*00-*FF	

Raw data message types:

Data	Description
MPC	GPS/GLONASS/SBAS measurements
SNV	GPS ephemeris data
SNG	GLONASS ephemeris data
SNW	SBAS ephemeris data
SAL	GPS almanac data
SAG	GLONASS almanac data
SAW	SBAS almanac data
ION	Ionospheric parameters

The interval between two navigation messages (ephemeris and almanac data) is 1 second. The f4 parameter defines the interval between two messages pertaining to the same satellite. By default, it is set to 900 s for this message type.

Example

Enabling output of MPC message type on port A to 1 second:

$PASHS,RAW,MPC,A,ON,1

Relevant Query Command

$PASHQ,RAW
$PASHQ,RWO

See also

$PASHS,RAW,PER
$PASHS,RAW,ALL

RAW,PER: Setting Unique Output Rate for Raw Data

Function

This command is used to set the same output rate for raw data. This command will overwrite all the output rates set individually for each message type using $PASHS,RAW,xxx.

Command Format

Syntax

$PASHS,RAW,PER,f[*cc]

Parameters

Parameter	Description	Range	Default
f	Output rate	0.1-0.9 s 1-999 s	1 s
*cc	Optional checksum	*00-*FF	

Example

Setting the output rate to 1 second:

$PASHS,RAW,PER,1

Relevant Query Command

$PASHQ,RAW

See also

$PASHS,RAW
$PASHS,RAW,ALL

RDP,OFF: Powering Off the Internal Radio

Function

This command is used to power off the internal radio.

Command Format

Syntax

$PASHS,RDP,OFF[*cc]

Parameters

None.

Example

Turning off the internal radio:

$PASHS,RDP,OFF

Relevant Query Command

$PASHQ,RDP,PAR,D

See also

$PASHS,RDP,ON
$PASHS,RDP,PAR

RDP,ON: Powering On the Internal Radio

Function

This command is used to power on the internal radio.

Command Format

Syntax

$PASHS,RDP,ON[*cc]

Parameters

None.

Example

Turning on the internal radio:

$PASHS,RDP,ON

Relevant Query Command

$PASHQ,RDP,PAR,D

See also

$PASHS,RDP,OFF
$PASHS,RDP,PAR

RDP,PAR: Setting the Radio

Function

This command is used to set the radio connected to the specified port.

Command Format

Syntax

$PASHS,RDP,PAR,c1,s2,c3[,s4][,c5][,c6][,s7][*cc]

Parameters

Parameter	Description	Range
c1	ID of the port connected to the radio you want to set.	A, D
s2	Radio Model: • MGL: Magellan UHF • PDL: Pacific Crest	PDL, MLG (port A) PDL (port D)
c3	Channel number	0-15
s4	Power management (if port D is used) • AUT: Automatic • MAN: Manual	AUT, MAN
c5	Protocol used (if a PDL radio model is used) • 0: Transparent • 1: TRIMTALK • 2: Magellan	0-2
c6	Air link speed: • 4800: 4800 Bd, GMSK modulation • 9600: 9600 Bd, GMSK or four-level FSK modulation • 19200: 19200 Bd, four-level FSK modulation	4800, 9600, 19200
s7	Radio sensitivity	LOW, MED, HIG
*cc	Optional checksum	*00-*FF

Comments

The air link speed depends on the type of modulation used (GMSK or four-level FSK) as well as the channel spacing used.

If the system can detect the channel spacing used, then the choice of modulation is done automatically as indicated in the table below.

Channel Spacing is:	You set c6 to:	Then modulation will be:
12.5 kHz	4800	GMSK
12.5 kHz	9600	4-level FSK
12.5 kHz	19200	Irrelevant, NAK message returned
25 kHz	4800	Irrelevant, NAK message returned
25 kHz	9600	GMSK

Channel Spacing is:	You set c6 to:	Then modulation will be:
25 kHz	19200	4-level FSK

If the system fails to detect the channel spacing used, then the system tries to set the radio as indicated below. A NAK message will be returned if the the radio cannot respond properly to the request.

You set c6 to:	Then modulation will be:
4800	GMSK
9600	GMSK
19200	4-level FSK

Examples

Setting the internal radio receiver:

$PASHS,RDP,PAR,D,PDL,2,AUT,0,9600

Setting the external Magellan transmitter:

$PASHS,RDP,PAR,A,MGL,1

Relevant Query Command

$PASHQ,RDP,PAR

See also

$PASHS,RDP,ON
$PASHS,RDP,OFF
$PASHS,RDP,TYP
$PASHQ,RDP, CHT

RDP,TYP: Defining the Type of Radio Used

Function

This command is used to set the type of radio connected to the specified port.

Command Format

Syntax

$PASHS,RDP,TYP,c1,s2[*cc]

Parameters

Parameter	Description	Range
c1	ID of port connected to the radio you want to set.	A, D
s2	Radio Model: • MGL: Magellan UHF • PDL: Pacific Crest PDL RXO • UNKNOWN: Automatic detection of the type of internal radio used on port D	PDL, MLG (if port A used), PDL (if port D used), UNKNOWN
*cc	Optional checksum	*00-*FF

Examples

Auto-detecting the internal radio receiver:

$PASHS,RDP,TYP,D,UNKNOWN

Setting the external radio as a Magellan U-Link transmitter:

$PASHS,RDP,TYP,A,MGL

Relevant Query Command

$PASHQ,RDP,TYP

See also

$PASHS,RDP,PAR
$PASHS,RDP,ON
$PASHQ,RDP, OFF

REC: Enable/Disable, Start/Stop Raw Data Recording

Function

This command allows you to enable, disable, start or stop raw data recording. Raw data is recorded in the memory you selected with the $PASHS,MEM command.

Command Format

Syntax

$PASHS,REC,c[*cc]

Parameters

Parameter	Description	Range
c	Control character: • Y: Yes. The receiver will immediately start recording data. This option also enables data recording at receiver power-up, i.e. recording will start every time you turn the receiver on, even if you stopped recording before the end of the previous session. • N: No. The receiver will immediately stop recording data. This option also disables data recording at receiver power up, i.e. the receiver won't resume data recording when you next turn it on. This is the default mode. • S: Stop. The receiver will immediately stop recording raw data. This option does not affect the way the receiver operates at power-up. • R: Restart. The receiver will immediately start recording raw data. This option does not affect the way the receiver operates at power-up.	Y, N, S, R
*cc	Optional checksum	*00-*FF

Examples

Starting raw data recording:

$PASHS,REC,Y

Stopping raw data recording:

$PASHS,REC,N

Relevant Query Command

$PASHQ,REC

See also

$PASHS,MEM
$PASHS,ATM
$PASHS,NME

RST: Default Settings

Function

This command is used to reset the receiver parameters to their default values.

Command Format

Syntax

$PASHS,RST[*cc]

Parameters

None.

Example

Resetting the receiver:

$PASHS,RST

Relevant Query Command

None.

See also

$PASHS,INI

RTC,MSG: Defining a User Message

Function

This command is used to input a user message that a base will be able to forward to a rover through RTCM message type 16, 36 or1029. This command can only be applied to a base receiver, and provided message type 16 or 1029 is enabled in this receiver.

Command Format

Syntax

$PASHS,RTC,MSG,s[*cc]

Parameters

Parameter	Description	Range
s	User message	90 characters max.
*cc	Optional checksum	*00-*FF

Example

Submitting a user message:

$PASHS,RTC,MSG,<user message 90 characters max>

Relevant Query Command

None.

See also

$PASHS,RTC,TYP
$PASHS,BAS
$PASHS,CPD,MOD,BAS

RTC,TYP: RTCM Message Type

Function

This command is used to choose the RTCM message type that will be generated and broadcast by a base receiver as well as its output rate. This command can only be applied to a base receiver.

Command Format

Syntax

$PASHS,RTC,TYP,d1,d2[*cc]

Parameters

Parameter	Description	Range
d1	Message type	0-36, 1000-1033 See tables below
d2	Output rate, or “0” for message disabled	0, 0.5, 1-1800
*cc	Optional checksum	*00-*FF

RTCM 2.3 messages:

Parameter	Description	Default
0	Disables all RTCM 2.3 messages	
1	Differential GPS corrections	
3	GPS reference station parameters	30
16	GPS special message	0
18	RTK uncorrected carrier phase (18) RTK uncorrected pseudoranges (19)	1
20	RTK carrier phase correction (20) RTK high-accuracy, pseudorange corrections (21)	
22	Extended reference station parameter	30
23	Antenna type definition record	0
24	Antenna reference point	0
31	Differential GLONASS corrections	
32	Differential GLONASS reference station parameters	0
36	GLONASS special message	0

RTCM 3.0 & 3.1 messages:

Parameter	Description	Default
1000	Disables all RTCM 3.0 messages	
1001	L1-only GPS RTK observables	0
1002	Extended L1-only GPS RTK observables	0
1003	L1 & L2 GPS RTK observables	0
1004	Extended L1 & L2 GPS RTK observables	1 s
1005	Stationary RTK reference station ARP	0

Parameter	Description	Default
1006	Stationary RTK reference station ARP with antenna height	13 s
1007	Antenna descriptor	0
1008	Antenna descriptor & serial number	0
1009	L1-only GLONASS RTK observables	0
1010	Extended L1-only GLONASS RTK observables	0
1011	L1 & L2 GLONASS RTK observables	0
1012	Extended L1 & L2 GLONASS RTK observables	1 s
1013	System parameter	0
1019	GPS ephemeris data	0
1020	GLONASS ephemeris data	0
1029	Unicode text string	0
1033	Receiver and antenna descriptors	31 s

Examples

Setting RTCM message type 18 (output rate: 1 s):

$PASHS,RTC,TYP,18,1

Disabling all RTCM 3.x messages:

$PASHS,RTC,TYP,1000

Relevant Query Command

$PASHQ,RTC,MSI

See also

$PASHS,BAS
$PASHS,CPD,MOD,BAS

SBA: Enabling/Disabling SBAS Tracking

Function

This command is used to enable or disable SBAS tracking.

Command Format

Syntax

$PASHS,SBA,s[*cc]

Parameters

Parameter	Description	Range	Default
s	Enables (ON) or disables (OFF) SBAS tracking	ON, OFF	ON
*cc	Optional checksum	*00-*FF	

Example

Enabling SBAS tracking:

$PASHS,SBA,ON

Relevant Query Command

$PASHQ,SBA

See also

$PASHS,GLO

SBA: Enabling/Disabling SBAS Messages

Function

This command is used to enable or disable SBAS messages.

Command Format

Syntax

$PASHS,SBA,s1,c2,s3[*cc]

Parameters

Parameter	Description	Range	Default
s1	Message type	DAT, INF See table below	
c2	Port routing the message: • A: Serial port • C: Bluetooth port • M: Internal memory • U: External memory (USB)	A, C, M, U	
s3	Enables (ON) or disables (OFF) the message	ON, OFF	OFF
*cc	Optional checksum	*00-*FF	

SBAS message types:

Data	Description
DAT	SBAS data
INF	SBAS info (see $PASHQ,SBA,INF)

Example

Enabling SBAS DAT message on port A (1-s output rate):

$PASHS,SBA,DAT,A,ON

Relevant Query Commands

$PASHQ,RAW
$PASHQ,SBO

See also

$PASHS,SBA
$PASHS,SBA,ALL

SBA,ALL: Disabling All SBAS Messages

Function

This command is used to disable all the SBAS messages currently enabled on the specified port.

Command Format

Syntax

$PASHS,SBA,ALL,c1,OFF[*cc]

Parameters

Parameter	Description	Range
c1	Port routing the SBAS message(s): • A: Serial port • C: Bluetooth port • M: Internal memory • U: External memory (USB)	A, C, M, U
*cc	Optional checksum	*00-*FF

SBAS message types:

Data	Description
DAT	SBAS data
INF	SBAS info (see $PASHQ,SBA,INF)

Example

Disabling all SBAS messages on port A:

$PASHS,SBA,ALL,A,OFF

Relevant Query Commands

$PASHQ,RAW
$PASHQ,SBO

See also

$PASHS,SBA

SIT: Defining a Site Name

Function

This command is used to define a site name that will be used in the naming of the next logged raw data file.

Command Format

Syntax

$PASHS,SIT,s[*cc]

Parameters

Parameter	Description	Range
s	Site name (or site ID), a 4-character string where "*", ".", "/" and "\" are not allowed.	
*cc	Optional checksum	*00-*FF

Example

Defining site name "ECC1":

$PASHS,SIT,ECC1

Relevant Query Command

$PASHQ,SIT

See also

$PASHS,REC

STI: Defining a Station ID

Function

This command is used to define the station ID the base receiver will broadcast in its messages to the rover. The format of the station ID depends on the message type in which it is included.

Command Format

Syntax

$PASHS,STI,s[*cc]

Parameters

Parameter	Description	Range
s	Station ID	0-1023 (RTCM 2.3) 0-4095 (RTCM 3.x) 0-31 (CMR & CMR+)
*cc	Optional checksum	*00-*FF

Examples

Defining station ID “150” for use in RTCM messages:

$PASHS,STI,150

Note

If the station ID is not a pure number, as required for RTCM, CMR and CMR+ messages, then it is transformed into a pure number (example: “ST56” becomes “56”). If the resulting number is out of bounds, then the maximum value in the applicable range is chosen instead (e.g. “31” instead of “56” if CMR messages are broadcast).

Relevant Query Command

$PASHQ,STI

See also

$PASHS,BAS
$PASHS,CPD
$PASHS,MOD,BAS

WAK: Acknowledging Alarms

Function

This command is used to acknowledge all alarms. This will also turn off the beeper (if previously allowed to beep on occurrence of an alarm). Basically all alarms will switch from the "current" to the acknowledged ("pending") status.

Command Format

Syntax

$PASHS,WAK[*cc]

Parameters

None.

Example

Acknowledging all alarms:

$PASHS,WAK

Relevant Query Command

$PASHQ,WARN

ZDA: Setting Time & Date

Function

This command is used to set the data and time in the receiver.

Command Format

Syntax

$PASHS,ZDA,m1,d2,d3,d4[*cc]

Parameters

Parameter	Description	Range
m1	UTC time (hhmmss.ss)	000000.00-235959.99
d2	Current day	01-31
d3	Current month	01-12
d4	Current year	0000-9999
*cc	Optional checksum	*00-*FF

Example

$PASHS,ZDA,151145.00,13,03,2008

Relevant Query Command

$PASHQ,ZDA

See also

$PASHS,LTZ

Appendix C. Query Command Library

ALM: Almanac Message

Function

This command allows you to get the latest GPS almanac data. Each response line describes the almanac data from a given GPS satellite.

Command Format

Syntax

$PASHQ,ALM[*cc]

Response Format

Syntax

$GPALM,d1,d2,d3,d4,h5,h6,h7,h8,h9,h10,h11,h12,h13,h14,h15*cc

Parameters

Parameter	Description	Range
d1	Total number of messages	01-32
d2	Number of this message	01-32
d3	Satellite PRN number	01-32
d4	GPS week	4 digits
h5	SV health (in ASCII hex)	2 bytes
h6	e: Excentricity (in ASCII hex)	4 bytes
h7	toe: Almanac reference time, in seconds (ASCII hex)	2 bytes
h8	Io: Inclination angle, in semicircles (ASCII hex)	4 bytes
h9	OMEGADOT: Rate of ascension, in semicircles/second (ASCII hex)	4 bytes
h10	A1/2: Square root of semi-major axis, in meters 1/2 (ASCII hex)	6 bytes
h11	OMEGA: Argument of perigee, in semicircles (ASCII hex)	6 bytes
h12	OMEGA0: Longitude of ascension mode, in semicircles (ASCII hex)	6 bytes
h13	Mo: Mean anomaly, in semi-circles (ASCII hex)	6 bytes
h14	af0: Clock parameter, in seconds (ASCII hex)	3 bytes
h15	af1: Clock parameter, in seconds/second (ASCII hex)	3 bytes
*cc	Optional checksum	*00-*FF

Example

$PASHQ,ALM

$GPALM,31,1,01,65535,00,39A8,4E,1FEA,FD65,A10C8C,B777FE,935A86,C994BE,0C6,001*73
$GPALM,31,2,02,65535,00,4830,4E,00D9,FD49,A10D24,64A66D,3B6857,E6F2A3,0BA,001*7A
$GPALM,31,3,03,65535,00,552B,4E,F572,FD3B,A10CE1,20E624,0CD7E1,D10C32,0CA,001*0D
$GPALM,31,4,04,65535,00,4298,4E,0069,FD46,A10D5C,0EE3DC,3C2E3E,51DDF9,FF0,FFF*0A
...

ANH: Antenna Height

Function

This command allows you to read the entered antenna height as well as the measurement type used.

Command Format

Syntax

$PASHQ,ANH[*cc]

Response Format

Syntax

$PASHR,ANH,f1,c2*cc

Parameters

Parameter	Description	Range
f1	Antenna height.	0-6.553 m
c2	Antenna height measurement type: • V: Vertical measurement • S: Slant measurement	V, S
*cc	Checksum	*00-*FF

Example

$PASHQ,ANR
$PASHR,ANR,1.568*cc

Relevant Set Command

$PASHS,ANH

See also

$PASHQ,ANR

ANR: Antenna Reduction Mode

Function

This command is used to read the current setting for the antenna reduction mode. This setting defines the physical location on the system for which the position is computed.

Command Format

Syntax

$PASHQ,ANR[*cc]

Response Format

Syntax

$PASHR,ANR,s1*cc

Parameters

Parameter	Description	Range
s1	Antenna reduction mode: • OFF: The computed position is assumed to be the location of the antenna's L1 phase center. • ON: The computed position is assumed to be the location of the ground mark. • ARP: The computed position is assumed to be the location of the Antenna Reference Plane (ARP).	OFF, ON, ARP
*cc	Checksum	*00-*FF

Example

$PASHQ,ANR
$PASHR,ANR,ON*04

Relevant Set Command

$PASHS,ANR

See also

$PASHS,ANH
$PASHQ,ANH

ATM: ATOM Data Parameters

Function

This command allows you to read the current settings of the ATOM data-related parameters.

Command Format

Syntax

$PASHQ,ATM[*cc]

Response format

Syntax

(Through an example)

```
PER:020.00 ELM:10
DRI:001.00 SIT:abcd REC:Y MEM:M
ANH:02.132 ANT:SLANT ANR:ON
ATOM: COR MES PVT ATR NAV DAT BAUD
PRTA: OFF OFF OFF OFF OFF OFF 6
PRTC: OFF OFF OFF OFF OFF OFF 6
MEMM: OFF OFF OFF OFF OFF OFF 1
MEMU: OFF OFF OFF OFF OFF OFF 0
```

Parameters

Parameter	Description	Range
PER	ATOM output rate	0.00-999.0 s
ELM	Elevation mask used in data recording & data output	0-90
DRI	Recording rate	0.00-999.0 s
SIT	Site ID	4 characters
REC	Data recording: • Y: Data recording enabled • N: Data recording disabled • S: Data recording enabled but stopped	Y, N, S
MEM	Selected memory: • M: Internal memory • U: USB memory	M, U
ANH	Antenna height	0.000-6.553
ANT	Height measurement type (slant/vertical)	SLANT, VERT
ANR	Antenna reduction mode	ON, OFF, ARP
ATOM	ATOM message type	COR, MES, PVT, ATR, NAV, DAT
PRTA PRTC	Labels for serial ports A (PRTA) and C (PRTC)	ON, OFF
MEMM MEMU	Labels for memories M (MEMM) and U (MEMU)	ON, OFF
BAUD	If serial port used, then baud rate If memory used, “0” if not available, else “1”	0-9 (see table below) 0-1

Code	Baud Rate	Code	Baud Rate
0	300	5	9600
1	600	6	19200
2	1200	7	38400
3	2400	8	57600
4	4800	9	115200

Relevant Set Command

$PASHS,ATM

See also

$PASHQ,ATO

ATO: ATOM Message Parameters

Function

This command allows you to read the different parameters of the ATOM message, as currently set on the specified port or memory.

Command Format

Syntax

$PASHQ,ATO,c[*cc]

Parameters

Parameter	Description	Range
c	Port ID for which you need to know the ATOM message settings: • A: Serial port • C: Bluetooth port • M: Internal memory • U: External memory (USB)	A, C, M, U
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,ATO,c1,d2,f3,d4,s5,f6,s5,f6,s5,f6,s5,f6,s5,f6*cc

Parameters

Parameter	Description	Range
c1	The port ID mentioned in the query command is replicated in this field.	A, C, M, U
d2	Baud rate code	0-9
f3	PER setting	0-999.0
d4	Number of ATOM messages	6
s5	ATOM message type	(COR), MES, PVT, ATR, NAV, DAT
f6	Output rate (0 if messgae disabled)	0-999.0
*cc	Optional checksum	*00-*FF

Example

Querying ATOM message parameters as currently set on port A:

$PASHQ,ATO,A
$PASHR,ATO,A,6,001.00,5,COR,0.00,MES,0.00,PVT,0.00,ATR,0.00,NAV,0.00*24

See also

$PASHS,ATM
$PASHQ,ATM

BAS: Differential Data Type

Function

This command is used to list the message types generated and sent by a base.

Command Format

Syntax

$PASHQ,BAS[*cc]

Response Format

Syntax

$PASHR,BAS,c1,s2[,c3,s4]*cc

Parameters

Parameter	Description	Range
c1	First port ID: • A: Serial port (default) • C: Bluetooth port • D: Internal radio • E: Modem • M: Internal memory • U: External memory (USB)	A, C, D, E, M, U
s2	Differential data type: • RT2: RTCM 2.3 messages • RT3: RTCM 3.0 & 3.1 messages (default) • CMR: CMR messages • CMP: CMR+ messages	RT2, RT3, CMR, CMP
c3	Second port ID: same as c1 above	A, C, D, E, M, U
s4	Differential data type: same as s2 above.	RT2, RT3, CMR, CMP
*cc	Checksum	*00-*FF

Examples

The response line below reports RTCM 3.x messages sent on port A:

$PASHQ,BAS
$PASHR,BAS,A,RT3*50

The response line below reports RTCM 2.3 messages sent on port D and CMR+ messages on port E:

$PASHQ,BAS
$PASHR,BAS,D,RT2,E,CMP*4F

Relevant Set Command

$PASHS,BAS

See also

$PASHQ,CPD,MOD

$PASHQ,RTC

BEEP: Beeper State

Function

This command is used to read the current state of the internal beeper.

Command Format

Syntax

$PASHQ,BEEP[*cc]

Response Format

Syntax

$PASHR,BEEP,s*cc

Parameters

Parameter	Description	Range
s	Beeper enabled (ON) or disabled (OFF)	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,BEEP
$PASHR,BEEP,OFF*05

Relevant Set Command

$PASHS,BEEP

BTH: Bluetooth Settings

Function

This command is used to read the current Bluetooth settings.

Command Format

Syntax

$PASHQ,BTH[*cc]

Response Format

Syntax

$PASHR,BTH,s1,s2,d3*cc

Parameters

Parameter	Description	Range
s1	Bluetooth address (xx:xx:xx:xx:xx:xx)	17 characters
s2	Bluetooth name	64 characters max.
d3	Bluetooth PIN code	0-99999999 -1: no PIN code
*cc	Checksum	*00-*FF

Example

$PASHQ,BTH
$PASHR,BTH,00:07:80:83:91:86,PM_743109,-1*68

See also

$PASHS,BTH,NAME
$PASHS,BTH,PIN

CMR,MSI: CMR Message Status

Function

This command is used in a base receiver to read the current settings of the CMR messages the base currently generates and delivers.

Command Format

Syntax

$PASHQ,CMR,MSI[*cc]

Response Format

Syntax

$PASHR,CMR,MSI,d1,d2,d3,d4,d5,d6,d7*cc

Parameters

Parameter	Description	Range
d1	Number of CMR message	3
d2	Message type “0” label	0
d3	Message type “0” output rate	0-300
d4	Message type “1” label	1
d5	Message type “1” output rate	0-300
d6	Message type “2” label	2
d7	Message type “1” output rate	0-300
*cc	Checksum	*00-*FF

Example

The response line below reports three enabled CMR messages, type “0” at 1 second, and types “1” and “2” at 30 seconds:

$PASHQ,CMR,MSI

$PASHR,CMR,MSI,3,0,1.0,1,30.0,2,30.0*50

See also

$PASHS,CMR,TYP

$PASHQ,BAS

$PASHQ,CPD,MOD

CPD,AFP: Ambiguity Fixing Parameter

Function

This command is used to read the current setting for the ambiguity fixing parameter.

Command Format

Syntax

$PASHQ,CPD,AFP[*cc]

Response Format

Syntax

$PASHR,CPD,AFP,f*cc

Parameters

Parameter	Description	Range
f	Ambiguity fixing value. “0” means the receiver will stay in Float mode.	0, 95.0, 99.0, 99.9
*cc	Checksum	*00-*FF

Example

$PASHQ,CPD,AFP
$PASHQ,CPD,AFP,99.0*5A

See also

$PASHS,CPD,AFP

CPD,ANT: Base Antenna Height

Function

This command is used to read the current parameters of the base antenna height, as received by the rover.

Command Format

Syntax

$PASHQ,CPD,ANT[*cc]

Response Format

Syntax

$PASHR,CPD,ANT,f1,f2,f3,m4,f5*cc

Parameters

Parameter	Description	Range
f1	Antenna height, in meters	0-99.999
f2	Antenna radius, in meters	0-9.9999
f3	Vertical offset, in meters	0-99.999
m4	Horizontal azimuth, in degrees, minutes (dddmm.mm)	0-35959.99
f5	Horizontal distance, in meters	0-99.999
*cc	Checksum	*00-*FF

Example

$PASHQ,CPD,ANT

$PASHR,CPD,ANT,1.893,0.0980,0.040,0.0000,0.000*56

See also

$PASHS,ANH

$PASHS,ANR

$PASHQ,CPD,POS

CPD,FST: Fast RTK Output Mode

Function

This command is used to read the current fast RTK output mode setting.

Command Format

Syntax

$PASHQ,CPD,FST[*cc]

Response Format

Syntax

$PASHR,CPD,FST,s*cc

Parameters

Parameter	Description	Range
s	Fast RTK mode	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,CPD,FST
$PASHR,CPD,FST,ON*63

Relevant Set Command

$PASHS,CPD,FST

See also

$PASHQ,CPD

CPD,MOD: Base/Rover Mode

Function

This command is used to query the operating mode of the receiver and the satellite constellations used if the receiver is operated as a base.

Command Format

Syntax

$PASHQ,CPD,MOD[*cc]

Response Format

Syntax

$PASHR,CPD,MOD,s1,d2*cc

Parameters

Parameter	Description	Range
s1	Current operating mode: • BAS: Base • ROV: Rover	BAS, ROV
d2	Constellations currently used if the receiver is defined as a base: • 0: GPS, GLONASS, SBAS • 1: Only GPS and SBAS • 2: Only GPS and GLONASS • 3: Only GPS	0-3
*cc	Checksum	*00-*FF

Example

The response line below indicates that the receiver is configured as a base and uses the GPS and SBAS constellations:

$PASHQ,CPD,MOD
$PASHR,CPD,MOD,BAS,2*2B

Relevant Set Command

$PASHS,CPD,MOD

See also

$PASHQ,CPD

CPD,NET: RTK Network Operation Mode

Function

This command is used to read the current setting of the RTK network operation mode.

Command Format

Syntax

$PASHQ,CPD,NET[*cc]

Response Format

Syntax

$PASHR,CPD,NET,d*cc

Parameters

Parameter	Description	Range
d	Current RTK network operation mode: • 0: Network corrections not processed • 1: Network corrections processed if available and healthy. The receiver will automatically switch to "standard" RTK mode if network corrections are no longer available or healthy. • 2: Network corrections are mandatory. Any satellite for which network corrections are not healthy will not be used.	0-2
*cc	Checksum	*00-*FF

Example

$PASHQ,CPD,NET
$PASHR,CPD,NET,1*4D

The response line reports that the receiver will process network corrections, if available and healthy.

Relevant Set Command

$PASHS,CPD,NET

See also

$PASHQ,CPD

CPD,POS: Base Position

Function

If applied to a base, this command allows you to read the geographic coordinates previously entered for the base position.

Depending on the last $PASHS,ANR command applied to the base, the position you get will be either that of the phase center, the ARP or the ground mark.

If applied to a rover, this command allows you to read the position of the base the rover receives from the base. The coordinates will all be “0” if the rover does not receive the base position.

Command Format

Syntax

$PASHQ,CPD,POS[*cc]

Response Format

Syntax

$PASHR,CPD,POS,m1,c2,m3,c4,f5*cc

Parameters

Parameter	Description	Range
m1	Latitude in degrees and minutes with 7 decimal places (ddmm.mmmmmmm)	0-90
c2	North (N) or South (S)	N, S
m3	Longitude in degrees, minutes with 7 decimal places (ddmm.mmmmmmm)	0-180
c4	West (W) or East (E)	W, E
f5	Height in meters	+ or -9999.9999
*cc	Checksum	*00-*FF

Examples

$PASHQ,CPD,POS
$PASHR,CPD,POS,4717.959483,N,00130.500968,W,70.229*59

$PASHQ,CPD,POS
$PASHR,CPD,POS,0000.000000,N,00000.000000,E,00.000*7A

See also

$PASHS,POS
$PASHQ,CPD,ANT
$PASHQ,ANR
$PASHQ,ANH

CPD,REM: Differential Data Port

Function This command allows you to read the port IDs that route differential data as well as the port selection mode.

Command Format

Syntax

$PASHQ,CPD,REM[*cc]

Response Format

Syntax

$PASHR,CPD,REM,s1[,c2][,c3]*cc

Parameters

Parameter	Description	Range
s1	Reception mode: • AUT: Automatic (default) • MAN: Manual	AUT, MAN
c2	Input port #1	A, C, D, E
c3	Input port #2	A, C, D, E
*cc	Checksum	*00-*FF

Examples

(Automatic selection of the input port:)

$PASHQ,CPD,REM
$PASHR,CPD,REM,AUT*39

(Manual selection, port D (radio) expected to receive the data:)

$PASHQ,CPD,REM
$PASHR,CPD,REM,MAN,D*53

(Manual selection, ports D and E (radio + GSM) expected to receive the data:)

$PASHQ,CPD,REM
$PASHR,CPD,REM,MAN,D,E*3A

Relevant Set Command $PASHS,CPD,REM

See also $PASHQ,CPD,MOD

CRT: Cartesian Coordinates of Position

Function

This command allows you to get the message containing the absolute ECEF coordinates of the last computed position as well as other information on the position solution.

Command Format

Syntax

$PASHQ,CRT[*cc]

Response Format

Syntax

$PASHR,CRT,d1,d2,m3,f4,f5,f6,f7,f8,f9,f10,f11,f12,f13,f14,f15,s16*cc

Parameters

Parameter	Description	Range
d1	Position mode: • 0: Autonomous • 1: RTCM or SBAS differential • 2: RTK float • 3: RTK fixed	0-3
d2	Count of SVs used in position computation	3-27
m3	UTC time (hhmmss.ss)	000000.00-235959.99
f4	ECEF X coordinate, in meters	+ or - 9999999.999
f5	ECEF Y coordinate, in meters	+ or - 9999999.999
f6	ECEF Z coordinate, in meters	+ or - 9999999.999
f7	Receiver clock offset, in meters	+ or -9.999
f8	Velocity vector, X component, in m/s	+ or -9.999
f9	Velocity vector, Ycomponent, in m/s	+ or -9.999
f10	Velocity vector, Z component, in m/s	+ or -9.999
f11	Receiver clock drift, in meters	+ or - 9.999
f12	PDOP	0.0-99.9
f13	HDOP	0.0-99.9
f14	VDOP	0.0-99.9
f15	TDOP	0.0-99.9
s16	Firmware version ID (GNSS board fw)	4-char string
*cc	Checksum	*00-*FF

Example

$PASHQ,CRT
$PASHR,CRT,3,07,130452.50,4331844.177,-114063.156,4664458.677,
-0.023,-0.002,0.002,0.001,-0.023,2.1,1.2,1.7,1.3,G010*6C

See also

$PASHS,NME

CTS: Handshaking

Function

This command allows you to query the handshaking (RTS/CTS) protocol status.

Command Format

Syntax

$PASHS,CTS[*cc]

Response Format

Syntax

$PASHR,CTS,s*cc

Parameters

Parameter	Description	Range
s	Current handshaking protocol status	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHS,CTS
$PASHR,CTS,ON*1D

Relevant Set Command

$PASHS,CTS

See also

$PASHQ,PRT
$PASHQ,MDP

DCR: Cartesian Coordinates of Baseline

Function

This command allows you to output the DCR message containing the ECEF components of the baseline for the last computed position as well as other information on the position solution.

Command Format

Syntax

$PASHQ,DCR[*cc]

Response Format

Syntax

$PASHR,DCR,d1,d2,m3,f4,f5,f6,f7,f8,f9,f10,f11,f12,f13,f14,f15,s16*cc

Parameters

Parameter	Description	Range
d1	Position mode: • 0: Autonomous • 1: RTCM or SBAS differential • 2: RTK float • 3: RTK fixed	0-3
d2	Count of SVs used in position computation	3-27
m3	UTC time (hhmmss.ss)	000000.00-235959.99
f4	ECEF X component of baseline, in meters	+ or - 99999.999
f5	ECEF Y component of baseline, in meters	+ or - 99999.999
f6	ECEF Z component of baseline, in meters	+ or - 99999.999
f7	Receiver clock offset, in meters	+ or -9.999
f8	Velocity vector, X component, in m/s	+ or -9.999
f9	Velocity vector, Ycomponent, in m/s	+ or -9.999
f10	Velocity vector, Z component, in m/s	+ or -9.999
f11	Receiver clock drift, in meters	+ or - 9.999
f12	PDOP	0.0-99.9
f13	HDOP	0.0-99.9
f14	VDOP	0.0-99.9
f15	TDOP	0.0-99.9
s16	Firmware version ID (GNSS board fw)	4-char string
*cc	Checksum	*00-*FF

Example

$PASHQ,DCR
$PASHR,DCR,3,09,130924.00,-37.683,55.081,17.925,0.109,0.001,
0.002,0.001,0.047,1.9,1.0,1.6,1.1,G010*71

See also

$PASHS,NME

DIP: Direct IP Parameters

Function

This command is used to query the parameters used for a Direct IP connection.

Command Format

Syntax

$PASHQ,DIP[*cc]

Response Format

Syntax

$PASHR,DIP,RIP,s1,PRT,d2[,LGN,s3,PWD,s4]*cc

Parameters

Parameter	Description	Range
RIP,s1	IP address (xxx.xxx.xxx.xxx) or host name	000.000.000.000 to 255.255.255.255
PRT,d2	Port number	0-65535
LGN,s3	User name (optional)	20 char. max.
PWD,s4	Password (optional)	20 chars max.
*cc	Checksum	*00-*FF

Examples

$PASHQ,DIP
$PASHR,DIP,RIP,192.65.54.1,PRT,80*xx

$PASHQ,DIP
$PASHR,DIP,RIP,www.magellangps.com,PRT,8080*xx

Relevant Set Command

$PASHS,DIP

See also

$PASHQ,MDM

DPO: Delta Position

Function

This command is used to output a DPO message containing the coordinates of the last computed position as well as other information about the position solution.

Command Format

Syntax

$PASHQ,DPO[*cc]

Response Format

Syntax

$PASHR,DPO,d1,d2,m3,f4,c5,f6,c7,f8,c9,f10,f11,f12,f13,f14,f15,f16,s17*cc

Parameters

Parameter	Description	Range
d1	Position mode: • 0: Autonomous • 1: RTCM or SBAS differential • 2: RTK float • 3: RTK fixed	0-3
d2	Count of SVs used in position computation	3-27
m3	UTC time (hhmmss.ss)	000000.00-235959.99
f4	Northing coordinate difference, in meters	+ or - 9999999.999
c5	North label	N
f6	Easting coordinate difference, in meters	+ or - 9999999.999
c7	East label	E
f8	Ellipsoid height difference, in meters	+ or - 99999.999
c9	Reserved	+ or -9.999
f10	COG: Course Over Ground, in m/s	0-359.9
f11	SOG: Speed Over Ground, in m/s	+ or - 9.999
f12	Vertical velocity, in m/s	+ or - 999.9
f13	PDOP	0.0-99.9
f14	HDOP	0.0-99.9
f15	VDOP	0.0-99.9
f16	TDOP	0.0-99.9
s17	Firmware version ID	4-char string
*cc	Checksum	*00-*FF

Example

$PASHQ,DPO
$PASHR,DPO,3,09,131143.50,40.910,N,54.072,E,-13.363,,0.0,0.0,-0.0,1.9,1.0,1.6,1.2,G010*5B

See also

$PASHS,NME

DRI: Raw Data Recording Rate

Function

This command queries the current recording rate for all raw data logged in the internal or external memory.

Command Format

Syntax

$PASHQ,DRf[*cc]

Response Format

Syntax

$PASHR,DRI,f*cc

Parameters

Parameter	Description	Range
s	Current raw data recording rate	0.1-0.9 s 1-999 s
*cc	Checksum	*00-*FF

Example

$PASHQ,DRI
$PASHR,DRI,1.00*18

Relevant Set Command

$PASHS,DRI

See also

$PASHQ,ATM
$PAHQ,REC

DYN: Receiver Dynamics

Function

This command allows you to query the current setting for the receiver dynamics.

Command Format

Syntax

$PASHQ,DYN[*cc]

Response Format

Syntax

$PASHR,DYN,d*cc

Parameters

Parameter	Description	Range
d	Receiver dynamics: • 1: Static • 2: Quasi-static • 3: Walking • 4: Ship • 5: Automobile • 6: Aircraft • 7: Unlimited • 8: Adaptive	1-8
*cc	Checksum	*00-*FF

Example

$PASHQ,DYN
$PASHR,DYN,8*33

Relevant Set Command

$PASHS,DYN

See also

$PASHQ,CPD

ELM: Elevation Mask

Function

This command is used to read the current value of the elevation mask. The elevation mask impacts data recording, data output and satellite reception at the base.

Command Format

Syntax

$PASHQ,ELM[*cc]

Response Format

Syntax

$PASHR,ELM,d1*cc

Parameters

Parameter	Description	Range
d1	Current value of elevation mask, in degrees	0-90
*cc	Checksum	*00-*FF

Example

$PASHQ,ELM
$PASHR,ELM,5*29

See also

$PASHS,ELM
$PASHQ,PEM

FLS: List of Raw Data Files

Function

This command is used to list the raw data files stored in the selected memory. An index number is used in the command fomat to limit the number of listed files. Files are listed in blocks of 10 files.

Command Format

Syntax

$PASHQ,FLS,d[*cc]

Parameters

Parameter	Description	Range
d	File index number (“0” for 1st file, “1” for 2nd file, etc.). All files with index number equal to or greater than this number will be listed.	0-99
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,FLS,d1,d2,d3,s4,m5,d6,s4,m5,d6,s4,m5,d6...*cc

Parameters

Parameter	Description	Range
d1	Free memory space, in kbytes, in the selected memory	000000-999999
d2	Total number of files currently stored in the selected memory	000-999
d3	Number of files listed corresponding to those matching the command criterion	00-10
s4	Site name assigned to the file	4 characters
m5	File time in the “wwwwdhhmm” format where: • wwww: GPS week number • d: Day in week • hh: Time (hours) • mm: Time (minutes)	0000-9999 1-7 00-23 00-59
d6	File size in kbytes	0-999999
*cc	Checksum	*00-*FF

Example

Listing the files from index number “10”:

$PASHQ,FLS,10

$PASHR,FLS,65240,012,02,sit3,146821321,7,sit3,146821321,4*06

See also

$PASHS,REC
$PASHS,FIL,D
$PASHS,MEM

GGA: GNSS Position Message

Function

This command is used to output a GGA message containing the last computed position. If no position is computed, the message will be output anyway, but with some blank fields.

Command Format

Syntax

$PASHQ,GGA[*cc]

Response Format

Syntax

$GPGGA,m1,m2,c3,m4,c5,d6,d7,f8,f9,M,f10,M,f11,d12*cc

Parameters

Parameter	Description	Range
m1	Current UTC time of position (hhmmss.ss)	000000.00-235959.99
m2	Latitude of position (ddmm.mmmmmm)	0-90 0-59.999999
c3	Direction of latitude	N, S
m4	Longitude of position (dddmm.mmmmmm)	0-180 0-59.999999
c5	Direction of longitude	E,W
d6	Position type: • 0: Position not available or invalid • 1: Autonomous position • 2: RTCM Differential or SBAS Differential • 3: Not used • 4: RTK fixed • 5: RTK float	0-5
d7	Number of GNSS Satellites being used in the position computation	3-27
f8	HDOP	0-99.9
f9,M	Altitude, in meters, above mean seal level. “M” for meters	+ or - 99999.999,M
f10,M	Geoidal separation in meters. “M” for meters	+ or - 999.999,M
f11	Age of differential corrections, in seconds	0-999
d12	Base station ID (RTCM only)	0-4095
*cc	Checksum	*00-*FF

Example

$PASHQ,GGA
$GPGGA,131745.00,4717.960847,N,00130.499476,W,4,10,0.8,35.655,M,
47.290,M,3.0,1000*61

See also

$PASHS,NME

GLL: Geographic Position - Latitude/Longitude

Function

This command is used to output a GLL message containing the last computed position. If no position is computed, the message will be output anyway, but all position-related fields will be blank.

Command Format

Syntax

$PASHQ,GLL[*cc]

Response Format

Syntax

$GPGLL,m1,c2,m3,c4,m5,c6,c7*cc

Parameters

Parameter	Description	Range
m1	Latitude of position (ddmm.mmmmmm)	0-90 0-59.999999
c2	Direction of latitude	N, S
m3	Longitude of position (dddmm.mmmmmm)	0-180 0-59.999999
c4	Direction of longitude	E,W
m5	Current UTC time of position (hhmmss.ss)	000000.00- 235959.99
c6	Status • A: Data valid • V: Data not valid	A, V
c7	Mode indicator: • A: Autonomous mode • D: Differential mode • N: Data not valid	A, D, N
*cc	Checksum	*00-*FF

Example

$PASHQ,GLL
$GPGLL,4717.960853,N,00130.499473,W,132331.00,A,D*7D

See also

$PASHS,NME

GLO: GLONASS Tracking Status

Function

This command is used to query the GLONASS tracking status.

Command Format

Syntax

$PASHQ,GLO[*cc]

Response Format

Syntax

$PASHR,GLO,s*cc

Parameters

Parameter	Description	Range
s	ON: GLONASS satellites currently tracked and used. OFF: GLONASS satellites not tracked.	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,GLO
$PASHR,GLO,ON*1D

Relevant Set Command

$PASHS,GLO

GRS: GNSS Range Residuals

Function

This command is used to output a GRS message containing the satellite range residuals. No message will be output if there is no position computed.

Command Format

Syntax

$PASHQ,GRS[*cc]

Response Format

Syntax

$--GRS,m1,d2,f3,f3,f3,f3...*cc

Parameters

Parameter	Description	Range
"$--GPGRS" Header	$GPGRS: Only GPS satellites are used. $GLGRS: Only GLONASS satellites are used. $GNGRS: Several constellations (GPS, SBAS, GLONASS) are used.	$GPGRS, $GLGRS, $GNGRS
m1	Current UTC time of GGA position (hhmmss.ss)	000000.00-235959.99
d2	Mode used to compute range residuals	Always "1"
f3	Range residual for satellite used in position computation. Residuals are listed in the same order as the satellites in the GSV message so that each residual provided can easily be associated with the right satellite.	+ or - 999.999
*cc	Checksum	*00-*FF

Example

$PASHQ,GRS
$GNGRS,141003.50,1,1.14,-0.48,0.26,0.20,-0.94,-0.28,-1.18*61
$GNGRS,141003.50,1,-0.20*4F

See also

$PASHS,NME

GSA: GNSS DOP and Active Satellites

Function

This command is used to output a GSA message containing data related to DOP values and satellites used in the position solution.

Where applicable, one response line per constellation used is returned. In this case, the returned DOP values are the same in all response lines.

Command Format

Syntax

$PASHQ,GSA[*cc]

Response Format

Syntax

$--GSA,c1,d2,d3,d4,d5,d6,d7,d8,d9,d10,d11,d12,d13,d14,f15,f16,f17*cc

Parameters

Parameter	Description	Range
"$--GPGSA" Header	$GPGSA: Only GPS satellites are used. $GLGSA: Only GLONASS sats are used. $GNGSA: Several constellations (GPS, SBAS, GLONASS) are used.	$GPGSA, $GLGSA, $GNGSA
c1	Output mode: • M: Manual • A: Automatic	M, A
d2	Position indicator: • 1: No position available • 2: 2D position • 3: 3D position	1-3
d3-d14	Satellites used in the position solution (blank fields for unused channels)	GPS: 1-32 GLONASS: 65-96 SBAS: 33-64
f15	PDOP	0-9.9
f16	HDOP	0-9.9
f17	VDOP	0-9.9
*cc	Checksum	*00-*FF

Example

$PASHQ,GSA
$GNGSA,A,3,20,11,13,23,17,04,31,,,,,,1.6,0.9,1.3*21
$GNGSA,A,3,81,83,68,,,,,,,,,1.6,0.9,1.3*2C

See also

$PASHS,NME

GST: GNSS Pseudo-Range Error Statistics

Function This command is used to output a GST message containing standard deviations relevant to the position solution.

Command Format

Syntax

$PASHQ,GST[*cc]

Response Format

Syntax

$--GST,m1,f2,f3,f4,f5,f6,f7,f8*cc

Parameters

Parameter	Description	Range
"$--GPGST" Header	$GPGST: Only GPS satellites are used. $GLGST: Only GLONASS sats are used. $GNGST: Several constellations (GPS, SBAS, GLONASS) are used.	$GPGST, $GLGST, $GNGST
m1	Current UTC time of position (hhmmss.ss)	000000.00-235959.99
f2	RMS value of standard deviation of range inputs (DGNSS corrections included), in meters	0.000-99.999
f3	Standard deviation of semi-major axis of error ellipse, in meters	0.000-99.999
f4	Standard deviation of semi-minor axis of error ellipse, in meters	0.000-99.999
f5	Orientation of semi-major axis of error ellipse, in degress from true North	0.000-99.999
f6	Standard deviation of latitude error, in meters	0.000-99.999
f7	Standard deviation of longitude error, in meters	0.000-99.999
f8	Standard deviation of altitude error, in meters	0.000-99.999
*cc	Checksum	*00-*FF

Example

$PASHQ,GST
$GNGST,145623.50,,,,,0.023,0.023,0.029*40

See also $PASHS,NME

GSV: GNSS Satellites in View

Function

This command is used to output a GSV message containing information on the satellites in view.

Command Format

Syntax

$PASHQ,GSV[*cc]

Response Format

Syntax

$--GSV,d1,d2,d3,d4,d5,d6,f7,d4,d5,d6,f7,d4,d5,d6,f7...*cc

The set of parameters (d4,d5,d6,f7) can be repeated up to 4 times in a single response line, corresponding to the description of 4 different satellites. The number of response lines is therefore dependent on the number of satellites in view (e.g. three response lines if between 9 and 12 satellites are visible).

Parameters

Parameter	Description	Range
"$--GPGSV" Header	$GPGSV: Only GPS satellites are used. $GLGSV: Only GLONASS sats are used. $GNGSV: Several constellations (GPS, SBAS, GLONASS) are used.	$GPGSV, $GLGSV, $GNGSV
d1	Total number of messages	1-4
d2	Message number	1-4
d3	Total number of satellites in view	1-15
d4	Satellite PRN	GPS: 1-32 GLONASS: 65-96 SBAS: 33-64
d5	Elevation in degrees	0-90
d6	Azimuth in degrees	0-359
f7	SNR in dB.Hz	30.0-60.0
*cc	Checksum	*00-*FF

Example

$PASHQ,GSV
$GPGSV,2,1,07,20,61,066,50,11,30,146,36,13,41,200,50,23,73,134,52*7C
$GPGSV,2,2,07,33,34,198,42,17,40,242,50,04,37,304,48*47
$GLGSV,1,1,04,77,29,098,46,84,19,332,46,83,49,276,52,68,57,300,52*67

See also

$PASHS,NME

MDM,LVL: Modem Signal Level

Function

This command is used to query the current modem signal level.

Command Format

Syntax

$PASHQ,MDM,LVL[*cc]

Response Format

Syntax

$PASHR,MDM,LVL,d*cc

Parameters

Parameter	Description	Range
d	Current signal level: • 0-100: Signal level. The higher the number, the higher the signal level. • "-1": No signal detected or modem on-line.	0 to 100 -1
*cc	Optional checksum	*00-*FF

Example

$PASHQ,MDM
$PASHR,MDM,LVL,-1*7A

See also

$PASHQ,MDM

MDM: Modem Status and Parameters

Function This command is used to query the modem status and parameters.

Command Format

Syntax

$PASHQ,MDM[*cc]

Response Format

Syntax

$PASHR,MDM,c1,d2,s3,PWR=s4,PIN=s5,BND=d6,PTC=d7,CBS=d8,
APN=s9,LGN=s10,PWD=s11,IPT=d12,PHN=s13,ADL=c14,RNO=d15*cc

Parameters

Parameter	Description	Range
c1	Modem port	E
d2	Modem baud rate	9
s3	Modem state “NONE” means that the GSM option is not valid.	OFF, ON, INIT, DIALING, ONLINE, NONE
PWR=s4	Power mode: • AUT: Automatic • MAN: Manual	AUT, MAN
PIN=s5	PIN code	4-8 digits
BND=d6	Band: • 0: 850/1900 (North America) • 900/1800 (Europe) • 900/1900	0-2
PTC=d7	Protocol: • 0: CSD • 1: GPRS	0-1
CBS=d8	CSD mode: • 0: V.32 9600 bauds • 1: V.110 9600 bauds ISDN	0-1
APN=s9	Access Point Name (GPRS)	32 char. max.
LGN=s10	Login (GPRS)	32 char. max.
PWD=s11	Password (GPRS)	32 char. max.
IPT=d12	Internet Protocol: • 0: TCP • 1: UDP	0-1
PHN=s13	Phone number (CSD)	20 digits max.
ADL=c14	Auto-dial mode (CSD)	Y, N
RNO=d15	Maximum number of re-dials (CSD)	0-15
*cc	Optional checksum	*00-*FF

Example

$PASHQ,MDM
$PASHR,MDM,E,9,ONLINE,PWR=MAN,PIN=,BND=1,PTC=1,CBS=1,APN=a2bouygtel.com,LGN=,PWD=,IPT=0,PHN=,ADL=Y,RNO=2*47

See also

$PASHS,MDM
$PASHQ,MDM,LVL
$PASHQ,MWD
$PASHS,NTR
$PASHS,DIP
$PASHS,MDM,DAL

MDP: Port A Setting

Function This command is used to read the current setting of port A.

Command Format

Syntax

$PASHQ,MDP[*cc]

Response Format

Syntax

$PASHR,MDP,A,c*cc

Parameters

Parameter	Description	Range
c	Current port setting (RS232 or RS422)	232, 422
*cc	Checksum	*00-*FF

Example

$PASHQ,MDP
$PASHR,MDP,A,RS232*5E

Relevant Set Command $PASHS,MDP

See also $PASHQ,CTS

MEM: Selected Memory Device

Function

This command is used to query the memory device used by the receiver.

Command Format

Syntax

$PASHQ,MEM[*cc]

Response Format

Syntax

$PASHR,MEM,d[*cc]

Parameters

Parameter	Description	Range
d	Memory used: • 0: Internal memory (NAND Flash) • 1: SD card (not used in ProMark 500) • 2: USB mass storage key	0, 2
*cc	Checksum	*00-*FF

Example

$PASHQ,MEM
$PASHR,MEM,0*2D

Relevant Set Command

$PASHS,MEM

See also

$PASHQ,FLS

MWD: Modem Watchdog Timeout

Function

This command is used to query the current setting for the modem watchdog timeout.

Command Format

Syntax

$PASHQ,MWD[*cc]

Response Format

Syntax

$PASHR,MWD,d1,d2*cc

Parameters

Parameter	Description	Range
d1	Current timeout setting: • 1-99: Modem timeout in minutes. • 0: No timeout	0-99
d2	Current idle time for modem, in minutes.	0-99
*cc	Checksum	*00-*FF

Example

$PASHQ,MWD
$PASHR,MWD,0*36

Relevant Set Command

$PASHS,MWD

See also

$PASHQ,MDM

NMO: NMEA Message Output Settings

Function

This command is used to query the types of NMEA messages currently enabled on the specified port.

Command Format

Syntax

$PASHQ,NMO,c[*cc]

Parameters

Parameter	Description	Range
c	Queried port ID: • A, D, E: Serial port • C: Bluetooth • M, U: Memory	A, C, D, E, M, U
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,NMO,c1,d2cf3,d4,s5,f6,s5,f6,s5,f6,...*cc

Parameters

Parameter	Description	Range
s1	Queried port ID: • A, D, E: Serial port • C: Bluetooth • M, U: Memory	A, C, D, E, M, U
d2	Baud rate code	0-9 (A, C, D, E) 0, 1 (M, U)
f3	Output rate as defined by the last $PASHS,NME,PER command run.	0-999.0
d4	Number of NMEA messages listed in the response line	18
s5	NMEA message type	ALM, GGA, GLL, GRS, GSA, GST, GSV, RMC, VTG, ZDA, CRT, DCR, DPO, MSG, POS, RRE, SAT, VEC
f6	Output rate: • 0.1-0.9 or 1-999: Output rate in seconds • 0: Message disabled	0.999.00 s
*cc	Checksum	*00-*FF

Example

$PASHQ,NMO,A

```
$PASHR,NMO,A,6,001.00,17,ALM,0.00,GGA,0.00,GLL,0.00,GRS,0.00,GSA,
0.00,GST,0.00,GSV,0.00,RMC,0.00,VTG,0.00,ZDA,0.00,CRT,0.00,DCR,0.00,
DPO,0.00,MSG,0.00,POS,0.00,RRE,0.00,SAT,0.00*04
```

See also $PASHS,NME

NTR: NTRIP Settings

Function
This command is used to read the current NTRIP settings.

Command Format

Syntax

$PASHQ,NTR[*cc]

Response Format

Syntax

$PASHR,NTR,ADD=s1,PRT=d2,LGN=s3,PWD=s4,TYP=d5*cc

Parameters

Parameter	Description	Range
s1	Caster IP address or host name	000.000.000.000- 255.255.255.255
d2	Caster port number	0-65535
s3	Login	32 characters max.
s4	Password	32 characters max.
d5	Caster type: • 0: Client • 1: Server	0-1
*cc	Checksum	*00-*FF

Example

$PASHQ,NTR
$PASHR,NTR,ADD=192.34.76.1,PRT=2100,LGN=Magellan,PWD=u6huz8,
TYP=0*cc

See also
$PASHS,NTR,PAR
$PASHQ,NTR,TBL

NTR,TBL: Source Table

Function
This command is used to read the source table stored in the receiver.

Command Format

Syntax

$PASHQ,NTR,TBL[*cc]

Response Format

Syntax

$PASHR,NTR,TBL
SOURCETABLE 200 OK
<source table as specified in the RTCM standard>

ENDSOURCETABLE

Parameters

Source table as defined in the RTCM standard.

Example

$PASHQ,NTR,TBL
$PASHR,NTR,TBL
SOURCETABLE 200 OK
Content-Type: text/plain
Content-Length: 7864
CAS;129.217.182.51;80;ICD;BKG;0;GER;51.5;7.5;Trial Broadcaster
NET;GREF;BKG;B;N;http://igs.ifag.deGREF.htm;none;
denise.dettmering@bkg.bund.de;none
NET;IGSIGLOS;BKG;B;N;http://igscb.jpl.nasa.gov/projects/rtwg
;none;denise.dettmering@bkg.bund.de;none
STR;FFMJ2;Frankfurt;RTCM2.0;1(1),3(19),16(59);0;GPS;GREF;GER;50.12;8
.68;0;1;GPSNetV1.9;none;N;N;560;DemoSTR;FFMJ1;Frankfurt;RTCM
2.1;3(19),16(59),18(1),19(1);2;GPS;GREF;GER;50.09;8.66;0;0;GPSNet
V1.9;none;N;N;2800;Demo
STR;FFMJ0;Frankfurt;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;50.09;8.66;0;0;Javad Legacy E;none;N;N;3600;Demo
STR;LEIJ0;Leipzig;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;51.33;12.37;0;0;Javad Legacy E;none;B;N;3600;none
STR;WTZJ0;Wettzell;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;49.13;12.88;0;0;Javad Legacy E;none;B;N;3600;none
STR;HELJ0;Helgoland;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;54.18;7.88;0;0;Javad Legacy E;none;B;N;3600;none
STR;TITZ0;Titz;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;51.00;6.42;0;0;Javad Legacy E;none;B;N;3600;none
STR;HUEG0;Huegelheim;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;47.82;7.62;0;0;Javad Legacy E;none;B;N;3600;none
STR;DREJ0;Dresden;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;51.05;13.73;0;0;Javad Legacy E;none;B;N;3600;none
STR;SASS0;Sassnitz;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;54.51;13.64;0;0;Javad Legacy E;none;B;N;3600;none
STR;KARJ0;Karlsruhe;RAW;Compact(1);2;GPS+GLO;IGSIGLOS;
GER;49.01;8.41;0;0;Javad Legacy E;none;B;N;3600;none
STR;WILH0;Wilhelmshaven;RTCM
2.0;1(1),3(19),16(59);0;GPS;GREF;GER;53.52;8.10;0;1;GPSNet
V1.9;none;B;N;560;VRS
ENDSOURCETABLE

See also

$PASHS,NTR,LOD
$PASHS,NTR,PAR
$PASHS,NTR,MTP

OCC: Ocupation State and Parameters

Function

This command is used to read the current occupation settings.

Command Format

Syntax

$PASHQ,OCC[*cc]

Response Format

Syntax

$PASHR,OCC,d1,d2[,s3,s4]*cc

Parameters

Parameter	Description	Range
d1	Occupation type: • 0: Static • 1: Quasi-static • 2: Dynamic	0-2
d2	Occupation state: • 0: Occupation in progress • 1: No occupation in progress	0-1
s3	Occupation name	255 characters max.
s4	Occupation description	255 characters max.
*cc	Checksum	*00-*FF

Examples

$PASHQ,OCC
$PASHR,OCC,2,1*38

Relevant Set Command

$PASHS,OCC

OPTION: Installed Receiver Firmware Options

Function

This command is used to list the firmware options currently installed in the receiver. The returned message includes one response line per installed option.

Command Format

Syntax

$PASHQ,OPTION[*cc]

Response Format

Syntax

$PASHR,OPTION,c1,s2,h3*cc

Parameters

Parameter	Description	Range
c1	Option ID	K, F, Z, S (See table below)
s2	Option label	
h3	Hexadecimal unlock code	13 characters max.
*cc	Optional checksum	*00-*FF

Option ID	Label	Description
K	RTK	RTK processing enabled. Corrections generated in RTCM2.3, RTCM3.0, CMR or CMR+ format.
F	FASTOUTPUT	10-Hz data output rate enabled
Z	MODEM	GSM/GPRS modem enabled
S	GLONASS	GLONASS enabled

Example

$PASHQ,OPTION
$PASHR,OPTION,0,SERIAL,NUMBER,200751223*7A
$PASHR,OPTION,K,RTK,6756975c71766*36
$PASHR,OPTION,S,GLONASS,6756945714671*7B

Relevant Set Command

$PASHS,OPTION

PEM: Position Elevation Mask

Function

This command is used to read the current value of elevation mask used in the position processing.

Command Format

Syntax

$PASHQ,PEM[*cc]

Response Format

Syntax

$PASHR,PEM,d1*cc

Parameters

Parameter	Description	Range
d1	Elevation mask angle	0-90°
*cc	Checksum	*00-*FF

Example

$PASHQ,PEM
$PASHR,PEM,9*39

Relevant Set Command

$PASHS,PEM

See also

$PASHQ,ELM

POS: Computed Position Data

Function

This command allows you to query the computed position.

Command Format

Syntax

$PASHQ,POS[*cc]

Response Format

Syntax

$PASHR,POS,d1,d2,m3,m4,c5,m6,c7,f8,f9,f10,f11,f12,f13,f14,f15,f16,s17*cc

Parameters

Parameter	Description	Range
d1	Position mode: • 0: Autonomous • 1: RTCM code differential or SBAS differential • 2: RTK float • 3: RTK fixed	0-3
d2	Count of satellites used in position computation	3-27
m3	Current UTC time of position (hhmmss.ss)	000000.00-235959.99
m4	Latitude of position (ddmm.mmmmmmm)	0-90°
c5	North (N) or South (S)	N, S
m6	Longitude of position (ddmm.mmmmmmm)	0-180°
c7	East (E) or West (W)	E, W
f8	Altitude above the WGS84 ellipsoid	+ or - 9999.000
f9	Reserved	
f10	True Track/Course Over Ground, in degrees	0-359.9
f11	Speed Over Ground, in knots	0-999.9
f12	Vertical velocity in dm/s	+ or - 999.9
f13	PDOP	0-99.9
f14	HDOP	0-99.9
f15	VDOP	0-99.9
f16	TDOP	0-99.9
s17	Firmware version ID	4-char. string
*cc	Checksum	*00-*FF

Example

$PASHQ,POS
$PASHR,POS,3,10,151858.00,4717.960848,N,00130.499487,W,82.972,,0.0,0.0,-0.0,2.0,1.1,1.7,1.3,G010*49

Relevant Set Command

$PASHS,POS

See also $PASHS,NME

PRT: Baud Rate Settings

Function This command is used to query the baud rate setting for each of the serial ports used in the receiver.

Command Format

Syntax

$PASHQ,PRT,c1[*cc]

Parameters

Parameter	Description	Range
c1	Queried port ID	A, D, E
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,PRT,c1,d2*cc

Parameters

Parameter	Description	Range
c1	Queried port ID	A, D, E
d2	Baud rate code	0-9 (see table below)
*cc	Checksum	*00-*FF

Code	Baud Rate	Code	Baud Rate
0	300	5	9600
1	600	6	19200
2	1200	7	38400
3	2400	8	57600
4	4800	9	115200

Example

$PASHQ,PRT,A
$PASHR,PRT,A,6*55

Relevant Set Command $PASHS,PRT

See also $PASHQ,CTS
$PASHQ,MDP

PWR,PAR: Power Status

Function This command is used to query the power status of the receiver.

Command Format

Syntax

$PASHQ,PWR[*cc]

Response Format

Syntax

$PASHR,PWR,PAR,f1,f2,d3,f4,d5,f6,d7,d8*cc

Parameters

Parameter	Description	Range
f1	Battery voltage threshold, in volts, triggering a low-battery alarm	6.7-8.4
f2	External power voltage threshold, in volts, triggering a low-power alarm	9.0-28.0
d3	Power source: • 0: Internal battery • 1: External battery • 2: External DC source	0-2
f4	Battery DC output voltage, in volts	0.0-12.0
d5	Percentage of remaining battery energy	0-100
f6	DC input voltage from external power, in volts	0.0-30.0
d7	Battery charging status: • 0: Charging • 1: Discharging • 2: Fully charged	0-2
d8	Internal temperature, in °Celsius	
*cc	Checksum	*00-*FF

Example

$PASHQ,PWR
$PASHR,PWR,6.8,9.1,2,,,11.6,,44*0D

See also $PASHS,PWR,PAR

RAW: Raw Data Logging Settings

Function

This command is used to query the raw data recording parameters.

Command Format

Syntax

$PASHQ,RAW[*cc]

Response Format

Syntax

(Through an example):

PER:020.00 ELM:10
RAW: MPC SNV SNG SNW SAL SAG SAW ION DAT INF BAUD
PRTA: ON OFF OFF OFF OFF OFF OFF OFF OFF OFF 6
PRTC: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF 6
MEMM: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF 1
MEMU: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF 0

Parameters

Parameter	Description	Range
PER	Output rate, in seconds	0.00-999.00
ELM	Elevation mask used in data recording & data output	0-90
RAW	Raw data type	MPC, SNV, SNG, SNW, SAL, SAG, SAW, ION, DAT, INF
PRTA PRTC	Labels for serial ports A (PRTA) and C (PRTC)	ON, OFF
MEMM MEMU	Labels for memories M (MEMM) and U (MEMU)	ON-OFF
BAUD	For a serial port, baud rate code For a memory, “0” if not available, else “1”	0-9 (see table below) 0-1

Code	Baud Rate	Code	Baud Rate
0	300	5	9600
1	600	6	19200
2	1200	7	38400
3	2400	8	57600
4	4800	9	115200

Relevant Set Command

$PASHS,RAW

See also

$PASHS,SBA

RDP,CHT: Radio Channel Table

Function

This command is used to read the radio channel settings.

Command Format

Syntax

$PASHQ,RDP,CHT,c1[*cc]

Parameters

Parameter	Description	Range
c1	Serial port used to communicate with the radio (A for external radio, D for internal radio)	A, D
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,RDP,CHT,s1,d2,d3,f4,f5,d3,f4,f5,d3,f4,f5...*cc
Or, if the channel table does not exist: $PASHR,RDP,CHT,s1,0

Parameters

Parameter	Description	Range
s1	Radio Model: • NONE • MGL: Magellan UHF • PDL: Pacific Crest	NONE, MGL, PDL
d2	Total number of available channels	0-16
d3	Channel index	0-15
f4	Receive frequency	410-470 MHz
f5	Transmit frequency	410-470 MHz
*cc	Optional checksum	*00-*FF

Comment

The number of (d3,f4,f5) data sets in the response line is equal to the number of channels (d2).

Examples

$PASHQ,RDP,CHT,D
$PASHR,RDP,CHT,PDL,7,0,446.7750,446.7750,1,444.1000,444.1000,2,445.1000,445.1000,3,446.1000,446.1000,4,447.1000,447.1000,5,448.1000,448.1000,6,449.1000,449.1000*35

$PASHQ,RDP,CHT,A
$PASHR,RDP,CHT,NONE,0*7B

See also

$PASHS,RDP,TYP
$PASHQ,RDP, PAR

RDP,PAR: Radio Parameters

Function

This command allows you to query the radio settings relevant to the port used to communicate with the radio.

Command Format

Syntax

$PASHQ,RDP,PAR,c1[*cc]

Parameters

Parameter	Description	Range
c1	Serial port used to communicate with the radio	A, D
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,RDP,PAR,c1,s2,s3,c4,s5,c6,c7,s8,f9,f10,c11,s12,s13*cc

Parameters

Parameter	Description	Range
c1	The port ID you specified in the command is reminded in this field	A, D
s2	Radio Model: • NONE: No radio detected • MGL: Magellan UHF • PDL: Pacific Crest	NONE, PDL, MLG (port A) PDL (port D)
s3	Radio state (if port D is queried)	ON, OFF
c4	Channel number	0-15
s5	Power management (if port D is queried) • AUT: Automatic • MAN: Manual	AUT, MAN
c6	Protocol used (if a PDL radio model is used) • 0: Transparent • 1: TRIMTALK • 2: Magellan	0-2
c7	Air link speed: • 4800: 4800 Bd, GMSK modulation • 9600: 9600 Bd, GMSK or four-level FSK modulation • 19200: 19200 Bd, four-level FSK modulation	4800, 9600, 19200
s8	Radio sensitivity	LOW, MED, HIG, OFF
f9	Receiver frequency, in MHz	410-470
f10	Transmit frequency, in MHz	410-470
c11	Channel spacing, in kHz (for PDL only)	12.5, 25
s12	RF band, in MHz (for PDL only)	410-430, 430-450, 4750-470
s13	Firmware version	
*cc	Checksum	*00-*FF

Examples

If an internal PDL radio receiver is used:

$PASHQ,RDP,PAR,D
$PASHR,RDP,PAR,D,PDL,ON,4,AUT,2,4800,MED,447.1000,447.1000,25.0,430-450,V02.53*24

If an external Magellan transmitter is used:

$PASHQ,RDP,PAR,A
$PASHR,RDP,PAR,A,MGL,,1,,,,,0.0000,447.1000,,,TD20-EUHFV10300*04

Relevant Set Command

$PASHS,RDP,PAR

See also

$PASHS,RDP,TYP

RDP,TYP: Radio Type Used

Function

This command is used to query the type of radio used on the specified port.

Command Format

Syntax

$PASHQ,RDP,TYP,c1[*cc]

Parameters

Parameter	Description	Range
c1	Serial port used to communicate with the radio	A, D
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,RDP,TYP,c1,s2*cc

Parameters

Parameter	Description	Range
c1	The port ID you specified in the command is reminded in this field	A, D
s2	Radio Model: • NONE: No radio detected • MGL: Magellan UHF • PDL: Pacific Crest	NONE, PDL, MLG (if port A used), PDL (if port D used)
*cc	Checksum	*00-*FF

Examples

If an external Magellan transmitter is used:

$PASHQ,RDP,TYP,D
$PASHR,RDP,TYP,D,PDL*5F

If an internal PDL radio receiver is used:

$PASHQ,RDP,TYP,A
$PASHR,RDP,TYP,A,PDL*44

Relevant Set Command

$PASHS,RDP,TYP

REC: Raw Data Recording Status

Function

This command allows you to read the current raw data recording status.

Command Format

Syntax

$PASHQ,REC[*cc]

Response Format

Syntax

$PASHR,REC,c*cc

Parameters

Parameter	Description	Range
c	Control character: • Y: Yes. Data recording enabled. • N: No. Data recording disabled. • S: Stop. Data recorded enabled but stopped.	Y, N, S
*cc	Checksum	*00-*FF

Example

$PASHQ,REC
$PASHR,REC,N*42

Relevant Set Command

$PASHS,REC

RID: Receiver Identification

Function

This command allows you to read the receiver identification parameters.

Command Format

Syntax

$PASHQ,RID[*cc]

Response Format

Syntax

$PASHR,RID,s1,d2,s3,s4,s5,s6*cc

Parameters

Parameter	Description	Range
s1	Receiver type	PM (for ProMark 500)
d2	Not used	30
s3	Firmware version	8 characters
s4	Receiver option. When an option is valid, a letter is displayed, else a dash is displayed. The options are: • K: RTKBASE • F: FASTOUTPUT • Z: MODEM • S: GLONASS	4 characters
s5	Not used	
s6	Serial number	9 characters
*cc	Checksum	*00-*FF

Example

$PASHQ,RID
$PASHR,RID,PM,30,S020G010,KFZS,,200751223*1A

See also

$PASHQ,VERSION
$PASHQ,OPTION

RMC: Recommended Minimum Specific GNSS Data

Function This command is used to output an RMC message containing the last computed position as well as navigation-related data.

Command Format

Syntax

$PASHQ,RMC[*cc]

Response Format

Syntax

$GPRMC,m1,c2,m3,c4,m5,c6,f7,f8,d9,f10,c11,c12*cc

Parameters

Parameter	Description	Range
m1	Current UTC time of position (hhmmss.ss)	000000.00-235959.99
c2	Status • A: Data valid • V: Data not valid	A, V
m3	Latitude of position (ddmm.mmmmmm)	0-90 0-59.999999
c4	Direction of latitude	N, S
m5	Longitude of position (dddmm.mmmmmm)	0-180 0-59.999999
c6	Direction of longitude	E,W
f7	Speed Over Ground, in knots	000.0-999.9
f8	Course Over Ground, in degrees (true)	000.0-359.9
d9	Date (ddmmyy)	010100-311299
f10	Magnetic variation, in degrees	0.00-99.9
c11	Direction of variation	E, W
c12	Mode indicator: • A: Autonomous mode • D: Differential mode • N: Data not valid	A, D, N
*cc	Checksum	*00-*FF

Example

$PASHQ,RMC
$GPRMC,160324.50,A,4717.959275,N,00130.500805,W,0.0,0.0,250208,1.9,W,A*3D

See also $PASHS,NME

RRE: Residual Error

Function This command is used to output an RRE message. The message is output only if a position solution is computed.

Command Format

Syntax

$PASHQ,RRE[*cc]

Response Format

Syntax

$PASHR,RRE,d1,d2,f3,d2,f3,d2,f3,d2,f3,... ,f4,f5*cc

Parameters

Parameter	Description	Range
d1	Number of satellites used to compute the position	000000.00-235959.99
d2	Satellite number	GPS: 1-32 SBAS: 33-64 GLONASS: 65-96
f3	Range residual	+ or - 999.9 m
f4	RMS horizontal position error	0-9999.9 m
f5	RMS vertical position error	0-9999.9 m
*cc	Checksum	*00-*FF

Example

$PASHQ,RRE

$PASHR,RRE,12,20,0.5,13,0.4,23,-0.4,17,-0.6,25,-0.3,04,-0.1,02,0.5,77,
-0.0,84,0.0,83,0.0,78,0.0,68,0.1,1.2,2.3*34

See also $PASHS,NME

RTC: RTCM Status

Function

This command queries the current status of the RTCM. The return message is in free-form format.

Command Format

Syntax

$PASHQ,RTC[*cc]

Response Format

Syntax

(Through an example)

```
STATUS:
SYNC:* VER:V2.3 STID:0000 STHE:0
AGE:+0000 TYPE:18/19
MSG:
SETUP:
MODE:BAS PORT:A,E VER:V3,V2.3
STI:0000
TYP: 1   3   16   18   19   20   21   22
FRQ: 0  30   0    1    1    0    0   30
TYP: 23 24  31   32   36
FRQ: 0   0   0    0    0
TYP: 1001 1002 1003 1004 1005 1006 1007 1008
FRQ:    0    0    0    1    0   30    0    0
TYP: 1009 1010 1011 1012 1013 1019 1020 1029 1033
FRQ:    0    0    0    1   30    0    0    0   31
MSG:
```

Parameters

Status:

Parameter	Description	Range
SYNC	RTCM status: • *: Corrections from base received in rover in due time. • <space>: No corrections are received that would be compatible with the" maximum age of corrections" requirement.	*, <space>
VER	RTCM version	V2.3, V3
STID	Station ID received from the base	0-4095
STHE	Station health index received from the base	0-7 (RTCM2.3)
AGE	Age of last message received	0-999
TYPE	RTCM message being received or sent	1, 18/19, 20/21,23, 24, 31, 32, 1001, 1002, 1003, 1004, 1009, 1010, 1011, 1012, 1019, 1020, 1033

Parameter	Description	Range
MSG	User message received in message type 16, 36 or 1029	90 characters max.

Setup:

Parameter	Description	Range
MODE	RTCM Base/Rover mode: • ROV: If the receiver is a rover. • BAS: If the receiver is a base and the selected differential data type is RT2 or RT3.	ROV, BAS, OFF
PORT	Communication port:	A, C, D, E, AUT
VER	RTCM version	V2.3, V3
STI	Station ID	0-4095
TYP	Type of RTCM message the receiver generates (base receiver only)	
FRQ	Transmit rate of RTCM message, in seconds	0-1800
MSG	User message sent through message type 16, 36 or 1029	90 characters max.

See also $PASHS,RTC,TYP
$PASHS,BAS
$PASHS,CPD,REM

RTC,MSI: RTCM Message Status

Function

This command queries a base receiver for the current RTCM message status.

Command Format

Syntax

$PASHQ,RTC,MSI[*cc]

Response Format

Syntax

$PASHR,RTC,MSI,d1,d2,f3,d2,f3,d2,f3,d2,f3,... *cc

Parameters

Parameter	Description	Range
d1	Number of RTCM message types in the RTCM output message	30
d2	RTCM message type	1, 3, 16, 18-24, 31, 32, 36, 1001-1013, 1019, 1020, 1029, 1033
d3	Message output rate in seconds	0-1800
*cc	Checksum	*00-*FF

Example

$PASHQ,RTC,MSI
$PASHR,RTC,MSI,30,1,0.0,3,0.0,16,0.0,18,1.0,19,1.0,20,0.0,21,0.0,22,0.0,23,31.0,24,13.0,31,0.0,32,0.0,36,0.0,1001,0.0,1002,0.0,1003,0.0,1004,1.0,1005,0.0,1006,13.0,1007,0.0,1008,13.0,1009,0.0,1010,0.0,1011,0.0,1012,1.0,1013,0.0,1019,0.0,1020,0.0,1029,0.0,1033,31.0*51

See also

$PASHS,RTC,TYP

RWO: Raw Data Output Settings

Function

This command is used to query the raw data output parameters on the specified port.

Command Format

Syntax

$PASHQ,RWO,c[*cc]

Parameters

Parameter	Description	Range
c	Port ID the command refers to	A, C, M, U
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,RWO,c1,d2,f3,d4,s5,f6,c7,s5,f6,c7,s5,f6,c7,s5,f6,c7,s5,f6,c7,s5,f6,c7,s5,f6,c7,s5,f6,c7*cc

Parameters

Parameter	Description	Range
c1	The port ID specified in the command is reminded in this field: • A: Serial port • C: Bluetooth • M, U: Memory	A, C, M, U
d2	Baud rate code	0-9 (A, C) 0-1 (M, U) See table below
f3	Output rate defined by the last $PASHS,RAW,PER command run	0-999.9
d4	Number of raw data messages	8
s5	Raw data message types	MPC, SNV, SNG, SNW, SAL, SAG, SAW, ION
f6	Output rate 0: Message disabled	0-999.00
c7	ASCII/Binary setting Always binary with ProMark 500	B
*cc	checksum	*00-*FF

Code	Baud Rate	Code	Baud Rate
0	300	5	9600
1	600	6	19200
2	1200	7	38400
3	2400	8	57600

Code	Baud Rate	Code	Baud Rate
4	4800	9	115200

Example

$PASHQ,RWO,A
$PASHR,RWO,A,6,001.00,8,MPC,0.00,B,SNV,0.00,B,SNG,0.00,B,SNW,0.00,B,SAL,0.00,B,SAG,0.00,B,SAW,0.00,B,ION,0.00,B*6D

See also

$PASHQ,RAW

SAT: Satellites Status

Function

This command allows you to read the status of the different satellite constellations used.

Command Format

Syntax

$PASHQ,SAT[*cc]

Response Format

Syntax

$PASHR,SAT,d1,d2,d3,d4,f5,c6,d2,d3,d4,f5,c6,d2,d3,d4,f5,c6... *cc

Parameters

Parameter	Description	Range
d1	Number of satellites locked	1-27
d2	SV PRN number	1-32: GPS 33-64: SBAS 65-96: GLONASS
d3	SV azimuth, in degrees	0-359
d4	SV elevation angle, in degrees	0-90
f5	SV signal-noise ratio, in dB.Hz	30.0-60.0
c6	SV used in computation or not • U: SV used • -: Not used	U, -
*cc	Checksum	*00-*FF

Example

$PASHQ,SAT

$PASHR,SAT,13,20,092,32,44.0,U,13,206,78,50.0,U,23,056,55,48.0,U,33,198,34,44.0,-,17,218,13,42.0,U,25,152,34,38.0,U,04,276,65,50.0,U,02,308,31,48.0,U,77,052,37,48.0,U,84,294,33,48.0,U,83,234,23,48.0,U,78,124,42,46.0,U,68,034,65,48.0,U*35

See also

$PASHS,NME

SBA: SBAS Tracking Status

Function

This command is used to query the SBAS tracking status.

Command Format

Syntax

$PASHQ,SBA[*cc]

Response Format

Syntax

$PASHR,SBA,s*cc

Parameters

Parameter	Description	Range
s	ON: SBAS satellites are being tracked and used OFF: SBAS satellites not tracked	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,SBA
$PASHR,SBA,ON*09

See also

$PASHS,SBA

SBA,INF: SBAS Info Message Output

Function This command is used to output the SBAS information message.

Command Format

Syntax

$PASHQ,SBA,INF[*cc]

Response Format

Syntax

$PASHR,SBA,INF,d1,d2,f3,d4,d2,f3,d4,d2,f3,d4,... *cc

Parameters

Parameter	Description	Range
d1	SBAS channel number	3
d2	SBAS SV PRN number	000000.00-235959.99
f3	Signal-to-noise ratio	00.0-99.9
d4	SBAS channel status: 0=not used 1=used	0, 1
*cc	Checksum	*00-*FF

Example

$PASHQ,SBA,INF
$PASHR,SBA,INF,2,33,44.0,7F,40,00.0,00*22

See also $PASHS,SBA (,INF)

SBO: SBAS Message Output Settings

Function

This command allows you to read the current settings of the SBAS message on the specified port.

Command Format

Syntax

$PASHQ,SBO,c[*cc]

Parameters

Parameter	Description	Range
c	Port ID the command refers to	A, C, M, U
*cc	Optional checksum	*00-*FF

Response format

Syntax

$PASHR,SBO,c1,d2,f3,d4,s5,f6,s5,f6*cc

Parameters

Parameter	Description	Range
c1	The port ID specified in the command is reminded in this field: • A: Serial port • C: Bluetooth • M, U: Memory	A, C, M, U
d2	Baud rate code	0-9 See table below
f3	Not used	
d4	Number of SBAS messages	2
s5	SBAS message type	DAT, INF
f6	Output control 0: Message disabled 1: Message enabled	0, 1
*cc	Checksum	*00-*FF

Code	Baud Rate	Code	Baud Rate
0	300	5	9600
1	600	6	19200
2	1200	7	38400
3	2400	8	57600
4	4800	9	115200

Example

$PASHQ,SBO,A
$PASHR,SBO,A,6,,2,DAT,0,INF,1*60

See also $PASHS,SBA,DAT
$PASHS,SBA,INF

SIT: Site Name

Function This command is used to read the name of the site on which data is currently being logged.

Command Format

Syntax

$PASHQ,SIT[*cc]

Response Format

Syntax

$PASHR,SIT,s*cc

Parameters

Parameter	Description	Range
s	Site name	4 characters max.
*cc	Checksum	*00-*FF

Example

$PASHQ,SIT
$PASHR,SIT,SITE*1D

Relevant Query Command $PASHS,SIT

See also $PASHQ,FLS

STI: Station ID

Function

This command is used to query the receiver for the station ID it transmits to the rover through the corrections message.

Command Format

Syntax

$PASHQ,STI[*cc]

Response Format

Syntax

$PASHR,STI,s*cc

Parameters

Parameter	Description	Range
s	Station ID	0-1023 (RTCM 2.3) 0-4095 (RTCM 3.x) 0-31 (CMR & CMR+)
*cc	Optional checksum	*00-*FF

Example

$PASHQ,STI
$PASHR,STI,DBN= B02,CMR= 0002,RTCM2.3=0002,RTCM3.0=0002*4E

Relevant Set Command

$PASHS,STI

VEC: Vector & Accuracy Data

Function

This command is used to query the receiver for vector and accuracy data.

Command Format

Syntax

$PASHQ,VEC[*cc]

Response Format

Syntax

$PASHR,VEC,c1,d2,m3,f4,f5,f6,f7,f8,f9,f10,f11,f12,d13*cc

Parameters

Parameter	Description	Range
c1	Position mode: 0: Autonomous 1: RTCM or SBAS differential 2: RTK float 3: RTK fixed	0-3
d2	Number of SVs used in position computation	3-27
m3	UTC time (hhmmss.ss)	000000.00-235959.99
f4	X component of vector (along ECEF X axis), in meters	±99999.999
f5	Y component of vector (along ECEF Y axis), in meters	±99999.999
f6	Z component of vector (along ECEF Z axis), in meters	±9999.999
f7	X component standard deviation	99.999
f8	Y component standard deviation	99.999
f9	Z component standard deviation	99.999
f10	XY correlation	±9.999999
f11	XZ correlation	±9.999999
f12	YZ correlation	±9.999999
d13	Base station ID (RTCM only)	0-4095
*cc	Optional checksum	*00-*FF

Example

$PASHQ,VEC
$PASHR,VEC,3,09,130924.00,-37.683,55.081,-17.925,0.016,0.012,0.026,
0.234765,0.098765,0.098763,0001*71

Relevant Set Command

$PASHS,NME

VERSION: Firmware Version

Function

This command is used to list the firmware versions installed in the receiver, including those of the modem and internal radio.

Command Format

Syntax

$PASHQ,VERSION[*cc]

Response Format

Syntax

(Through an example)

$PASHQ,VERSION
APPLICATION: S024G013
KERNEL: 2.6.19-pm4 #157 Wed Feb 27 15:33:55
RESCUE: 2.6.19-rescue
BOOT LOADER: 1.1.5.3
PMU: 2.21
API: 1.107
BSP: 1.0-108
GNSS uploader: pm4loader 0.14
RFS: 044
GSM : 6.63 stack IP : WIP Soft v301 on Open AT OS v421
Internal Radio: PDL V02.53

See also

$PASHQ,RID

VTG: Course Over Ground and Ground Speed

Function

This command is used to output a VTG message.

Command Format

Syntax

$PASHQ,VTG[*cc]

Response Format

Syntax

$GPVTG,f1,T,f2,M,f3,N,f4,K,c5*cc

Parameters

Parameter	Description	Range
f1,T	COG (with respect to True North) T for “True” North: COG orientation	000000.00- 235959.99
f2,M	COG (with respect to Magnetic North) M for “Magentic” North: COG orientation	A, V
f3,N	SOG (Speed Over Ground) N for “knots”: SOG unit	0-90 0-59.999999
f4,K	SOG (Speed Over Ground) K for “km/hr”: SOG unit	N, S
c5	Mode indicator: • A: Autonomous mode • D: Differential mode • N: Data not valid	A, D, N
*cc	Checksum	*00-*FF

Example

$PASHQ,VTG
$GPVTG,128.00,T,129.92,M,0.17,N,0.31,K,A*2D

See also

$PASHS,NME

WARN: Warning Messages

Function

This command is used to list the possible warning messages stored in the receiver.

Command Format

Syntax

$PASHQ,WARN[*cc]

Response Format

Syntax

$PASHR,WARN,s1,s2*cc

Parameters

Parameter	Description	Range
s1	Warning message label NONE: No warning message	See table below
s2	Status: • Pending: Alarm acknowledged • Current: Alarm not acknowledged yet • Occurred: An error condition was detected earlier but has vanished since then	PENDING, CURRENT, OCCURRED
*cc	Checksum	*00-*FF

Alarm Label
Software error
Unknown command
Bad parameter format
Bad command checksum
File open error
File close error
File write error
File read error
File system mount error
GSM connection failed
GSM initialization failed
GSM data read error
GSM data write error
GSM network error
GSM power error
USB removed while file opened
File transfer Error
Transfer to USB failed
RTC send error
Bad radio settings
No radio detected

Alarm Label
Radio settings corrupted
Bad radio response
Bad radio channel
No GNSS detected
Bad PVT received
Bad PVT decoded
PVT multiflag
Unknown option code
C3 code checksum is bad
Option has expired
All attempts failed
Memory full
Spy too long
GSM already in DIP Mode
GSM currently in NTRIP Mode
GSM currently in CSD Mode
Invalid mount point
Input buffer full
GSM Pin code invalid
GSM band error
GSM protocol error
GSM CSD mode error
APN error
GPRS login error
GPRS password error
GPRS connection failed
Connection to caster failed
Invalid caster hostname
Invalid caster port
Disconnect. from IP failed
Connect. to mount point failed
Disconnect. from GPRS failed
Connect. to DIP failed
CSD dial error
CSD hangup error
Auto dial error
Redial number error
Auto pickup error
No SIM card detected
Incomplete srce table
Too many files

Example

$PASHQ,WARN
$PASHR,WARN,connect. to GPRS failed,PENDING*5F

See also $PASHS,WAK

ZDA: Time & Date

Function This command returns the receiver date & time.

Command Format

Syntax

$PASHQ,ZDA[*cc]

Response Format

Syntax

$GPZDA,ZDA,m1,d2,d3,d4,d5,d6*cc

Parameters

Parameter	Description	Range
m1	UTC time (hhmmss.ss)	000000.00-235959.99
d2	Current day	01-31
d3	Current month	01-12
d4	Current year	0000-9999
d5	Local zone offset from UTC time (hour)	-13 to +13
d6	Local zone offset from UTC time (minutes)	00-59
*cc	Checksum	*00-*FF

Example

$PASHQ,ZDA
$GPZDA,162256.27,25,02,2008,+00,00*43

Relevant Set Command $PASHS,ZDA

See also $PASHS,LTZ
$PASHS,NME

ProMark™500

Reference Manual

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