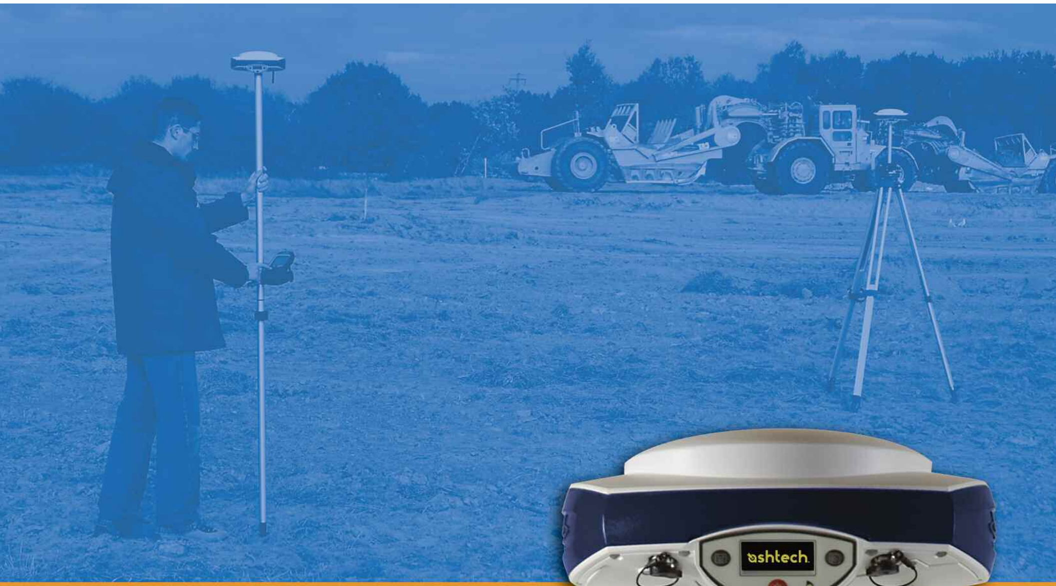
ashtech

ProMark™ 500



Reference Manual

Copyright Notice

P/N 631630-01E, January 2011

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 Ashtech 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.

To comply with CE and FCC electrical safety regulations, ProMark 500 should only be powered from a 6 to 28 V DC external source, with 20 W power limitation, or the recommended battery (P/N 111374). The battery should be charged only with the supplied battery charger (P/N 802064).

Replacing the Power Fuse of Radio Transmitter P/N 800986

This radio transmitter is protected by a 4-A fuse inserted in the data/power cable. This Y-shaped cable is used to connect the 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.

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

Ashtech 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, Ashtech 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. Ashtech 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). Ashtech'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. Ashtech 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 ASHTECH'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 ASHTECH SERVICE CENTER. ANY REPAIRS BY A SERVICE CENTER NOT AUTHORIZED BY ASHTECH 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 (North America) or 1-408-572-1134 (International) and leaving a voice mail at option 3, or by submitting a repair request on-line at: http://ashtech.com (fill out the RMA request from under the Support tab). The purchaser must return the product postpaid with a copy of the original sales receipt to the address provided by Ashtech with the RMA number. Purchaser's return address and the RMA number must be clearly printed on the outside of the package.

Ashtech 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. Ashtech 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. Ashtech 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 Ashtech Service Center; (6) any product, components or parts not manufactured by Ashtech; (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: Ashtech 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 Ashtech Service Center will void this warranty.

ASHTECH 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 OFASHTECH OR NEGLIGENT USAGE OF THE PRODUCT. IN NO EVENT WILL ASHTECH BE RESPONSIBLE FOR SUCH DAMAGES, EVEN IF ASHTECH HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

This written warranty is the complete, final and exclusive agreement between Ashtech 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 Ashtech'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 Ashtech, 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:

Ashtech LLC, 451 El Camino Real, Suite 210, Santa Clara, CA 95050, Phone: +1 408 572 1100, Fax: + +1 408 572 1199 or

Ashtech - 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.

Ashtech Products Limited Warranty (Europe, Middle East, Africa)

All Ashtech 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. ASHTECH WARRANTY

Ashtech 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, Ashtech 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. Ashtech 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). Ashtech'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. Ashtech 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 ASHTECH'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 ASHTECH SERVICE CENTER. ANY REPAIRS BY A SERVICE CENTER NOT AUTHORIZED BY ASHTECH 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.

Ashtech 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. Ashtech 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. Ashtech 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 Ashtech Service Center;

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

(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: Ashtech 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 Ashtech Service Center will void this warranty.

6. EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES

ASHTECH 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 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 OFASHTECH OR NEGLIGENT USAGE OF THE PRODUCT. IN NO EVENT WILL ASHTECH BE RESPONSIBLE FOR SUCH DAMAGES, EVEN IF ASHTECH 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 Ashtech 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 ASHTECH'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 Ashtech, 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:

Ashtech - 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.

January 2011 Manual Release Note (Rev E)

Compared to the previous release of this manual (Jan 2010, Rev D), the present publication includes the following enhancements and changes:

- The ProMark 500 antenna is now Galileo and L5 capable.
- Minor changes in the FAST Survey user interface are reflected in this manual. Sections about MobileMapper 6 and ProMark 3 used as field terminals have been removed.
- FAST Survey-related sections were moved from the Appendix chapter (Chapter 12) to Chapter 2 and the U-Link-related sections from Chapter 12 to Chapter 1.

The set of $PASH proprietary commands is augmented to offer the following new functions in expert mode:

- The receiver may provide its position on the local datum requested by the base in a specific RTCM3.1 message (1021, 1022 or 1023). This function relies on the use of the new command $PASHS,LCS.
- You can choose the distance unit in which coordinates are displayed on the receiver screen ($PASHS,UNT).
- Observation masks are now customizable (see new commands SOM - SOM,CTT - SOM,NAV - SOM,SNR - SOM,WRN).
- DPC raw data message now available (compact GPS measurements).
- DTM NMEA message now available (Reference datum).
- GLONASS biases may be adjusted in the receiver (AGB). This function relies on the bias parameters entered for the receiver (RCP).
- As a base, the receiver can generate and transmit DBEN differential data (BAS and DBN,TYP commands updated).
- You can set the maximum number of satellites that may be part of the PVT process (SVM).
- You can declare the name of the base receiver providing the differential stream used by your reciver (RCP,REF). This name can also be decoded from the differential stream.
- You can declare the name of the base receiver antenna (ANP,REF). This name can also be decoded from the differential stream.
- You can define antennas and enter their properties ($PASHS,ANP).
- The output of measurements and positions may be synchronized with the GPS time ($PASHS,UDP).
- RNX,TYP replaces ATD,TYP to define ATOM messages.
- Direct connection to IP address using new commands DIP,PAR and DIP,ON.
- Enhanced management of files and directories (FIL,DEL).
- Additional commands: DSY - FIL,CUR
- Minor changes in existing commands: CPD,VRS - GNS,CFG - NME - POP - RAW - RWO.

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 32 sections included in **Chapters 1 through 5**, 23 are shared by the Getting Started Guide and the present manual. When Ashtech revises any of the 23 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 additional sections about software installation, base position, use of a geoid and use of a background map.

Chapter 3 focuses on setup and configuration steps at the base and the rover, including radio setups and network connections for RTK operation. Compared to the Getting Started Guide, this chapter includes four additional sections: Network Connection, Direct IP Connection To Your Own Base Through RTDS Software, Using an External CDMA Cell Phone for Network Connections and Using a Repeater.

Chapter 4 provides step-by-step procedures to perform RTK surveying with ProMark 500 and FAST Survey. Compared to the Getting Started Guide, this chapter includes two additional sections: Localization and Logging Points in Continuous Mode.

Chapter 5 deals with raw data logging, also described in the Getting Started Guide. Compared to this Guide, Chapter 5 does not include any additional section.

Chapter 6 provides all the instructions required to run post-processed surveys. This chapter is somewhat redundant with Chapter 5. However, whereas Chapter 5 is more focused on describing the receiver's raw data logging capabilities and all the functions attached to it, Chapter 6 is more survey-oriented, focusing on field instructions when the equipment is used with FAST Survey for post-processed surveys exclusively.

Chapters 7 through 9 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 Ashtech 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 7 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 8 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 8 also introduces the two position output modes available in RTK and helps surveyors choose the one that's best for their applications.

Chapter 9 explains how to perform a large-scale static survey using GNSS equipment, emphasizing the difference between conventional and GNSS systems.

Chapter 10 gives an in-depth description of the BLADE algorithms and performance.

Chapter 11 is a collection of first-level maintenance instructions you may have to refer to, should you encounter problems with your equipment.

Chapter 12 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, four additional appendices are provided describing all serial commands and data outputs pertaining 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.

Appendix D provides a full description of all the output messages.

Table of Contents

Chapter 1. Introduction

What is ProMark 500?

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

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 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

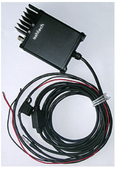
Item	Part Number	Picture
ProMark 500 GNSS receiver with standard accessories	990596	
7.4 V-4.4 Ah Li-ion Battery Pack (rechargeable)	111374	
ProMark500 User Documentation CD	501503	

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.	702104	
USB Host Cable (long) Makes ProMark 500 a USB device.	702103	
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
U-Link TRx, 12.5-kHz channel bandwidth	Transmitter: 802080-10 (0.5/2/4W; 410-430 MHz) 802080-30 (0.5/2/4W; 430-450 MHz) 802080-50 (0.5/2/4W; 450-470 MHz) Repeater: 802106-10 (0.5/2/4W; 410-430 MHz) 802106-30 (0.5/2/4W; 430-450 MHz) 802106-50 (0.5/2/4W; 450-470 MHz) Each P/N includes a whip antenna, and an antenna bracket. The Y-shaped power/data cable is an integral part of the transmitter (no connector).	 Picture of transmitter with its cable
Radio Transmitter, 12.5-kHz channel bandwidth	800986-10 (0.5/4W, 410-430 MHz) 800986-30 (0.5/4W, 430-450 MHz) 800986-50 (0.5/4W, 450-470 MHz) Each P/N includes a whip antenna, an antenna bracket and a Y-shaped data/power cable (P/N 730476).	 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 and an OEM Y-shaped data/power cable.	 Picture of transmitter alone

Item	Part Number	Picture
Radio receiver kit (includes radio module, whip antenna and small parts)	U-Link Rx: 802083-10 (410-430MHz, 12.5 kHz) 802083-30 (430-450 MHz, 12.5 kHz) 802083-50 (450-470 MHz, 12.5 kHz) PacCrest: 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	

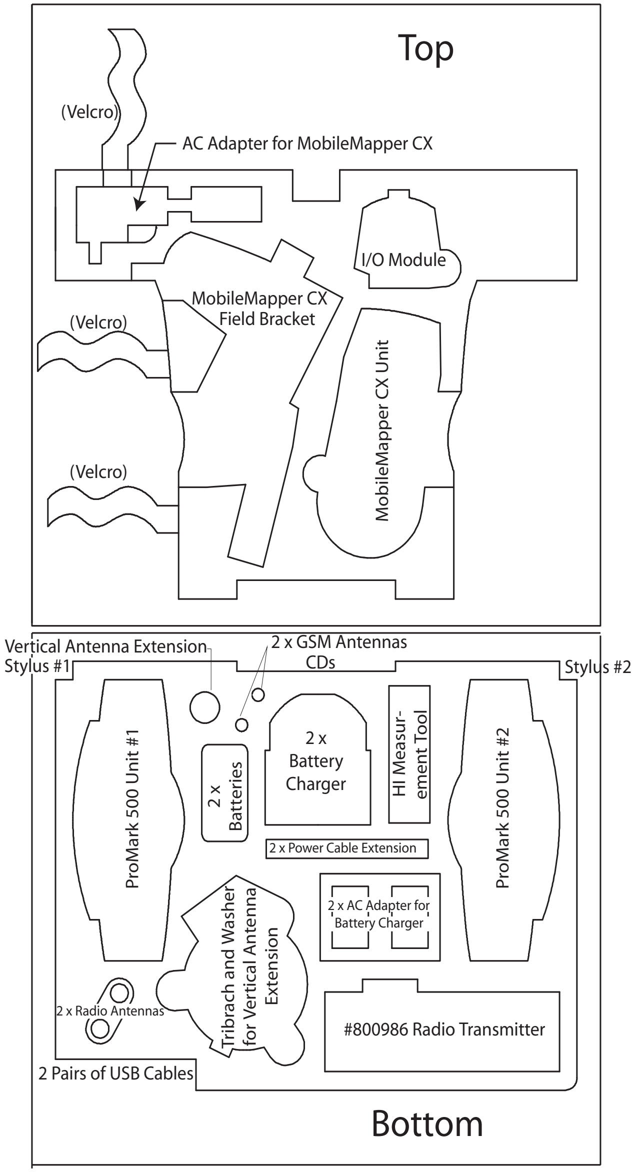
Base Accessories

Item	Part Number	Picture
External DC Power Cable for Receiver (fuse included)	730477	
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

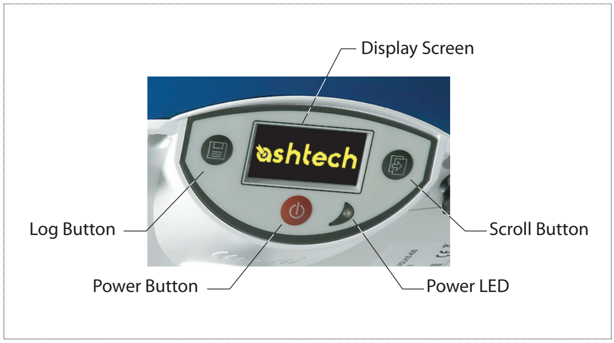


Packing a ProMark 500 System in the Carrying Case

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 “Ashtech” 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

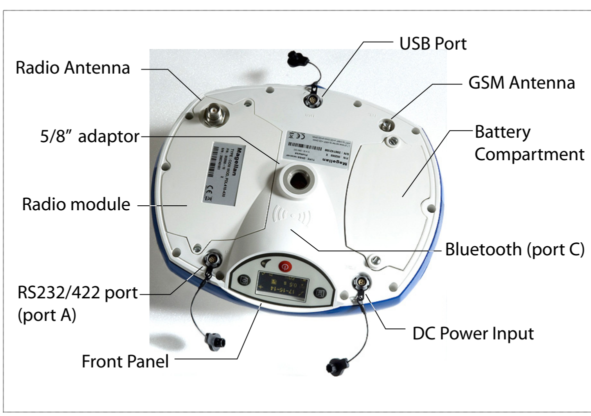
Press this button briefly to start recording raw data on the selected storage medium.

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 233*.

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

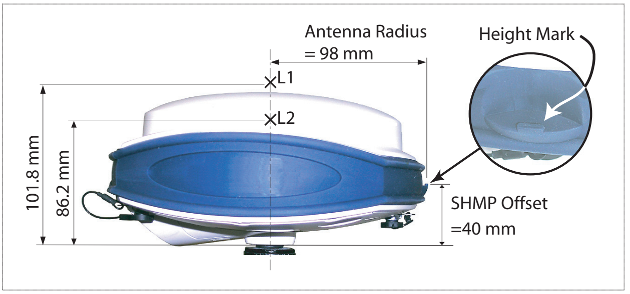
A seven-contact female connector (Fischer type) allowing you to connect the ProMark 500 to an external device via an RS232 or RS422 serial line (default: RS232). Changing the configuration of the port can be done from the field terminal using the $PASHS,MDP serial command. See *MDP: Setting Port A to RS232 or RS422 on page 268*.

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.



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.

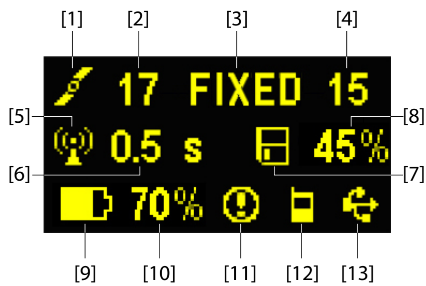
Power-On Screen

When you power on the receiver, the Ashtech logo appears on the screen. It is displayed until the receiver 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
  - S DGPS: SBAS Differential GPS position
  - FLOAT: Float solution
  - FIXED: Fixed solution (RTK is operational)
  - BASE: Receiver configured as a base.

- Number of satellites used **[4]**: Number of satellites used in the position processing, regardless of the current position solution status.
- : Data link icon **[5]**. This icon is displayed only when corrections are received.
- Age of corrections **[6]**, in seconds. This value is displayed when corrections are received and only after base station information has been received (Position status is at least "DGPS").
- Raw data logging icon **[7]**:

	Data recording through front panel Log button: – Blinking: Raw data logging in progress – Fixed: No raw data logging in progress.
	ATL data recording for advanced diagnosis.

- 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 receiver 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%. When an internal battery is used with external power applied, this icon alternates between the plug and the percentage of charge on the battery.
	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 module (modem) status **[12]**. This may be one of the following icons:

Icon	Definition
Blank	Modem turned off.
 	Blinking icon: Modem turned on but not initialized yet. Indicates signal strength at modem antenna input. Fixed icon: Modem turned on and initialized (ready for a connection). Indicates signal strength received at modem antenna input. The higher the number of bars, the better the signal. This icon will show four horizontal bars and an upside down antenna when the input signal is zero.
	Modem 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 the receiver?

- 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.

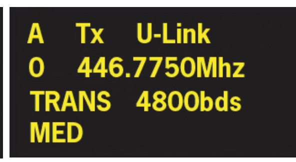
- Receiver Serial Number
- Firmware Version
- Receiver Bluetooth Identifier

Position Computation Screen

From the Receiver Identification screen, press the Scroll button to access the Position Computation screen. This screen displays the latitude, longitude and ellipsoidal height of the position currently computed by the receiver. If the receiver is a base, the displayed coordinates are set ones (not computed ones) representing the reference position assigned to the base. See example below for a rover.

The upper line contains the same information as in the upper line of the General Status screen.

A new press on the Scroll button will take you back to the General Status screen. If however the receiver is fitted with a radio receiver or is connected to an external radio transmitter, one or two additional display screens will show up before pressing the Scroll button takes you back to the General Status screen.



These possible two screens show the current radio settings:

- First line: Serial port used, "Rx" for radio receiver or "Tx" for radio transmitter, radio type (U-Link, PDL). Extra-parameter for "Rx": Power status
- Second line: Channel number, carrier frequency
- Third line: Protocol used (Transparent, Trimtalk, DSNP), airlink speed
- Fourth line: Squelch setting (medium, low, high). Extra-parameters for Rx if a Pacific Crest: "FEC" if forward error correction enabled, "SCR" if scrambling enabled.

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 87*.

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.

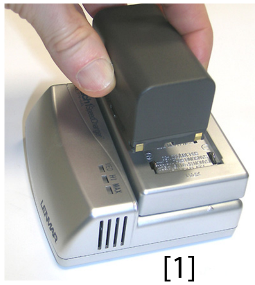
- Keeping one hand on the battery still in its compartment, put the ProMark 500 the right way up. The battery will then easily slide out of the battery compartment.

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),

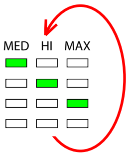
then push the battery against the plate and slide it forward **[2]** until it locks into place.



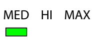
[1]

[2]

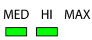
[3]



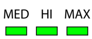
[4]



[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, L2C, L1/L2 full wavelength carrier
  - GLONASS L1 C/A L1/L2 P-code, L1/L2 full wavelength carrier
  - Galileo- and L5-capable antenna
  - SBAS code & carrier (WAAS/EGNOS/MSAS)
  - Low-signal acquisition and tracking engines for signal detection in difficult environments
- Fully independent code and phase measurements
- Ashtech BLADE™ technology for optimal performance
- Advanced multipath mitigation
- Update rate: Up to 20 Hz position and raw data output

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

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.

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

Long Static [1]
- Horizontal: 3 mm (0.009 ft) + 0.5 ppm
- Vertical: 6 mm (0.019 ft) + 0.5 ppm

Post-Processed Kinematic
- Horizontal: 10 mm (0.033 ft) + 1.0 ppm
- Vertical: 20 mm (0.065 ft) + 1.0 ppm

See also notes [2] and [3].

Data Logging Characteristics

Recording Interval:
- 0.05 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
- 1PPS output

Data Format

- RTCM 2.3, RTCM 3.1
- CMR, CMR+
- Ashtech ATOM™
- NMEA 0183
- NTRIP
- Ashtech DBEN & LRK (Topaze)

1.Long baselines, long occupations, precise ephemeris used.

2.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.

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

Operation

- RTK rover/base, post-processing
- RTK network rover: VRS, FKP, MAC
- Point-to-point Circuit Switched Data (GSM)
- Point-to-Point GPRS through Real-time Data Server Software (internal GSM or external cell phone).
- Limited RTK baseline (3 km)
- RTC Bridge
- Capability to decode RTCM messages 1021 to1023 to deliver rover position in the datum specified by the base.

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
- 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

- Communication Module:
  – UHF radio receiver
  – U-Link Rx
  – Pacific Crest UHF
  – GSM/GPRS/EDGE (class 10) Quad-band
- Transmitter Kits
  – UHF radio transmitter #800986
  – U-Link TRx
  – Pacific Crest UHF
- Rechargeable battery kit
- Field terminal kit with FAST Survey
  – Ashtech MobileMapper CX
  – Ashtech ProMark 100
  – Ashtech FT-1

- Ashtech ProMark 3
- Juniper Allegro CX
- Juniper Allegro MX

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]:

– Ashtech MobileMapper CX
– Ashtech ProMark 100
– Ashtech FT-1
– Juniper Allegro CX

Firmware Options

The pre-installed and optional firmware modules are listed in the table below.

ID	Label	Description	P/N	Pre-installed
K	Unlimited 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	No
F	FASTOUT-PUT	Allows position output at a rate of up to 20 Hz.	680527	No
Z	MODEM	Enables the use of the internal GSM/GPRS modem	680528	No
S	GLONASS	Enables the use of signals from the GLONASS constellation	680500	No
P	GNSSL2	Enables the reception of the L2 frequency	-	Yes
L	Limited RTK range	For a rover, limits the RTK range to 3 km	-	Yes
N	Base Mode	Enables a base receiver to generate RTCM, CMR or ATOM corrections data.	-	Yes

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 278*.

IMPORTANT! After enabling firmware option [F] to enable fast position output, the $PASHS,POP,20 command *must* be run to make the fast output effective.

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

U-Link Radios

U-Link TRx Specifications

Radio specifications:

- Frequency range: 410 to 470 MHz, with factory adjustment of input filter in ± 2.5-MHz steps
- Channel spacing: 12.5 kHz
- RF link speed: 4800, 7600 or 9600 bps
- Modulation: GMSK
- Two operating modes: DSNP or Transparent
- Serial link speed: 38400 bps
- Serial link: RS232 or RS422
- Adjacent channel power: > 60 dBc
- RF connector type: TNC
- Two transmitter status LEDs (Type of RS connection, data transfer, repeater mode)

Configuration tool:

- Ashtech radio configuration software used to set channels and output power
- Up to 16 channels can be saved in the radio
- Radio output power : 0.5 W, 2 W or 4 W

Power requirements:

- DC input voltage range: 9-28 V
- Power consumption: 1.5 A @ 12 V DC and 4 W RF

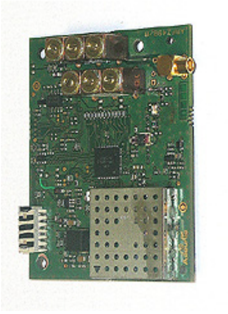
Physical characteristics:

- Size: 150 x 105 x 48 mm (5.9 x 4.1 x 1.9”)
- Weight: 660 grams (23.3 oz)

Environmental specifications:

- Sealing: IP65
- Full performance from -20°C to +55°C
- Extended temperature range from -30°C to +55°C
- CE, FCC and IC marked
- EN300-113 certified
- Shock: ETS300019 - 0107
- Vibrations: MIL-STD 810F

U-Link Rx Specifications



The U-Link Rx basically is an electronic board with the following specifications:

Radio Specifications:

- Frequency range: 410 to 470 MHz, with factory adjustment of input filter in ±2.5 MHz steps
- Sensitivity: -114 dBm at 10^{-5} BER
- Channel spacing: 12.5 kHz
- RF link speed: 4800, 7600 or 9600 bps
- Modulation: GMSK
- Operating modes: DSNP or Transparent
- Serial link speed: 38400 bps
- Serial link: RS232
- Up to 16 channels can be saved in the radio
- Adjacent channel power: > 60 dBc
- Ashtech radio configuration software used to set channels.

The board is mounted inside the radio module and so can neither be seen nor identified from outside. To know the model of the reception board installed in the module, just read the part number printed on the sticker located at the bottom of the radio module.

Configuration Tool:

- Ashtech radio configuration software used to set channels and output power

  Up to 16 channels can be saved in the radio

Power requirements:

- DC input voltage range: 5.5 to 9 V
- Power consumption: < 700 mW

Physical characteristics:

- Size: 76 x 65 x 20 mm (3 x 2.6 x 0.8”)
- Weight: 50 grams (1.76 oz)

Environmental specifications:

- Full performance from -20°C to +55°C
- Extended temperature range from -30°C to +55°C
- CE, FCC and IC marked
- EN300-113 certified

Channel Settings

Once the central frequency has been set, the chosen channels can only be located ±2.5 MHz around the central frequency.

Only certified dealers are authorized to set the central frequency and channels. For both settings, the radio configuration software is used. Setting the central frequency requires additional instrumentation.

The central frequency of the U-Link TRx can be read on the label placed on the transmitter case.

The central frequency of the U-Link Rx can be read on the label located under the radio module.

The central frequency of both the U-Link TRx and U-Link Rx can be read using the $PASHQ,RDP,PAR command (the central frequency setting is the last parameter in the response line).

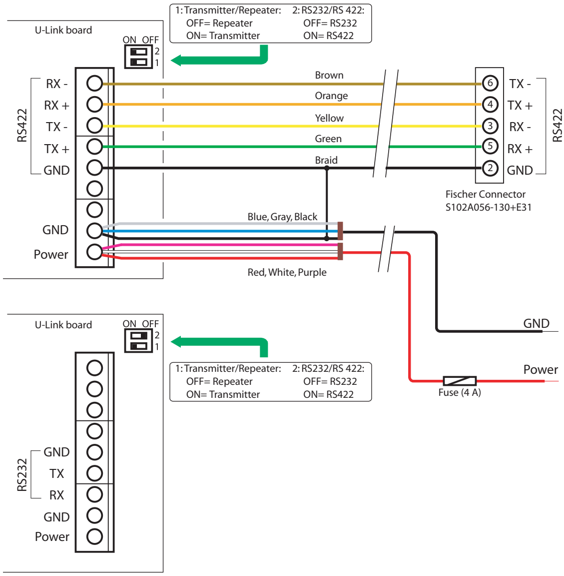
U-Link TRx LEDs

Two LEDs located at the bottom of the case are used to indicate the current status of the radio:

- ON indicator: a bi-color LED indicating power status and serial port type. It is off when no power is applied to the U-Link TRx. It is on when power is applied through the cable. The LED color then depends on the current setting of the serial port: green if it is of the RS232 type, or red if it is of the RS422 type.
- TX-RX indicator: a bi-color LED indicating the current transmission/reception status of the U-Link TRx. It is on and red while data are being transmitted; it is on and green while the U-Link TRx is properly receiving and decoding data. In repeater mode, the LED should change color at regular intervals of time (typically 1 second).

U-Link TRx Cable Pinout and Hardware Settings

The diagram below shows the pinout of the Y-shaped cable, an integral part of the U-Link TRx, when the unit is configured in RS422. The diagram also shows the location of the hardware settings as well as the RS232 pinout in the unit.



UHF Data Link Compatibility Table

Interoperability between Ashtech and PacCrest radios is presented in this section.

In the two tables below, "Yes" means the corresponding combination of radios is possible, "No" means the opposite.

The 25-kHz channel spacing is usable with PacCrest radios only.

Channel spacing: 12.5 kHz

Radio module used in the rover:	**PacCrest**	**U-Link Rx**
Base using PacCrest Transmitter	Yes; Transparent protocol	No
Base using Ashtech radio transmitter (old model)	Yes; DSNP protocol	Yes; DSNP protocol
Base using U-Link TRx	Yes; DSNP protocol	Yes; DSNP or Transparent protocol (Transparent is recommended)

Channel spacing: 25 kHz

Radio module used in the rover:	PacCrest	U-Link Rx
Base using PacCrest Transmitter	Yes; Transparent protocol	No
Base using Ashtech radio transmitter (old model)	No	No
Base using U-Link TRx	No	No

Any combination of radio devices using different channel spacing will not work.

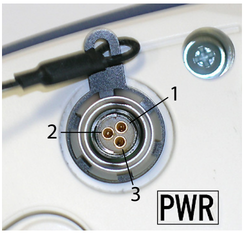
Generally speaking, a non-hybrid combination of radios is recommended.

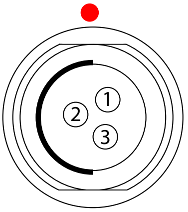
Port Pinouts

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

Power

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

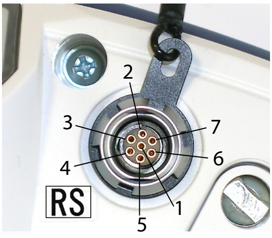


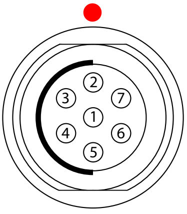


Pin	Signal Name	Description
1	GND	External Power Ground
2	PWR	External Power Input (10-28 V DC)
3	-	**Mandatory! Leave this pin unconnected.**

RS Port (Port A)

7-C Connector, Type: Fischer DBPU 102 A056-139





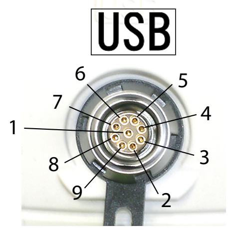
RS232 Configuration:

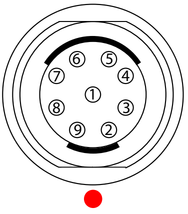
Pin	Signal Name	Description
1		NC
2	GND	Ground
3	CTS	Clear To Send
4	RTS	Request To Send
5	RXD	Receive Data
6	TXD	Transmit Data
7	PPS	1PPS output

RS422 Configuration:

Pin	Signal Name	Description
1		NC
2	GND	Ground
3	RXD-	Receive Data-
4	TXD+	Transmit Data+
5	RXD+	Receive Data+
6	TXD-	Transmit Data-
7	PPS	1PPS output

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 Ashtech 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 Windows 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.

Installation Procedure

- Connect the field terminal to your office computer using the USB data cable provided. For ProMark 200 or ProMark 100, place the receiver on its docking station and connect the docking station to the computer through the USB cable.
- Turn on the field terminal (or receiver).
- 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...** option corresponding to your equipment. 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**.
- At the end of this phase, a message appears asking you to check the field terminal (or receiver) 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 or receiver, the installation phase has automatically started. For ProMark 200 or ProMark 100, a message first appears asking you to choose the location where to install FAST Survey (the default “Device” option is recommended), then tap on **Install** to continue.

  When the progress bar disappears from the screen, this means installation is complete. The FAST Survey icon can then be seen on the screen.

  For ProMark 200 and ProMark 100, a message indicates that installation has been successful. Tap **OK** to go back to the Today screen where the FAST Survey command line and icon line are now visible.

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:

www.survce.com/Ashtech

You will be asked 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 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 MobileMapper CX, a ProMark 100 or ProMark 200, 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 

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 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 your equipment.

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).

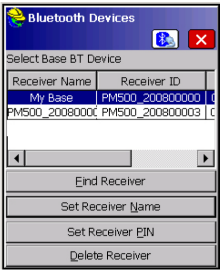
9. Tap . This creates the file, closes the Job Settings window and takes you to the FAST Survey menu.

How FAST Survey Interfaces With Your Equipment 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.

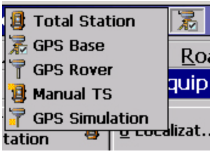
Assuming your base and rover are nearby and powered on, follow the procedure below to perform a Bluetooth connection with the base.



- Tap **Equip>GPS Base**.
- Tap on the **Comms** tab.
- Select "Bluetooth" from the **Type** field and, depending on the field terminal used, "Ashtech BT" or "Windows Mobile" from the **Device** field.
- Tap on . 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, your equipment 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 53*).
- 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.

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	•	•

Parameters	Base	Rover
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

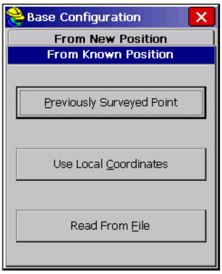
This section is a supplement to the section *Set Base Position on page 57* where the procedure is only outlined.

For theoretical aspects, see also *Choosing a Location for the Base on page 112*.

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.

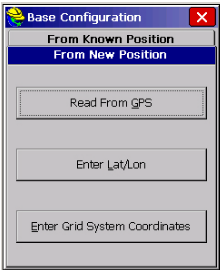
Then of the three possible choices, choose the one that suits your job.

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.

Using a Geoid File in the Localization Process

A library of geoids is available from the Ashtech website. Once you have downloaded the desired geoid, you need to use the Extract tool, also available and downloadable from the same web page, to convert the geoid into a GSF file, the only format FAST Survey can work from. The converted file can then be downloaded to the field terminal through ActiveSync.

The details of the procedure are given below. Note that the Extract Tool can also be used to reduce the geographical extent of the geoid before you download it to the field terminal.

Downloading a Geoid to your Computer

- Use your office computer to go to the web page: http://resources.ashtech.com/GEOIDS,
- Select the desired geoid by clicking on the corresponding link. You are then prompted to save the *Install_<Geoid_Name>.exe* file on your computer.
- Click **Save File** and wait until the download is complete.
- Run the *Install_<Geoid_Name>.exe* file on your computer. Follow the instructions on the screen to complete the installation.

  If your field terminal is currently connected to the computer via ActiveSync, instructions will also be provided to install the geoid file on the receiver as well (in *\Program Files\Geoids Data*). Tap "No" in this case.

Installing the Extract Tool on your Computer

- Go back to the web page: http://resources.ashtech.com/GEOIDS,
- Click on **Extract Tool** located at the bottom of the menu in the left-hand part of the screen.
- Again, click on the **Extract Tool** link, now appearing at the bottom of the web page (you need to scroll down the page). You are then prompted to save the *Install_Geoids.exe* file on your computer.
- Click **Save File** and wait until the download is complete.
- Run *Install_Geoids.exe* on your computer. Follow the instructions on the screen to complete the installation. Click on the **Close** button once complete.

Preparing the Geoid for Use in FAST Survey

- From the computer's task bar, select **Start**>**All Programs**>**Ashtech**> **Geoids**.
- Select **File**>**Open**. The program opens directly the folder containing the downloaded geoid.
- Select it and click **Open**.
- Select **File**>**Save**, select "GSF File (*.gsf)" as the new file format, name the file and click **Save**. By default, the resulting GSF file is saved to the same folder on the computer.
- Copy the resulting GSF file to the *...\FAST Survey\Data* folder on the receiver, using Microsoft ActiveSync.

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.

Deselecting the Currently Used Geoid File

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.

- Select the file corresponding to the geoid currently used.
- Tap ✕. This causes the geoid filename to disappear from underneath the **Geoid File:** button, meaning the geoid is no longer used in FAST Survey.

Using a Background Map In FAST Survey

Preparing a Map File for Use as a Background Map in FAST Survey

Use your office computer and the Carlson Image X-Port.exe program to georeference a map before uploading it into your FAST Survey field terminal as a background map.

The Carlson Image X-Port.exe program can be downloaded for free from:

http://update.carlsonsw.com/kbase_main.php?action=display_topic&topic_id=477

After opening this web page, click on the "Carlson Image-Export.exe" link at the bottom of the page and save the file to your computer.

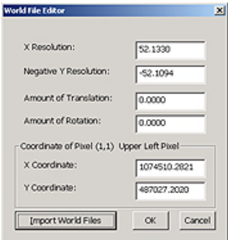
Follow the instructions below to prepare a map.

1. Create a new folder (e.g. "Maps") on your computer, **necessarily in the "My Documents" folder**.
2. Copy the image file (e.g. "RFS20L.TIF") you want to georeference to the new folder.
3. Run Carlson Image X-Port.exe.
4. Select **File>Open Image File**. Browse to the image file folder, and double-click the file name. This opens the map in the program window.

   If necessary, use the **Zoom Level** drop-down menu to adjust the map zoom setting.

   You can also use the **Tools>Image Brightness** function to make the map lighter or darker. **Important!** The resulting background map in FAST Survey will feature the same brightness.

5. Select **Tools>World File Editor**. This opens the World File Editor window in which you have to define the following parameters:

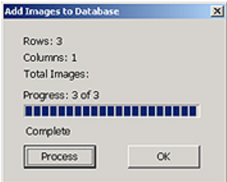


   - **X Resolution**: Indicates the real distance represented by one pixel in the image file. It is obtained by making the ratio between the real distance represented by the total width of the map and the total number of pixels used horizontally. For example, the map width represents 200 meters and the number of pixels used is 1000, then X Resolution=0.2, which means one pixel represents a square of 20 cm.
   - **Negative Y Resolution**: Usually equal to X Resolution with a minus sign placed before.
   - **Amount of Translation**, **Amount of Rotation**: Keep the default value “0.0000” for these two parameters.
   - **X Coordinate**: Easting of upper left corner of the map (pixel 1,1)
   - **Y Coordinate**: Northing of upper left corner of the map (pixel 1,1)

   Note that if the file was georeferenced earlier, all these parameters may have been saved in a *.tfw, *.jgw or *.bpw file. If that is the case, click on the **Import World Files** button, select the corresponding file and click **Open**. This causes all the fields on the World File Editor window to be filled in from this file.

   If there is not such a file, you have to work on finding georeferencing information for the map, as explained in *Determining Georeferencing Information for an Image File on page 44*.

6. After entering all the parameters in the World Map Editor window, click **OK** to close it.
7. Select **Image Database>Add Image to Database**. This opens the Add Images to Database window in which the program indicates that the original map is going to be split into several smaller map sections, each in BMP file format. The program indicates the number of files that will be created in the horizontal (columns) and vertical (row) directions. Depending on the extent of the original map, up to five different levels of image resolution may be created to match the different zoom settings in FAST Survey.

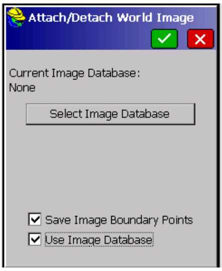


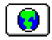
8. Click on the **Process** button and wait until the program has finished processing the original map. In the left column is an example of a map split into three smaller map sections arranged vertically (i.e. column=1; rows=3).
9. Click **OK** to close the window.
10. Click **File>Save as Image Database** and name the project file (e.g. "Map1"). This will be a text file gathering the georeferencing data of the map project as well as the paths and names of the different bmp files created through the above process step.
11. Click **Save** to save the different files of the map project to the folder created earlier ("Maps" in our example).
12. Click **File>Exit** to quit the program. If you now have a look into the "Maps" folder, you will see the following list of files (still referring to our example):
    – Map1.imd (map project description file)
    – A_RFS20Lr1c1.bmp (1st bitmap file, 1st row, 1st column),
    – A_RFS20Lr2c1.bmp (2nd bitmap file, 2nd row, 1st column),
    – A_RFS20Lr3c1.bmp (3rd bitmap file, 3rd row, 1st column).

    The naming convention used for the BMP files is the following:
    – Prefix representative of the resolution of each file ("A_"= lower resolution; "F_"= higher resolution),
    – Original file name re-used in the body of the filename,
    – "rxcx" suffix to identify the row and column of the map section,
    – File extension (bmp).

Enabling/Disabling a Background Map in FAST Survey

1. Create a new folder in the root directory of your field terminal's memory card. This folder must have the same name as the one created in "My documents" on the office computer ("Maps" in our example).
2. Copy the IMD file as well as the generated BMP files to that folder. You don't need to copy the original image file or the world file to the folder.



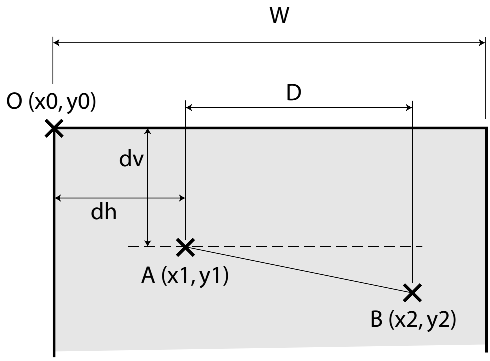
3. Remove the memory card from the office computer and insert it into your field terminal.
4. Run FAST Survey and start a new job.
5. Tap  in the upper-right corner of the screen.
6. Tap **TOOLS>Place World Image**.
7. Check on **Use Image Database** and **Save Image Boundary Points**.
8. Tap on the **Select Image Database** button and find the IMD file on the memory card.
9. Select the IMD file and tap  twice.
10. Tap  to adjust the zoom so the background map can now be seen.

    If later on you wish to hide the background map, simply go back to **TOOLS>Place World Image** and clear the **Use Image Database** box.

Determining Georeferencing Information for an Image File

You may have no information at all that would allow you to quickly georeference the image file of your background map. In that case, you need to determine the following parameters (illustrated in the diagram below) to be able to georeference the image file:

1. **Real coordinates of points A (x1, y1) and B (x2, y2)**, and **horizontal distance (D)** between points A and B. Points A and B are arbitrary points well distributed horizontally on the image file and easy to spot both on the image file (map) and in the field.
2. **Real coordinates of point O (x0, y0)** located at the upper-left corner of the image file.
3. **Image width** expressed in pixels.



Determining Points A & B and Distance D

- Choose two points that can easily be spotted both on the image file and in the field.
- Go the the field and survey these two points with your surveying system. This immediately gives the coordinates x1, y1 and x2, y2 of points A and B respectively.
- From these coordinates, you can deduce D:

  D = | x2-x1 |

Determining the Coordinates (xO, yO) of Point O

- Print out the image file using a high-quality printer.
- Using a graduated ruler, measure successively the lengths of D, dh and dv on the map printout.
- Assuming the obtained measurements are respectively D', dh' and dv', we have:

  D / D' = dh /dh' = dv / dv'

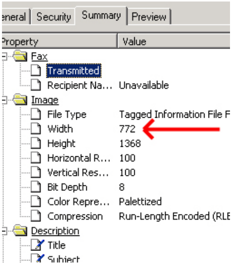
  This means the values of dv and dh can be determined as follows (make sure you use the same distance unit for all these distances):

  dh = (D x dh') / D' and dv = (D x dv') / D'

  The (xO, yO) coordinates are then:

  x0 = x1 - dh and y0 = y1 + dv

  xO and yO are the values you have to enter in the **X Coordinate** and **Y Coordinate** fields of the World File Editor window.



Reading the Image Width

- Still with the graduated ruler, measure the map width. Assuming W is the real distance in the field, then W' is the equivalent length measured on the map printout.
- Using Windows Explorer on your office computer, navigate to the folder containing the image file.
- Right-click on the filename and select **Properties** from the popup menu.
- On the **Summary** tab, click on the **Advanced** button (this may not be necessary if the advanced parameters are displayed by default).
- Read the number of pixels (P) displayed for the width parameter (see example on the left).

Computing the X Resolution

- Since we have:

  W / W' = D / D'

- Then the value of the real distance W is:

  W = (W' x D) /D'

- And the X Resolution is finally equal to:

  X Resolution = W /P

The X Resolution is the value you have to enter in the **X Resolution** field of the World File Editor window. Enter this value as well in the **Negative Y Resolution** field, this time with a minus sign placed ahead.

Saving the Georeferencing Information

Yo can create an ASCII text file, using a simple text editor such as Microsoft Notepad, to save the parameters you have just determined. The file should be saved with the tfw, jgw or bpw extension, depending on whether the original image file is respectively a TIF (or TIFF), JPG (or JPEG) or BMP file. The content of the ASCII text file should always be formatted as follows:

X Resolution (x.x)
Amount of Translation (x.xxx)
Amount of Rotation (x.xxx)
Y Resolution -x.x)
x0 coordinate (xxxxxx)
y0 coordinate (xxxxxx)

After saving the ASCII text file to the same folder as the original image file, you can come back to the procedure described in *Preparing a Map File for Use as a Background Map in FAST Survey on page 41* to georeference your map and generate the corresponding BMP map sections used by FAST Survey.

Chapter 3. RTK Configuration Steps

RTK Base Setup

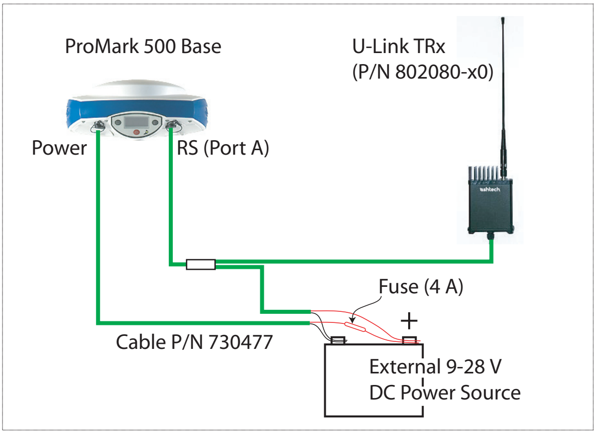
Prerequisites

- 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, it is good practice to 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 9-28 V DC (U-Link TRx), 10-16 V DC (Radio P/N 800986-x0) or 9-16 V DC (Pacific Crest radio) power source. In all cases, using a standard 12-V DC battery is a convenient choice. 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:

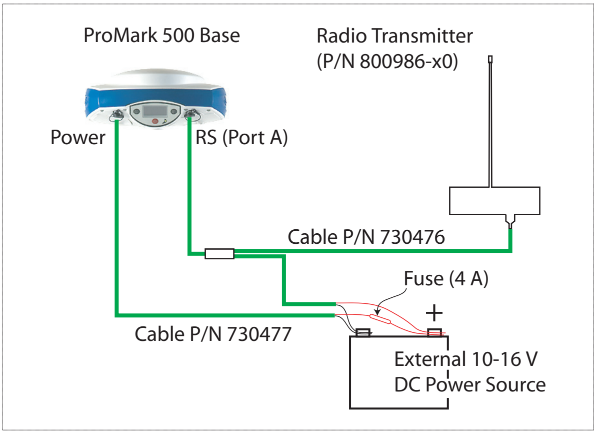
  1. Operating sessions can be extended significantly.
  2. The external battery operates as a trickle charger for the ProMark 500’s internal battery.

U-Link TRx The connection diagram is as follows.



Mount the different items as shown on the picture.

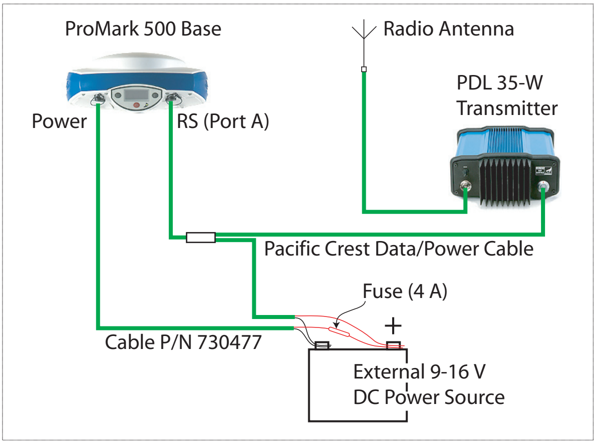
Radio P/N 800986 The connection diagram is as follows.



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 Your Equipment Via Bluetooth on page 34*) 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** (“Ashtech”) and **Model** (“ProMark 500”) of the equipment used as the base.

  Note that the button beside the **Manufacturer** field allows you to read the following information about the connected receiver:

  – Firmware version
  – Receiver ID
  – Power status
  – Free memory space
  – Firmware options installed.

  Tap on to return to the **Current** tab.

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** = “Ashtech BT” or “Windows Mobile”, depending on the field terminal used.
  - **Instr** = should be set to the name you gave earlier to the base, as seen from FAST Survey Bluetooth.

  Note that located 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 Your*

Equipment Via Bluetooth on page 30). Changes can be made now if necessary.

Set Receiver Parameters

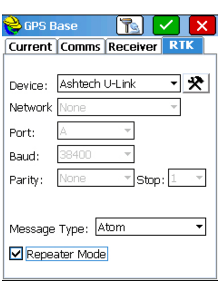
- Using the HI measurement tool provided, perform a slant measurement of the antenna height (recommended).
- On the field terminal, tap on the **Receiver** tab.
- Select the **Slant** option for the antenna height measurement.
- Tap within the **Antenna Height** field and enter the value you have just measured.
- Choose your preferred settings for **Elevation Mask**, **SBAS**, **GLONASS** and **Virtual Antenna**.

  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.

  The **Virtual Antenna** option is disabled by default. Enabling the virtual antenna, which is defined as the generic "ADVNULLANTENNA" GNSS antenna, allows all broadcast differential data and recorded raw data to be decorrelated from the GNSS antenna actually used at signal reception level. This may be useful when a rover from another manufacturer, which does not know the type of antenna used at the base, needs to receive RTK corrections from this base.

Set Data Link

Selecting Radio



- Tap on the **RTK** tab. This tab allows you to set the data link on the base side. Several configurations are possible:
  1. Using a U-Link TRx device
  2. Using radio transmitter P/N 800986-x0
  3. Using an external Pacific Crest radio.
  4. Using the internal modem in CSD mode for a "phone call" type connection (Direct Dial).
  5. Using the internal modem for a Direct IP connection to the RTDS software.
  6. Using an external device connected to ProMark 500's port A. The external device may be a radio transmitter from another manufacturer, or the local computer running the RTDS software.

The table below gives all the required settings depending on the chosen configuration.

	#1 U-Link TRx	#2 Radio P/N 800986	#3 Pacific Crest Radio	#4 Direct Dial	#5 Direct IP/GPRS - RTDS	#6 External Device
Device	Ashtech U-Link	Magellan Radio	Pacific Crest PDL	Internal GSM	Internal GSM	Cable or Generic Device
Network	[None]	[None]	[None]	Direct Dial	"TCP/IP Netw." or "UDP/IP Network"	[None]
Port	[A]	[A]	[A]	[E]	[E]	[A]
Parity	[None]	[None]	[None]	[None]	[None]	[None]
Baud	[38400]	[19200]	9600 to 115200 User-settable	[19200]	[19200]	1200 to 115200 User-settable
Stop	[1 bit]	[1 bit]	[1 bit]	[1 bit]	[1 bit]	[1 bit]
Message Type	Choose the format used to generate base data messages: ATOM, ATOM compact, RTCM V3.0, RTCM V2.3, CMR or CMR+, (RTCM-DGPS)					
Base ID	Choose a number to identify the base. Several ranges are possible depending on the selected data format (0-4095 for RTCM 3.0, 0-1023 for RTCM 2.3, 0-31 for CMR and CMR+)					

NOTE: All parameters between square brackets [..] are software-set, they cannot be changed.

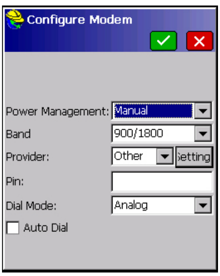
- If you want to use a radio, tap on [icon] located next to the **Device** field to set the radio. The table below lists the required and recommended settings for the three radio models available.

Field	Model P/N 800986-x0	U-Link TRx Model	Pacific Crest Radio Model
Protocol	-	"Transparent" recommended	"Transparent" recommended
Channel	Choose channel used (channel No. - Frequency)	Choose channel used (channel No. - Frequency	Choose channel used (channel No. - Frequency)
Over the Air Baud	-	4800 Bd recommended	"9600 Bd" recommended
Scrambling	-	-	In a PacCrest radio transmitter, enables or disables scrambling in this radio. Keep disabled for other radios.
Forward Error Correction	-	-	In a PacCrest radio transmitter, enables or disables FEC in this radio. Keep disabled for other radios.

The DSNP protocol should be used for the following transmitter-receiver combinations:

Transmitter	Receiver
800986-x0	U-Link Rx
800986-x0	PDL
U-Link TRx	PDL
U-Link TRx	TDRE (Z-Max)

- If you want to use the internal modem, tap on [icon] located next to the **Device** field to set the internal modem. The modem settings are listed in the table below:



Field	Setting
Power Management	"Automatic" is recommended. 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 when you configure the base.
Band	Select the frequency band used for GSM communications in the country where you are.
Provider	- If you choose **Network**=" TCP/IP Direct" or **Network**="UDP/IP Direct", choose the name of your mobile communication provider in this field. There are three preset providers: Cingular, T-Mobile and MoviStar. If you are using another provider, select "Other" in this field and then tap on the **Settings** button underneath to enter the parameters of your provider (APN server, APN User Name and APN Password). - If you choose **Network**="Direct Dial", ignore this field.
Pin	Enter the Pin number of the SIM card inserted in your ProMark 500.
Dial Mode	"Analog" is usually the right selection at the base. Please call your communication provider for more information.
Auto Dial	Keep this box disabled for a base.

- If you choose Network="TCP/IP DIrect" or "UDP/IP Direct", tap on the **Config** button next to the **Network** field and enter the IP address and port number allowing the connection to the RTDS software.
- If a repeater is used within your system to extend the range of the UHF radios used, enable the **Repeater Mode** check box. Enabling this option causes the output rates of all the differential messages to be changed into an even value (2 sec.) in order to make them compatible with the use of the repeater.

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

Load Configuration to the Base

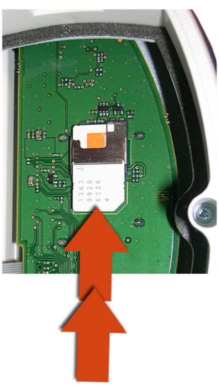
Now that you have browsed all the tabs in the Base Configuration window and set all the parameters, just tap to connect and load the configuration to the base. This may take a few seconds.

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. (See Chapter 11 for more details.) This completes the base configuration phase.

RTK Rover Setup

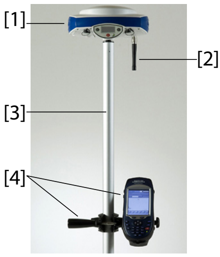
Prerequisites



- 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.

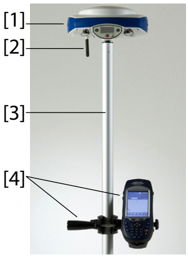
Radio Link



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]**.

Caution! Use of a non-metal range pole is recommended to maintain the performance level of the radio antenna.

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]**.

Caution! Use of a non-metal range pole is recommended to maintain the performance level of the GSM antenna.

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** (“Ashtech”) and **Model** (“ProMark 500”) of the equipment used as the rover.

Note that the button beside the **Manufacturer** field allows you to read the following information about the connected receiver:

– Firmware version
– Receiver ID
– Power status
– Free memory space
– Firmware options installed.

Tap on to return to the **Current** tab.

Set Bluetooth Connection

- Tap on the **Comms** tab.
- In the **Type field**, select “Bluetooth”.
- In the **Device** field, select “Ashtech BT” or “Windows Mobile” depending on which field terminal is used.
- Tap on 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 table below), **SBAS**, **GLONASS** and **Virtual Antenna**.

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

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.

The **Virtual Antenna** option is disabled by default. Enabling the virtual antenna, which is defined as the generic "ADVNULLANTENNA" GNSS antenna, allows all collected data to be decorrelated from the GNSS antenna actually used at signal reception level. This may be useful if you wish to post-process the collected raw data using base raw data collected with a base from another manufacturer.

Set Data Link

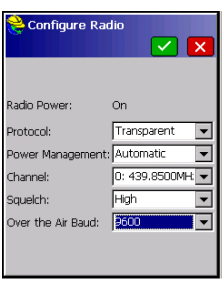
- Tap on the **RTK** tab. This tab allows you to set the data link on the rover side, in accordance with the base or network you will be working with. Several configurations are possible:
  1. Using the internal radio receiver.
  2. Using the internal modem in CSD mode for a "phone call" type connection with the base (Direct Dial).
  3. Using the internal modem in Direct IP mode (TCP/IP or UDP/IP) to receive base data from either a third-party network or the remote RTDS software.
  4. Using the internal modem for a network connection (NTRIP or SpiderNet).
  5. Using an external CDMA cell phone for a network connection (Direct IP, NTRIP or SpiderNet).
  6. Using an external device (for example an external corrections receiver).

The table below gives all the required settings depending on the chosen configuration.

	#7 Internal Radio	#8 Internal Radio	#9 Direct Dial	#10 Direct IP GPRS	#11 Network, GPRS	#12 Network, CDMA	#13 External Device
Device	Ashtech U-Link	Pacific Crest	Internal GSM	Internal GSM	Internal GSM	Data Collector Internet	Cable or Generic Device
Network	[None]	[None]	Direct Dial	"TCP/IP Direct", or "SpiderNet"	NTRIP	"NTRIP", "TCP/IP Direct", "UDP/IP Direct" or "Spi-derNet"	[None]
Port	[D]	[D]	[E]	[E]	[E]		[A]
Parity	[None]	[None]	[None]	[None]	[None]		[None]
Baud	[38400]	[38400]	[19200]	[19200]	[19200]		1200 to 115200 User-settable
Stop	[1 bit]	[1 bit]	[1 bit]	[1 bit]	[1 bit]		[1 bit]
Send Rover..	This option should be enabled only when working with networks offering VRS capability (NTRIP).						

NOTE: All parameters between square brackets [..] being software-set, they cannot be changed.

- If you want to use the internal radio, tap on next to the **Device** field to set the radio receiver:



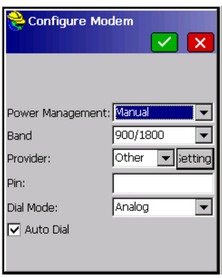
Field	Setting
Protocol	Select "DSNP" if the radio transmitter used at the base is radio model P/N 800986-x0. Select "Transparent" if it's a U-Link TRx or a Pacific Crest radio transmitter.
Power Man-agement	"Automatic" is recommended. In Automatic, the radio module is automatically powered when you turn on the receiver and will only be turned off when you turn off the receiver. In Man-ual, the module will be powered on only when you configure the rover.
Channel	Choose channel used (Channel No. - Frequency)
Squelch	The factory default setting of "High" provides maximum effec-tive sensitivity to incoming signals.This is the preferred set-ting. "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	Forced to "4800" with DSNP protocol; "9600 Bd" recom-mended with other protocols; "7600 Bd" for U-Link.
Scrambling	Relevant to Pacific Crest radios only. Set this parameter as set at the base if it uses a Pacific Crest transmitter. For another radio used at the base, keep this option disabled.

Field	Setting
Forward Error Correction	Relevant to Pacific Crest radios only. Set this parameter as set at the base if it uses a Pacific Crest transmitter. For another radio used at the base, keep this option disabled.

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 want to use the internal GSM modem, tap on next to the **Device** field to set the internal modem.

  The modem settings are listed in the table below:



Field	Setting
Power Management	"Automatic" is recommended. 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 when you configure the rover. "Automatic" is mandatory if "Auto Dial" is enabled.
Band	Select the frequency band used for GSM communications in the country where you are.
Provider	- Choose the name of your mobile communication provider in this field. There are three preset providers: Cingular, T-Mobile and MoviStar. If you are using another provider, select "Other" in this field and then tap on the **Settings** button underneath to enter the parameters of your provider (APN server, APN User Name and APN Password). - If you set Network=Direct Dial, ignore this field.
Pin	Enter the Pin number of the SIM card inserted in your Pro-Mark 500.
Dial Mode	Depending on the provider, this may be "Analog" or "Digital". "Analog" is usually the right selection. Please call your communication provider for more information
Auto Dial	Check this box when the data link is based on a GSM connection in CSD mode between the base and the rover. Check this box as well if you wish that after a power cycle, the receiver can connect automatically to the last used NTRIP mount point or last used Direct IP server.

- If you want to use a CDMA cell phone, you should first establish and then pair a Bluetooth link between that cell phone and your field terminal, using Bluetooth Manager. Then, you should use the Network and Dial-up Connections utility in your field terminal to connect it to the Internet. The incoming corrections will be automatically transferred to the ProMark 500.

For more information on this option, see *Using a CDMA Cell Phone for Network Connection on page 70*.

- When this button is visible, tap on next to the **Network** field, for additional settings. The table lists all the parameters that need to be defined, depending on the desired operating mode.

Parameter	TCP/IP Direct	NTRIP	SpiderNet	Direct Dial (CSD mode)
Name	•	•	•	•
IP Address	•	•	•	
Port	•	•	•	
User Name		•	•	
Password		•	•	
Phone Number				•

For more information on network connections, see *Network Connection on page 65*.

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

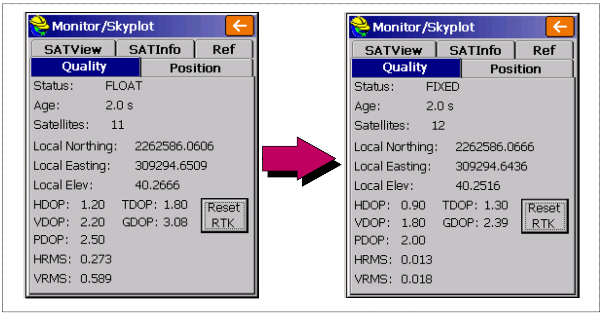
Load Configuration to the Rover

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.

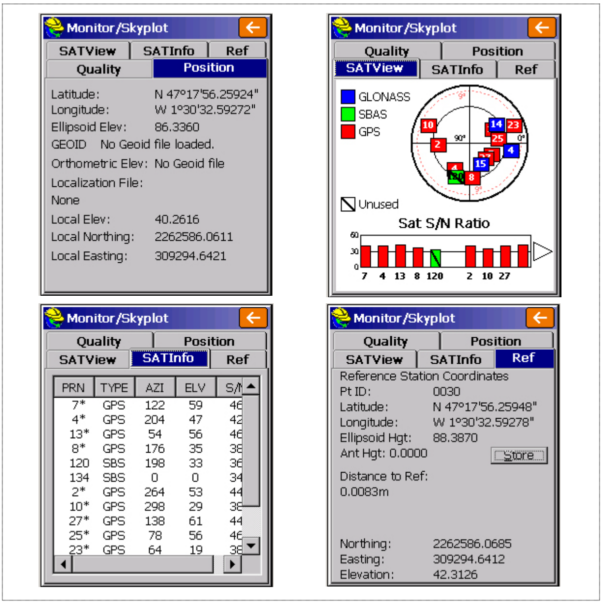
Check that a "Fixed" Solution is Now Available

The rover then starts acquiring corrections data from the selected base. Note that the rover will automatically recognize the format of the received data (ATOM, RTCM2.3, RTCM 3, CMR, CMR+, DBEN). 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.

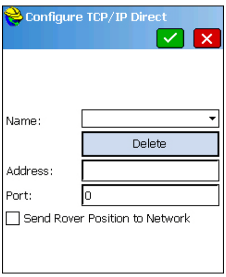
In Direct Dial mode, a **Hang up** button is available on the same tab to terminate the connection with the base.

- 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

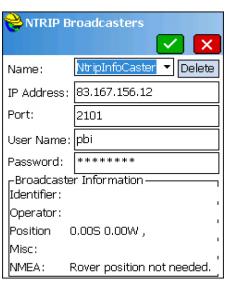
From the GPS Rover's **RTK** tab, do the following to choose, set and activate a network connection.

TCP/IP Direct Connection

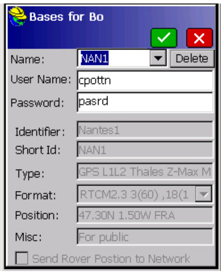


1. Select "TCP/IP Direct" from the **Network** field.
2. Tap on located next to the **Base ID** field to set the connection:
   - **Name**: Select <New> from this field and then, in the same field, enter a name for the file in which the properties of the TCP/IP Direct connection you are now creating 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.

NTRIP Network Connection

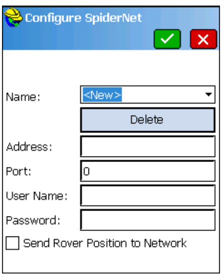


1. Select "NTRIP" from the **Network** field.
2. Tap on located next to the **Network** field to set the connection:
   - **Name**: Select <New> from this field and then, in the same field, enter a name for the file in which the properties of the NTRIP connection you are now creating will be saved.
   - **IP 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 from which you want to receive data.
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 on located next to the **Base ID** 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.

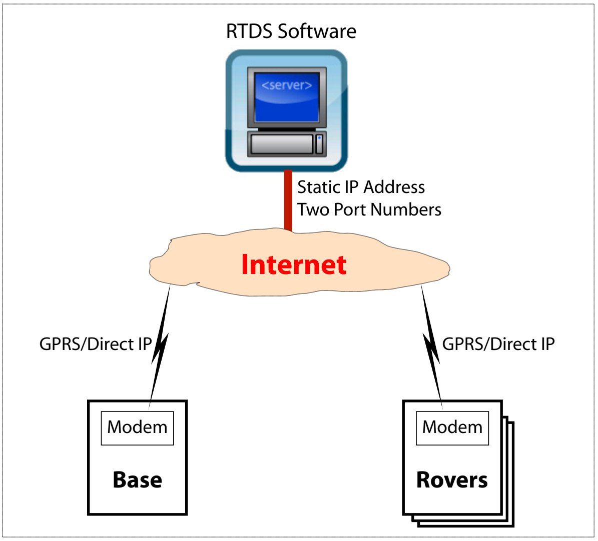
Direct IP Connection To Your Own Base Through GPRS Modem and RTDS Software

Introduction

Until recently, Direct IP connections from Ashtech rovers were possible only with third-party reference stations. Today, with the Ashtech RTDS[1] software, you can also have your own base transmitting its corrections to your rovers through a Direct IP connection.

1. RTDS for Real Time Data Server

In this configuration, the RTDS software serves as the relaying device between the base and the rovers. The presence of a relaying device is required because modems are assigned an IP address by the network when they connect to it, and this IP address cannot be known ahead of time for both modems. The RTDS software solves this problem by providing a fixed IP address through which that base and rover modems can communicate.

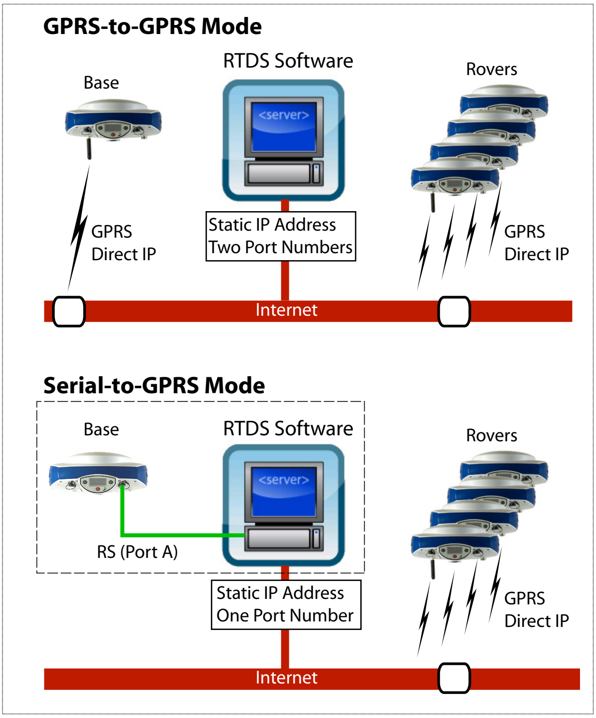


Software Requirements & Features

- The computer used to run the RTDS software is Internet-accessible through **a static IP address** and one or two port numbers.
- Several instances of the RTDS software can be run on the same computer, meaning the same computer can serve as data relay for several bases.
- Up to 100 rovers can receive data from a single instance of the RTDS software. All rovers communicate with a given instance of RTDS through the same port number.

Configuration Modes

The diagram below summarizes the possible two cases of use for the RTDS software with your system.



In Serial-to-GPRS mode, the base and the computer running RTDS are at the same location since a conventional RS232 serial line is used to connect one to the other.

Getting Started With RTDS

The implementation procedure can be outlined as follows:

1. You first need to know which IP address should be entered in your surveying system to establish a Direct IP connection to the RTDS software.

   Unless you already have a static IP address, or if you don't know whether you have one or not, call your Internet Service Provider (ISP) to obtain **a static IP address** for the computer on which you will install the RTDS software.

   With most ISPs, you'll have to pay a fee to get a static IP address option for your computer.
2. You then have to choose one or two **port numbers**. depending on whether you will be using the GPRS-to-GPRS or Serial-to-GPRS mode.

In theory, port numbers can range from 1 to 65536 but No. 1 to No. 1024 are considered as reserved numbers.

There are also conventions recommending the use of specific port numbers for specific applications. For example, all GNSS-related data exchanged on the Internet are usually routed through port 2101. This port number can then be chosen (plus others if necessary, for example, “2102”, “2103”, etc.), but remember that any numbers greater than 1024 may be chosen, provided they are not used on your computer for some other application.

3. Take the necessary steps to allow data to flow freely between RTDS and your surveying system through the chosen port number(s). This means you have to declare the use of this port (or these ports) in the ADSL modem firewall (or gateway), and possibly in the computer firewall. You may need some advice from your computer specialist to complete this operation.

   If your computer is part of a local network (LAN), ask the network administrator to perform the required network address translations (NAT) and declare the port numbers used so the data arriving at the public IP address can be routed to your computer through its local IP address and port.
4. Install the RTDS software on your computer. This is an easy step during which you just have to run the “Ashtech Real Time Data Server x.x-x setup.exe” file provided, then follow the instructions to complete the installation phase.
5. Determine whether you need to use the GPRS-to-GPRS or Serial-to-GPRS mode (see above), depending on your application. Choose the base location and computer location accordingly.
6. On the computer, launch RTDS and make the appropriate settings (plus make the serial connection if the Serial-to-GPRS mode is selected). See *RTDS on-line help* for more details.
7. Start the RTDS server and let the software run throughout your field survey, or permanently if you wish to set up a community base station.
8. Set the base in Direct IP mode so that it sends its corrections to the RTDS software. When defining the Direct IP connection, you need to enter:
   - The static IP address of the computer running the RTDS software.

- The port number assigned to the base connection in the RTDS software (as entered in RTDS Software's **RTDS Config>Port Config>Base Port** field).

  The RTDS operator will see the base-to-server arrow blink when corrections are received from the base. The IP address of the base will appear under the base icon. The incoming data throughput will be indicated just underneath the blinking arrow.

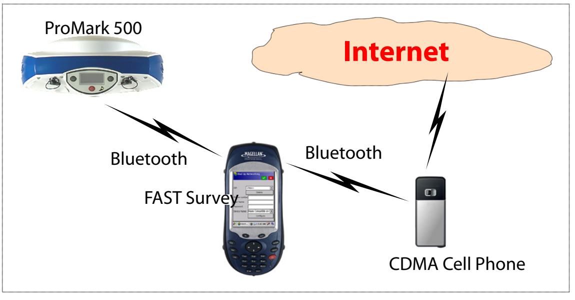
9. Set the rover in Direct IP mode in order to receive corrections from the RTDS software.
   - The static IP address of the computer running the RTDS software.
   - The port number assigned to the rover connection in the RTDS software (as entered in RTDS Software's **RTDS Config>Port Config>Rover Port** field).

   On the rover side, wait until the data link icon appears on the front panel. When this happens, corrections are received and at least a float solution is available.

   The RTDS operator will see the server-to-rover arrow start blinking when at least one rover queries the server for corrections. The outgoing data throughput is also indicated just underneath the blinking arrow.

Using a CDMA Cell Phone for Network Connection

Your receiver is fitted with an internal GSM/GPRS modem but can also be operated with an external CDMA cell phone, as illustrated in the diagram below.



The CDMA connection is entirely controlled from the field terminal running FAST Survey.

FAST Survey will automatically forward corrections through the receiver-field terminal Bluetooth link.

The procedure for operating a rover with a CDMA cell phone can be outlined as follows:

For detailed information on steps 1-4, refer to "Step-by-Step Procedure to Establish a GPRS Connection Via Bluetooth" (pages 18-28) in the MobileMapper CX Getting Started Guide. This procedure also applies for a CDMA cell phone.

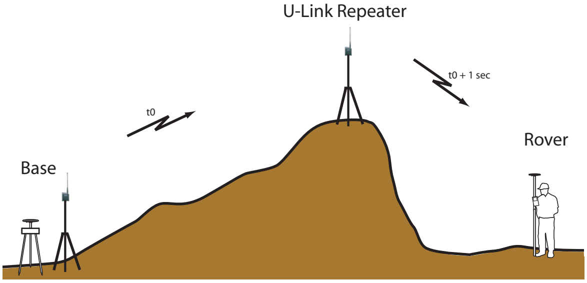
1. Use Bluetooth Manager on MobileMapper CX to detect the cell phone. When this is done, pair MobileMapper CX with the cell phone. This will ease and speed up future connections.
2. Establish a Bluetooth connection between MobileMapper CX and the cell phone.
3. Use the **Start>Settings>Network and Dial-up Connections** utility on MobileMapper CX to create a dial-up connection to your Internet Service Provider.
4. Make this connection active.
5. In FAST Survey, go to **Equip>GPS Rover**, **RTK** tab and select "Data Collector Internet" in the **Device** field.
6. Select the desired connection type in the **Network** field (NTRIP, etc.). Assuming the connection data have already been entered for the selected mode, your rover should start receiving corrections and rapidly switch to the FLOAT then the FIXED position status.

You can download the MobileMapper CX Getting Started Guide from:

ftp://ftp.ashtech.com/Mobile Mapping/MobileMapper CX/Manuals/MMCX Getting Started Guide/

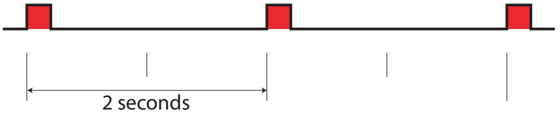
Using a U-Link Repeater to Extend the Radio Range

Typically, you will need to use a repeater when a major natural or artificial obstacle gets in the way of the direct path between the base and the rover. This is simply illustrated in the diagram below.



Assuming the U-Link repeater has been configured to operate with the U-Link transmitter you are using at the base and the U-Link receiver used in the rover[1], do the following to operate the radio link:

1. **Adjust the configuration of the U-Link TRx at the base**:
   - Perform a Bluetooth connection with the base receiver from your field terminal and run FAST Survey.
   - Go to **Equip**>**GPS Base** and select the **RTK** tab.
   - Enable the **Repeater mode** function located in the lower part of the screen.
   - Tap . As a result, the transmission rate of the U-Link transmitter is changed to 2 seconds. This can be verified by watching the TX-RX LED on the U-Link TRx, which blinks, still in red color, but this time at a rate of 2 seconds.



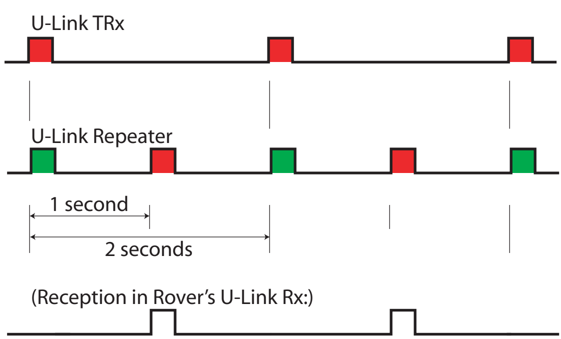
1.This means that the U-Link TRx, the U-Link repeater and the U-Link Rx work in the same sub-band, use the same central frequency and channel number, and also the same modulation type and over-the-air baud rate.

- Terminate the communication with the base by quitting FAST Survey and then turning off your field terminal.

2. **Install and run the repeater**:
   - Take the following equipment with you before making for the installation site: U-Link repeater and its whip antenna, battery and pole. Make sure that the cable coming out of the repeater is fitted with the appropriate items for a steady connection to the battery terminals.
   - When you are on the installation site, first connect the antenna to the repeater, then mount the repeater at the top of the pole.
   - Secure the pole in vertical position on the chosen installation point.
   - Place the battery on the ground, by the pole.
   - Connect the power end of the cable to the two terminals of the battery.

     Note that the other end of the cable is not used and so should be left free, with its protective cap on.

3. **Check repeater operation**:
   - As soon as you connect the repeater to the battery, the ON LED on the repeater is instantly turned on (red color). This indicator will stay on as long as power is applied to the repeater.
   - After a short time, the TX-RX LED starts a sequence of green and red flashes, indicating that the repeater first receives data from the base (green color), and then broadcasts these data in the second that follows (red color). See diagram below.

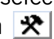


- When the repeater reaches this operational status, you can let it operate on its own and proceed with your job.

NOTE 1: In somes cases, the location of the rover may be such that it can receive the data from both the repeater and the base transmitter. This situation will not affect the operation of the rover but simply give the opportunity for the rover to receive the same data twice.

NOTE 2: You should be aware of the following when using a repeater: **Any change to the settings of the U-Link transmitter will cause the repeater to stop working**. If however you have to change the channel number of the U-Link TRx for example, use one of the following procedures to update the channel number used in the repeater:

1. Bring the repeater back to the base, unplug the U-Link TRx normally used at the base and connect the repeater instead.

   From FAST Survey, select **Equip**>**GPS Base** and then tap on the **RTK** tab. Tap on  next to the **Device** field and then change the channel number of the repeater.

   Once this is done, unplug the repeater and connect the U-Link TRx back to the base. Put the repeater back to work on its installation site.
2. If it is more convenient to perform the update from the rover, you can proceed as explained for the base, but in addition you will have to temporarily transform the rover into a base, in order to allow the receiver to access the repeater settings.

   When this is done, don't forget to put the receiver back in rover configuration, and also change the channel number in the rover.

NOTE 3: Using the RTCM2.3 format is not recommended when a repeater is used, owing to the larger amount of data to be transmitted with this format.

Chapter 4. RTK Surveying

Uploading Stakeout Points to the Field Terminal

In your office, do the following:

- Connect the receiver or field terminal to your office computer using the USB data cable. For ProMark 200 or ProMark 100, place the receiver on its docking station and connect the docking station to the computer via the USB 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:

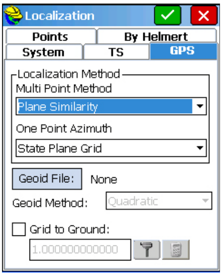
  http://www.microsoft.com/windowsmobile/activesync/default.mspx

  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 receiver or 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 receiver or field terminal and upload the job (to \My Device\Program Files\FAST Survey\Data\).
- After the job has been uploaded, turn off the receiver or 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

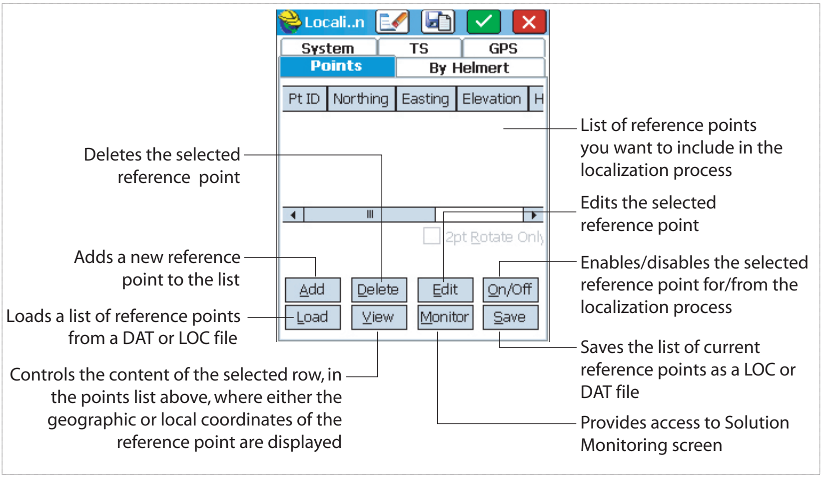


- With your job open in FAST Survey, tap on the **Equip** tab and then on the **Localization** button. This opens the Localization window with the **System** tab shown first.

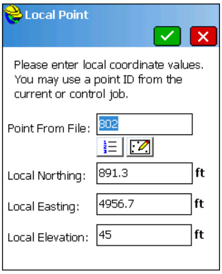
  For your information, this tab shows the name of the projection selected earlier for the project (see **File>Job Settings>System**). Choosing another projection here would change the projection used in the job. It is your responsibility to have the right projection selected on which the localization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

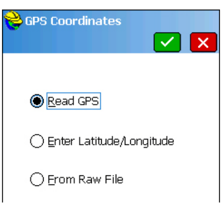


For each of the available reference points, you need to enter the local coordinates and then the WGS84 coordinates, as measured by your equipment.

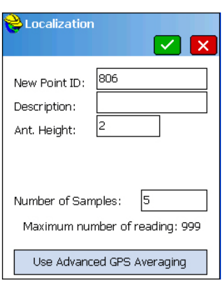


2. Tap **Add** to define the first reference point. A new window (Local Point) is displayed allowing you to do that. To add a reference point that already exists in the job, do one of the following:
   - Type its name in the **Point From File** field. This automatically updates the window with the point's 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:

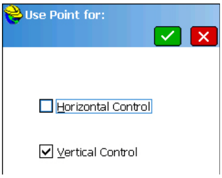


   - **Read GPS**. Choosing this method means your equipment should be placed exactly over the reference point. Then enter a number of samples required before the equipment delivers an averaged WGS84 solution for the point (5 minimum recommended). Tap on the green button to let the equipment take the required 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.



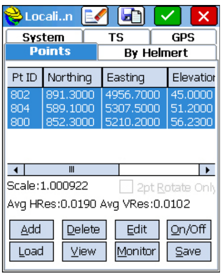
   - **From Raw File**: Select a point from the job holding the WGS84 coordinates of the reference point. This point should have been surveyed earlier by the system in the same measurement conditions (same base setup, etc.) as now.

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.

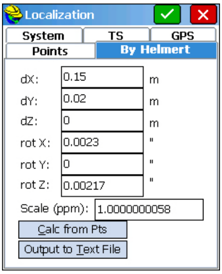
7. Name the file and tap . **The localization process is now complete and active. This means every new point you will now survey will be expressed on the local grid**.

   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



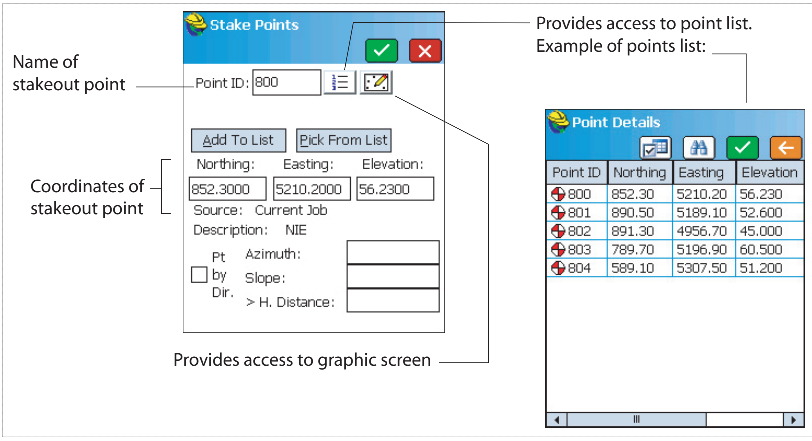
1. With your job open in FAST Survey, tap on the **Equip** tab and then on the **Localization** button.
2. Tap on the **GPS** tab and select “Helmert” from the **Multi Point Method** field.
3. Tap on the **By Helmert** tab and then enter the seven parameters defining the new datum of the local grid.
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

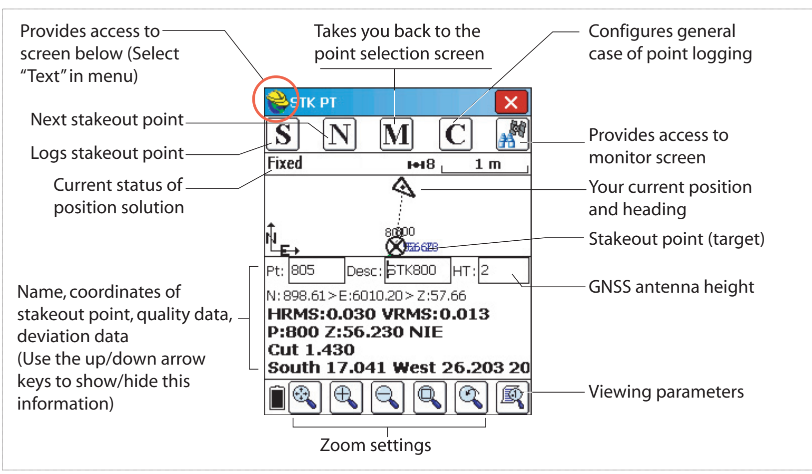
- Follow the instructions to perform a multi-point localization.
- After all the points have been defined, tap on the **By Helmert** tab.
- Tap on the **Calc from Pts** button. FAST Survey computes the seven Helmert parameters and displays the result in the corresponding fields.
- To save the seven parameters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

Staking Out Points

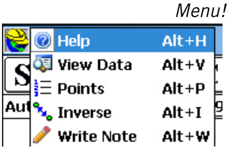
1. Run FAST Survey and open the job containing the points you want to stake out.
2. Tap on the **Survey** tab and then select **Stake Points**. The screen now displayed allows you to stake out points.
3. On this screen, FAST Survey asks you to choose the point you want to stake out. You can either type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

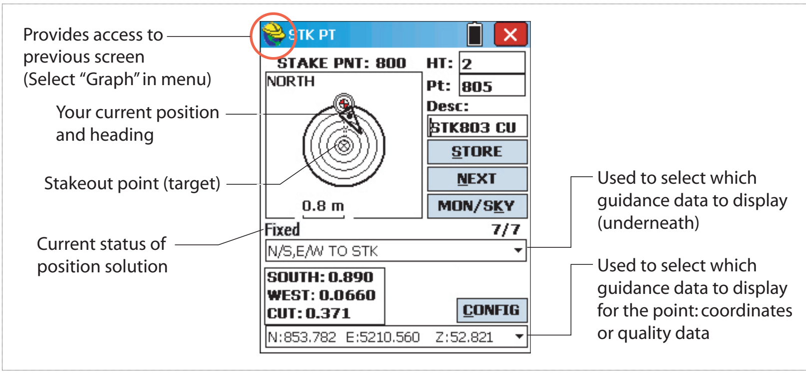


Yellow helmet gives access to Function Menu!



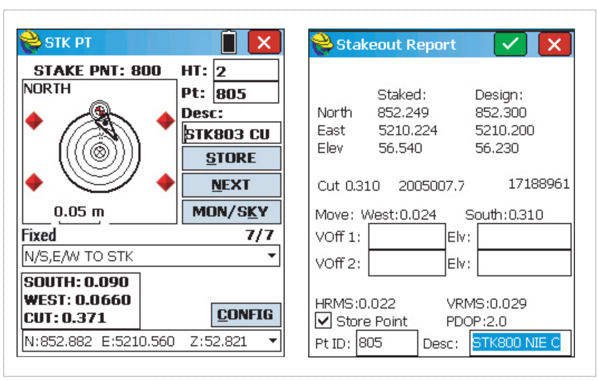
5. When the distance to the stakeout point is too small to be clearly seen on this screen, tap on the surveyor's helmet in the upper-left corner and select **Text** from the menu that pops up.

   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.



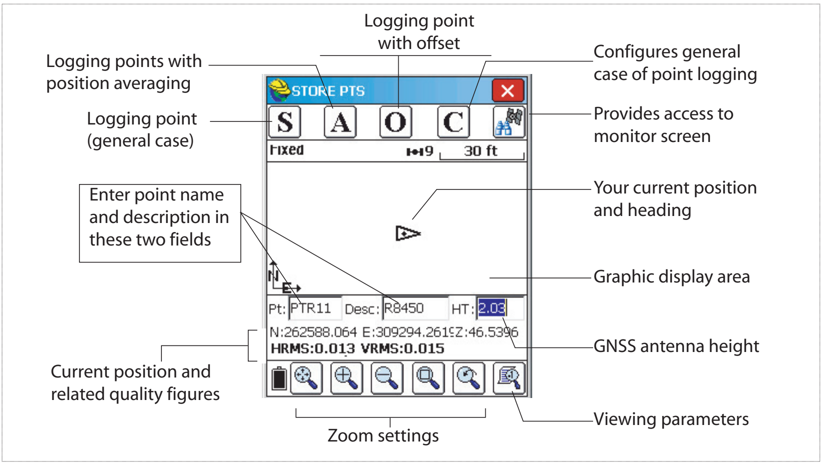
7. Tap  if you agree. The "**Point Stored**" message appears briefly. The screen then comes back to the Stake Points screen where you can choose the next point to be staked.

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.



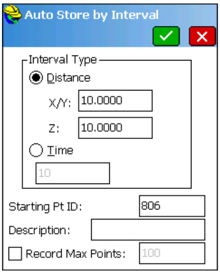
2. Type in the point name and description in the corresponding two fields (see above)
3. Tap on the "**A**" button
4. Enter the number of readings you want before FAST Survey is allowed to compute an average position for this point.

   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.

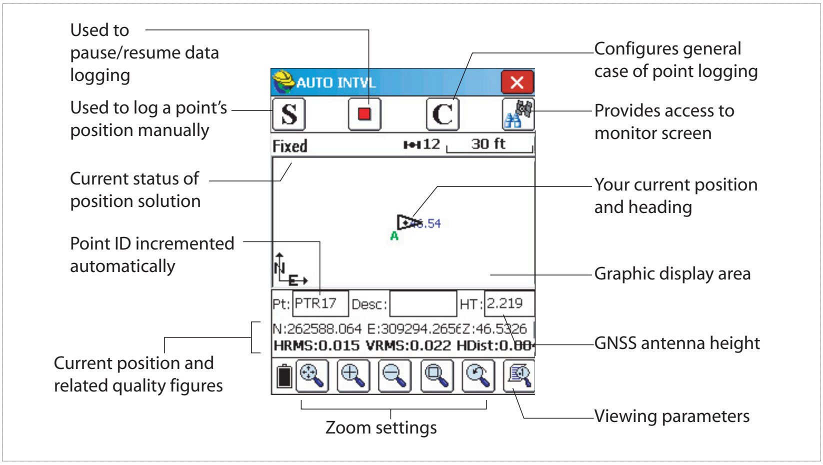
5. Tap if you agree. The "**Point Stored**" message appears briefly. The screen then shows the location of the point together with its name and description.

6. After logging all your points, tap in the upper-right corner of the screen to return to the menu.

Logging a Line



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. Initially, the Point Id. may only consist of letters (e.g. "ABCD"). FAST Survey will then increment the Point Id. as follows: ABCD1, ABCD2, etc.
4. Tap [✓] to switch to the graphic screen (see figure below) and start logging the series of points along the line.



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 receiver or field terminal to your office computer using the USB data cable. For ProMark 200 or ProMark 100, place the receiver on its docking station and connect the docking station to the computer via the USB 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.

Vector information relative to surveyed points is available only in .rw5 files. FAST Survey saves vector information directly in this file format and so *does not* create O-files that would contain such information.

Chapter 5. Logging Raw Data

Introduction

You can 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 receiver'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 receiver, then no data logging will take place.

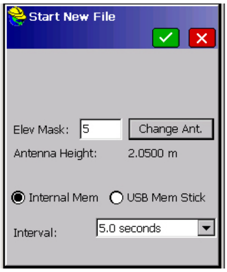
In both data logging methods, the Raw Data Logging icon on the General Status screen will start flashing when a raw data file is open for logging.

Raw Data Logging Methods

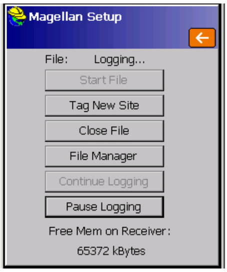
Standalone

- 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 receiver front panel.

Downloading Raw Data

Use a USB mass storage device as a transit storage medium to download raw data files from the receiver'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 receiver via the short USB Device cable provided (P/N 702103).

  If raw data files are present in the receiver'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 the receiver'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 receiver'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

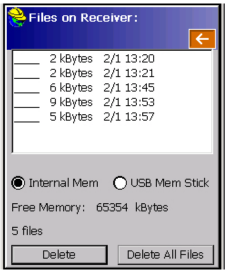
When static surveys are performed without the field terminal and FAST Survey, you must be careful with raw data file names. In view of the ATOM naming conventions used and the system's default settings, there is indeed every chance that the base file and the rover file have the same name. It is good practice to 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 receiver 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 6. 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 85*).

  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

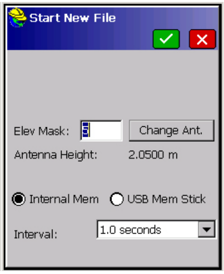
1. Run FAST Survey on your field terminal and create a new job.
2. Tap on the **Equip** tab and then on the **GPS Base** or **GPS Rover** button, whichever is the currently active button (for more convenience).

   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, in the **Device** field, "Ashtech BT" or "Windows Mobile", depending on the field terminal used.
5. Tap on  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

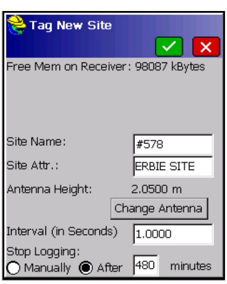
Before starting base data collection, you need to define the elevation mask, the base antenna height, the storage medium used in the receiver and the raw data recording rate. Follow the instructions below.

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)

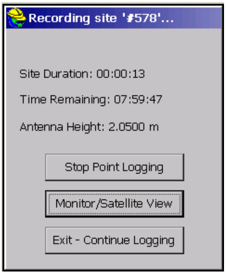


- **Antenna Height**: Current value of antenna height, expressed in the chosen unit. Use the **Change Ant.** button to change the antenna height. Choose the measurement type first (**Vertical** or **Slant**) and then enter the measured value.
- Choose the storage medium where to store the file (**Internal Mem** or **USB Mem Stick**).
- **Interval**: Raw data recording rate, in seconds (possible range: 0.1 to 999 seconds, or 0.05 to 999 seconds with the [F] option activated and $PASHS,POP,20 executed).

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 195*.
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.

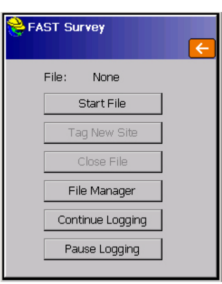


7. Tap on the **Monitor/Satellite View** button to make sure GNSS reception is good at the base location (enough satellites are received, DOP values low). Ignore all RTK-related indicators.
8. Tap to return to the previous screen.
9. Tap on the **Exit-Continue Logging** button.
10. Tap **Yes** to confirm 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

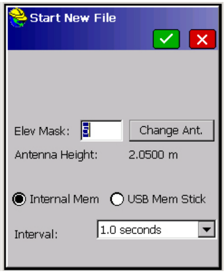
1. Tap on the **Equip** tab and then on the **GPS Base** or **GPS Rover** button, whichever is the currently active button.
2. Tap on the **Comms** tab.
3. Tap on next to the **Device** field. This opens the Bluetooth Devices window.
4. Select the rover Bluetooth identifier from the list.
5. Tap to connect 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



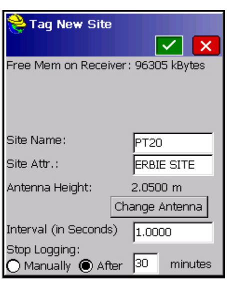
The rover has been installed on the survey point and will stay there throughout the static survey. What you will have to do now with your rover is much similar to what you’ve just done for the base. Follow the instructions below to run the survey:

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)



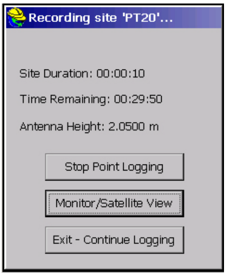
- **Antenna Height**: Current value of antenna height, expressed in the chosen unit. Use the **Change Ant.** button to change the antenna height. Choose the measurement type first (**Vertical** or **Slant**) and then enter the measured value.
- Choose the storage medium where to store the file (**Internal 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 195*.
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:



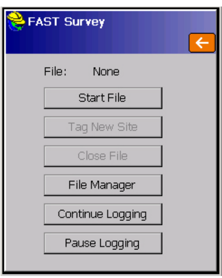
   - **Site Name**: Enter a name for the survey point. A four-character name is recommended so that the entire name, and not a truncated name, appears later in the raw data file name. Longer site names will not be truncated however in GNSS Solutions.
   - **Site Attr.**: Enter an optional description for 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**.

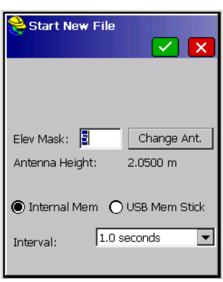
6. Tap . A new screen is displayed summarizing all your settings.



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

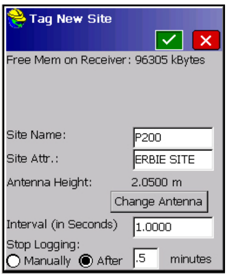




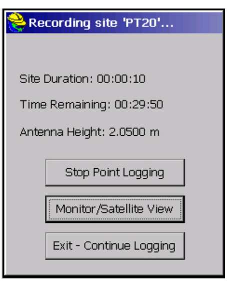
Once the rover is located on the first survey point, follow the instructions below to run the survey:

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 195*.
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:



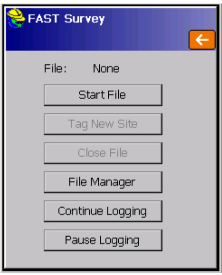
- **Site Name**: Enter a name for the survey point. A four-character name is recommended so that the entire name, and not a truncated name, appears later in the raw data file name. Longer site names will not be truncated however in GNSS Solutions. In stop & go the filename will pick up the name of the 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.

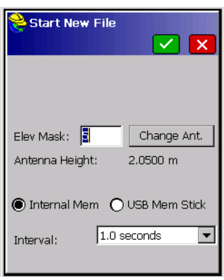
14. Tap on the **File Manager** button. You should recognize the last file in the list as the file you have just closed (the file is identified by the point name you last entered).

Continuous Kinematic Survey

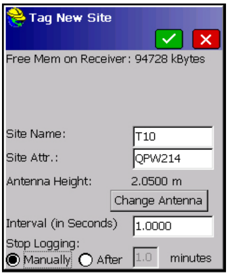


Once your rover is located at the beginning of the trajectory, do the following to run the survey:

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)

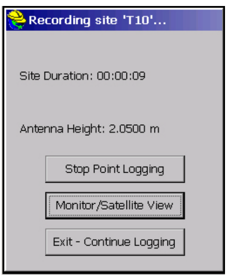


   - **Antenna Height**: Current value of antenna height, expressed in the chosen unit. Use the **Change Ant.** button to change the antenna height. Choose the measurement type first (**Vertical** or **Slant**) and then enter the measured value.
   - Choose the storage medium where to store the file (**Internal 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 195*.
5. As you start walking or driving 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 7. 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 constellations.

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

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

This chapter introduces the basics of the two surveying families.

Note that Ashtech RTK-capable receivers can also be used for post-processed surveys, either simultaneously with RTK or as post-processed only. 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 fractional phase of the carrier at the receiver location. This fractional phase is then added to the integer number of full carrier cycles between the receiver and the satellite, thus converting the carrier phase measurement into an extremely accurate range measurement.

CPD: Carrier-Phase Differential. An acronym that refers to the processing of reference carrier phase measurements for precise (RTK) differential measurements.

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

GNSS: Global Navigation Satellite System. GPS, GLONASS, SBAS 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. In addition, the SBAS satellites' carrier phase ranging data are used like any other GNSS satellite by Ashtech's BLADE processing algorithm.

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, for example for road construction or civil engineering. These additional functions are all enabled by 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 121*). 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: A 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. Not relevant to logging points in continuous mode where each point recorded is a single epoch measurement.

Position Averaging: Process run in a rover during an occupation consisting of 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 is derived, is assigned to the point on which the occupation took place.

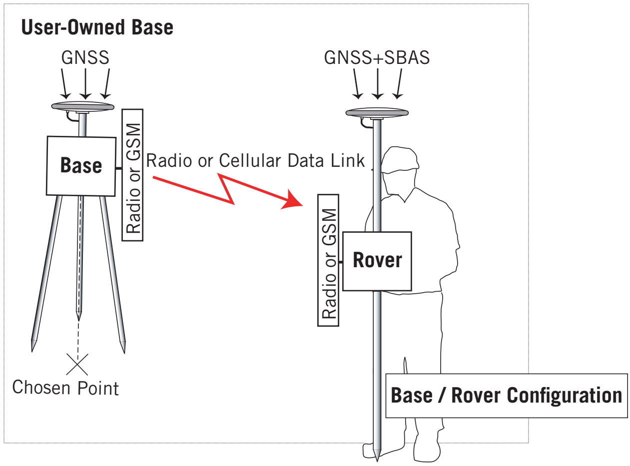
Rover-Only Configuration: Refers to an RTK surveying system consisting only of a rover, which uses data from a third-party base or network to deliver centimeter-accurate positions.

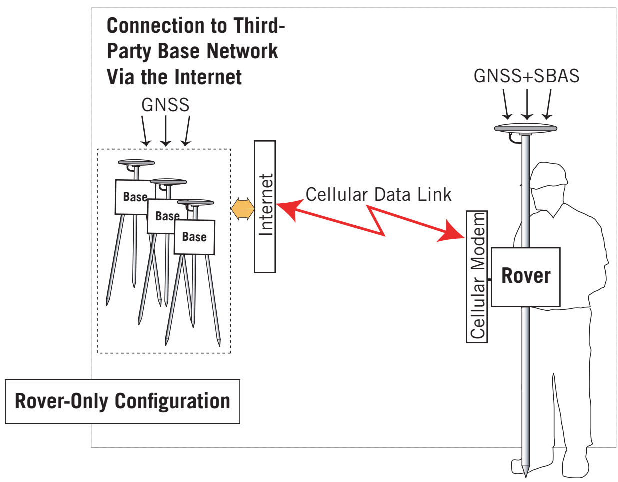
RTK Correction Data or *base data*: Carrier phase differential data generated by a base allowing a rover processing this data to deliver centimeter-accurate positions.

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 suitable data link. To choose a reference location for the base, see *Choosing a Location for the Base on page 112*.
   – A third-party operated base (Direct IP) or base network (NTRIP) that delivers its data to the rover via a GSM/GPRS or CDMA modem.





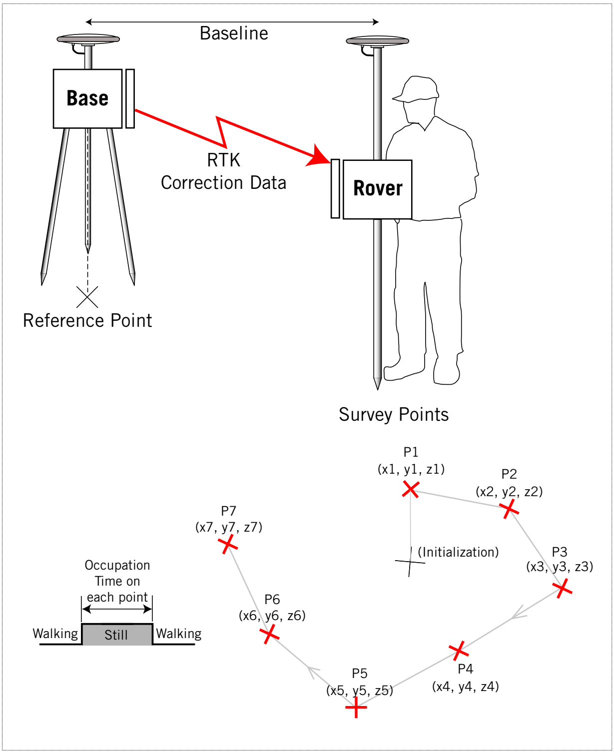
3. A data link must be established to transfer the base's RTK correction data to the rover. This data link can be implemented in several ways:
   - UHF radio
   - Cellular modem (GSM, GPRS or CDMA)
   - Other external device (e.g. Wi-Fi, spread-spectrum re-broadcast).
4. Successful surveying requires getting the system to be initialized and preserving initialization, or re-initialzing if initialization is lost, throughout the survey. See *Initialization on page 115*.

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

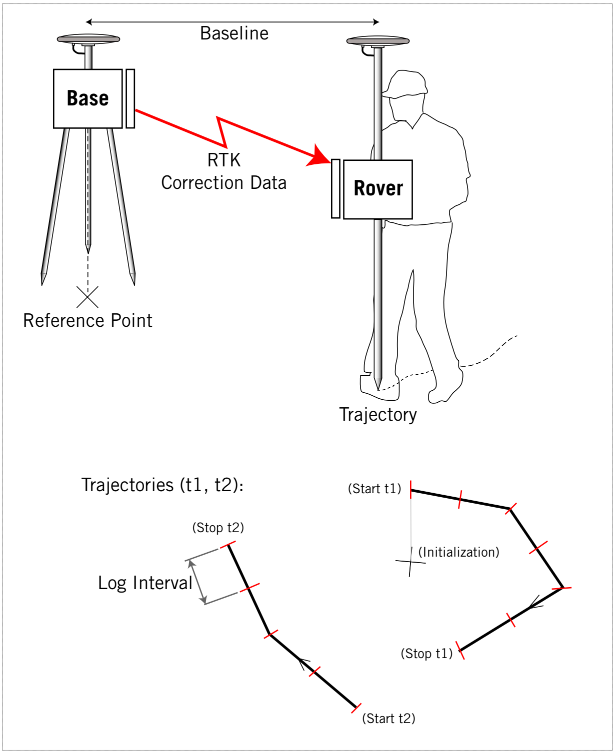
- Make sure the rover delivers RTK positions before starting the job. (Initialization must be achieved and maintained.)
- Hold the antenna pole still and vertical over each survey point.
- Occupation time on each point is user-presettable. A countdown timer tells you when the receiver has finished logging the position of the point.
- During the countdown, the rover averages the successive positions it computes.

- With single-epoch measurements, 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

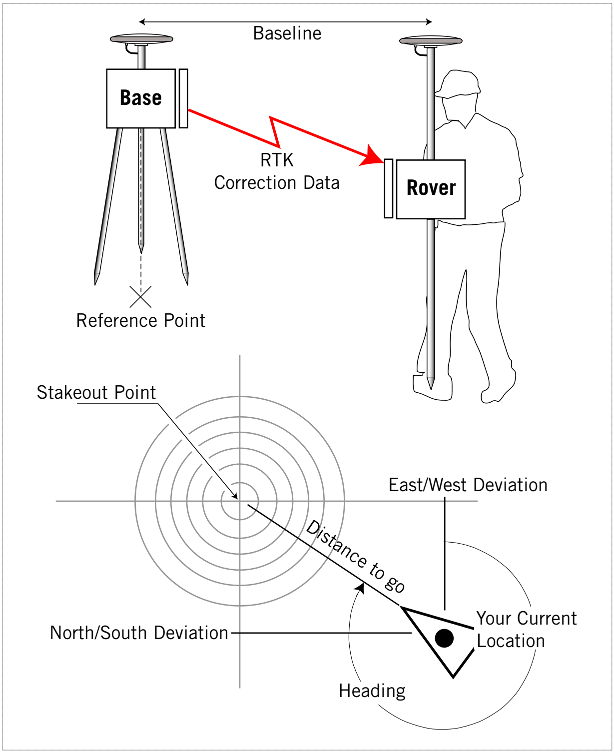
- Make sure the rover delivers RTK positions before starting the job. (Initialization must be achieved and maintained.)
- Hold the antenna pole vertical all along the trajectory.
- Points are automatically logged at regular intervals of time or distance. You set the log interval before starting the survey.
- Because you will be steadily moving 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 move 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 121*). 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 feet or meters, between any two successive markers inserted into the logged raw data file.

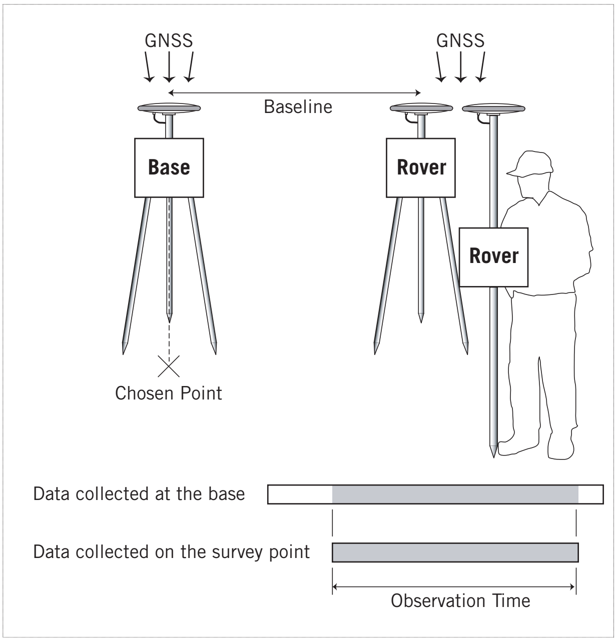
NOTE: Log Interval vs. Raw Data Recording Rate. The Log Interval should not be less than the Raw Data Recording Rate. For example, if Raw Data Recording Rate=1 second, then Log Interval should be at least 1 second (or 2 meters if for example your moving speed is 5 km/hr)

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 is continuous from the start to end of the observation time.

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: Interval, 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 112*), 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) for post-processing. Rover data can also be uploaded to a centralized processing system (cf. OPUS or AutoGIPSY), which will in return provide centimeter-accurate position results.
2. Data must be collected simultaneously by the base and the rover. **It is best to use the same raw data recording rate on both units**.

3. Successful survey requires proper initialization of the system. See *Initialization on page 115*.

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

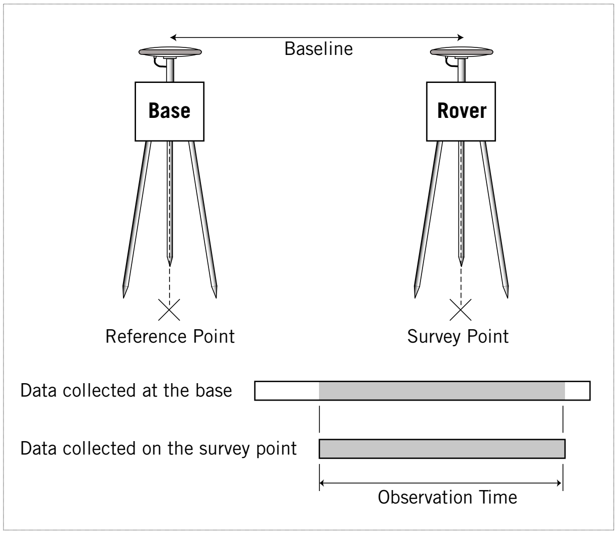
   For some Ashtech receivers such as the ProMark3, and in case of poor reception or complete loss of satellite signals, a message will prompt you to resume initialization.
4. The common observation time is determined by the last unit set up (start) and the first unit turned off (end). It is advisable to start the base first and turn it off last.
5. The required observation time mainly depends on the baseline length, the reception conditions, the number of GNSS constellations and signal frequencies tracked by the receiver and the initialization method used. See *Initialization on page 115*.
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 should continually keep the GNSS antenna clear of any obstructions.

   If satellite lock is broken by obstructions, you will need to collect additional data after the tracking resumes before continuing. This data is used by the post-processing software to re-determine the ambiguities. The amount of data needed for re-initialization is the same as for the original initialization as discussed above.
7. There can be several rovers logging data at the same time.

Static Survey

Typical Use

Surveying a New Control Point.



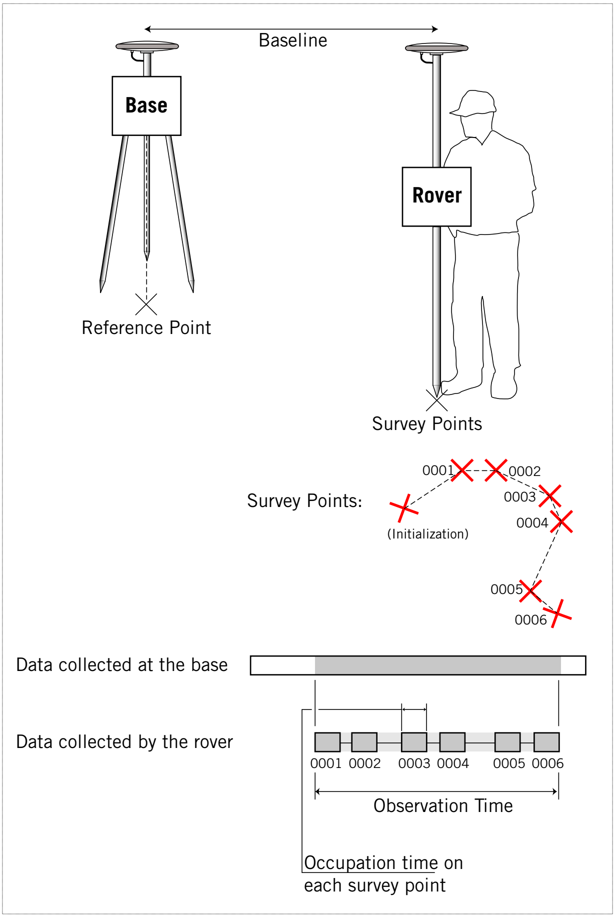
Key Points

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

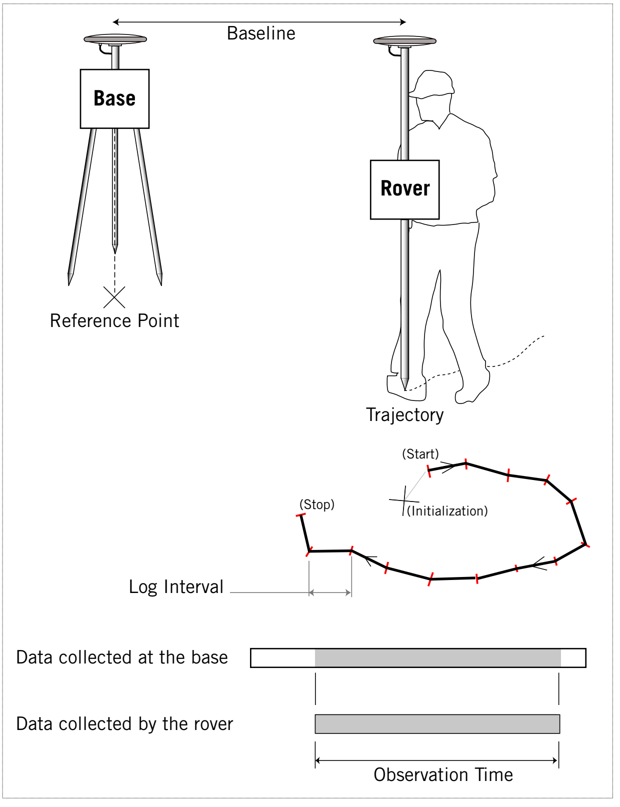
1. The rover is moved successively onto each of the survey points. The rover antenna pole should be kept still and vertical over each survey point for a given occupation time.
2. Occupation time on each surveyed point is user-preset. A countdown timer tells you when to move to the next point.
3. In the 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 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 or the ProFlex 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 moving 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 moving speed (m/s) x raw data recording rate (s)

4. *Number of trajectories in a single file*. Some receivers, such as the ProMark 500 or ProFlex 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 long as possible.

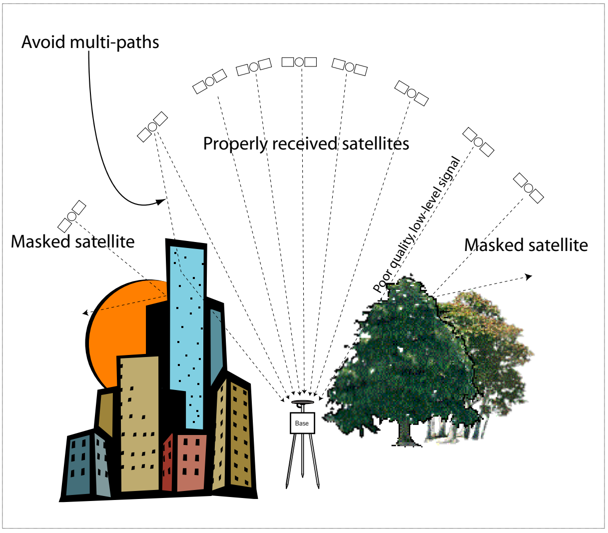
First Criterion: GNSS Reception Conditions

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

When 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 in the same coordinate system.

   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 Ashtech FAST Survey, you can also use the Localization function to attach your job to a local coordinate 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 (also known as "ambiguity fixing", "integer fixing" or just "fixing") 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 for the integer ambiguities 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 standalone 5- to 10-meter-accurate position.

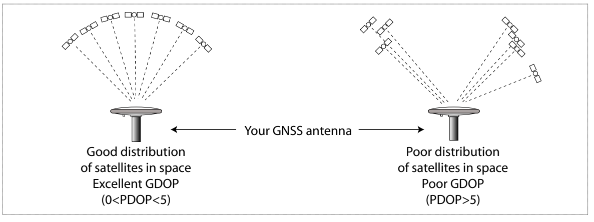
Importance of Baseline Length

The amount of data required to fix ambiguities 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 natural that you make sure the initialization process has been successful. Should you lose the “RTK” position status, then 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 separates them from dual-frequency systems.

Strategies for Securing Initialization

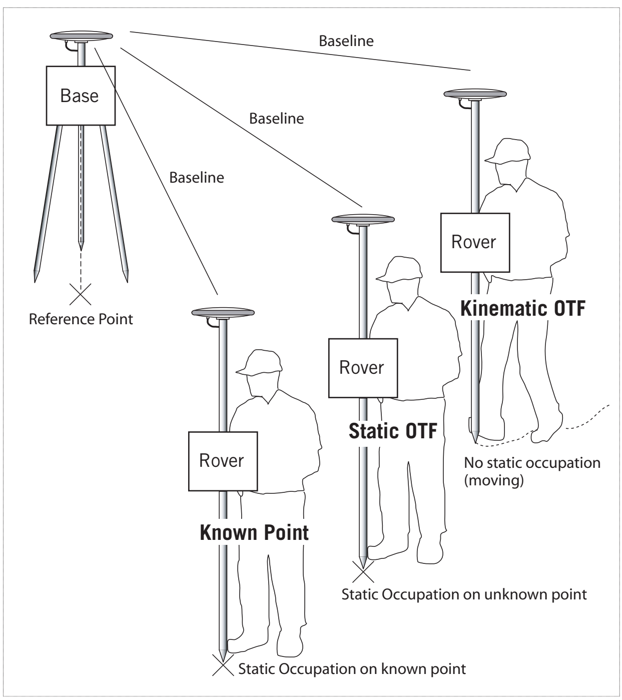
When starting a survey, you will sometimes be asked to choose an initialization method (more particularly if you are using a single-frequency receiver). The selected method tells the system how it should deal with initialization. Some of these methods can make initialization easier and faster, resulting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

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

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

- Kinematic OTF.
- Static OTF (for RTK surveying only).
- Known Point.
- Initializer Bar (with 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 no reference in the working area that can help secure the initialization.

Static OTF. An initialization method usable in RTK 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.

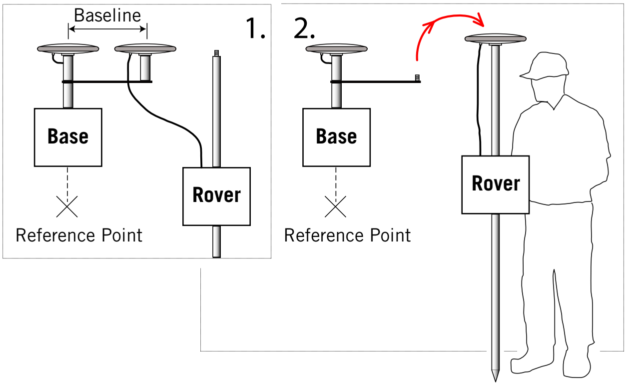
Known Point. In RTK surveying, the rover asks you to stay still on a known point until initialization is achieved (i.e. RTK position fixed). The declared static occupation time helps the rover initialize more quickly. This is a statistically faster initialization method than Static OTF for a given baseline 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 Ashtech 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 is attached to the antenna base and, for a limited time, the rover antenna as well.

The bar in fact defines a 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 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).

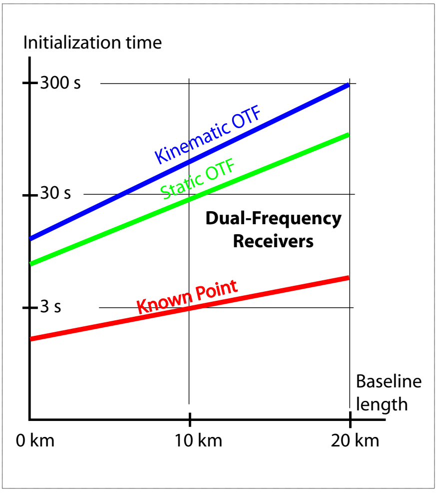
Obviously, for a given baseline length, the better the operating conditions (low DOP, large number of received satellites, open sky conditions), the easier the initialization, and therefore the shorter the TTFF.

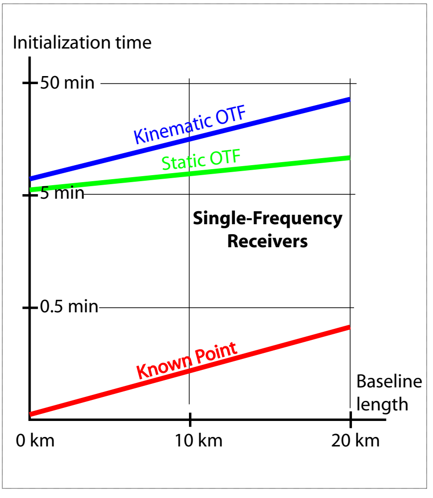
The initialization can even be faster if there is a possibility for you to use the "Known Point" initialization method, or, if your receiver is a ProMark3, the "Initializer Bar" method.

Typical Initialization Times (TTFF)

The charts below show the variations of the TTFF obtained with Ashtech 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 when one or more SBAS satellites are in view and their collection data are available.

Initialization in Post-Processed Surveys

Field Approach

In post-processed surveys, determining if 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:

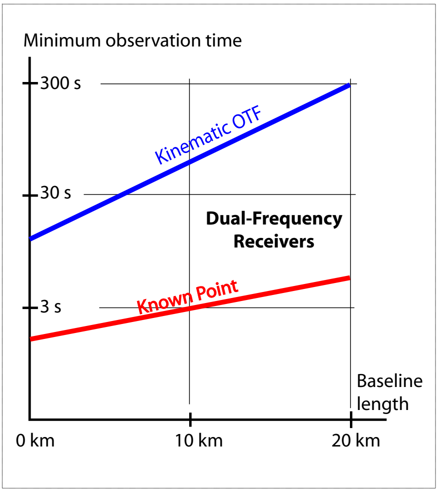
- The observation time is an important factor for successful initialization. The longer the baseline length, the larger the required amount of data and so the longer the required observation time. Such indicators as the “Observation Timer” or “Observation Range” available on some Ashtech receivers will 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.

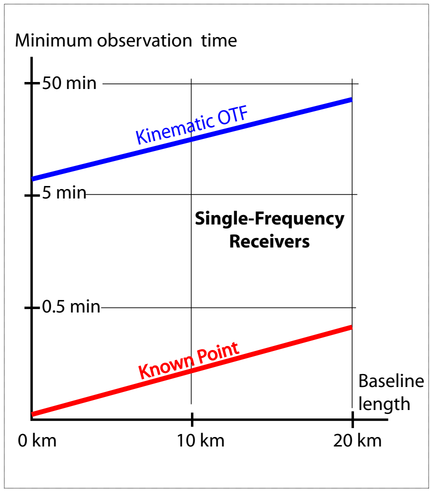
  However, you should be aware that, whether you are performing a kinematic or static survey and regardless of the method used to help secure initialization, the only thing that counts for a successful initialization is **the amount, quality and continuity of the collected data**. This means that **all** 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 most appropriate to your survey. The Initializer Bar method (for ProMark3 users) and the “Known Point” method are preferred whenever possible.

Required Observation Times

The charts below show the minimum observation times required with Ashtech 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:





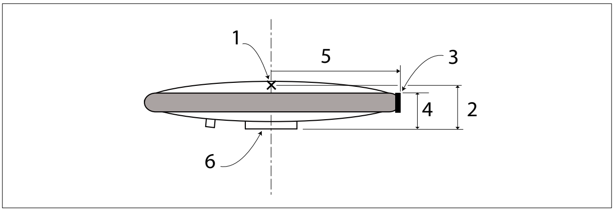
Not surprisingly, the minimum observation times in post-processed surveys are roughly equal to the TTFF's in real-time surveys, for the same type of equipment, baseline and initialization methods.

For single-frequency receivers using the initializer bar (baseline length: 20 cm), the minimum observation time is about 60 seconds when one or more SBAS satellites are in view and their collection data are available.

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 or the United States National Geodetic Survey 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)

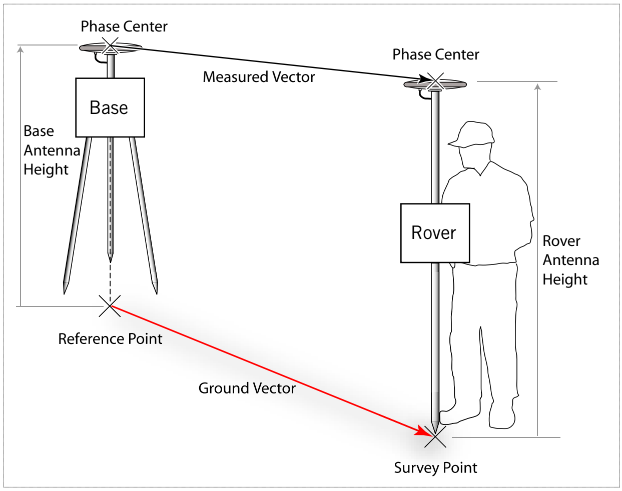
Horizontal distance from the geometrical center to the edge of the antenna. This parameter is needed by the system to determine the real height of the antenna over the landmark after a slant measurement has been entered into the system.

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 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.

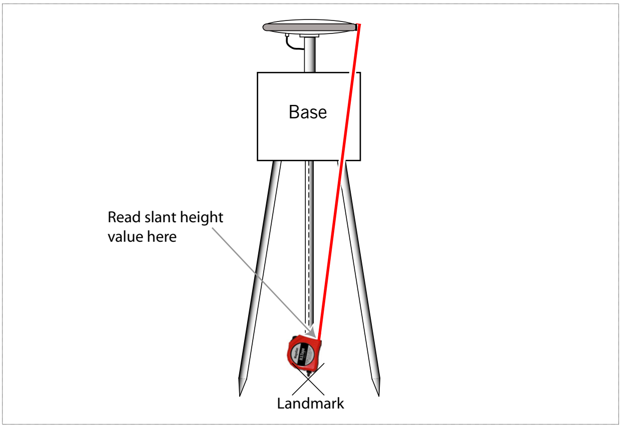
There are two different ways of measuring the antenna height:

- 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.) being 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 use a slant measurement, which is much more accurate, provided the antenna parameters are also accurately known and the specific Ashtech measurement tape is used for this purpose.



- Position the base system exactly over the landmark.
- Insert the end of the Ashtech 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.

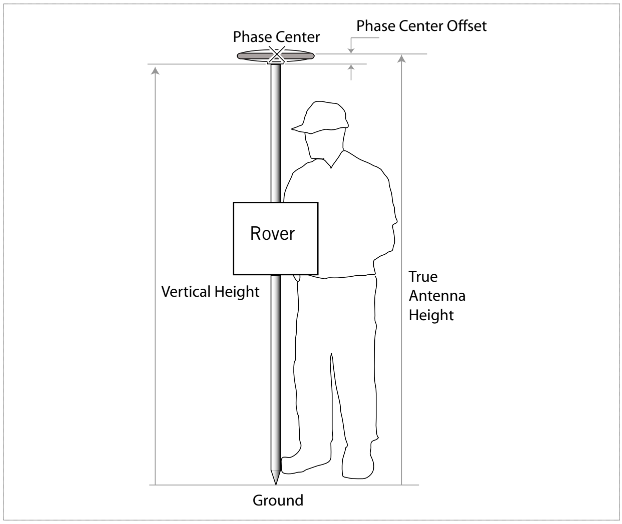
  If an Ashtech antenna is used, the system will automatically determine the true antenna height because it has got all the antenna parameters in its memory to perform the conversion.

  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 121*) 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 the 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 an Ashtech 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.

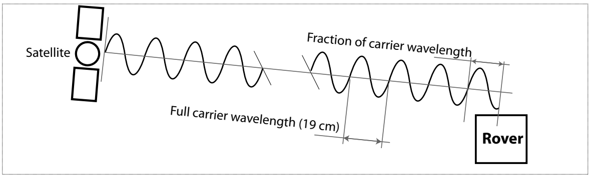
For another antenna however, you will first have to create a new antenna type in the system and enter its parameters (see *GNSS Antenna Features on page 121*) in order to be sure the system can accurately convert the vertical measurement into real height.

General Considerations Regarding 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 115*).

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 less 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 all the collected raw data, accuracies are better than in real time, provided the observation times are long enough.

Expression of Accuracy

For all Ashtech 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 127*). 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.

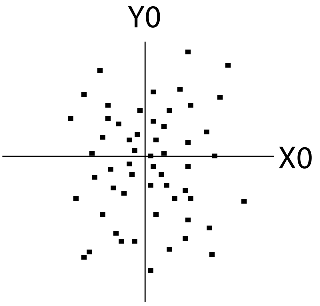
Accuracy (rms)	RTK	Post-Processing
Horizontal	1 cm + 1 ppm	0.5 cm + 1 ppm
Vertical	2 cm + 1 ppm	1 cm + 2 ppm

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.



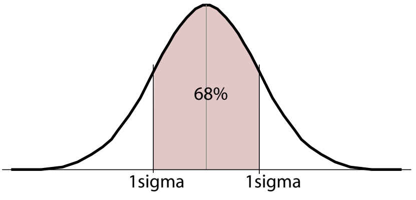
The origin of the (X0, Y0) axis system is the true position of the reference point. Each dot represents a position solution delivered by the GNSS System for this point.

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.

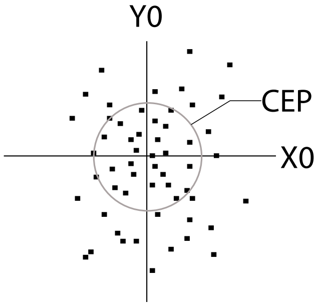


2. Some manufacturers use the “2drms” measure, which is derived from the rms measure on the horizontal plane, using the following formula:

$$Accuracy(2drms) = 2 \times Accuracy(rms)$$

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.

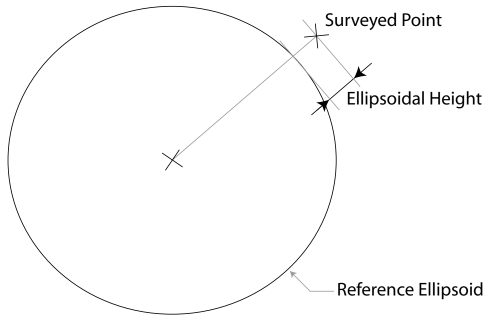
The reference ellipsoid refers to the WGS84, or better the ITRFxx, where xx is the year the ITRF was realized (e.g. ITRF00 was realized in the year 2000).

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.

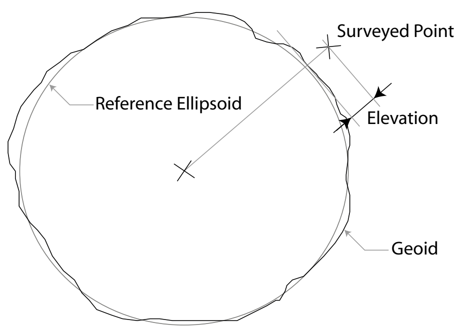
Things are a bit more complicated though when dealing with vertical coordinates because surveyors need to define very precisely which type of vertical coordinates they wish to measure.

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.



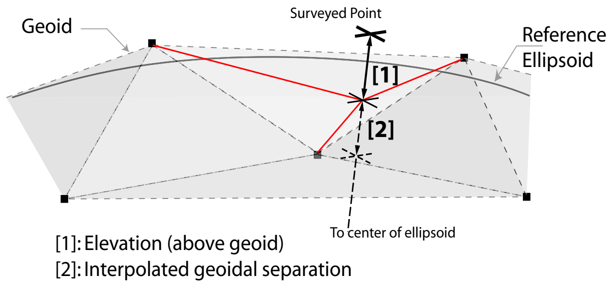
This surface is irregular depending on the density and distribution of materials on the surface of the Earth, which means the geoid may not exactly follow the natural features on the Earth’s surface. (The geoid is a fictitious surface that can’t be seen).

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

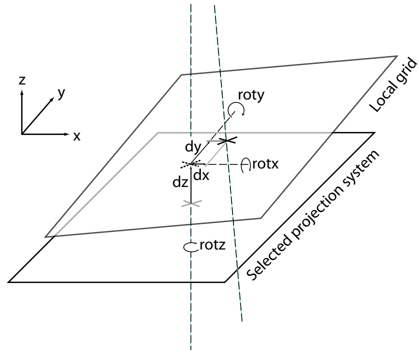
Localization

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. Ashtech 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 8. 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 (Ashtech 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 (Ashtech equipment used in rover-only configuration)

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

- Radio (standalone)
- Cellular mobile communications (cell phone, cellular modem).

For mobile communications, 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.

CDMA: A standard for mobile communications based on CDMA (Code Division Multiple Access) technology. CDMA is mostly found in the United States, Canada, and North and South Korea.

CSD: Circuit Switched Data. CSD 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 to a static IP address.

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. A widespread standard for mobile communications based on TDMA (Time-Division Multiple Access) technology.

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).

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.

TCP/IP Direct: Designates a network connection in Direct IP mode that includes secure data exchange mechanism between the different units involved (about 90% of the connections available in Direct IP mode).

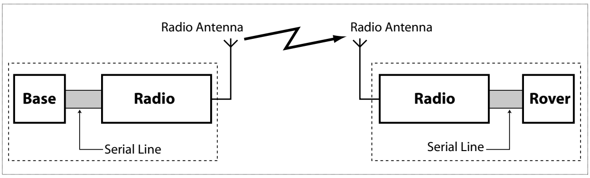
Transfer Rate: The interval at which a base is set to transmit its RTK correction data. Usually expressed in seconds.

UDP/IP Direct: Designates a network connection in Direct IP mode in which data exchange only relies on the use of IP addresses and port numbers (unlike TCP/IP Direct, there is no secured data exchange mechanism; about 10% of the available connections in Direct IP mode).

Radio

Implementation

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 Ashtech receiver used, the pair of radios can be:

- Incorporated into the Ashtech receiver. Only the radio antenna is visible from outside. The modem is connected to the system via a serial line.
- External to the Ashtech 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 subject 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, Ashtech offers two types of radios:

- License-free, low-power radios (short range) (available for some models of Ashtech receivers).
- Licensed medium-power radios (longer range). For this type of equipment, Ashtech 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 (or Spread Spectrum): 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 usually 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).

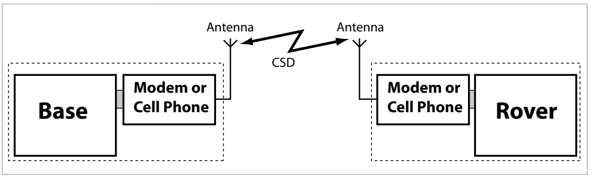
However, wave propagation in the UHF band is sometimes difficult. The radio range can dramatically be reduced if obstructions exist between the base and the rover. As a general rule, radio antennas should be raised as high as possible.

Cellular Mobile Communications

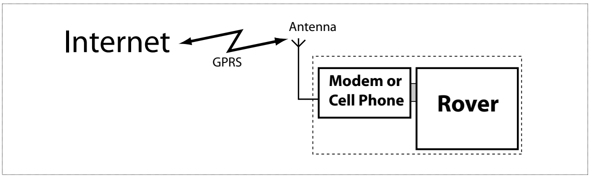
Implementation

Cellular modems or cell phones can be used for the data link in one of the following two configurations:

- A pair of 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 modem or cell phone 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 Modems

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

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

Features

GSM:

- Based on TDMA technology (TDMA= Time-Division Multiple Access). The frequency band is divided into multiple channels which are then stacked together into a single stream.
- Frequency bands used: 900MHz and 1,800 MHz in Europe and Asia, 850 MHz and 1,900 MHz in North America and Latin America.

CDMA:

- Based on CDMA technology (CDMA=Code Division Multiple Access) spreading data out over the channel after the channel is digitized. Multiple calls can then be overlaid on top of one another across the entire channel, with each assigned its own “sequence code” to keep the signal distinct.
- No specific frequency band per country.

Activating a Data Link in CSD Mode (GSM Only)

In this mode, you will have to:

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

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

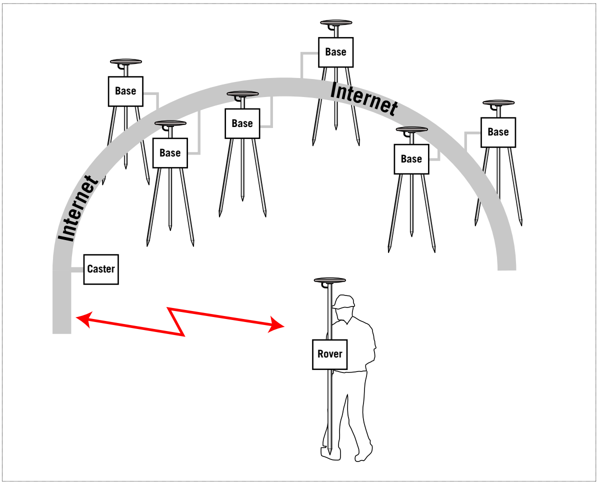
- Auto-dial: The phone number will automatically be dialed right after the rover modem has been initialized.
- Number of re-dials: In case of unsuccessful connection, the rover will automatically re-dial the base phone number until the data link is established. After “x” unsuccessful re-dials, the modem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



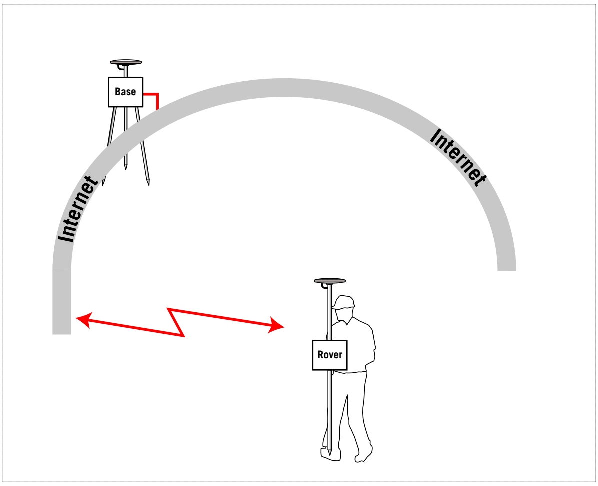
In this mode, you will have to:

- 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 the base from the caster with which you would like the rover to work. 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 (VRS, MAC or FKP).

Activating a Data Link in Direct IP Mode



In this mode, you will have to:

- Enter the two 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.

NOTE: Introduced late 2008, the Ashtech RTDS PC software allows rovers to communicate with a user-owned base, also through the Direct IP mode. The software serves as a relaying device between the base and the different rovers used in the field. This is an attractive solution for users who want to work in standalone mode. In this respect, this solution resembles that of the radio link, but without its radio coverage limitation as long as there is a cellular coverage in the working area.

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 Ashtech 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 Ashtech 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 and the ProFlex 500.

RTK Correction Data Formats

This section describes the different data formats that can be used by Ashtech 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

ATOM

ATOM is an Ashtech proprietary format. More compact than DBEN, it is intended to replace it in the latest Ashtech products (ProMark 500, ProFlex 500). The ATOM format consists of the following message types:

Message Type	Transfer Rate (default)	Range
Standard observations	1 second	0.05 to 1800 seconds
Compact observations	0	0.05 to 1800 seconds
Super-compact observations	0	0.05 to 1800 seconds
Reference position and antenna height	13 seconds	0.05 to 1800 seconds
Receiver and antenna attributes	31 seconds	0.05 to 1800 seconds

DBEN

DBEN is an Ashtech proprietary format. 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 many 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 Ashtech 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, 9	Differential GPS Corrections	
3	ECEF XYZ base coordinates	
16, 36	GPS special message	
18	Uncorrected carrier phase	1 second
19	Uncorrected pseudoranges	1 second
20	RTK carrier phase corrections	
21	RTK high-accuracy, pseudorange corrections	
22	Extended base parameter	
23	Antenna type definition	31 seconds
24	Antenna reference point	13 seconds
31, 34	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

Message Type	Description	Default Transfer Rate
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	
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.

Ashtech receivers offer two different RTK position output modes:

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

Key Terms and Expressions

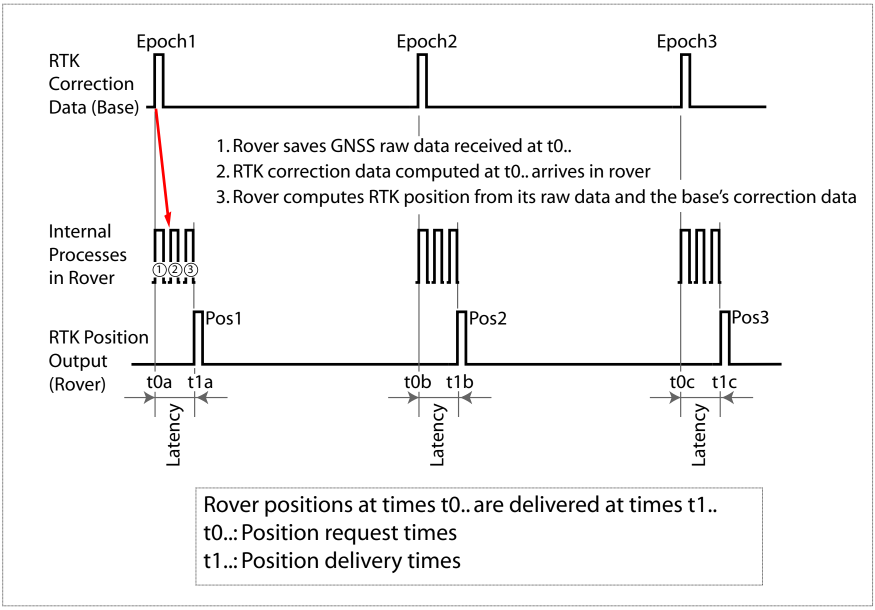
Latency: Delay between the time (t0) for which an RTK position is requested and the time (t1) when the rover starts delivering that position. More precisely, t1 represents the time when the rover outputs the position data’s first character. **Caution!** At time t1, the rover will start delivering the 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, the rover 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 GPS System 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 Ashtech 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.

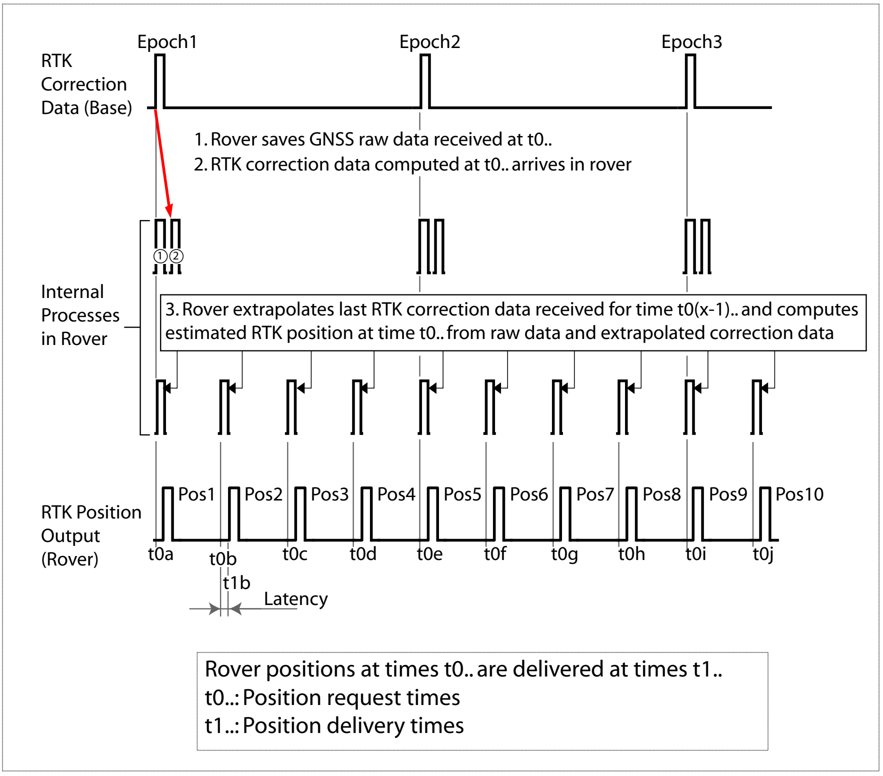
Benefit. RTK positions are consistently accurate.

Drawback. Time-tagged RTK can be inconsistent 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 Ashtech 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.

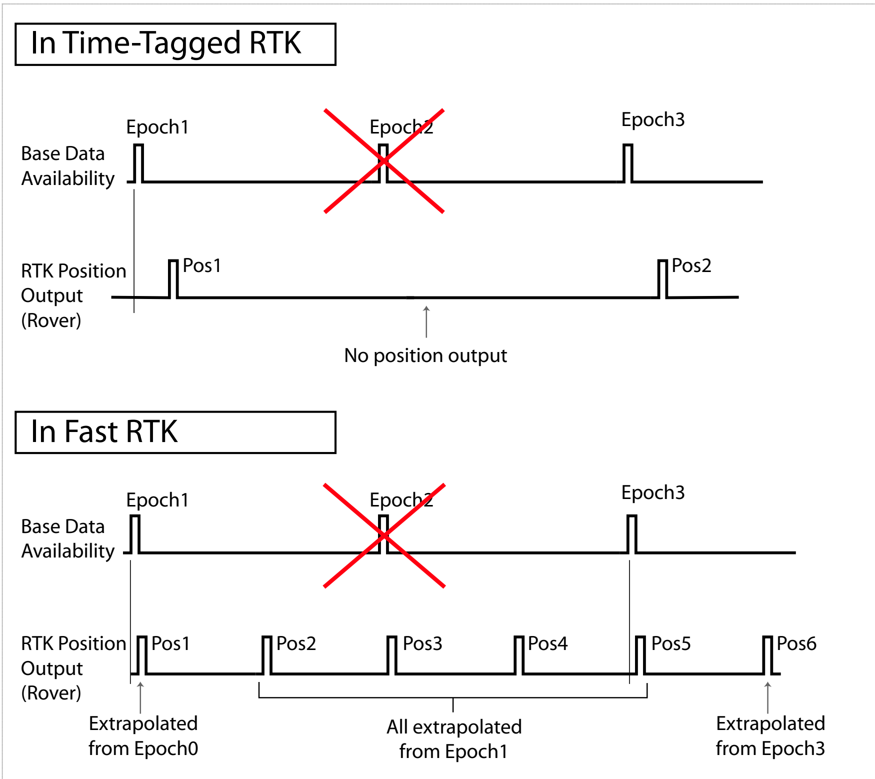
The latency is shorter than in time-tagged mode thanks to the extrapolation process.

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 corrections slowly deviate from the true correction.

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 Ashtech 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 Ashtech equipment used.

Chapter 9. Planning a Large-Scale Post-Processed Static Survey

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

- *Network design*
- O*bservation plan*

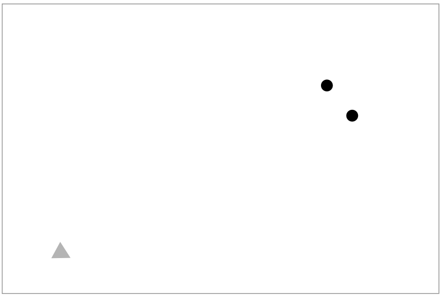
Following these two steps will greatly increase your chances of success. Each of these steps is discussed below.

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.

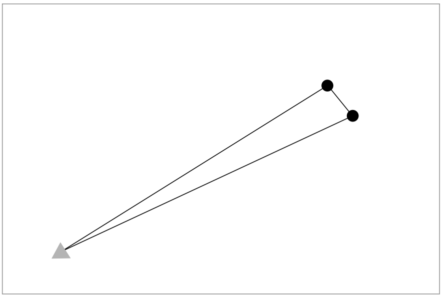
As an illustration, consider an example where two new intervisible points are to be established on a project site for use as control for a boundary survey (see *Fig. 1*). The two new points need to be tied to an existing control point three kilometers (1.9 miles) away.

Fig. 1. Three-Point Control Survey Example



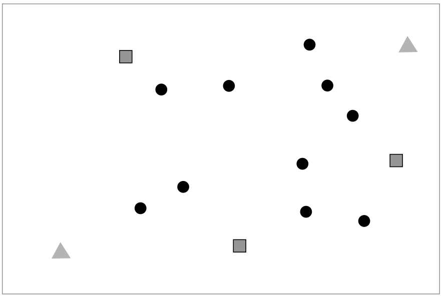
If you were to perform this survey with a conventional total station, you would probably plan on running a closed-loop traverse from the existing control point through the two new points (see *Fig. 2*). The same philosophy can be used for GNSS surveys. The figure below is your network design for this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

Fig. 2. Closed-Loop Traverse Design



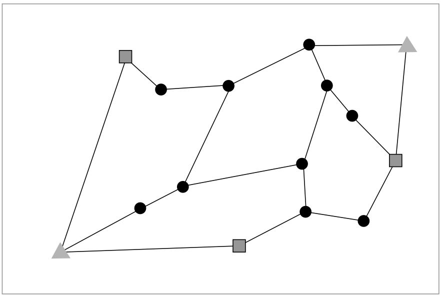
The previous example resulted in a very simple network design. *Fig. 3* represents a more complex control survey where 10 new points are to be established based on two existing horizontal and three existing vertical control points.

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.

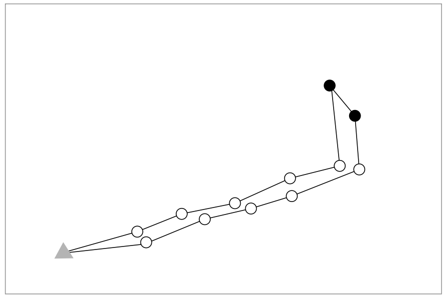
Observation Plan

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

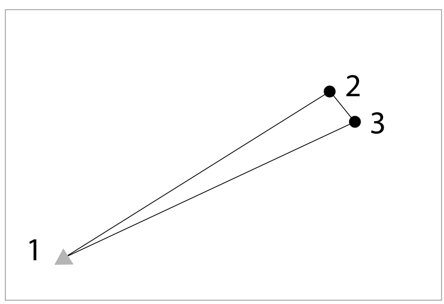


The number of traverse legs required to traverse between each point in the network will depend upon the conditions on the ground between the points.

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

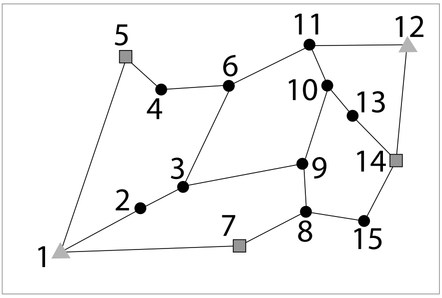


Assume that a two-receiver system will be used to perform the above survey. To produce the link between the existing control point 1 and the new point 2, simply place one receiver system on point 1, place the other receiver on point 2 and simultaneously collect data between the two points. When the observation 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.

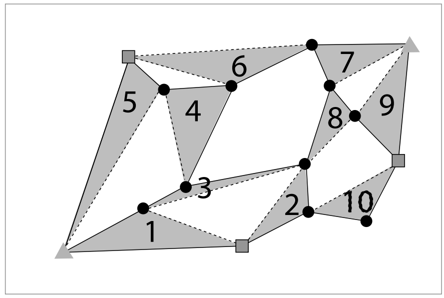
If the survey was to be performed using a two-receiver system, 19 separate data collection sessions (observations) would be required. For example, you can start with a receiver on point 1 and another on point 2. After this observation, you would move the receiver from point 1 to point 3 to perform an 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. This is one reason why multi-constellation receivers like the ProMark 500 and ProFlex 500 can provide superior performance. The additional available satellites from the multiple constellations improve the DOP compared to GPS-only receivers

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 Ashtech 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 10. Introduction to BLADE

Benefits of BLADE

Ashtech's BLADE technology provides the following user benefits:

- Use of SBAS and GLONASS ranging signals to strengthen the GPS solution allowing reliable RTK with GPS+SBAS or GPS+GLONASS+SBAS receivers.
- Faster time to a decimeter-accurate solution when not resolving ambiguities.
- Use of third party reference stations for GLONASS correction data resulting in reliable rover operation in any RTK Network.
- Reliable fixed RTK solutions with constant checking for correct ambiguity resolution.
- Routine operation over baselines up to 70 km.

Technical Description

Features

1. **General**: Extended Kalman filter of variable size to process data sequentially epoch-by-epoch forward [and backward for post-processing usage] used to estimate the baseline between a single static or moving base and a single static of moving rover.
2. **Positioning modes**: Code differential, Float RTK, Flying RTK, Fixed RTK.
3. **Measurements currently used**: Code [+carrier] from L1 GPS only up to GPS+GLONASS+SBAS L1&L2. (BLADE is open to processing future signals including GPS and GLONASS L5, Galileo, and Compass data).
4. **Acceptable measurement quality**: From high-quality measurements down to non-coherent signal tracking. BLADE performance is driven by base and rover measurement data quality.

5. **Base data formats accepted**: RTCM 2.3, RTCM 3.1, CMR/CMR+, Ashtech Proprietary ATOM.
6. **Network data formats accepted**: FKP, MAC, VRS.
7. **Carrier ambiguity**: From Float/Flying, through partially fixed and up to fixed solution with different levels of reliability.
8. **Initialization**: On-The-Fly [+ different geometric constraints].
9. **Dynamics**: From pure static to unpredictable kinematics, adaptive filter is default.
10. **Baseline length**: Limited only by common satellites in view.
11. **Solution protection**: Built-in guard against incorrect ambiguity determination [+ the use of tracking channel warnings].
12. **Reporting accuracy**: rms estimate of position fix.

Modules and Functions

1. Extended Kalman Filter of variable size
2. Built-in guard & warning processing
3. Ambiguity transformation/search/fixing routines
4. Service procedures.

Kalman Filter

Kalman filter (KF) models up to the following states:

- 3D position & clock (4 states)
- [3D velocity & clock drift (4 states)]
- [Single Difference L1 ambiguity (one for each Sat)]
- [Single Difference L2 ambiguity (one for each Sat)]
- [Single Difference ionosphere (one for each Sat)]
- [L1-L2 GPS code bias (1 state)]
- [Troposphere parameter (1 state)]
- [L1-L2 vertical antenna offset (1 state)]

All optional states are initialized when needed and deleted when values are not observable.

KF works with Single Difference (SD) measurements between rover and base.

KF may absorb up to 4 blocks of original SD measurements per epoch:

- L1 (C/A or P1) code (GPS+SBAS+GLONASS)
- L1 (C/A or P1) carrier (GPS+SBAS+GLONASS)
- L2 (P2 or CS) code (GPS+GLONASS)
- L2 (P2 or CS) carrier (GPS+GLONASS).

KF may take advantage of the following supplementary information:

- *A priori* position information (Known Point Initialization option)
- *A priori* baseline length and maximum elevation difference information (heading option).

KF may support up to 9 kinematic modes:

- Pure static
- Quasi static
- Walking
- Ship
- Automobile
- Aircraft
- Unlimited
- Adaptive - default
- User defined.

Built-in Guard

The built-in guard includes:

- Raw base and rover data checks
- Rover receiver channel warning processing
- Distance-free SD measurement combinations processing
- SD failure guard for each epoch
- Reset management.

SD failure epoch guard is intended to:

- Detect small and medium code outliers for all kinematic modes
- Detect small (up to 0.5 cycle) carrier cycle slips for all kinematic modes.

The efficiency of SD failure guard depends on the number of measurements at an epoch and the kinematic model used.

The SD failure guard is built into the KF routine, and performs sequentially:

- Anomaly detection
- Anomaly isolation

Reset management includes:

- Detection of suspected but not-repaired data anomalies or KF divergence (wrong ambiguity fix, missed cycle slips, etc.)
- Flexible mapping of different types of detected anomalies into one of 4 types of RTK resets (from the 'hardest' up to the 'softest')

Ambiguity Routines

KF estimates SD ambiguity, while only Double Difference (DD, between satellites) ambiguities are subject to search and fix.

Ambiguity responsible routines include:

- Selection of DD ambiguity and combinations to be searched
- Integer search of up to 100 of the most probable solutions
- Different search/fixing strategies
- Support of decision rules
- KF state vector and covariance transformation in case of ambiguity fixing
- Adaptive partial-fixing routines
- Thin algorithms related with GLONASS carrier biases
- Special aids to support heading option.

Adaptive partial fixing allows for a fixed ambiguity solution in cases where a few (*a priori* unknown) carriers are biased.

Thin algorithms related with GLONASS biases include background estimation of fractional part of GPS-GLONASS carrier bias in order to use it to speed up ambiguity fixing after full loss of lock.

With heading option, *a priori* information about baseline length and maximum expected elevation is used for deselecting the wrong integers.

Service Procedures

1. RTK resets/initialization management
2. Particular states health monitoring
3. Estimators of achieved accuracy
4. Estimators of GLONASS inter-channel hardware biases.

BLADE supports different kinds of RTK resets:

- Whole RTK reset (reset all possible, imitates receiver start up)
- Whole KF reset (some information from service procedures is not reset)
- Partial KF reset (biases and ionosphere are not reset, imitates receiver reacquisition after short-term full blockage)
- Soft KF reset (position and ambiguity states are slightly released).

BLADE can estimate actually achieved accuracy, based on post-fit residual analysis. It takes into account not only the magnitude of residuals, but also their time correlation.

In the background of KF processing, BLADE can effectively estimate GLONASS hardware biases, which are usually specific for a given pair of receivers. This information may be saved in Battery Backed-Up receiver memory in order to be used and updated during next sessions with the same receivers. This feature allows considering GLONASS measurements to be of equal quality to their GPS counterparts.

BLADE Performance in Detail

Preamble

All performance figures presented in this White Paper were obtained with default BLADE settings. Specifically, no static assumption was made when processing static data. All the tests related to ambiguity fixing were performed with a preset 99% reliability level. In all the cases, the reliability requirement was met (in most of the tests, 100% reliability was achieved).

All performance figures were derived on a computer with pre-collected data using a PC-based version of the BLADE engine, which worked in the exact real-time manner as if it were running in a receiver.

All performance figures are statistical. Sufficient data was used to evaluate these figures with a high level of confidence.

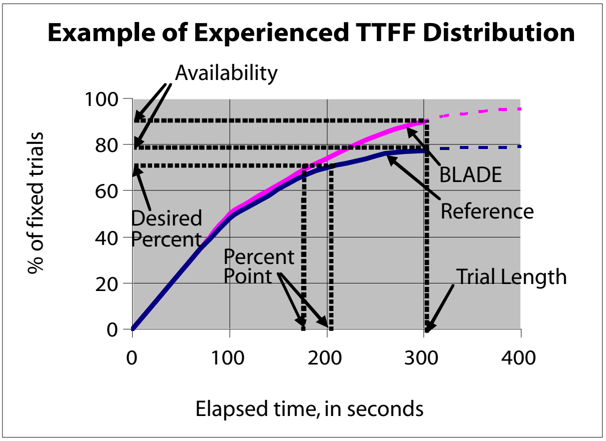
The performance evaluation procedure in each case consisted of running the BLADE engine with automatic reset every 300 or 600 seconds to get a sufficient number of independent, fixed-length RTK trials. The result of each trial was subject to further statistical evaluation.

Ashtech always uses the fixed-length trial methodology (compared to float-length trials) because only this approach is statistically adequate, and is generally more pessimistic than the float-length trials.

The diagram below shows the meaning of Time To First Fix (TTFF) performance figures we provide when speaking about fixed ambiguity solutions in BLADE. First of all, the results of all the fixed-length trials are used to build a cumulative distribution function vs. time (t) elapsed from BLADE reset. Since not all the trials can be fixed (trial length is T=300 sec in this example), this distribution function is valid only for t<T. The values for t>T usually cannot be well extrapolated and are not used in any BLADE performance evaluation.

Below, instead of plotting the complete distribution function, we provide some typical values (marked red) corresponding to the desired parameter (marked yellow). These are:

- Availability = the percentage of ambiguity fixed trials over all the trials of length T.
- TTFF percent point = the minimum time needed to fix ambiguity in given percent of trials.



Since the TTFF can be very dependent on time and local environmental conditions, the absolute performance often tells nothing valuable. That is why for each test we provide comparative figures, which demonstrate the benefits of the BLADE over another standard Reference post-processing engine, providing thereby a direct comparison. This Reference case can be another engine running with the same data, or the same BLADE engine not using an advanced option.

It must be noted that in many cases the difference between Reference and BLADE cases is not so obvious at the 50% level of TTFF. However, the difference can be dramatic at the 90% and 99% levels. These points refer to so-called worst case scenario where the BLADE technology shows its full power.

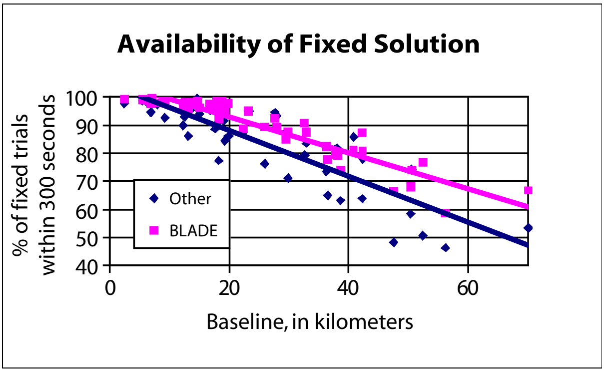
Long Range RTK Performance (GPS L1&L2)

The diagram below shows the performance of the long-range GPS L1&L2 RTK algorithm with the BLADE engine compared to another Reference RTK engine previously used by Ashtech.

For each of the 50 baselines that were collected, more than 400 independent 300-second trials were conducted.

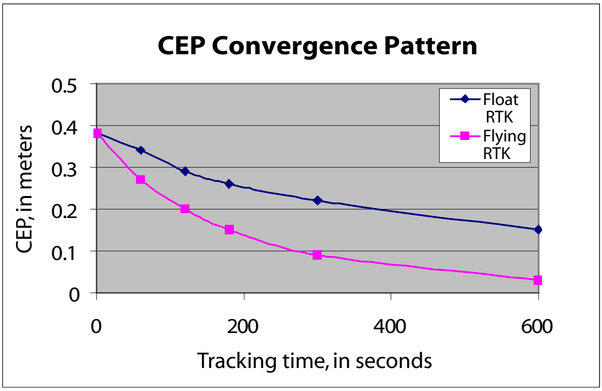
The diagram shows that the BLADE engine insures:

- Very high fixed-solution availability for short baselines (<20 km)
- Good fixed-solution availability for up to 70-km baselines.
- The speed of initialization for the data with baseline less than 20 km was less than 2 seconds in 95% of the cases.



Flying RTK Performance (GPS L1)

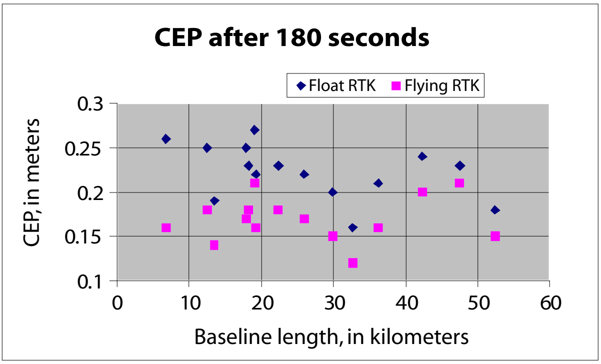
The diagram below demonstrates the benefit of BLADE by applying the Flying RTK algorithm rather than the conventional Float RTK algorithm. The results are shown for L1 GPS only, over a short baseline.



The CEP error (50% horizontal) is plotted vs. the time elapsed after BLADE was reset. The collected data include more than 150 reset operations for each of the different 22 baseline lengths used, which ranged from several meters up to ten kilometers.

This plot shows that with BLADE's Flying RTK, Ashtech can insure much better position convergence compared to conventional Float RTK algorithms.

The diagram below shows how the CEP figure can be improved for long baselines using the Flying RTK algorithm. The CEP was measured three minutes after BLADE reset.



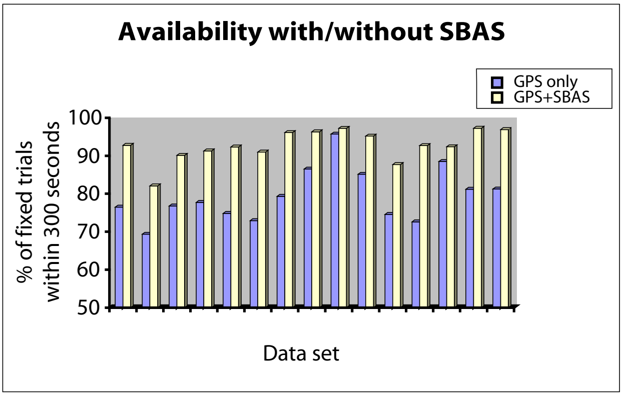
Again, L1 GPS-only data were used for evaluation. The plot shows that, even for long baselines, with only L1 GPS data, Flying RTK can deliver decimeter-level performance.

GPS+SBAS RTK performance (L1)

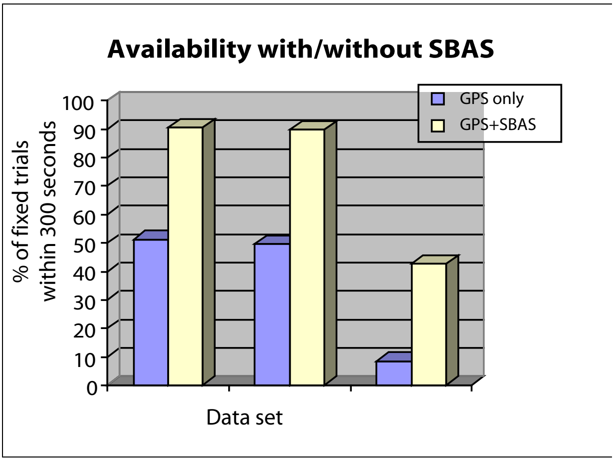
The diagram below demonstrates the improvement in fixed position availability using SBAS ranging data (pseudorange and carrier phase) in the BLADE RTK process.

Fifteen data sets (each at least 24 hours long) were used from open-sky baselines that varied in length from a few tens of meters to 7 km.

One or two common SBAS satellites were available to both base and rover. Most of the data sets were collected in Europe (EGNOS) and US (WAAS), the last data set corresponds to China (MSAS). Thanks to SBAS ranging, the improvement in fixed position availability is obvious.



Using SBAS ranging in BLADE, the improvement is even more dramatic when processing baselines under medium/ heavy shading. SBAS satellites noticeably improve geometry and result in dramatic improvement in performance over the GPS-only case. The first two data sets correspond to medium sky shading, while the third one corresponds to heavy shading where a GPS-only solution is typically useless.

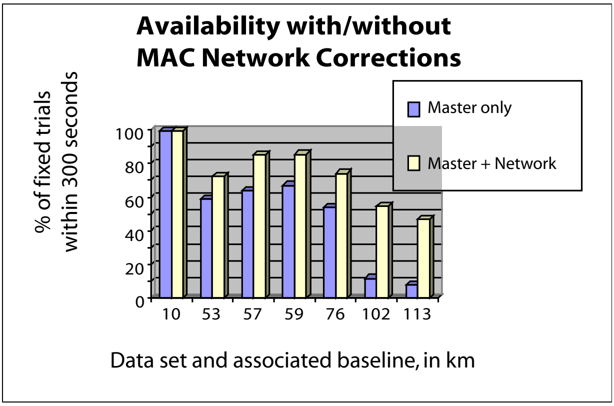


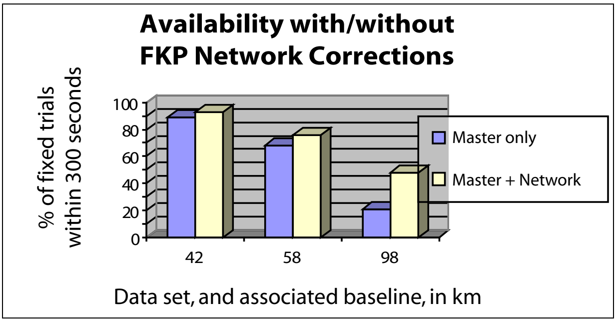
Network Performance (GPS L1&L2)

The two diagrams below show BLADE performance in GPS networks transmitting single-base (master) data and standardized network corrections:

- MAC as RTCM-3 messages 1014-1016 (Orpheon Spider Network, France)
- FKP as RTCM-2 message 59 (Teria FKP Network, France)

Making proper use of different types of network corrections in the BLADE engine shows that the range of fixed ambiguity RTK can be extended effectively to over one hundred kilometers.

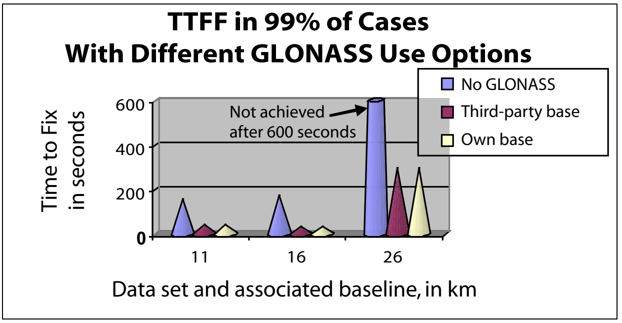




GLONASS Performance (L1&L2)

The diagram below shows 99% point to fix ambiguity for three different short baselines. The trial duration was 600 seconds. All data sets were collected with Ashtech ProMark 500 GPS+GLONASS L1&L2 receivers and processed with three different assumptions:

- GPS only, i.e. no GLONASS data was used.
- GPS+GLONASS with "third-party base" assumption. In this case, GLONASS differential carrier phase biases were assumed to be not known *a priori* and the receiver ran an OTF bias calibration.
- GPS+GLONASS with "own base" assumption. In this case GLONASS differential carrier phase biases were known to be zero.

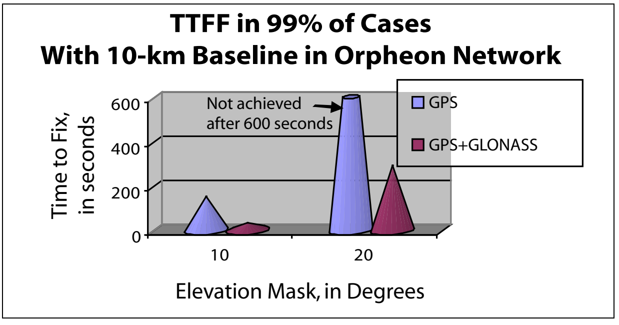


The diagram shows that:

- Using GLONASS brings good improvement compared to GPS only.
- OTF GLONASS carrier bias calibration (i.e. third-party base assumption) demonstrates a performance level similar to the "own base" assumption.

The diagram below shows BLADE performance when actually working against a third-party base from an unknown manufacturer (i.e. carrier bias calibration was run), for which using GLONASS data in the BLADE algorithm can dramatically improve TTFF performance.

This appears more clearly in the test with specially applied 20-degree elevation mask, for which 99% point of TTFF was not even achieved after 600-second intervals.

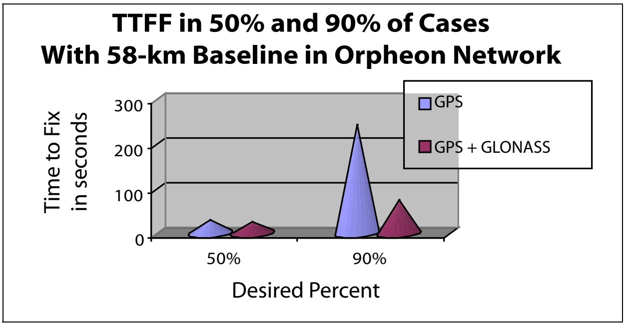


When working in a network, 10-km baselines are not really the typical case of use. Usually, rovers work on baselines from 30 to 70 kilometers, and may be either within or out of range of the network.

For long baselines, effective OTF calibration of the GLONASS carrier bias is not so easy as on short baselines. This is because systematic errors on long baselines, like residual orbit, troposphere and ionosphere errors, noticeably affect the calibration process.

However, the diagram below shows how the BLADE RTK engine, through an adequate processing of the GLONASS data from a third-party base, can improve the TTFF over the GPS-only case, even for a long 58-km baseline.

On this diagram is a statistical summary gathering the results of two data sets collected in the same conditions (i.e. same receiver, same antenna, same network mount point) but two weeks apart.



One can see that while 50% point of TTFF is almost equivalent for both cases, for 90% point there is a dramatic improvement thanks to using BLADE GPS+GLONASS solution. In other words, GLONASS being not so important in cases when GPS alone is good, is very important in worst cases when the power of GPS alone is not sufficient to get quickly fixed solutions.

Chapter 11. Troubleshooting

Bluetooth Connection from FAST Survey 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 receiver.

To ask for a Bluetooth connection with a receiver, you have to select “Bluetooth” and “Ashtech BT” (or “Windows Mobile”) on the **Comms** tab when setting your base or rover.

Using , 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 Ashtech 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 receiver has a faulty Bluetooth device.
2. You may try to isolate the problem by turning on another receiver and resuming the search phase. If it's successful, then it means the first receiver is malfunctioning. Call your local dealer or email Ashtech 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 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 Ashtech 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 Ashtech 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 Ashtech Technical Support for assistance.
2. **If the memory is not full** (>0%), you may have a malfunctioning receiver. Contact your local dealer or email Ashtech 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 exceed 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, ) 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 Ashtech 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 179* 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 176* 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 the receiver front panel or FAST Survey's Monitor/Skyplot function 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 Ashtech 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 Ashtech 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 Ashtech technical support for assistance.

Rover is Computing Positions with High Uncertainties

	RTK Base	RTK Rover	PP Base	PP Rover
Relevant to		•		

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. Check that the system is configured as an RTK rover. For example, with FAST Survey:

- **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. 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 Ashtech 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 Ashtech Technical Support for assistance.

Logging Data for RTK Troubleshooting Purposes - Reporting a Problem to Ashtech Tech Support

Logging the data received, processed and output by the receiver may help Ashtech isolate RTK malfunction when none of the available troubleshooting procedures has allowed you to solve the problem.

This procedure is based on the capability of the receiver to execute serial commands from a text file stored on a USB key.

You can create by yourself the text file required to launch this process. Create the text file with the following content, making sure the four commands are typed in that order:

$PASHS,MEM,2
$PASHS,ATL,ON
(Press the ENTER key after typing the last command. This is mandatory.)

Save the file as “autoconfig.cmd” and copy it to the USB key. By naming the file that way, the receiver will automatically prompt you to run the script when you connect the USB key to the receiver.

Then follow the instructions below:

- Check that the receiver is not currently logging data. If it is logging data, press the Log button to stop data logging.
- Connect the USB key to the receiver. Wait until the USB logo appears on the receiver screen and a message is prompted (**Upload Script?**).
- Accept the request by pressing the Log button. The receiver will then run the script from the text file, and then will start logging the data, as indicated by the blinking diskette icon on the receiver screen.
- After enough data has been recorded, firmly press the Log button once, then wait until the diskette icon on the

screen stops blinking. When this happens, this means data recording has been stopped.

- Turn off the receiver.
- Remove the USB key and read the content of the USB key on your computer.
- Send the collected data file (ATL_yymmdd_hhmmss.log) to Ashtech for further diagnosis.

When reporting a problem to Ashtech Technical Support, please attach to your email the response of your receiver to the following commands:

$PASHQ,RID
$PASHQ,VERSION
$PASHQ,OPTION
$PASHQ,PAR

Log these responses in Terminal mode (with Hyperterminal for example) at a speed of 19600 Bd in a text file (*.txt).

Chapter 12. Miscellaneous

List of Alarms

Alarms are reported on the receiver 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.

#	Rank	Alarm Label	Symptoms & Remedies
0	Medium	Software error	Receiver detected an internal error due to software. If persisting, 2nd-level maintenance is required for the receiver.
1	Medium	Unknown command	Unknown serial command received. Correct syntax and re-send command.
2	Medium	Bad parameter	Not well-formatted parameter in the command sent. Correct syntax and re-send command.
3	Medium	Bad command checksum	Serial command received with bad checksum. Correct checksum and re-send command.
4	Medium	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	Medium	File close error	Receiver failed to close the raw data file. Try again. If still unsuccessful, turn off the receiver and try again.

#	Rank	Alarm Label	Symptoms & Remedies
6	Medium	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	Medium	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	Medium	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	Medium	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	Medium	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	Medium	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 Ashtech technical support for assistance.
19	Medium	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 Ashtech technical support for assistance.
21	High	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	High	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 Ashtech technical support for assistance.
23	High	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	Low	RTC send error	Receiver has detected a task not running properly. Restart receiver. If error still persists, call your local dealer or email Ashtech technical support for assistance
25	Medium	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.
26	Medium	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.

#	Rank	Alarm Label	Symptoms & Remedies
27	Medium	Radio settings corrupted	Receiver failed to interpret data received from Pacific Crest receiver or transmitter. Check baud rate and retry.
28	Medium	Bad radio response	Receiver failed to interpret data received from transmitter. Check baud rate and retry.
29	Medium	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	Medium	No GNSS detected	GNSS board found missing. Restart receiver. If error persists, call your local dealer or email Ashtech technical support for assistance.
31	Low	Bad PVT received	Bad position data delivered by GNSS board. If error persists, call your local dealer or email Ashtech technical support for assistance.
32	Low	Bad PVT decoded	Bad position data delivered by GNSS board. If error persists, call your local dealer or email Ashtech technical support for assistance.
33	Low	PVT multiflag	If error persists, call your local dealer or email Ashtech technical support for assistance.
34	Medium	Unknown option code	OPTION command received includes invalid option code. Check command syntax/parameters and send the command again.
35	Medium	C3 code checksum is bad	Option codes are corrupted at power-on. Re-install receiver options.
36	High	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	High	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 Ashtech technical support for assistance
38	High	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	Low	Spy too long	A Debug command. Apart from acknowledging the alarm, no particular action required.
40	Medium	GSM already in DIP Mode	Source table requested whereas GSM already used in DIP mode. End DIP connection before requesting the source table.
41	Medium	GSM currently in NTRIP Mode	Source table requested whereas GSM already used in NTRIP mode. End NTRIP connection before requesting the source table.
43	Medium	Invalid mount point	You are trying to connect the receiver to an invalid mount point. Correct mount point parameters and try again.
44	Low	Input buffer full	If error persists, call your local dealer or email Ashtech technical support for assistance.
45	Medium	GSM Pin code invalid	Correct pin code and try again. If error persists, contact GPRS provider to fix the problem.
46	Medium	GSM band error	Correct GSM band and try again. If error persists, call your local dealer or email Ashtech technical support for assistance.
47	Medium	GSM protocol error	Correct protocol used and try again. If error persists, call your local dealer or email Ashtech technical support for assistance.

#	Rank	Alarm Label	Symptoms & Remedies
48	Medium	GSM CSD mode error	Problem configuring the modem in CSD mode. Try again. If error persists, call your local dealer or email Ashtech technical support for assistance.
49	Medium	APN error	Problem configuring the APN. If error persists, contact GPRS provider to fix the problem.
51	Medium	GPRS login error	Check GPRS login. If error persists, contact GPRS provider to fix the problem.
53	Medium	GPRS password error	Check GPRS password. If error persists, contact GPRS provider to fix the problem.
54	Medium	GPRS connection failed	Receiver failed to connect to GPRS. Check GSM antenna. Check GPRS parameters and reception level and try again.
56	Medium	Invalid caster hostname	Correct caster hostname and try again.
57	Medium	Invalid caster port	Receiver failed to access the caster through the port mentioned. Check caster port number.
60	Medium	Disconnect. from GPRS failed	Receiver failed to disconnect from GPRS. Try again. If still unsuccessful, shut down the receiver.
61	Medium	Connect. to DIP failed	Receiver failed to connect to the specified DIP address. Check DIP parameters and access rights and try again.
62	Medium	CSD dial error	Receiver failed to dial the specified phone number.
63	Medium	CSD hangup error	Receiver failed to hang up. Shut down the receiver.
66	Medium	Auto pickup error	Receiver failed to set “auto pickup” in GSM modem
67	Medium	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.
69	High	Too many files	Up to 96 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.
70	High	Low battery	Battery output voltage below lower limit defined by $PASHS,PWR,PAR.
71	High	Low voltage	External DC source voltage below lower limit defined by $PASHS,PWR,PAR.
72	Medium	Storage overflow	Storage overflow. This can be solved by reducing the data recording rate.
90	Medium	BTH Name Rejected	Bluetooth name rejected
91	Medium	BTH PIN Rejected	Bluetooth pin rejected
93	Medium	GPRS Ini Failed No Signal Detected	Modem initialization failed resulting in no input signal detected
94	Medium	No ATOM Session File	Receiver could not find any G-file collected through session
95	High	Rinex Convers. Failed	Receiver could not convert G-file into Rinex files
96	High	Hatanaka Convers. Failed	Receiver could not convert G-file into Hatanaka Rinex files
97	High	TarZ Compres. Failed	Receiver could not compress converted files
99	High	Session Start Failed	Receiver could not start programmed session
100	High	Session Stop Failed	Receiver could not terminate session in progress

Special Button Combinations Summary

Button Combination	Receiver 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 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 261*.

Firmware Upgrade Procedure

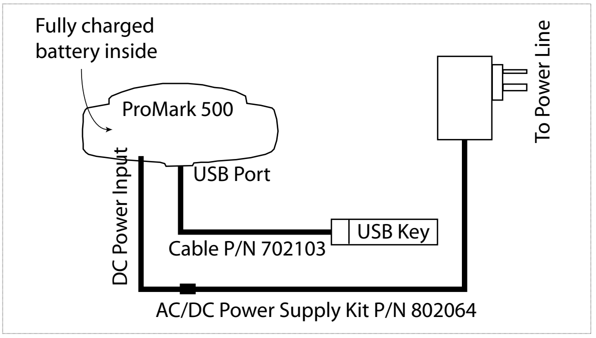
Firmware upgrades can be downloaded from the Ashtech FTP server in the form of one or more compressed ".tar.bz2" files. The file(s) provided, as well a the step-by step upgrade procedure are given in the relevant *Release Note*.

Completing a firmware upgrade procedure may take up to 30 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.

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 “.tar.bz2” file(s) 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 receiver 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 receiver’s USB connector through cable P/N 702103 (provided).
7. Hold down the Scroll button and then press the Power button for about 10 seconds. After about 30 seconds, the Ashtech logo on the screen is replaced with the “Upgrade in progress” message, meaning that the upgrade procedure has now started.
8. Let the receiver proceed with the upgrade. **Take care not to turn off the receiver while the upgrade is in progress**.

   The receiver screen will display successively:

   Upgrade in progress.
   Writing xx%
   ramdisk.img.gz
   ...
   uboot
   uimage_pm4_rd
   Upgrading GNSS
   ...
   Erasing partitions
   Creating Backing file
   Creating partition
   Config

Starting...

9. Follow the instructions provided in the *Release Note* to complete the upgrade. The receiver is automatically re-started at the end of the procedure.
10. Disconnect the USB key and its cable from the receiver.
11. Check that the new firmware is installed (read the second line on the Receiver Identification Screen).

Time-tagged RTK vs. FAST RTK Position Output

Your receiver can deliver RTK positions either in Time-Tagged or Fast RTK mode. The default mode is Fast RTK.

If you wish your receiver to operate in Time-Tagged mode, use the appropiate serial command to switch into that mode (see *CPD,FST: RTK Output Mode on page 242*).

In its standard version, the receiver features a Fast RTK mode with an output rate of 2 Hz. With the FASTOUTPUT firmware option, the output rate is 20 Hz. After purchasing this option, use the $PASHS,OPTION command to install it. See *OPTION: Receiver Firmware Options on page 278*).

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 (in the form “A” to “Z” for the first 26 files logged in the same day, then “AA” to “ZZ” for the next ones recorded in the same day, starting from the 27th file).
<Year>	Last two figures of current year (e.g. “08” for 2008) for up to26 files recorded in the same day, then only the last figure of current year for the 27th and next files.

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:

G584VAA8.127

Changing the Radio Module or Using One for the First Time

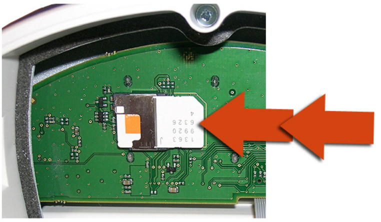
- Turn the ProMark 500 upside down.
- Using a flat screw driver, loosen the two quarter-turn screws of the radio module (or compartment door if your ProMark 500 was purchased without a radio module).
- Gently pull the module (or compartment door) out of the ProMark 500. The picture below shows a ProMark 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 Serial Port A

- 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 Commands Through Bluetooth or a Serial Port on page 204* in this manual to know how this can be done.
- Use the $PASHS,MDP serial command to configure serial port A as an RS232 or RS422 port. Refer to *MDP: Setting Port A to RS232 or RS422 on page 268* 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 248*.

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 Commands*

Through Bluetooth or a Serial Port on page 204 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 278* in this manual to learn how to use this command.

  Through this command, you will enter the code provided by Ashtech after you purchased the option. Entering this code into the receiver will unlock the option.

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 an Ashtech 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
& Data Outputs
Supplement

Appendix A. Using Serial Commands

Introduction to Serial Commands

Serial commands allow you to communicate directly with the receiver in its proprietary command 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)

String or sign	Description
n	Used in the syntax of responses to query commands to indicate that a sequence of parameters will be repeated "n" times in the response. For example, n(f1,f2,f3) means the response will include the sequence "f1,f2,f3,f1,f2,f3,f1,f2,f3...". The value of n is specific to each command.
s..	Character string
*cc	Checksum

In response to a well recognized and properly executed set command, the receiver will return the message:

$PASHR,ACK*3D

A set command is said to be "NAKed" when it is not accepted or acknowledged. The following message is then returned:

$PASHR,NAK*30

If this happens, check that the command has been typed correctly and the number and format of parameters are correct. In some cases, the execution of a set command may be contingent upon the prior activation of the corresponding firmware option.

Checksum Calculation: The checksum is computed by "exclusive-ORing" all of the bytes in the message between, but not including, the "$" and the "*". The result is "*hh" where h is a hexadecimal character.

Applying Commands Through Bluetooth or a Serial Port

From the Office Computer

Use GNSS Solutions' WinComm utility, or any terminal emulation program such as HyperTerminal (a standard Windows communication accessory), to send serial commands to the receiver.

Interfacing the chosen program with the receiver is achieved by establishing a connection through one of the computer's COM port (a serial data cable is then required), or using Bluetooth if this device is available on the computer.

For more information on WinComm, see *GNSS Solutions Reference Manual* or WinComm On-Line Help.

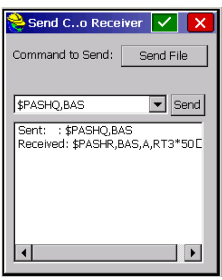
When using HyperTerminal, perform the following settings after creating a new connection and before typing your first command:

- In the HyperTerminal menu bar, select **File>Properties**.
- Click on the **Settings** tab.
- Click on the **ASCII Setup** button.
- Enable the following two options: **Send line ends with line feeds** and **Echo typed characters locally**. This will automatically complete all your command lines with <cr><lf> characters and allow you to see in real time the commands you are typing.
- Click **OK** twice to close the Properties window.

From FAST Survey

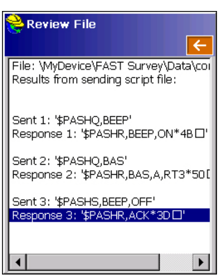
From the FAST Survey menu, tap on the **Equip** tab, then on the **GPS Utilities** button, and then on the **Send Command** button. It is assumed that the communication with the receiver has been established via Bluetooth or a serial cable.

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.

Running Serial Commands from a USB Key

Serial commands can also be run from a USB key you connect to the receiver's USB port through the dedicated cable.

What you have to do is create a text file containing the list of serial commands you would like the receiver to execute.

In this file can also be inserted the $PASHS,CMD,WTI command, which is used to introduce an idle time before the receiver is allowed to execute the command that comes after.

After typing the last command in the file, press the ENTER key to insert a carriage return + line feed as the last item in the file. This is mandatory.

Then you just have to copy the file to the USB key's root directory.

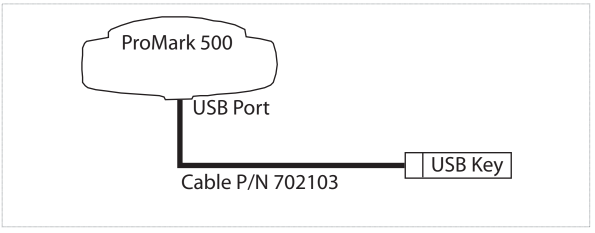
The receiver will always execute the list of commands (the *script*) in the given order, except for some commands like $PASHS,REC and $PASHS,INI, which are necessarily run last.

Starting the execution of the script may be done in two different ways:

- **Automatically**: The receiver will automatically prompt you to run the script when you connect the USB key to the receiver. This is achieved by simply naming the file "autoconfig.cmd"
- **Manually**: This is achieved by naming the file differently and using the $PASHS,CMD,LOD command to initiate the execution of the script.

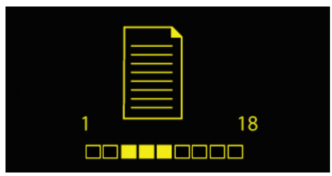
Described below is the typical procedure to make the receiver run automatically a series of commands stored on a USB key under a file named "autoconfig.cmd":

- Connect the USB key to the receiver.



- Wait until the USB logo appears on the receiver screen and a message is prompted (**Upload Script?**).

- Accept the request by pressing the Log button (you could reject it by pressing the Scroll button). The receiver will then start executing the script of commands. This is indicated on the display screen where you can see the number of commands to be run (on the right) and the rank of the command being currently run (on the left). In the example below, the receiver is running the 1st command of the 18 ones it has to go through:



- When all the commands have been run, the receiver comes back to the screen it was displaying before.
- Remove the USB key.
- You can now have a check on how the receiver ran each of the commands: Connect the USB key to a computer and edit the autoconfig.log file created on the USB key by the receiver while executing the commands. Each correctly executed command is followed by:

  $PASHR,ACK*3D

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.

Table 1. Receiver Configuration Commands

Set Command	Description	Query Command	Description
$PASHS,AGB	Adjusting GLONASS biases	$PASHQ,AGB	GLONASS biases
$PASHS,ANH	Antenna height	$PASHQ,ANH	Antenna height

Table 1. Receiver Configuration Commands (Continued)

Set Command	Description	Query Command	Description
$PASHS,ANP,..	Antenna definitions	$PASHQ,ANP	Antenna parameters
$PASHS,ANP,DEL	Deleting user-defined antennas		
$PASHS,ANP,OUT	Virtual antenna	$PASHQ,ANP,OUT	Virtual antenna
		$PASHQ,ANP,OWN	Local antenna name
$PASHS,ANP,REF	Reference antenna	$PASHQ,ANP,REF	Reference antenna
$PASHS,ANR	Antenna reduction mode	$PASHQ,ANR	Antenna reduction mode
$PASHS,ANT	Antenna height	$PASHQ,ANT	Antenna height
		$PASHQ,ATD,MSI	ATOM differential message status
$PASHS,ATD,TYP	ATOM differential messages		
$PASHS,ATL	Debug data recording	$PASHQ,ATL	Debug data recording
$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
$PASHS,BRD	RTC Bridge	$PASHQ,BRD	RTC Bridge
		$PASHQ,BTH	Bluetooth settings
$PASHS,BTH,NAME	Bluetooth device name		
$PASHS,BTH,PIN	Bluetooth device pin code		
$PASHS,CMD,LOD	Run command file		
$PASHS,CMD,WTI	Insert wait time in command file		
		$PASHQ,CMR,MSI	CMR message status
$PASHS,CMR,TYP	CMR message type & rate		
$PASHS,CPD,AFP	Set confidence level	$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
$PASHS,CPD,REM	Differential data port	$PASHQ,CPD,REM	Differential data port
$PASHS,CPD,RST	RTK process reset		
$PASHS,CPD,VRS	VRS assumption mode	$PASHQ,CPD,VRS	VRS assumption mode
$PASHS,CTS	Handshaking	$PASHQ,CTS	Handshaking
		$PASHQ,DBN,MSI	DBEN message type & rate
$PASHS,DBN,TYP	DBEN message type & rate		
$PASHS,DIP		$PASHQ,DIP	Direct IP parameters
$PASHS,DIP,OFF	Direct IP connection		
$PASHS,DIP,ON	Direct IP connection		
$PASHS,DIP,PAR	Direct IP parameters		
$PASHS,DRI	Raw data recording rate	$PASHQ,DRI	Raw data recording rate
$PASHS,DSY	Daisy chain mode	$PASHQ,DSY	Daisy chain mode
$PASHS,DYN	Receiver dynamics	$PASHQ,DYN	Receiver dynamics
$PASHS,ELM	Elevation mask	$PASHQ,ELM	Elevation mask
		$PASHQ,FIL,CUR	G-File information

Table 1. Receiver Configuration Commands (Continued)

Set Command	Description	Query Command	Description
$PASHS,FIL,D	Deleting files		
$PASHS,FIL,DEL	Deleting files and directories		
		$PASHQ,FIL,LST	List of files
		$PASHQ,FLS	List of raw data files
$PASHS,GLO	GLONASS tracking	$PASHQ,GLO	GLONASS tracking
$PASHS,GNS,CFG	GNSS mode	$PASHQ,GNS,CFG	GNSS mode used
$PASHS,INI	Receiver initialization		
$PASHS,LCS	Enable/disable local datum	$PASHQ,LCS	Local datum
		$PASHQ,LOG	Editing a log file
$PASHS,LOG,DEL	Deleting log files		
		$PASHQ,LOG,LST	Listing log files
$PASHS,LOG,PAR	Log file settings	$PASHQ,LOG,PAR	Log file settings
$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,ALL	Disabling all NMEA messages		
$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	$PASHQ,NTR,MTP	Current 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
		$PASHQ,PAR	Receiver parameters
$PASHS,PEM	Position elevation mask	$PASHQ,PEM	Position elevation mask
$PASHS,POP	Internal update rates	$PASHQ,POP	Internal update rates
$PASHS,POS	Antenna position		
$PASHS,PPS	1 PPS properties	$PASHQ,PPS	1 PPS properties
$PASHS,PRT	Baud rates	$PASHQ,PRT	Baud rates
$PASHS,PWR,OFF	Powering off the receiver		
$PASHS,PWR,PAR	Power management	$PASHQ,PWR	Power status
$PASHS,RAW	Raw data messages (ON/OFF)	$PASHQ,RAW	Raw data settings

Table 1. Receiver Configuration Commands (Continued)

Set Command	Description	Query Command	Description
$PASHS,RAW,ALL	Disabling all raw data messages		
$PASHS,RAW,PER	Raw data output rate		
$PASHS,RCP,GB..	GLONASS biases		
		$PASHQ,RCP	Receiver parameters
$PASHS,RCP,DEL	Delete user-defined rec. name		
		$PASHQ,RCP,OWN	Receiver name
$PASHS,RCP,REF	Naming reference receiver	$PASHQ,RCP,REF	Reference receiver name
		$PASHQ,RDP,CHT	Radio channel table
		$PASHQ,RDP,LVL	Radio reception level
$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
$PASHS,RNX,TYP	ATOM RNX message		
		$PASHQ,RNX,MSI	ATOM RNX message
$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		
		$PASHQ,RWO	Raw data output settings
$PASHS,SBA	SBAS tracking (ON/OFF)	$PASHQ,SBA	SBAS tracking status
$PASHS,SIT	Site name	$PASHQ,SIT	Site name
$PASHS,SNM	Signal/noise ratio mask (PVT)	$PASHQ,SNM	Signal/noise ratio mask (PVT
$PASHS,SOM	Masking signal observations	$PASHQ,SOM	Masking signal observations
$PASHS,SOM,CTT	Cumulative tracking time mask	$PASHQ,SOM,CTT	Cumulative tracking time mask
$PASHS,SOM,NAV	Navigation data mask	$PASHQ,SOM,NAV	Navigation data mask
$PASHS,SOM,SNR	Signal-to-Noise ratio mask	$PASHQ,SOM,SNR	Signal-to-Noise ratio mask
$PASHS,SOM,WRN	Channel warnings mask	$PASHQ,SOM,WRN	Channel warnings mask
$PASHS,STI	Station ID	$PASHQ,STI	Station ID
$PASHS,SVM	No. of observations in PVT	$PASHQ,SVM	No. of observations in PVT
$PASHS,UDP	User-defined dynamic model	$PASHQ,UDP	User-defined dynamic model
$PASHS,UNT	Distance unit on display screen	$PASHQ,UNT	Distance unit on display screen
$PASHS,UTS	Synchronization with GPS time	$PASHQ,UTS	Synchronization with GPS time
		$PASHQ,VERSION	Firmware version
$PASHS,WAK	Alarm acknowledgement		
		$PASHQ,WARN	Warning messages
$PASHS,ZDA	Time and date		

Table 2. Data Output Commands

Set Command	Description	Query Command	Description
		$PASHQ,ALM	Almanac message
		$PASHQ,CPD,POS	Base position
		$PASHQ,CRT	Cartesian coordinates of position
		$PASHQ,DCR	Cartesian coordinates of baseline
		$PASHQ,DPO	Delta position
		$PASHQ,DTM	DTM message output
		$PASHQ,GGA	GNSS position message
		$PASHQ,GLL	Geographic position-lat./long.
		$PASHQ,GRS	GNSS range residuals
		$PASHQ,GSA	GNSS DOP & active satellites
		$PASHQ,GST	GNSS pseudorange error statistics
		$PASHQ,GSV	GNSS satellites in view
		$PASHQ,POS	Computed position data
		$PASHQ,PTT	PPS time tag
		$PASHQ,RMC	Recomm. min. specific GNSS data
		$PASHQ,RRE	Residual error
		$PASHQ,SAT	Satellites status
		$PASHQ,VEC	Vector & accuracy data
		$PASHQ,VTG	COG and ground speed
		$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.	
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 E - xxx	ON, OFF	OFF
Port E - 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

Parameter	Range	Default
Port U - xxx	ON, OFF	OFF
Port U - xxx rate	0.05 s - 999 s	1 s

xxx: NMEA message type ALM, DTM, GGA, GLL, GRS, GSA, GST, GSV, RMC, VTG, ZDA, CRT, DCR, DPO, LTN, POS, PTT, RRE, SAT or 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 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, DPC, PBN, SNV, SNG, SNW, SAG, SAL, SAW, SBD or ION.

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	The last four digits of the serial number

GNSS Reception

Parameter	Range	Default
Frequencies used in each constellation	L1, L2 (GLONASS); L1, L2, L2C, L2P (GPS)	GPS L1/L2P and GLONASS L1/L2
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 (GPS)	0-1	1
RTK network operation mode (GLONASS)	0-1	0
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, ATM, RT2 (RTCM2.3), RT3 (RTCM3.x), CMR, CMR+, DBN	RT3
Differential data port 1	A, C, E, M, U	A
Differential data type 2	NONE, ATM, RT2 (RTCM2.3), RT3 (RTCM3.0), DBN (DBEN), CMR, CMR+	NONE
Differential data port 2	A, C, E, M, U	A
RTCM 2.3 type xxx rate*	0-300 s	Type 18: 1 s Type 19: 1 s Type 23: 31 s Type 24: 13 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
ATOM scenario xxx ***	0-1800 s	Scenario No.: 4 Observations: 1 s Attributes: 31 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

Parameter	Range	Default
Elevation mask	0-90 degrees	5 degrees

*: Message type 1, 3, 9, 16, 18, 20, 22, 23, 24, 31, 32, 34 or 36.

**: Message type 1001, 1002,.. 1013, 1019, 1020, 1029 or 1033.

***: Message scenario 1-4, 100, 101, 201-204 or 300.

Other Settings

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
Local time zone, hours	-13 to +13	0
Local time zone, minutes	0-59	0
Beeper state	ON, OFF	ON
RTC Bridge	ON, OFF	OFF
VRS	Automatic, Compulsory	Automatic
Generating log files automatically	Enabled, disabled	Enabled, 1 Mbyte size limit, saved for 3 days
Auto-dial mode	Yes, No	Yes
1 PPS	OFF-ON	OFF
Dynamic model	0-100000 m/s velocity 0-100 m/s^2 acceleration	Hor. & vert. velocity: 100000m/s; Hor. & vert acceleration: 100 m/s^2

Appendix B. Set Command Library

AGB: Enabling/Disabling GLONASS Bias Adjustments

Function

This command is used to enable or disable the adjustment of L1 & L2 GLONASS carrier biases in the receiver so that the GLONASS Double-Difference carrier residuals between the receiver and the *golden Ashtech receiver* are equal to zero (± noise errors).

MB 500 is considered as the golden Ashtech receiver.

After activating the adjustment function, the receiver name provided by any message supposed to deliver that name (e.g. RTCM-3 MT 1033) will appear in the form "**ASHTECH <name>**" where <name> is the receiver name entered through the $PASHS,RCP,OWN command.

Command Format

Syntax

$PASHS,AGB,s1[*cc]

Parameters

Parameter	Description	Range	Default
s1	Enabling (ON) or disabling (OFF) adjustment of GLONASS biases	ON, OFF	OFF
*cc	Optional checksum	*00-*FF	

Example

Enabling adjustment of GLONASS biases:

$PASHS,AGB,ON*1C

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

ANP,PCO & ANP,EDx: Creating/Editing Antenna Definitions

Function

These commands allow you to create or modify antenna definitions. The definition of an antenna includes a name for the antenna, all its phase center offsets as well as the elevation-dependent delays (in 5-degree steps).

Command Format

Syntax

$PASHS,ANP,PCO,s1,f2,f3,f4,f5,f6,f7[*cc]
$PASHS,ANP,ED1,s1,f2,f3,f4,f5,f6,f7,f8,f9,f10,... ,f19,f20[*cc]
$PASHS,ANP,ED2,s1,f2,f3,f4,f5,f6,f7,f8,f9,f10,... ,f19,f20[*cc]

Parameters

ANP,PCO (PCO for Phase Center Offsets)

Parameter	Description	Range
s1	Antenna name	31 characters max.
f2	L1 phase center offset, in mm, in the North direction	±0-1000.0
f3	L1 phase center offset, in mm, in the East direction	±0-1000.0
f4	L1 phase center offset, in mm, in the vertical direction	±0-1000.0
f5	L2 phase center offset, in mm, in the North direction	±0-1000.0
f6	L2 phase center offset, in mm, in the East direction	±0-1000.0
f7	L2 phase center offset, in mm, in the vertical (up) direction	±0-1000.0
*cc	Optional checksum	*00-*FF

ANP,EDx (EDx for L1 and L2 Elevation Dependent delays)

Parameter	Description	Range
s1	Antenna name	31 characters max.
f2-f20	Elevation-dependant delays, in mm, for elevations from 90 to 0 degrees, in 5-degree steps.	±0-1000.0
*cc	Optional checksum	*00-*FF

Examples

Setting the PCO parameters for antenna ASH8987:

$PASHS,ANP,PCO,ASH8987,0,0,110,0,0,128*29

Setting the L1 delays for antenna MYANTENNA:

$PASHS,ANP,ED1,MYANTENNA,0,-2,0,-1.5,1,1.2,0,0,0,0,1,1,-1,0,1.2, -1.2,0,1,0*49

Relevant Query Command

$PASHQ,ANP

See also

$PASHS,ANP,DEL

ANP,DEL: Delete User-Defined Antenna

Function

This command allows you to delete the definition of a user-defined antenna.

Command Format

Syntax

$PASHS,ANP,DEL,s1[*cc]

Parameters

Parameter	Description	Range
s1	User-defined antenna name (case-sensitive)	31 characters max.
*cc	Optional checksum	*00-*FF

Example

Deleting RZ510A antenna definition:

$PASHS,ANP,DEL,RZ510A*1A

Relevant Query Command

$PASHQ,ANP

See Also

$PASHS,ANP,PCO
$PASHS,ANP,ED1
$PASHS,ANP,ED2

ANP,OUT: Defining a Virtual Antenna

Function

This command allows you to specify the name of an antenna that raw data will be adjusted to. By specifying the name of a virtual antenna, you ask the receiver to correct ("reduce") the raw and differential data it generates from the received GNSS signals to make them available as if they had been received through *that* antenna.

Command Format

Syntax

$PASHS,ANP,OUT,s1[*cc]

Parameters

Parameter	Description	Range
s1	Virtual antenna name (case-sensitive) or "OFF" to specify that no virtual antenna is used.	31 characters max. or OFF
*cc	Optional checksum	*00-*FF

Examples

Setting the ADVNULLANTENNA as the virtual antenna:

$PASHS,ANP,OUT,ADVNULLANTENNA*73

Disabling the use of the virtual antenna:

$PASHS,ANP,OUT,OFF*2B

Comments

- Raw data reduction will not be performed on data from any satellite located below the elevation mask.
- When raw data reduction is effective, any antenna name messages generated by the receiver will include the name of the virtual antenna, and not the antenna serial number or the setup ID.
- If no reference position has been entered in the receiver, raw data reduction is performed in such a way that the location of the L1 phase center is left unchanged.
- Antenna reduction is performed in such a way that the ARP is unchanged.If the reference position is given with respect to the ARP, and not to the L1 phase center, then the receiver computes the position of the ARP using the physical parameters of the antenna, and then re-computes the position of the L1 phase center according to the ANP,OUT antenna parameters. This guarantees that the reported reference position, the antenna name and the observables are all consistent with one another.

Relevant Query Command

$PASHQ,ANP

ANP,REF: Naming the Antenna Used at the Base

Function

This command is used to enter the name of the antenna used by the base with which the receiver is working.

Command Format

Syntax

$PASHS,ANP,REF,s1[,d2][*cc]

Parameters

Parameter	Description	Range	Default
s1	User-defined antenna name (case-sensitive).	31 characters max.	UNKNOWN
d2	Antenna name preference: • 0: s1 is ignored if a base antenna name is decoded from the incoming reference data. • 1: s1 is always used regardless of whether a base antenna name is decoded from the incoming reference data or not.	0, 1	0
*cc	Optional checksum	*00-*FF	

Comments

- Specifying the antenna name allows the receiver to know the antenna offset parameters using the predefined list. In the receiver, the predefined parameters can be listed using $PASHQ,ANP. New offset parameters can be added using $PASHS,ANP,PCO.
- The predefined list complies with the IGS antenna source table.

Example

Entering “MAG990596” as the name of the base antenna:

$PASHS,ANP,REF,MAG990596*3A

Relevant Query Command

$PASHQ,ANP
$PASHQ,ANP,REF

See Also

$PASHS,ANP,OWN

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. The receiver ignores the antenna parameters entered via $PASHS, ANH or $PASHS,ANT. The computed position is that of the antenna's **L1 phase center**. This implies that the entered position for the base should also be that of its antenna's L1 phase center • **ON**: Antenna reduction is active (default). From the parameters entered through the $PASHS, ANH or $PASHS,ANT command, the position computed for the L1 phase center is projected to the ground thus making this point (**ground mark**) the real location of the rover. This implies that the entered position for the base should also be that of its ground mark. • **ARP**: The receiver ignores the antenna parameters entered via $PASHS,ANH or $PASHS,ANT. The computed position represents the location of the **ARP**. This implies that the entered position for the base should also be that of its antenna's ARP.	OFF, ON, ARP
*cc	Optional checksum	*00-*FF

Example

Setting the antenna reduction mode to ON:

$PASHS,ANR,ON*05

Relevant Query Command

$PASHQ,ANR

See also

$PASHS,ANH
$PASHS,ANT

ANT: Antenna Height

Function

This command is used to define the antenna height, especially when it was determined using the slant measurement method. However, a vertical measurement can also be entered through this command.

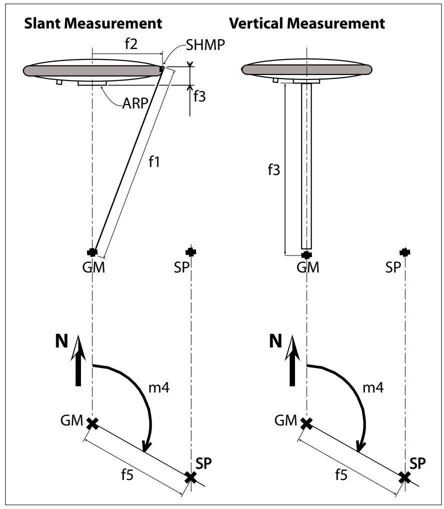
Using the $PASHS,ANT command overwrites all previous settings performed with the $PASHS,ANH command.

Command Format

Syntax

$PASHS,ANT,f1,f2,f3[,m4,f5][*cc]

Diagrams and Definitions



- ARP: Antenna Reference Point (usually bottom of the antenna).
- SHMP: Slant Height Measurement Point (usually at the hedge of the antenna, above the ARP).
- Ground Mark (GM): above the ARP (same horizontal coordinates).
- Survey Point (SP): same height as Ground Mark but with a horizontal offset.

Parameters

Parameter	Description	Range
f1	Slant height measurement, from ground mark (GM) to antenna edge (SHMP).	0-6.553 m
f2	Antenna radius: horizontal distance from the geometrical center to the antenna edge.	0-6.553 m
f3	Vertical offset: • From ARP to SHMP, if radius and slant height are not null. • From Ground Mark to ARP, if radius and slant height are null.	0 to ±6.553 m
m4	Horizontal azimuth [dddmm.mm], in degrees, for the horizontal line connecting the ground mark (GM) to the surveyed point (SP), measured with respect to WGS84 North.	0-35959.99 (from 0° to 359° 59.99”)
f5	Horizontal offset from the ground mark (GM) to the surveyed point (SP).	0-6.553 m
*cc	Optional checksum	*00-*FF

Examples

Entering the vertical measurement (2 m) of a rover antenna:

$PASHS,ANT,0,0,2.000*2E

Entering the slant measurement (1.543 m) of the MAG11406 antenna used at a base:

$PASHS,ANT,1.543,0.0921,-0.0516*0A

Comments

- The vertical height from ARP to ground mark can also be entered through the ANT command, which in this case should be used as follows:
  - Set **f1** and **f2** to “0.0”
  - Enter the antenna height from ARP to ground mark as **f3**. Only when **f1**=**f2**=0.0 can you define **f3** this way.
  - **f3** is negative when the ARP is below the SHMP.
- Parameters **m4** and **f5** are currently NOT processed in the ProMark 500.
- Using this command is not recommended to enter a slant height in the ProMark 500 for which **f2** anf **f3** are hard-coded (**f2**=0.098 m and **f3**= -0.04 m).

Relevant Query Command

$PASHQ,ANT

See Also $PASHS,ANH
$PASHS,ANR

ATD,TYP: Defining the ATOM Differential Messages a Base Will Deliver

This command has been made obsolete to be replaced with $PASHS,RNX,TYP (May 2010).

However, as $PASHS,ATD,TYP is still supported for compatibility reasons, the description of this command is given below. Note that the output rate of message type "10" can no longer be set through this command because it had to be hard coded when the command was made obsolete.

Function This command allows you to define the types of ATOM messages a base has to deliver.

Command Format

Syntax

$PASHS,ATD,TYP,d1,d2[*cc]

Parameters

Parameter	Description	Range
d1	Message type.	See table below
d2	Output rate, in seconds If d2=0, the message is disabled	0, 0.5, 1-1800 0.1 allowed with [F] option activated
*cc	Optional checksum	*00-*FF

Type	Description	Default rate
0	Disables all ATOM messages	-
1	Standard observations (RNX, scenario 4)	1 s
2	Compact observations (RNX, scenario 100)	0
3	Super-compact observations (RNX, scenario 101)	0
10	Reference position and antenna height (RNX-REF)	13 s
11	Receiver and antenna attributes (ATR-ANM, RNM)	31 s

Examples

Enabling super-compact observations message at 1 second:

$PASHS,ATD,TYP,3,1*57

Disabling all ATOM messages:

$PASHS,ATD,TYP,0*49

Comments

Only one of the observation messages (1, 2 or 3) can be enabled at a time. Enabling a new one will automatically disable the previously enabled one.

Relevant Query Command

$PASHQ,ATD,MSI

See Also

$PASHS,BAS
$PASHS,CPD,MOD,BAS

ATL: Debug Data Recording

Function

This command allows you to enable or disable the recording of debug data. The resulting log file (called "ATL file") is saved to the memory selected through the $PASHS,MEM command. The file is named as follows:.

ATL_yymmdd_hhmmss.log

Normally you don't have to record debug data. However, the Ashtech Technical Support may ask you to do so if a problem occurs in your receiver and Technical Support needs to analyze the resulting log file to fix the problem. The content of this file can only be analyzed by Ashtech as it uses a proprietary, undisclosed data format, which in addition is subject to change without notice.

Command Format

Syntax

$PASHS,ATL,s1[,d2][,f3][,d4][*cc]

Parameters

Parameter	Description	Range	Default
s1	Controls debug data recording: • ON: Enables debug data recording • OFF: Disables debug data recording • AUT: Automatically starts debug data recording every time the receiver is turned on.	ON, OFF, AUT	OFF
d2	Recorded data: • 0: Only those from GNSS board to system board • 1: Only those from system board to GNSS board • 2: All data exchanged between GNSS board and system board	0-2	0
f3	Output interval, in seconds	0.05, 0.1, 0.2, 0.5, 1	1
d4	Configuration index	0-1	0
*cc	Optional checksum	*00-*FF	

Example

Enabling the ATL message:

$PASHS,ATL,ON*01

Comment

- If the memory selected through $PASHS,MEM is unavailable, then “ACK” is returned in response to the command enabling recording (ON or AUT), prompting you to read the status of the debug data recording using the $PASHQ,ATL command.
- When running the $PASHS,ATL command to enable recording, in fact it is the $PASHS,ATL,A command that is sent by default to the GNSS firmware, which in return will provide the debug data to be recorded.
- You may customize the debug data collected in the ATL file by placing an “atl.ini” file in the selected memory. The atl.ini file should contain the list of commands you would like the receiver to execute when you run the $PASHS,ATL command to enable data recording (ON or AUT). When the receiver finds the atl.ini file in the selected memory, the default command ($PASHS,ATL,A) is not executed,

  Warning: To be valid, the atl.ini file must end with carriage return and line feed characters (<cr><lf>). When you transfer the atl.ini file (or any other file) from your computer to the receiver’s internal memory via USB, a receiver power cycle is required before the receiver can see and use the file stored in its internal memory.

Relevant Query Command $PASHQ,ATL

See Also $PASHS,MEM

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, EVT. See table below.
c2	Port routing the ATOM message: • A: Serial port • C: Bluetooth port • E: Modem • M, U: Internal memory (U), USB key (U) • R: Automatic recording session (internal or external memory)	A, C, E, M, R, U
s3	Enable (ON) or disable (OFF) this ATOM message type.	ON, OFF
f4	Output rate, in seconds. (Default value is specific to each message type.)	0.05 or 0.1-0.4 sec with [F] option activated. 0.5-0.9 s 1-999 s
*cc	Optional checksum	*00-*FF

ATOM Messages:

Data	ATOM Number	Description	Default Output Status on Port A	Default Output Status on Ports M, U and R
MES	4095,2	GNSS raw measurements	OFF	ON, at 1 second
PVT	4095,3	Positioning results	OFF	OFF
ATR	4095,4	Receiver attributes	OFF	ON
NAV	4095,5	GNSS navigation data	OFF	ON, at 300 seconds
DAT	4095,6	Raw GNSS data: • GPS Raw Subframe (DAT, GPS) • GLONASS Raw String (DAT, GLO) • SBAS Subframe (DAT, SBA)	OFF	OFF (no output rate)
EVT	4095,14	Event	OFF	OFF

$PASHS,ATM,ATR is used only to enable or disable the recording or output of ATOM ATR XDR messages. These are generated when a meteorological unit or tiltmeter is used.

When the ATOM MES message is enabled, and regardless of the last $PASHS,ATM,ATR command run, the following messages are always recorded in the G-file:

- ATOM ATR ANM (antenna name)
- ATOM ATR RNM (receiver name)
- ATOM ATR AOP (antenna offset parameter)
- ATOM ATR OCC (occupation)

Example

Enabling ATOM message type PVT on serial port A at a 1-second output rate:

$PASHS,ATM,PVT,A,ON,1*0E

Relevant Query Commands

$PASHQ,ATO
$PASHQ,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 • E: Modem • M, U: Internal memory (M), USB key (U)	A, C, E, M, U
*cc	Optional checksum	*00-*FF

Example

Disabling all ATOM messages on port A:

$PASHS,ATM,ALL,A,OFF*4E

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,MES and $PASHS,ATM,PVT.

Command Format

Syntax

$PASHS,ATM,PER,f[*cc]

Parameters

Parameter	Description	Range
f	Output rate. Setting $PASHS,POP to “20” is a prior condition to operating at 0.05 s (20 Hz).	0.05 sec or 0.1-0.4 sec if the [F] option is activated 0.5-0.9 sec 1-999 sec
*cc	Optional checksum	*00-*FF

Example

Setting the output rate to 1 second:

$PASHS,ATM,PER,1*5B

Relevant Query Command

$PASHQ,ATM

See also

$PASHS,ATM
$PASHS,POP

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.

The command can also be used with the OFF operator to disable the output.

Command Format

Syntax

$PASHS,BAS,c1,s2[,c3,s4][*cc]
or, to disable the differential data output:
$PASHS,BAS,OFF[*cc]

Parameters

Parameter	Description	Range
c1	First port ID: • A: Serial port (default) • C: Bluetooth port • E: Modem • M, U: Internal memory (M), USB key (U)	A, C, 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 • ATM: ATOM messages • DBN: DBEN messages	RT2, RT3, CMR, CMP, ATM, DBN
c3	Second port ID: same as c1 above	A, C, E, M, U
s4	Differential data type: same as s2 above.	RT2, RT3, CMR, CMP, ATM, DBN
*cc	Optional checksum	*00-*FF

Examples

Sending RTCM 3.0 message to the external UHF transmitter via port A:

$PASHS,BAS,A,RT3*51

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*4E

Disabling the differential data output:

$PASHS,BAS,OFF*46

Relevant Query Command

$PASHQ,BAS

See also

$PASHS,CPD,MOD
$PASHS,RTC,TYP
$PASHS,RNX,TYP
$PASHS,CMR,TYP

BEEP: Beeper Setup

Function

This command enables or disables the internal beeper.

Command Format

Syntax

$PASHS,BEEP,s1[,d2][*cc]

Parameters

Parameter	Description	Range	Default
s1	Enables (ON) or disables (OFF) the beeper.	ON, OFF	ON
d2	Timeout, in seconds: • 0: No timeout. If an alarm is activated, the beeper will sound indefinitely until the alarm is acknowledged. • >0: If an alarm is activated, the beeper will sound only for a limited period of time (it will go out automatically at the end of the specified timeout).	0-99	30
*cc	Optional checksum	*00-*FF	

Example

Disabling the beeper:

$PASHS,BEEP,OFF*04

Relevant Query Command

$PASHQ,BEEP

BRD: Enabling/Disabling the RTC Bridge Function

Function

This command is used to control the RTC Bridge function. Its use is required only in the receiver in charge of forwarding its RTK corrections to other nearby rovers through its licence-free radio transmitter.

Command Format

Syntax

$PASHS,BRD,s1[,d2,c3,c4][*cc]

Parameters

Parameter	Description	Range	Default
s1	Controls the availability of RTK corrections on the specified output port: • OFF: No RTK corrections forwarded to the output port. • ON: RTK corrections forwarded to the output port.	ON, OFF	OFF
d2	Enables or disables the use of RTK corrections in the receiver's position computation. • 0: RTK corrections used • 1: RTK corrections not used	0, 1	0
c3	Input port ID (port from which RTK corrections are available in the receiver).	E (modem)	E
c4	Output port ID (serial port to which the licence-free radio transmitter is connected).	A	A
*cc	Optional checksum	*00-*FF	

Examples

Enabling RTC Bridge in the receiver by forwarding RTK corrections from the modem to its port A (to which the license-free radio transmitter is connected):

$PASHS,BRD,ON,0,E,A*14

Disabling RTC Bridge by preventing RTK corrections from being forwarded to the output port:

$PASHS,BRD,OFF*42

Comments

- To receive data, the $PASHS,NTR,.. and $PASHS,DIP commands should be used.
- If the data needs to be sent to an external UHF transmitter, the $PASHS,RDP command should be used to configure the transmitter.
- The d2 parameter is taken into account only if the Automatic mode is selected for the choice of differential data inputs (see $PASHS,CPD,REM).

Relevant Query Command

$PASHQ,BRD

See also

$PASHS,NTR,..
$PASHS,DIP
$PASHS,RDP,TYP

$PASHS,RDP,PAR
$PASHS,CPD,REM

Using RTC Bridge

The RTC Bridge function is typically used to allow a rover to forward the RTK corrections it receives from an RTK network through its built-in modem to other rovers operated in the vicinity, using a license-free radio transmitter connected to its serial port. Being a low-power unit (<500 mW),the license-free radio can be powered directly from the receiver, without the need for another external battery.

Starting RTC Bridge is a three-step procedure:

- Mounting the license-free radio onto the range pole and connecting it to port A using the Y-shaped cable supplied (USB connection is for powering the radio, the other connection to the serial port is for the data).
- Setting the license-free radio, then the GPRS modem, using FAST Survey.
- Activating RTC Bridge through a serial command ($PASHS,BRD) sent from FAST Survey.

This procedure is detailed below.

Mounting and Connecting the License-Free Radio

The following setup is recommended for both the "transmitting" rover and the "receiving" rover(s).

Setting the License-Free Radio

Follow the instructions below. Each step should be executed in the specified order:

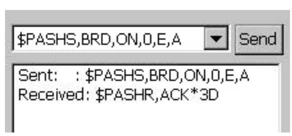
1. Establish a connection with the receiver from FAST Survey as described in *How FAST Survey Interfaces With Your Equipment Via Bluetooth on page 34*.
2. Select **Equip**>**GPS Rover** and then tap on the **RTK** tab
3. In the **Device** field, select "ARF7474.." corresponding to the license-free radio used.
4. Tap on and complete the license-free radio settings.
5. Still on the **RTK** tab and in the same **Device** field, select "Internal GSM".
6. Tap on and and complete the GSM settings.
7. Tap to complete the receiver setting.

Activating RTC Bridge

- In FAST Survey, select **Equip**>**GPS Utilities** and then tap on the **Send Command** button.
- In the combo box, type the following command, assuming port E is the input port and port A the output port:

  $PASHS,BRD,ON,0,E,A

- Tap on the **Send** button. The RTC Bridge function is activated once the receiver has executed the command and the $PASHR,ACK*3D line has been returned to FAST Survey.



- Tap twice to close the **GPS Utilities** window and return to the FAST Survey menu.

NOTE: As for the configuration of the rovers supposed to receive the RTK corrections from this receiver, there is nothing else to be done apart from configuring the licence-free radio connected to each of them. Setting this radio can be done using FAST Survey, from the **RTK** tab of the **GPS Rover** window (select the appropriate radio model in the **Device** field).

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*60

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	16 digits max. -1: no PIN code
*cc	Optional checksum	*00-*FF

Example

Assigning PIN code “02” to the Bluetooth device:

$PASHS,BTH,PIN,02*7E

Relevant Query Command $PASHQ,BTH

See also $PASHS,BTH,NAME

CMD,LOD: Running a List of $PASH Commands

Function

This command is used to run the complete list of $PASH commands stored in a file found in the USB key currently connected to the receiver.

This implies that the file (in text editable format) should have first been saved to that key before connecting the key to the receiver's USB port.

Command Format

Syntax

$PASHS,CMD,LOD[,s][*cc]

Parameters

Parameter	Description	Range	Default
s	File name. If s is omitted, it is assumed that the file to be run is "autoconfig.cmd".	255 characters max.	autoconfig.cmd
*cc	Optional checksum	*00-*FF	

Examples

Running the serial commands in autoconfig.cmd:

$PASHS,CMD,LOD*54

Running the serial commands in a file named "myconfig.cmd":

$PASHS,CMD,LOD,myconfig.cmd*02

Comments

- The file can contain any $PASHS or $PAHSQ commands.
- If the file contains the $PASHS,REC or $PASHS,INI command, this command will always be run last, whatever its position in the file.
- All data lines returned by the receiver in response to the executed commands are written to a log file named as follows:

  <command_file_name>.log

- To insert an idle wait time of several seconds between any two $PASH commands, you can insert a specific command named $PASHS,CMD,WTI between these two commands. The $PASHS,CMD,WTI command may be inserted as many times as necessary in the file.
- Naming the command file “autoconfig.cmd” or “uploadconfig.cmd” on the USB key will allow the receiver to automatically start the execution of all the commands stored in the file when you plug the USB key to the receiver. 6A6EC3667E000The difference between the two file names is in the need for a user confirmation before running the file: “autoconfig.cmd” will require user confirmation, not “uploadconfig.cmd”.

Relevant Query Command None.

See also $PASHS,CMD,WTI

CMD,WTI: Inserting Wait Times

Function This command can be inserted one or more times in the list of $PASH commands run with the CMD,LOD command. When running this command, in fact the receiver inserts a wait time of the requested value in the execution of the $PASH commands.

Command Format

Syntax

$PASHS,CMD,WTI,d[*cc]

Parameters

Parameter	Description	Range
d	Wait time generated by the command, in seconds.	1-3600
*cc	Optional checksum	*00-*FF

Example

The command line below inserted in a command file will generate a 10-s wait time when executed:

$PASHS,CMD,WTI,10*74

Comments This command will be interpreted by the receiver only if found in a command file.

Relevant Query Command None.

See also $PASHS,CMD,LOD

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 output.

Command Format

Syntax

$PASHS,CMR,TYP,d1,d2[*cc]

Parameters

Parameter	Description	Range
d1	Message type	0, 1, 2, 3 (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
3	GLONASS observables	0, 0.5 s or 1-300 s	1 s

Examples

Setting a CMR message type 0 (observables) at a 1-second output rate:

$PASHS,CMR,TYP,0,1*59

Setting a CMR message type 1 (base coordinates) at a 30-second output rate:

$PASHS,CMR,TYP,1,30*6A

Relevant Query Command

$PASHQ,CMR,MSI

See also

$PASHS,BAS
$PASHS,CPD,MOD,BAS

CPD,AFP: Setting the Confidence Level of Ambiguity Fixing

Function

This command is used to set the confidence level required of the ambiguity fixing process. The higher the confidence level, the more likely the ambiguities are fixed correctly, but the longer the time it takes to fix them.

Command Format

Syntax

$PASHS,CPD,AFP,f1[*cc]

Parameters

Parameter	Description	Range	Default
f1	Confidence level, in percent, required of ambiguity fixing process. Choosing “0” means the receiver will not try to fix ambiguities but instead will stay indefinitely in Float mode.	0, 95.0, 99.0, 99.9	99.0
*cc	Optional checksum	*00-*FF	-

Example

Setting the confidence level to 99.9%:

$PASHS,CPD,AFP,99.9*62

Relevant Query Commands

$PASHQ,CPD,AFP
$PASHQ,CPD

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,s1[*cc]

Parameters

Parameter	Description	Range	Default
s1	Enables (ON) or disables (OFF) the fast RTK output mode	ON, OFF	ON
*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 if the receiver is defined as a base.

Command Format

Syntax

$PASHS,CPD,MOD,s1[,[d2],[d3]][*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
d3	Position mode. If s1=BAS: • 0: Base position is a static position (as set through $PASHS,POS). • 1: Base position is a moving position • 2: “Current position” (the command allocates the currently computed position to the base. The base position is then kept unchanged.) If s1=ROV: • 0: Rover operates with static base • 1: Rover operates with moving base	0-2	0
*cc	Optional checksum	*00-*FF	

Examples

Setting the receiver as a base using all constellations:

$PASHS,CPD,MOD,BAS,0*28

Setting the receiver as a rover:

$PASHS,CPD,MOD,ROV*2F

Comments

- With s1=BAS (Base mode) and d3=2 (“Current position”), once the current position has been defined as the base position, then the position mode is automatically switched to “0”. The base position can then be read using the $PASHQ,CPD,POS command.

Relevant Query Command

$PASHQ,CPD,MOD

See also

$PASHS,BAS
$PASHS,CPD,REM
$PASHS,CPD,FST

CPD,NET: Network Corrections

Function

This command sets the behavior of the receiver with relation to network corrections, i.e. RTK correction data delivered by a network.

Command Format

Syntax

$PASHS,CPD,NET,d1[,d2][*cc]

Parameters

Parameter	Description	Range	Default
d1	RTK network operating mode relative to GPS corrections: • 0: GPS corrections from network are not used. • 1: FKP/MAC GPS corrections from network are used when available and healthy, otherwise they are rejected.	0-1	1
d2	RTK network operating mode relative to GLONASS corrections: • 0: GLONASS corrections from network are not used. • 1: FKP/MAC GLONASS corrections from network are used when available and healthy, otherwise they are rejected.	0-1	0
*cc	Optional checksum	*00-*FF	

Example

Setting the receiver to process GPS and GLONASS network corrections:

$PASHS,CPD,NET,1,1*51

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: Serial port • C: Bluetooth port • D: Radio • E: Modem	A, C, D, E	
c3	Input port #2: • A: Serial port • C: Bluetooth port • D: Radio • E: Modem	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*38

Setting the receiver to receive and process differential data in Manual mode with the data received on port D:

$PASHS,CPD,REM,MAN,D*52

Relevant Query Command

$PASHQ,CPD,REM

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*5B

Relevant Query Command

None.

CPD,VRS: VRS Assumption Mode

Function

This command is used specifically to set the receiver (a rover) to operate in the so-called "compulsory VRS mode" through which it is forced to consider that the differential corrections it receives are always VRS corrections (this impacts the way corrections are processed internally).

When not operated in this mode, the receiver will automatically detect whether the received corrections are, or are not, VRS corrections (Automatic detection).

Command Format

Syntax

$PASHS,CPD,VRS,d[*cc]

Parameters

Parameter	Description	Range	Default
d	VRS assumption mode: • 0: Automatic detection • 1: Compulsory VRS mode • 2: Never switches to VRS mode	0, 1, 2	0
*cc	Optional checksum	*00-*FF	

Example

Enabling the compulsory VRS mode:

$PASHS,CPD,VRS,1*44

Comment

Users working in VRS using the CMR or RT2 format should activate the compulsory VRS mode (d=1).

Relevant Query Command

$PASHQ,CPD,VRS

CTS: Handshaking

Function

This command enables or disables the RTS/CTS handshaking protocol for the specified port. If no port is specified, the command applies to the port through which the command is routed.

Command Format

Syntax

$PASHS,CTS,[c1],s2[*cc]

Parameters

Parameter	Description	Range	Default
c1	Port ID	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*3F

Relevant Query Command $PASHQ,CTS

See also $PASHS,PRT
$PASHS,MDP

DBN,TYP: DBEN Message Type & Output Rate

Function This command is used in a base to enable or disable the generation of DBEN messages.

Command Format

Syntax

$PASHS,DBN,TYP,s1,d2[*cc]

Parameters

Parameter	Description	Range
s1	Message type	See table below
d2	Output rate, in seconds	See table below
*cc	Optional checksum	*00-*FF

Type	Description	Range	Default Output Rate
RPC	Code & phase measurement	0, 0.1-0.9 s and 1-300 s	1
BPS	Reference station position	0-300 s	30

Examples

Selecting DBEN message type “RPC” at 0.5 second:

$PASHS,DBN,TYP,RPC,0.5*26

Selecting DBEN message type “BPS” at 60 seconds:

$PASHS,DBN,TYP,BPS,60*0B

Relevant Query Command $PASHQ,DBN,MSI

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*2C

Connecting the receiver to www.ashtech.com through port 8080:

$PASHS,DIP,RIP,www.ashtech.com,PRT,8080*63

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 IP connection to a server.

Command Format

Syntax

$PASHS,DIP,OFF[*cc]

Parameters

None.

Examples

Terminating the current connection:

$PASHS,DIP,OFF*4B

Relevant Query Command

$PASHQ,MDM

See also

$PASHS,DIP
$PASHS,DIP,PAR
$PASHS,DIP,ON

DIP,ON: Establishing the Programmed Direct IP Connection

Function

This command is used to establish the programmed Direct IP connection.

Command Format

Syntax

$PASHS,DIP,ON[*cc]

Parameters

None.

Examples

Establishing the programmed Direct IP connection:

$PASHS,DIP,ON*05

Relevant Query Command

$PASHQ,MDM

See also

$PASHS,DIP
$PASHS,DIP,PAR
$PASHS,DIP,OFF

DIP,PAR: Setting Direct IP Parameters

Function

This command is used to set the different parameters allowing the receiver to perform a Direct IP connection to an external server, typically a base.

Command Format

Syntax

$PASHS,DIP,PAR,ADD,s1,PRT,d2[,LGN,s3,PWD,s4][*cc]

Parameters

Parameter	Description	Range	Default
ADD,s1	IP address or host name of external server	32 characters max.	
PRT,d2	IP port of external server	0-65535	
LGN,s3	User name (optional)	20 characters max.	
PWD,s4	Password (optional)	20 characters max.	
*cc	Optional checksum	*00-*FF	

Comments

When connecting to the specified server requires a user name and password, then the receiver will send the serial command $GPUID,s3,s4 after the IP connection with the server has been established.

Examples

Entering the parameters of the server the receiver has to connect to (through an IP address):

$PASHS,DIP,PAR,ADD,192.65.54.1,PRT,80*7F

Entering the parameters of the server the receiver has to connect to (through a host name):

$PASHS,DIP,PAR,ADD,www.ashtech.com,PRT,8080*06

Relevant Query Commands

$PASHQ,DIP
$PASHQ,MDM
$PASHQ,ETH

See Also
$PASHS,DIP,ON
$PASHS,DIP,OFF
$PASHS,MDM
$PASHS,ETH

DRI: Raw Data Recording Rate

Function

This command sets the recording rate for all raw data logged in the internal or external memory. This rate can be independent of the data output rate on a serial port.

Command Format

Syntax

$PASHS,DRI,f[*cc]

Parameters

Parameter	Description	Range	Default
s	Raw data recording rate. Setting $PASHS,POP to “20” is a prior condition to operating at 0.05 s (20 Hz).	0.05 sec or 0.1-0.4 sec if the [F] option is activated. 0.5-0.9 s 1-999 s	1 s
*cc	Optional checksum	*00-*FF	

Example

Setting the recording rate to 5 seconds:

$PASHS,DRI,5*33

Relevant Query Command

$PASHQ,DRI

See also
$PASHS,ATM
$PASHS,RAW
$PASHS,REC
$PASHS,POP

DSY: Daisy Chain

Function

This command is used to redirect all the characters flowing through a given serial port (source port) to another (destination port), without interpreting the flow of redirected data.

Once the daisy chain mode is on, only the command used to discontinue this mode can be interpreted on the source port.

Redirection can be in both directions, in which case two DSY commands, instead of one, are required to allow bidirectional data flow.

Command Format

Syntax

Redirecting data from a source port to a destination port:

$PASHS,DSY,c1,c2[*cc]

Discontinuing the daisy chain mode from a specified source port:

$PASHS,DST,c1,OFF[*cc]

Discontinuing the daisy chain mode for all source ports:

$PASHS,DSY,OFF[*cc]

Parameters

Parameter	Description	Range
c1	Source port ID	A, C, D, E
c2	Destination port ID	A, C, D, E
*cc	Optional checksum	*00-*FF

Examples

Redirecting port D to port A:

$PASHS,DSY,D,A*3E

Redirecting port D to port A and port A to port D:

$PASHS,DSY,D,A*3E
$PASHS,DSY,A,D*3E

Discontinuing the daisy chain mode from port A:

$PASHS,DSY,A,OFF*35

Discontinuing the daisy chain mode from all source ports:

$PASHS,DSY,OFF*58

DYN: Receiver Dynamics

Function

This command allows you to define the receiver dynamics. The chosen number best represents the receiver motion.

Command Format

Syntax

$PASHS,DYN,d1[*cc]

Parameters

Parameter	Description	Range	Default
d1	Receiver dynamics: • 1: Static • 2: Quasi-static • 3: Walking • 4: Ship • 5: Automobile • 6: Aircraft • 7: Unlimited • 8: Adaptive • 9: User-defined	1-9	8
*cc	Optional checksum	*00-*FF	

Example

Setting rover dynamics to “Walking”:

$PASHS,DYN,3*39

Comments

In the adaptive mode (8), the receiver analyzes its own motion and automatically chooses one of the dynamic models that is the most suitable. The possible dynamic models are those corresponding to the other choices in the command (i.e. 2 to 7, but not 1 or 9). Using the adaptive mode rejects the possible use of the user-defined dynamic model.

Relevant Query Command

$PASHQ,DYN

See Also

$PASHS,UDP

ELM: Setting the Elevation Mask for Raw Data Output

Function

This command is used to set the minimum satellite elevation for raw data recording, raw data and differential data output.

Command Format

Syntax

$PASHS,ELM,d1[*cc]

Parameters

Parameter	Description	Range	Default
d1	Elevation mask, in degrees.	0-90°	5
*cc	Optional checksum	*00-*FF	

Example

Setting the elevation mask to 10 degrees:

$PASHS,ELM,10*1C

FIL,D: Deleting Files

Function

This command allows you to delete files from the selected internal or external memory.

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 deletion of the file. The index of a file is as listed when using the $PASHQ,FLS command. • =999: All the files in memory will be deleted, except for the following: G-file in use, D-file in use, ring file buffer, ATL file in use, all directories, all .log files excluding ATL log files not in use.	0-99, 999
*cc	Optional checksum	*00-*FF

Example

Deleting the 6th file from memory:

$PASHS,FIL,D,5*47

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.

FIL,DEL: Deleting Files and Directories

Function

This command allows you to delete files and directories from the selected internal or external memory.

Command Format

Syntax

$PASHS,FIL,DEL,[d1],[s2],s3[,s4[...,sn]][*cc]

Parameters

Parameter	Description	Range
d1	Memory from which to delete files or directories: • 0: Internal memory. • 2: USB key. If d1 is omitted, files or directories are deleted from the memory specified by the last run $PASHS,MEM command.	0, 2
s2	Path	255 characters max.
s3	Name of the file or directory you want to delete.	255 characters max.
	...	
sn	Name of the file or directory you want to delete.	255 characters max.
*cc	Optional checksum	*00-*FF

Comments

- To delete a file or directory located in a subdirectory, the full path to this file or directory should be specified in the s2 field. You cannot enter a path in the s3 field.
- The "*" character can be used as a wild card to delete several files at the same time. In this case, the complete string should be placed between simple or double quotation marks.

Examples

Deleting a G file:

$PASHS,FIL,DEL,,,GabcdA09.241*69

Deleting three G files:

$PASHS,FIL,DEL,,,GabcdA09.241,GabcdB09.242,GabcdC09.242*68

Deleting a G file from a subdirectory located on the USB key:

$PASHS,FIL,DEL,2,2009/241/,GabcdA09.241*67

Deleting all the files from the USB key:

$PASHS,FIL,DEL,2,,"*.*"*67

Deleting all the files recorded on the USB key on the 241th day of the year:

$PASHS,FIL,DEL,2,,"*.241"*7A

Relevant Query Command None.

See also $PASHQ,FIL,LST
$PASHS,MEM

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,s1[*cc]

Parameters

Parameter	Description	Range	Default
s1	Enables (ON) or disables (OFF) GLONASS tracking.	ON, OFF	ON
*cc	Optional checksum	*00-*FF	

Example

Enabling GLONASS:

$PASHS,GLO,ON*1C

Relevant Query Command $PASHQ,GLO

See also $PASHS,SBA

GNS,CFG: Selecting a GNSS Mode

Function This command allows you to select the GNSS mode that the receiver should use. The GNSS mode refers to the constellations and frequencies used.

Command Format

Syntax

$PASHS,GNS,CFG,d1[*cc]

Parameters

Parameter	Description	Range
d1	GNSS mode: • 0: GPS L1 • 1: GPS L1 & GLONASS L1 • 2: GPS L1/L2P • 3: GPS L1/L2C • 4: GPS L1/L2P & GLONASS L1/L2 • 5: GPS L1/L2C & GLONASS L1/L2	0, 1, 2, 3, 4, 5
*cc	Optional checksum	*00-*FF

The table below contains the tracked signals depending on the GNSS mode used:

GNSS Mode	GPS				GLONASS		SBAS
	L1C	L1P (Y)	L2C	L2P(Y)	L1C	L2C	L1C
0	•	•					•
1	•	•			•		•
2	•	•		•			•
3	•		•				•
4	•	•		•	•	•	•
5	•		•		•	•	•

Example

Setting the receiver GNSS mode to GPS L1/L2P & GLONASS L1/L2:

$PASHS,GNS,CFG,4*59

Comments

- Changing the GNSS mode setting causes GNSS reception to be reset (the number of received/used satellites drops to 0 straight away and then rapidly comes back to normal).
- The default value depends on the installed firmware options (“4” if the GNSS L2 option has been installed, “1” otherwise).
- The command will be NAKed if the firmware option corresponding to the requested change has not been activated.

Relevant Query Command $PASHQ,GNS,CFG

See Also $PASHS,GLO
$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	Init code: • 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 restarts the receiver.	0, 1, 2, 3
*cc	Optional checksum	*00-*FF

Example

Resetting all and restarting the receiver:

$PASHS,INI,1*26

Relevant Query Command None.

See also $PASHS,RST

LCS: Enabling/Disabling Use of the Local Coordinate System

Function

This command is used to enable or disable the use of the local coordinate system in the receiver. Having the receiver using a local coordinate system requires that it receives RTCM 3.1 message type 1021, 1022 or 1023 from the base.

Command Format

Syntax

$PASHS,LCS,s1[*cc]

Parameters

Parameter	Description	Range	Default
s1	ON: Local coordinate system used if RTCM 3.1 messages received OFF: Coordinate system used is WGS84	ON, OFF	OFF
*cc	Optional checksum	*00-*FF	-

Example

Enabling the use of the local coordinate system in the receiver:

$PASHS,LCS,ON*04

Relevant Query Commands

$PASHQ,LCS
$PASHQ,PAR

LOG,DEL: Deleting Log Files

Function

This command is used to delete log files.

Command Format

Syntax

$PASHS,LOG,DEL,d[*cc]

Parameters

Parameter	Description	Range
d	Index of the log file you want to delete. Use the $PASHQ,LOG, LST command to read the index associated with each existing log file. Use d=999 to delete all the log files, but the current one.	0 to no limit

Parameter	Description	Range
*cc	Optional checksum	*00-*FF

Example

Deleting all log files:

$PASHS,LOG,DEL,999*45

Relevant Query Command $PASHQ,LOG,LST

See Also $PASHQ,LOG

LOG,PAR: Log File Settings

Function This command is used to set the log file. A log file keeps track of the different connections performed in a day (one file created per day).

Command Format

Syntax

$PASHS,LOG,PAR,s1,d2,d3[*cc]

Parameters

Parameter	Description	Range	Default
s1	Enabling/disabling the log file: • ON: Enable • OFF: Disable	ON, OFF	ON
d2	Maximum size, in Mbytes, allowed for a log file.	1-90	1
d3	Number of days during which log files are kept in memory. After this delay, they are automatically deleted.	1-100	10
*cc	Optional checksum	*00-*FF	

Example

Enabling the log file with a maximum size of 2 Mbytes and 10 days of backup:

$PASHS,LOG,PAR,ON,2,10*40

Relevant Query Command $PASHQ,LOG

See Also $PASHS,LOG,DEL
$PASHS,LOG,LST

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*35

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 the modem.

Command Format

Syntax

$PASHS,MDM,DAL,d[*cc]

Parameters

Parameter	Description	Range
d	1: Dials the phone number. 0: Hangs up the modem.	0-1
[*cc]	Optional checksum	*00-*FF

Examples

Dialing the stored phone number:

$PASHS,MDM,DAL,1*49

Hanging up:

$PASHS,MDM,DAL,0*48

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. By default, the modem is off.

Command Format

Syntax

$PASHS,MDM,OFF[*cc]

Parameters

None.

Example

Turning off the internal modem:

$PASHS,MDM,OFF*52

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. By default, the modem is off.

Command Format

Syntax

$PASHS,MDM,ON[*cc]

Parameters

None.

Example

Turning on the internal modem:

$PASHS,MDM,ON*1C

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

Parameter	Description	Range	Default
ADL,c11	Auto-dial mode. When this parameter is set to Yes (Y), the receiver will do the following when next turned on: • if d4=0, the phone number that the receiver was last communicating with will be re-dialed automatically. • if d4=1, a connection to the mount point or IP server to which the receiver was last connected will be initiated automatically.	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*18

Setting GSM data configuration:

$PASHS,MDM,PAR,PWR,AUT,PIN,1234,BND,1,PTC,0,CBS,1,PHN,0228093838,ADL,Y,RNO,5*54

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 for data storage.

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*2C

Relevant Query Command $PASHQ,MEM

See also
$PASHS,FIL,D
$PASHQ,FLS
$PASHQ,FIL,LST

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*32

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 Ashtech 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 • C: Bluetooth • E: Modem • M, U: Internal memory (M), USB key (U)	A, C, E, M, U
s3	Enables (ON) or disables (OFF) the message	ON, OFF
f4	Output rate: • Omitted: The message output rate will be as defined with $PASHS,NME,PER • Setting $PASHS,POP to "20" is a prior condition to operating at 0.05 s (20 Hz). f4 is not applicable to message PTT.	0.05 s or 0.1-0.4 s if [F] option activated. 0.5-0.9 s 1-999 s
*cc	Optional checksum	*00-*FF

NMEA messages:

Data	Description
ALM	GPS almanac data
DTM	Reference Datum
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

Ashtech NMEA-like messages:

Data	Description
CRT	Cartesian coordinates
DCR	Delta Cartesian
DPO	Delta position
LTN	Latency
POS	Position

Data	Description
PTT	1 PPS time tag
RRE	Residual error
SAT	Satellite status
VEC	Baseline vector

Example

Setting GGA message on Bluetooth port at 1-second output rate:

$PASHS,NME,GGA,C,ON,1*01

Comments

- For ALM messages, the f4 parameter can only take an integer value of seconds (by default 3600) and refers to the interval between messages related to the same satellite and with the same content.
- For a given satellite, the ALM messages are therefore renewed every “x” seconds (x=f4), or following a change in the message content (“on change”), whichever occurs first.
- ALM messages cannot be output more than once over a given period of 1 second.

Relevant Query Command

$PASHQ,NMO

See also

$PASHS,NME,PER

NME,ALL: Disabling All NMEA and NMEA-Like Messages

Function

This command is used to disable all NMEA messages and Ashtech NMEA-like messages currently enabled on the specified port.

Command Format

Syntax

$PASHS,NME,ALL,c1,OFF[*cc]

Parameters

Parameter	Description	Range
c1	Port ID: A: Serial port C: Bluetooth port E: Modem M, U: Memory	A, C, E, M, U
*cc	Optional checksum	*00-*FF

Example

Disabling all NMEA and NMEA-like messages on port A:

$PASHS,NME,ALL,A,OFF*50

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 Ashtech 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. Setting $PASHS,POP to “20” is a prior condition to operating at 0.05 s (20 Hz).	0.05 s or 0.1-0.4 s with [F] option activated. 0.5-0.9 s 1-999 s	1 s
*cc	Optional checksum	*00-*FF	

Example

Setting the output rate to 1 second:

$PASHS,NME,PER,1*45

Relevant Query Command

$PASHQ,NMO

See also

$PASHS,NME

$PASHS,POP

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*14

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*4D

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 or host name	000.000.000.000-255.255.255.255 or www.......
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,Ashtech,PWD,u6huz8,TYP,0*52

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*63

Ending the static occupation on point “SITE01”:

$PASHS,OCC,0,1,SITE01,Park_Entrance*62

Relevant Query Command

$PASHQ,OCC

See also

$PASHS,REC
$PASHS,ATM

OPTION: Receiver Firmware Options

Function

This command is used to install the receiver firmware options that have been purchased after the initial receiver purchase. Options purchased at the time of receiver purchase are factory pre-loaded.

Command Format

Syntax

$PASHS,OPTION,c1,h2[*cc]

Parameters

Parameter	Description	Range
c1	Option ID	K, F, Z, S, P, M, L, N (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 20 Hz
Z	MODEM	Enables the GSM/GPRS modem
S	GLONASS	Enables GLONASS
P	GNSSL2	Enables L2 tracking
M	RTK2	Enables RTK using proprietary data formats (ATOM, DBEN or LRK)
L	RTK3	Enables limited RTK range
N	STA	Enables RTK base

NOTE: Options K, M and L are also relevant to a base.

Comments

When activating GLONASS or GNSSL2, it is essential that you modify the receiver configuration, using $PASHS,GNS,CFG to enable the tracking of the new signals. Alternatively, you can run $PASHS,RST to update the default configuration, taking into account all the activated firmware options.

Example

Enabling the RTK option:

$PASHS,OPTION,K,878A8874*48

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, in degrees	0-90°	5
*cc	Optional checksum	*00-*FF	

Example

Setting the elevation mask for position processing to 15 degrees:

$PASHS,PEM,15*05

Relevant Query Command

$PASHQ,PEM

See also

$PASHS,ELM

POP: Setting Internal Update Rate for Measurements and PVT

Function

This command allows you to set the updates rate used internally in the measurements and position processing.

Command Format

Syntax

$PASHS,POP,d[*cc]

Parameters

Parameter	Description	Range	Default
d	Internal update rate, in Hz, for measurements and PVT.	10, 20	20
*cc	Optional checksum	*00-*FF	

Example

Setting the update rate to 10 Hz:

$PASHS,POP,20*17

Comments

- Outputting data at 20 Hz through $PASHS,NME, $PASHS,ATM and $PASHS,RAW requires that the present update rate stays at 20 Hz (default value).
- Changing the update rate causes GNSS reception to be reset (the number of received/used satellites drops to 0 straight away and then rapidly comes back to normal).

Relevant Query Command

$PASHQ,POP

See Also

$PASHS,NME
$PASHS,ATM
$PASHS,RAW

POS: Setting the Antenna Position

Function

This command allows you to enter the geographic coordinates of the GNSS antenna. It is usually used to enter the position of a base. If there is no computed position available from the receiver when the command is applied, then the entered position is used to initialize the receiver position in order to speed up satellite tracking.

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	±0-9999.9999
*cc	Optional checksum	*00-*FF

Example

Setting the antenna position to 37°22.2912135’N, 121°59.7998217’W and 15.25 m:

$PASHS,POS,3722.2912135,N,12159.7998217,W,15.25*1F

Relevant Query Command

$PASHQ,CPD,POS

See also

$PASHS,CPD,MOD,BAS
$PASHS,RT3
$PASHS,ANH
$PASHS,ANR

PPS: Setting PPS Pulse Properties

Function

This command is used to set the period, offset and GPS synchronized edge (rising or falling) of the PPS pulse.

Command Format

Syntax

$PASHS,PPS,f1,f2,c3[*cc]

Parameters

Parameter	Description	Range	Default
f1	PPS time period, a multiple or fraction of 1 second. • 0: 1 PPS disabled	0 to 1, with 0.1-sec increments 1 to 60, with 1-sec increments	0
f2	Time offset in milliseconds.	± 999.9999	0
c3	GPS-synchronized edge code: • "R" for rising edge • "F" for falling edge	R, F	R
*cc	Optional checksum	*00-*FF	

Example

Setting the PPS signal to a period of 2 seconds, with an offset of 500 ms and a GPS-synchronized rising edge:

$PASHS,PPS,2,+500,R*74

Relevant Query Command $PASHQ,PPS

See Also $PASHS,NME (PTT)

PRT: Setting Baud Rates

Function This command is used to set the baud rate of any of the serial ports used in the receiver.

Command Format

Syntax

$PASHS,PRT,c1,d2[*cc]

Parameters

Parameter	Description	Range
c1	Port ID	A, D
d2	Baud rate	Port A: 0-15; Port D: 0-9 (see table below)
*cc	Optional checksum	*00-*FF

Code	Baud Rate	Code	Baud Rate
0	300	7	38400

Code	Baud Rate	Code	Baud Rate
1	600	8	57600
2	1200	9	115200
3	2400	10	230400
4	4800	11	480600
5	9600	12	921600
6	19200	13	1428571

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*43

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	Default
f1	Battery voltage threshold, in volts, triggering a low-battery alarm	6.7-8.4	6.8
f2	External power voltage threshold, in volts, triggering a low-power alarm	9.0-28.0	9.1
*cc	Optional checksum	*00-*FF	-

Example

Setting the thresholds to respectively 7 and 9 V:

$PASHS,PWR,PAR,7,9*41

Relevant Query Command

$PASHQ,PWR

RAW: Enabling/Disabling Raw Data Messages in Legacy Ashtech Format

Function

This command is used to enable or disable the standard, continuous output of raw data in legacy Ashtech format.

NOTE: The ATOM format, instead of the legacy 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	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 in seconds. Keeping $PASHS,POP at "20" is the necessary condition to operating at 0.05 s (20 Hz).	0.05 s or 0.1-0.4 s with [F] option activated. 0.5-0.9 s, 1-999 s	1
*cc	Optional checksum	*00-*FF	

Raw data message types:

Data	Description
MPC	GPS/GLONASS/SBAS measurements
DPC	Compact GPS raw data
PBN	Position information
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
SBD	SBAS data message

Examples

Enabling output of MPC message type on port A to 1 second:

$PASHS,RAW,MPC,A,ON,1*1E

Enabling output of SNV message type on port A to 300 seconds:

$PASHS,RAW,SNV,A,ON,300*09

Comments

- For each of the SNV, SNG, SNW, SAL, SAG, SAW and ION messages, the f4 parameter can only take an integer value of seconds and refers to the interval between messages related to the same satellite and with the same content.

For a given satellite, each of these messages is therefore renewed every x seconds (where x=f4), or following a change in the message content (“on change”), whichever occurs first.

Each of these messages cannot be output more than once over a given period of 1 second.

- By default, f4 is set as follows:

Output message	f4 Default Value
SNV, SNG, ION	900
SAL, SAG	3600
SNW	120
SAW	300

- The SBD message output rate is always 1 second (as decoded). Parameter f4 is ignored.

Relevant Query Command

$PASHQ,RAW
$PASHQ,RWO

See also

$PASHS,RAW,PER
$PASHS,RAW,ALL
$PASHS,POP

RAW,ALL: Disabling All Raw Data Messages

Function

This command is used to disable all the currently active raw data messages on the specified port.

Command Format

Syntax

$PASHS,RAW,ALL,c1,OFF[*cc]

Parameters

Parameter	Description	Range
c1	Port ID: • Serial port: A • Bluetooth port: C • Memory: M, U	A, C, M, U
*cc	Optional checksum	*00-*FF

Example

Disabling all raw data messages on port A:

$PASHS,RAW,ALL,A,OFF*52

Relevant Query Command None.

See Also $PASHS,RAW

RAW,PER: Setting Unique Output Rate for Raw Data

Function This command is used to set the same output rate for raw data messages MPC, DPC and PBN. This command will overwrite the output rates set individually for each of these message types using $PASHS,RAW,xxx. Setting this rate does not affect the data recording rate (set with $PASHS,DRI).

Command Format

Syntax

$PASHS,RAW,PER,f[*cc]

Parameters

Parameter	Description	Range	Default
f	Output rate, in seconds. Setting $PASHS,POP to “20” is a prior condition to operating at 0.05 s (20 Hz).	0.05 s or 0.1-0.4 s with [F] option activated. 0.5-0.9 s 1-999 s	1 s
*cc	Optional checksum	*00-*FF	

Example

Setting the data output rate to 2 seconds:

$PASHS,RAW,PER,2*44

Relevant Query Command $PASHQ,RAW

See also $PASHS,RAW
$PASHS,RAW,ALL
$PASHS,POP

RCP,GBx: GLONASS Carrier Phase Biases for User-Defined Receiver

Function

This set of two commands is used to define GLONASS carrier phase biases for a given receiver. One command deals with the GLONASS L1 band and the other with the GLONASS L2 band.

Command Format

Syntax

For the L1 band:

$PASHS,RCP,GB1,s1,f2,f3,f4,f5,f6,f7,f8,f9,f10,f11,f12,f13,f14,f15,f16,f17[*cc]

For the L2 band:

$PASHS,RCP,GB2,s1,f2,f3,f4,f5,f6,f7,f8,f9,f10,f11,f12,f13,f14,f15,f16,f17[*cc]

Parameters

Parameter	Description	Range
s1	Name of user-defined receiver for which GLONASS biases must be defined (case sensitive)	31 characters max.
f2	When a linear pattern is assumed for GLONASS biases, f2 represents the delta bias between two adjacent GLONASS frequency numbers.	Full range of Real variables allowed
f3-f16	When an arbitrary pattern is assumed for GLONASS biases, f3-f16 represent biases for GLONASS frequency numbers from -7 to 6	Full range of Real variables allowed
f17	Pseudo-range bias (in meters) between GPS and GLONASS constellations	
*cc	Optional checksum	*00-*FF

Comments

- **Only fractional parts of GLONASS carrier phase biases are of practical importance.**

- Running one of these commands on a receiver already stored in the list of user-defined receivers will save all the submitted parameters to permanent memory and keep all the others unchanged.
- You may not run the two commands (GB1 and GB2) for a given user-defined receiver. If you run just one of them, then the parameters corresponding to the other command will all be assumed to be invalid (i.e unknown). All user-defined receivers created from this receiver will also inherit these invalid parameters.
- The board will interpret any missing parameter in a command as a parameter for which there is currently no known valid value for this parameter.

Relevant Query Command $PASHQ,RCP

See Also $PASHS,RCP,DEL

RCP,DEL: Deleting User-Defined Receiver Name

Function This command is used to delete a user-defined receiver name.

Command Format

Syntax

$PASHS,RCP,DEL,s1[*cc]

Parameters

Parameter	Description	Range
s1	Receiver name you want to delete (case sensitive)	31 characters max.
*cc	Optional checksum	*00-*FF

Example

Deleting receiver name “MyReceiver”:

$PASHS,RCP,DEL,MyReceiver*74

Relevant Query Command $PASHQ,RCP

See Also $PASHS,RCP,GB1
$PASHS,RCP,GB2

RCP,REF: Naming Reference Receiver

Function This command is used to enter the reference receiver name.

Command Format

Syntax

$PASHS,RCP,REF,s1[,d2][*cc]

Parameters

Parameter	Description	Range	Default
s1	Receiver name (case-sensitive).	31 characters max.	Empty
d2	Receiver name preference: • 0: s1 is ignored if the incoming reference data contain the reference receiver name • 1: s1 is always used and the decoded reference receiver name is ignored.	0 or 1	0
*cc	Optional checksum	*00-*FF	

Comment

The supported receiver models are listed below (these are case-sensitive names):

ASHTECH
ProMark500
ProFlex500
MB500
PM5
MMapper100
ProMark100
MB100
NOVATEL
TRIMBLE
SEPTENTRIO
TOPCON

Example

Entering "Ashtech" as the name of the reference receiver:

$PASHS,RCP,REF,Ashtech*25

Relevant Query Commands

$PASHQ,RCP,REF
$PASHQ,RCP

See Also

$PASHS,ANP,REF

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*50

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*1E

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,d3,[s4],[c5],[d6],[s7],[c8],[c9][s10][*cc]

Parameters

Parameter	Description	Range
c1	ID of the port connected to the radio you want to set.	A, D
s2	Radio Model: • PDL: Pacific Crest PDL RXO, Pacific Crest PDL HPB/LPB • ADL: Pacific Crest ADL Vantage, Pacific Crest ADL Foundation • MGL: Radio transmitter P/N 800986 • MDL: U-Link • LFE: License-free radio, Europe (ARF7474B) • LFA: License-free radio, North America (ARF7474A)	PDL, MGL, MDL, LFE, LFA, ADL (port A) PDL, MDL (port D)
d3	Channel number	0-15 (PDL, MDL, MGL) 1-32 (ADL) 0-2 (LFE) 0-49 (LFA)

Parameter	Description	Range
s4	Power management (if port D is used) • AUT: Automatic • MAN: Manual	AUT, MAN
c5	Protocol used: • 0: Transparent (PDL, MDL or ADL) • 1: TRIMTALK (PDL or ADL) or not used (MDL) • 2: DSNP (PDL, MDL or ADL) • 3: SATEL (ADL)	0-3
d6	Air link speed. For PDL: • 4800: 4800 Bd, GMSK modulation • 9600: 9600 Bd, GMSK or four-level FSK modulation • 19200: 19200 Bd, four-level FSK modulation For MDL: 4800, 7600 or 9600 For ADL: • 9600: 9600 Bd, four-level FSK modulation • 19200: 19200 Bd, four-level FSK modulation • 4800: 4800 Bd, GMSK modulation • 8000: 8000 Bd, GMSK modulation • 9600: 9600 Bd, GMSK modulation • 16000: 16000 Bd, GMSK modulation • 19200: 19200 Bd, GMSK modulation	4800, 7600, 9600, 19200
s7	Radio sensitivity (PDL, ADL and MDL only)	LOW, MED, HIG, OFF
c8	Scrambler (PDL and ADL only): • 0: Off • 1: On	0, 1
c9	Forward Error Correction (PDL and ADL only): • 0: FEC Off • 1: Hamming FEC On	0,1
s10	Modulation format (for ADL only) • 4FSK • GMSK	4FSK, GMSK
*cc	Optional checksum	*00-*FF

Comments

The command will be NAKed if the receiver has not been told the radio is on the port specified by command $PASHS,RDP,TYP.

If a PDL radio is used:

- 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	GMSK
25 kHz	9600	GMSK
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

- If an MDL radio is used and the DSNP protocol is selected, only the 4800 Bd baud rate can be used.
- The relationship between channel number and frequency in an LDE radio is summarized in the table below.

Channel Number	Frequency (MHz)
0	869.450 (manufacturer’s channel 19)
1	869.525 (manufacturer’s channel 84)
2	869.600 (manufacturer’s channel 85)

Examples

Setting the internal Pac Crest radio receiver:

$PASHS,RDP,PAR,D,PDL,2,AUT,0,9600,LOW,0,0*75

Setting the internal U-Link Rx:

$PASHS,RDP,PAR,D,MDL,0,AUT,0,9600,LOW*6A

Setting the external U-Link TRx:

$PASHS,RDP,PAR,A,MGL,1*46

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 manually the type of radio connected to the specified port. Normally, the type of internal radio (typically connected to port D) is detected automatically.

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: • UNKNOWN: Auto-detection (port D only) • NONE: No radio • PDL: Pacific Crest PDL RXO • ADL: Pacific Crest ADL Vantage, Pacific Crest ADL Foundation • MGL: Radio transmitter P/N 800986 • MDL: U-Link • LFE: License-free radio, Europe (ARF7474B) • LFA: License-free radio, North America (ARF7474A)	Port A: NONE, PDL, MGL, MDL, LFE, LFA, ADL. Port D: UNKNOWN, NONE, PDL or MDL.
*cc	Optional checksum	*00-*FF

Examples

Auto-detecting the internal radio receiver:

$PASHS,RDP,TYP,D,UNKNOWN*4E

Setting the external radio as an Ashtech U-Link TRx:

$PASHS,RDP,TYP,A,MGL*45

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*54

Stopping raw data recording:

$PASHS,REC,N*43

Relevant Query Command $PASHQ,REC

See also
$PASHS,MEM
$PASHS,ATM
$PASHS,NME
$PASHS,RFB (Ring File Buffer)

RNX,TYP: ATOM RNX Differential Message

Function

This command is used in a receiver used as a base to define the type and output rate of the ATOM RNX message generated by the base.

This command is now used as a replacement to the $PASHS,ATD,TYP command, which was made obsolete in May 2010.

Command Format

Syntax

$PASHS,RNX,TYP,d1,d2[,d3][*cc]

Parameters

Parameter	Description	Range	Default
d1	Scenario number	See table below	4
d2	Output rate for observations, in seconds.	0.1-0.4 if [F] option activated. 0.5-0.9 1-1800	1
d3	Output rate for attributes (receiver and antenna names), in seconds.	0:Disabled 1-1800	31
*cc	Optional checksum	*00-*FF	

Scenario Number	Description
1	L1 pseudo-range and carrier phase in full presentation, extended fixed position follows each 12 epochs.
2	L1 SNR, pseudo-range and carrier phase in full presentation, extended fixed position follows each 12 epochs.
3	L1&L2 pseudo-range and carrier phase in full presentation, extended fixed position follows each 12 epochs.

Scenario Number	Description
4	L1 &L2 SNR, pseudo-range and carrier phase in full presentation, extended fixed position follows each 12 epochs.
100	L1&L2 compact pseudo-range and full carrier phase, extended fixed position follows each 12 epochs, all the data are decimated in 5 times compared to L1 carrier phase.
101	L1&L2 compact pseudo-range and compact carrier phase, extended fixed position follows every 12 epochs, all the data are decimated in 5 times compared to L1 carrier phase. **This scenario cannot be used with a moving receiver**.
201	Same as scenario 1, but extended computed reference position follows each epoch.
202	Same as scenario 2, but extended computed reference position follows each epoch.
203	Same as scenario 3, but extended computed reference position follows each epoch.
204	Same as scenario 4, but extended computed reference position follows each epoch.
300	Same as scenario 100, but extended computed reference position follows each epoch.

Example

Choosing scenario 4 with 1 sec and 30 sec for the output rates:

$PASHS,RNX,TYP,4,1,30*6A

Relevant Query Command

$PASHQ,RNX,MSI

See Also

$PASHS,BAS
$PASHS,CPD,MOD,BAS

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*20

Comments

The following GSM parameters are not affected by the $PASHS,RST command:

- PIN code
- Band
- Access Point Name (GPRS)
- Login (GPRS)
- Password (GPRS)

The following Ethernet parameters are not affected by the $PASHS,RST command:

- DHCP setting
- IP address
- Sub-network mask
- Gateway IP address
- DNS 1 IP address
- DNS 2 IP address
-

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 or 1029. This command can only be applied to a base receiver with message type 16 or 1029 enabled in the 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 messages 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, in seconds, or “0” for message disabled	0, 0.1-0.4 (with [F] option activated 0.5-0.9, 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	0
3	GPS reference station parameters	0

Parameter	Description	Default
9	GPS partial correction set	0
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)	0
22	Extended reference station parameter	0
23	Antenna type definition record	31 s
24	Antenna reference point	13 s
31	Differential GLONASS corrections	0
32	Differential GLONASS reference station parameters	0
34	GLONASS partial correction set	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
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 types 18 and 19 (output rate: 1 s):

$PASHS,RTC,TYP,18,1

Disabling all RTCM 3.x messages:

$PASHS,RTC,TYP,1000*6C

Comments

- RTCM2.3 and RTCM 3.x messages can coexist. The $PASHS,BAS command will finally determine which of the existing messages should be broadcast.
- $PASHS,RTC,TYP,0 will disable all enabled RTCM2.3 messages.
- $PASHS,RTC,TYP,1000 will disable all enabled RTCM3.x messages.

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,s1[*cc]

Parameters

Parameter	Description	Range	Default
s1	Enables (ON) or disables (OFF) SBAS tracking	ON, OFF	ON
*cc	Optional checksum	*00-*FF	

Example

Enabling SBAS tracking:

$PASHS,SBA,ON*08

Relevant Query Command

$PASHQ,SBA

See also

$PASHS,GLO

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*63

Relevant Query Command

$PASHQ,SIT

See also

$PASHS,REC

SNM: Signal-To-Noise Ratio Mask

Function

This command is used to mask the signal observations that do not meet the minimum C/A code signal-to-noise ratio you specify. This means that only the observations meeting this requirement will be used in the PVT computation (all the others will be rejected).

Command Format

Syntax

$PASHS,SNM,d1[*cc]

Parameters

Parameter	Description	Range	Default
d1	SNR mask, in dB.Hz	0-60	0
*cc	Optional checksum	*00-*FF	

Example

Setting the SNR mask to 45 dB.Hz:

$PASHS,SNM,45*08

Relevant Query Command

$PASHQ,SNM

SOM: Masking Signal Observations

Function

The SOM command is used to apply masks on the following data:

- Cumulative tracking time (CTT), in seconds
- Navigation data (NAV)
- Signal-to-Noise Ratio (SNR), in dBHz
- Channel warnings (WRN)

As a result of the presence of these masks, only the signal observations meeting the required level of quality will be made available by the receiver through the relevant output messages.

Command Format

Syntax

$PASHS,SOM,d[*cc]

Parameters

Parameter	Description	Range	Default
d	Observation mask index	See table below.	4
*cc	Optional checksum	*00-*FF	

Observation mask Index	
d	**Description**
0	No masking
1	Reference station
2	Static base
3	Moving base
4	Rover (default)
9	User-defined

Comments

"Masking" signal observations therefore means definitively rejecting those observations not meeting the level of quality requested by the different masks set through the SOM command.

"SOM" stands for "Signal Observations Masks".

Example

Setting masks for a reference station:

$PASHS,SOM,1*39

Relevant Query Command

$PASHQ,PAR
$PASHQ,SOM

See Also

$PASHS,SOM,SNR
$PASHS,SOM,NAV
$PASHS,SOM,WRN
$PASHS,SOMM,CTT

SOM,CTT: Cumulative Tracking Time Mask

Function

This command is used to mask the signal observations that do not meet the minimum continuous tracking time you specify. This means that only the observations meeting this requirement will be output (all the others will be rejected).

This mask is enabled only after the "User-defined" option (9) has been selected with the $PASHS,SOM command.

Command Format

Syntax

$PASHS,SOM,CTT,d1[,d2][*cc]

Parameters

Parameter	Description	Range	Default
d1	Minimum continuous tracking time for differential data, in seconds. "0" means no mask.	0-255	10
d2	Minimum continuous tracking time for raw data, in seconds. If d2 is omitted, then the receiver will assume d2=d1. "0" means no mask.	0-255	10
*cc	Optional checksum	*00-*FF	

Raw Data Masked by d2	Differential Data Masked by d1
MPC DPC ATM,MES ATM,RNX,SCN,0	All other messages

Comments

- "Continuous" tracking means tracking "without cycle slips".
- This command can only mask some particular signal data. If however at the same time the L1CA data are disabled, then ALL the satellite observations, and not only the masked ones, will be rejected.
- This command equally affects all GNSS and their signals.

Examples

Setting CTT masks for differential and raw data to 20 s:

$PASHS,SOM,CTT,20*65

Enabling all signal observations to be output regardless of the continuous tracking time requirement (no CTT mask):

$PASHS,SOM,CTT,0*57

Relevant Query Command

$PASHQ,PAR
$PASHQ,SOM,CTT

See Also

$PASHS,SOM
$PASHS,SOM,SNR
$PASHS,SOM,NAV
$PASHS,SOMM,WRN

SOM,NAV: Navigation Data Mask

Function

This command is used to mask the signal observations that are not consistent with the relevant navigation data. This means that only the observations meeting this requirement will be output (all the others will be rejected).

This mask is enabled only after the "User-defined" option (9) has been selected with the $PASHS,SOM command.

Command Format

Syntax

$PASHS,SOM,NAV,s1[,s2][*cc]

Parameters

Parameter	Description	Range	Default
s1	Differential data mask	ON, OFF	ON
s2	Raw data mask. If s2 is omitted, then the receiver will assume s2=s1	ON, OFF	OFF
*cc	Optional checksum	*00-*FF	

Raw Data Masked by s2	Differential Data Masked by s1
MPC DPC ATM,MES ATM,RNX,SCN,0	All other messages

Comments

- Stating that signal observations are consistent with the corresponding navigation data means the following:
  - GNSS time, receiver position and receiver clock offsets are available and valid.
  - L1CA pseudo-range for a given satellite is measured and valid.
  - The corresponding satellite navigation data are available and valid.
  - The L1CA pseudo-range and computed range are in agreement with each other.
  - Elevation and azimuth angles are available and valid.

  If at least one of the above requirements is not met, then signal observations are found to be not consistent with navigation data.
- The $PASHS,SOM,NAV command will mask all signals (all observables) corresponding to a given satellite, even if some other pseudo-ranges (e.g. L2C) can be consistent with the navigation data.
- The $PASHS,SOM,NAV command equally affects all GNSS systems.

Examples

Setting NAV masks for both differential and raw data:

$PASHS,SOM,NAV,ON*7C

Enabling all signal observations to be output regardless of whether they are consistent with navigation data or not (no NAV mask):

$PASHS,SOM,NAV,OFF*32

Relevant Query Command

$PASHQ,PAR
$PASHQ,SOM,NAV

See Also

$PASHS,SOM
$PASHS,SOM,SNR
$PASHS,SOM,CTT
$PASHS,SOM,WRN

SOM,SNR: Signal-to-Noise Ratio Mask

Function

This command is used to mask the signal observations that do not meet the minimum signal-to-noise ratio you specify. This means that only the observations meeting this requirement will be output (all the others will be rejected).

This mask is enabled only after the "User-defined" option (9) has been selected with the $PASHS,SOM command.

Command Format

Syntax

$PASHS,SOM,SNR,f1[,f2][*cc]

Parameters

Parameter	Description	Range	Default
f1	Differential data mask. "0" means no mask.	0-60 dBHz	28
f2	Raw data mask. If s2 is omitted, then the receiver will assume s2=s1. "0" means no mask.	0-60 dBHz	28
*cc	Optional checksum	*00-*FF	

Raw Data Masked by f2	Differential Data Masked by f1
MPC DPC ATM,MES ATM,RNX,SCN,0	All other messages

Comments

- The $PASHS,SOM,SNR command can only mask particular signal data for which the SNR does not meet your requirement. If however at the same time the L1CA data are disabled, then all the satellite observations will also be masked.
- The $PASHS,SOM,SNR command equally affects all GNSS systems and their signals, except GPS L1P(Y) and L2P(Y). For these two signals, a hard-coded SNR threshold is applied.

Examples

Setting SNR masks for both differential and raw data to 30 dBHz:

$PASHS,SOM,SNR,30*68

Enabling all signal observations to be output regardless of the signal-to-noise ratio:

$PASHS,SOM,SNR,0*5B

Relevant Query Command

$PASHQ,PAR
$PASHQ,SOM,SNR

See Also

$PASHS,SOM
$PASHS,SOM,NAV
$PASHS,SOM,CTT
$PASHS,SOMM,WRN

SOM,WRN: Channel Warnings Mask

Function

This command is used to mask the signal observations for those signals flagged with channel warnings (MPC warning bits are counted from 1 to 8). This means that only the observations from non-flagged signals will be output (all the others will be rejected).

This mask is enabled only after the “User-defined” option (9) has been selected with the $PASHS,SOM command.

Command Format

Syntax

$PASHS,SOM,WRN,s1[,s2][*cc]

Parameters

Parameter	Description	Range	Default
s1	Differential data mask	ON, OFF	ON
s2	Raw data mask. If s2 is omitted, then the receiver will assume s2=s1	ON, OFF	OFF
*cc	Optional checksum	*00-*FF	

Raw Data Masked by s2	Differential Data Masked by s1
MPC DPC ATM,MES ATM,RNX,SCN,0	All other messages

Comments

- A signal is considered as flagged in at least one of the following cases:
  - Carrier phase tracking is not stable (Bit 3 of MPC/MCA warning is set).
  - Pseudo-range data quality is bad (Bit 5 of MPC/MCA warning is set).
  - Polarity is not resolved (MPC/MCA Phase Tracking Polarity flag is set to 0).
- The $PASHS,SOM,WRN command will mask only some particular signal data (e.g. L1CA or L2P) corresponding to a given satellite. If at the same time the L1CA data are disabled, then ALL the satellite observations, and not only those masked, will be rejected.
- The $PASHS,SOM,WRN command equally affects all GNSS systems.

Examples

Setting WRN masks for both differential and raw data:

$PASHS,SOM,WRN,ON*6E

Enabling all signal observations to be output regardless of whether some signals are flagged or not (no WRN mask):

$PASHS,SOM,WRN,OFF*20

Relevant Query Command

$PASHQ,PAR
$PASHQ,SOM,WRN

See Also

$PASHS,SOM
$PASHS,SOM,SNR

$PASHS,SOM,CTT
$PASHS,SOM,NAV

STI: Defining a Station ID

Function

This command is used to define the station ID the base receiver will broadcast in its differential messages to the rover.

Command Format

Syntax

$PASHS,STI,d[*cc]

Parameters

Parameter	Description	Range
d	Station ID	0-1023 (RTCM 2.3) 0-4095 (RTCM 3.x and ATOM) 0-31 (CMR & CMR+)
*cc	Optional checksum	*00-*FF

Examples

Defining station ID “150” for use in RTCM messages:

$PASHS,STI,150*23

Note

If the chosen station ID is beyond the upper limit in the applicable range, then the value “31” is chosen instead (i.e. “31” instead of “56” for example if CMR/CMR+ messages are broadcast, or “31” instead of “1041” for example if RTCM 2.3 messages are broadcast).

Relevant Query Command

$PASHQ,STI

See also

$PASHS,BAS
$PASHS,MOD,BAS

SVM: Setting the Maximum Number of Observations in the PVT

Function: This function is used to set the maximum number of code and doppler observations used in the PVT calculation.

Command Format

Syntax

$PASHS,SVM,d1[*cc]

Parameters

Parameter	Description	Range	Default
d1	Maximum number of observations	0-26	14
*cc	Optional checksum	*00-*FF	-

Example

Setting the number of observations to 25:

$PASHS,SVM,25*16

Comments This setting affects all the positioning modes, except for the time-tagged RTK mode for which this limit is hardware coded and set to 14 satellites.

Relevant Query Command

$PASHQ,SVM

$PASHQ,PAR

UDP: User-Defined Dynamic Model Parameters

Function This command is used to set the upper limits of the dynamic model (velocity, acceleration).

Command Format

Syntax

$PASHS,UDP,f1,f2,f3,f4[*cc]

Parameters

Parameter	Description	Range	Default
f1	Maximum expected horizontal velocity in m/s.	0-100 000	100 000
f2	Maximum expected horizontal accelera-tion in m/s/s.	0-100	100
f3	Maximum expected vertical velocity in m/s.	0-100 000	100 000
f4	Maximum expected vertical acceleration in m/s/s.	0-100	100
*cc	Optional checksum	*00-*FF	-

Example

Setting the dynamic model:

$PASHS,UDP,10,1,2,0.5*1D

Comments

The user-defined dynamic model is activated by the $PASHS,DYN,9 command. Note that when the adaptive dynamic mode (DYN,8) is selected, the user-defined model is automatically excluded from the possible models that could best describe the current receiver dynamics.

Relevant Query Command

$PASHQ,UDP

See Also

$PASHS,DYN

UNT: Distance Unit Used on Display Screen

Function:

This function is used to choose the distance unit you want the receiver to use when providing coordinates on its display screen.

Command Format

Syntax

$PASHS,UNT,s1[*cc]

Parameters

Parameter	Description	Range	Default
s1	Desired distance unit: • M: Meters • F: US Survey Feet • IF: International Feet	M, F, IF	M
*cc	Optional checksum	*00-*FF	-

Example

Choosing US Survey Feet:

$PASHS,UNT,F*50

Relevant Query Command

$PASHQ,UNT

UTS: Synchronizing Onto GPS Time

Function:

This function is used to enable or disable a clock steering mechanism that synchronizes measurements and coordinates with the GPS system time rather than with the local (receiver) clock.

Command Format

Syntax

$PASHS,UTS,s1[*cc]

Parameters

Parameter	Description	Range	Default
s1	Enabling (ON) or disabling (OFF) synchronization with GPS time	ON, OFF	ON
*cc	Optional checksum	*00-*FF	-

Example

Enabling synchronization:

$PASHS,UTS,ON*0A

Comments

- All output data, except for legacy MPC, MCA, DPC and RPC, are always clock steered.

- Legacy MPC, MCA, DPC and RPC data appear as steered or not steered depending on the last $PASHS,UTS command run.
- The PBN message contains internal clock and clock drift estimates when UTS is OFF and reports zeros for these estimates when UTS is ON.
- The ATOM,RNX message with scenario 0 contains original clock and clock drift estimates that can be used on decoding side to restore the original (not steered) observables, if needed.

Relevant Query Command

$PASHQ,UTS
$PASHQ,PAR

WAK: Acknowledging Alarms

Function

This command is used to acknowledge all alarms. This will also turn off the beeper (if previously set to beep on occurrence of an alarm). After sending the command, 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*28

Relevant Query Command

$PASHQ,WARN

ZDA: Setting Date & Time

Function

This command is used to set the date 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*0A

Relevant Query Command

$PASHQ,ZDA

See also

$PASHS,LTZ

Appendix C. Query Command Library

AGB: Reading GLONASS Bias Setting

Function

This command tells you whether L1 & L2 GLONASS carrier biases are currently processed in the receiver or not.

Command Format

Syntax

$PASHQ,AGB[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,AGB,s1*cc

Parameters

Parameter	Description	Range
s1	ON: Processing enabled OFF: Processing disabled	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,AGB*33
$PASHR,AGB,ON*1D

Relevant Set Command

$PASHS,AGB

ALM: Almanac Message

Function

This command allows you to output 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	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,ANH
$PASHR,ANH,1.568,S*44 (slant measurement, H=1.568 m)

Relevant Set Command $PASHS,ANH

See also $PASHQ,ANR

ANP: Antenna Parameters

Function This command allows you to read the antenna parameters of the specified antenna name, or of the complete antenna database if no antenna name is specified.

Command Format

Syntax

$PASHQ,ANP[*cc]
or
$PASHQ,ANP,s1[*cc]

Parameters

Parameter	Description	Range
s1	Antenna name (case sensitive)	31 characters max.
*cc	Optional checksum	*00-*FF

Response Formats

(Through examples)

$PASHQ,ANP
LIST OF PREDEFINED ANTENNAS (d1):
ANT1 ANT2
ANT3 ANT4
...
LIST OF USERDEFINED ANTENNAS (d2):
ANT10 ANT11
ANT12 ANT13
...
OWN ANTENNA: MAG990596
REFERENCE ANTENNA: UNKNOWN
OUT ANTENNA: NULLANTENNA
RECEIVED ANTENNA: MAG990596

(Where d1 is the number of predefined antennas and d2 is the number of user-defined antennas.)

$PASHQ,ANP,MAG990596
MAG990596
L1 N: -000.80 E: -001.40 U: +101.80
L1 PAE:+000.0 +000.9 +001.9 +002.8 +003.7 +004.7 +005.4 +006.0 +006.4 +006.5
+006.3 +005.8 +004.8 +003.2 +001.1 -001.6 -005.1 +000.0 +000.0
L2 N: +000.80 E: -001.10 U: +086.20
L2 PAE:+000.0 -000.9 -001.1 -000.6 +000.2 +001.1 +002.0 +002.7 +003.0 +003.0
+002.6 +001.7 +000.5 -001.1 -003.0 -004.9 -006.8 +000.0 +000.0

Relevant Set Commands

$PASHS,ANP,OWN
$PASHS,ANP,REF
$PASHS,ANP,PCO

ANP,OUT: Virtual Antenna

Function

This command returns the name of the virtual antenna currently selected in the receiver.

Command Format

Syntax

$PASHQ,ANP,OUT[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,ANP,OUT,s1*cc

Parameters

Parameter	Description	Range
s1	Name of the virtual antenna. If “OFF” is returned, this means no virtual antenna is selected.	31 characters max.
*cc	Checksum	*00-*FF

Example

$PASHQ,ANP,OUT
$PASHR,ANP,OUT,ADVNULLANTENNA*72

Relevant Set Command

$PASHS,ANP,OUT

ANP,OWN: Local Antenna Used

Function

This command returns the name of the GNSS antenna currently used by the receiver.

Command Format

Syntax

$PASHQ,ANP,OWN[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,ANP,OWN,s1,s2,s3*cc

Parameters

Parameter	Description	Range
s1	Name of the local antenna	31 characters max.
s2	Antenna serial number	31 characters max.
	Antenna setup ID	0-255
*cc	Checksum	*00-*FF

Example

$PASHQ,ANP,OWN
$PASHR,ANP,OWN,MAG111406,,*35

Relevant Set Command

$PASHS,ANP,OWN

ANP,REF: Antenna Used at the Base

Function

This command returns the name of the GNSS antenna assumed to be used by the base currently sending data to the interrogated receiver (a rover).

Command Format

Syntax

$PASHQ,ANP,REF[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,ANP,REF,s1,d2*cc

Parameters

Parameter	Description	Range
s1	Name of the antenna used at the base	31 characters max.
d2	Antenna name preference: • 0: s1 is ignored if incoming reference data include base antenna name • 1: s1 is always used; decoded base antenna name is ignored	0, 1
*cc	Checksum	*00-*FF

Example

$PASHQ,ANP,REF
$PASHR,ANP,REF,MAG111406,1*2F

Relevant Set Command $PASHS,ANP,REF

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

ANT: Antenna Height

Function This command is used to read the current setting for the antenna height.

Command Format

Syntax

$PASHQ,ANT[*cc]

Response Format

Syntax

$PASHR,ANT,f1,f2,f3,m4,f5*cc

Parameters

Parameter	Description	Range
f1	Slant height measurement, from ground mark to antenna edge (SHMP)	0-6.553 m
f2	Antenna radius: horizontal distance from the geometrical center to the antenna edge.	0-6.553 m
f3	Antenna vertical offset: • Offset between SHMP and ARP if both slant height measurement and antenna radius are different from zero. • Offset between ground mark and ARP if either slant height measurement or radius is zero.	± 0-6.553 m
m4	Horizontal azimuth [dddmm.mm], in degrees, for the horizontal line connecting the ground mark to the surveyed point, measured with respect to the Geographical North. Currently NOT processed.	0-35959.99
f5	Horizontal offset from the ground mark to the surveyed point. Currently NOT processed.	0-6.553 m
*cc	Checksum	*00-*FF

Example

$PASHQ,ANT
$PASHR,ANT,0,0,2.000,0,0*49 (vertical, 2.000 m)

Relevant Set Command

$PASHS,ANT

See also

$PASHQ,ANR
$PASHQ,ANH

ATD,MSI: ATOM Differential Message Status

This command has been made obsolete to be replaced with $PASHQ,RNX,MSI (May 2010). For compatibility reasons, this command is still supported but you must be aware that the output rate reported in the status of message type "10" (position) is incorrect as this rate is now hard-coded.

Function

This command queries a base receiver for the current ATOM differential message status.

Command Format

Syntax

$PASHQ,ATD,MSI[*cc]

Response Format

Syntax

$PASHR,ATD,MSI,d1,n(d2,d3)*cc

Parameters

Parameter	Description	Range
d1	Number of ATOM data types in the ATOM differential message	5
d2	ATOM message type	1, 2, 3, 10, 11
d3	Message output rate, in seconds (0.0 if disabled)	0-1800
*cc	Checksum	*00-*FF

Example

$PASHQ,ATD,MSI
$PASHR,ATD,MSI,5,1,1.0,2,0.0,3,0.0,10,13.0,11,31.0*59

See also $PASHS,ATD,TYP for the description of the ATOM data types.

ATL: Debug Data Recording

Function

This command queries the receiver for the current status of the data recording function used for debugging.

Command Format

Syntax

$PASHQ,ATL[*cc]

Response Format

Syntax

$PASHR,ATL,s1,d2,c3,f4,d5*cc

Parameters

Parameter	Description	Range
s1	ON/OFF/AUT status: • ON: Debug data recording is enabled but will not re-start after a power cycle. • OFF: Debug data recording is disabled. • AUT: Debug data recording is enabled and will re-start after a power cycle.	ON, OFF, AUT
d2	Indicates which data are recorded: • 0: Only data from GNSS board to system board are recorded. • 1: Only data from system board to GNSS board are recorded. • 2: Data flowing in both directions are recorded.	0-2
c3	Recording status: • R: The receiver is currently recording data for debugging. • S: No debug data currently recorded.	R, S
f4	Output rate, in seconds (default: 1 sec.)	0.05, 0.1, 0.2,0.5, 1
d5	Configuration index	0, 1
*cc	Checksum	*00-*FF

Examples

Data recording disabled:

$PASHQ,ATL*2E
$PASHR,ATL,OFF,0,S,1,0*2C

Data recording enabled and in progress:

$PASHQ,ATL*2E
$PASHR,ATL,ON,0,R,0.5,0*79

Data recording is enabled but for some reason (no SD card, etc.), no data is being recorded:

$PASHQ,ATL*2E
$PASHR,ATL,ON,0,S,0.5,0*78

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)

$PASHQ,ATM

```
PER:001.00 ELM:5
DRI:001.00 SIT:2007 REC:N MEM:M
ANH:02.132 ANT:VERT ANR:ON
ATOM: MES PVT ATR NAV DAT EVT BAUD
PRTA: OFF OFF OFF OFF OFF OFF 7
PRTC: OFF OFF OFF OFF OFF OFF 1
PRTE: OFF OFF OFF OFF OFF OFF 1
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	0.000-99.999
ANT	Height measurement type (slant/vertical)	SLANT, VERT
ANR	Antenna reduction mode	ON, OFF, ARP
PRTA	Label for serial port A	ON, OFF
PRTC	Label for Bluetooth	ON, OFF
PRTE	Label for Modem	ON, OFF
MEMM MEMU	Labels for memories M and U	ON, OFF
BAUD	If serial port used, then baud rate If memory used, “0” if not available, else “1”	0-15 (see table below)

Code	Baud Rate	Code	Baud Rate
0	300	8	57600
1	600	9	115200
2	1200	10	230400
3	2400	11	480600
4	4800	12	921600
5	9600	13	1428571
6	19200	14	2500000

Code	Baud Rate	Code	Baud Rate
7	38400	15	5000000

Relevant Set Command $PASHS,ATM

See also $PASHQ,ATM
$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. The receiver will return the response on the port through which the query command is sent.

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 • E: Modem • M: Internal memory • U: External memory (USB)	A, C, E, M, R, U
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,ATO,c1,d2,f3,d4,6(s5,f6)*cc

Parameters

Parameter	Description	Range
c1	The port ID mentioned in the query command is replicated in this field.	A, C, E, M, R, U
d2	Baud rate code, 0 if not available	0-15
f3	PER setting	0-999.0
d4	Number of ATOM messages	6
s5	ATOM message type	MES, PVT, ATR, NAV, DAT, EVT
f6	Output rate (0 if message disabled)	0-999.0
*cc	Checksum	*00-*FF

Example Querying ATOM message parameters as currently set on port A:

$PASHQ,ATO,A

$PASHR,ATO,A,6,001.00,6,MES,0.00,PVT,0.00,ATR,0.00,NAV,0.00,DAT,0.00,EVT,0.00*71

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 • C: Bluetooth port • E: Modem • M, U: Memory • N: Undefined port	A, C, E, M, N, U
s2	Differential data type: • RT2: RTCM 2.3 messages • RT3: RTCM 3.0 & 3.1 messages (default) • CMR: CMR messages • CMP: CMR+ messages • ATM: ATOM messages • DBN: DBEN messages • NONE: Undefined	RT2, RT3, CMR, CMP, ATM, DBN, NONE
c3	Second port ID: same as c1 above	A, C, E, M, U
s4	Differential data type: same as s2 above.	RT2, RT3, CMR, CMP, ATM, DBN, NONE
*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 A and CMR+ messages on port E:

$PASHQ,BAS
$PASHR,BAS,A,RT2,E,CMP*4A

Relevant Set Command

$PASHS,BAS

See also

$PASHQ,CPD,MOD
$PASHQ,RTC
$PASHQ,ATD,MSI
$PASHQ,CMR,MSI
$PASHQ,RTC,MSI

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,s1,d2*cc

Parameters

Parameter	Description	Range
s1	Beeper enabled (ON) or disabled (OFF)	ON, OFF
d2	Timeout, in seconds: • =0: No timeout • >0: Buzzer will go out after thespecified timeout if the alarm has not been acknowledged at the end of that time.	0-99
*cc	Checksum	*00-*FF

Example

$PASHQ,BEEP
$PASHR,BEEP,OFF*05

Relevant Set Command

$PASHS,BEEP

BRD: RTC Bridge

Function

This command allows you to list the current settings of the RTC Bridge function.

Command Format

Syntax

$PASHQ,BRD[*cc]

Response format

Syntax

$PASHR,BRD,s1,d2,c3,c4*cc

Parameters

Parameter	Description	Range
s1	Availability of RTK corrections on the specified output port: • OFF: No RTK corrections forwarded to the output port. • ON: RTK corrections forwarded to the output port.	ON, OFF
d2	Use of RTK corrections in the receiver's position computation. • 0: RTK corrections used • 1: RTK corrections not used	0, 1
c3	Input port ID (port from which RTK corrections are available in the receiver).	E (modem)
c4	Output port ID (serial port to which the licence-free radio transmitter is connected).	A
*cc	Checksum	*00-*FF

Example

$PASHQ,BRD
$PASHR,BRD,ON,0,E,A*15

Relevant Set Command

$PASHS,BRD

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 to 16 digits max. -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 outputs.

Command Format

Syntax

$PASHQ,CMR,MSI[*cc]

Response Format

Syntax

$PASHR,CMR,MSI,d1,d2,d3,d4,d5,d6,d7,d8,d9*cc

Parameters

Parameter	Description	Range
d1	Number of CMR messages currently output	4
d2	Message type “0” label	0
d3	Message type “0” output rate, in seconds	0-300
d4	Message type “1” label	1
d5	Message type “1” output rate, in seconds	0-300
d6	Message type “2” label	2
d7	Message type “2” output rate, in seconds	0-300
d8	Message type “3” label	3
d9	Message type “3” output rate, in seconds	0-300
*cc	Checksum	*00-*FF

Example The response line below reports four enabled CMR messages, type “0” and “3” at 1 second, and types “1” and “2” at 30 seconds:

$PASHQ,CMR,MSI
$PASHR,CMR,MSI,4,0,1.0,1,30.0,2,30.0,3,1.0*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
$PASHR,CPD,AFP,99.0*6A

See also

$PASHS,CPD,AFP

CP2,AFP: Ambiguity Fixing Parameter, Second RTK Engine

Function

This command is used to read the current setting of the ambiguity fixing parameter used in the second RTK engine.

Command Format

Syntax

$PASHQ,CP2,AFP[*cc]

Response Format

Syntax

$PASHR,CP2,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,CP2,AFP
$PASHR,CP2,AFP,99.0*1C

See also $PASHS,CP2,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*50

See also

$PASHS,ANH
$PASHS,ANR
$PASHQ,CPD,POS

CPD,FST: Fast RTK Output Mode

Function

This command is used to read the current setting for fast RTK output mode.

Command Format

Syntax

$PASHQ,CPD,FST[*cc]

Response Format

Syntax

$PASHR,CPD,FST,s*cc

Parameters

Parameter	Description	Range
s	Fast RTK mode (fast CPD)	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,d3,c4*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 (default mode) • 1: Only GPS and SBAS • 2: Only GPS and GLONASS • 3: Only GPS	0-3
d3	Position mode. If BAS is the selected operating mode: • 0: Static position • 1: Moving position If ROV is the selected operating mode: • 0: means rover works with a static base • 1: means rover works with a moving base	0-1
c4	Input port for backup mode: • A: Serial port • C: Bluetooth port • D: Radio • E: Modem	A, C, D, E
*cc	Checksum	*00-*FF

Example

The response line below indicates that the receiver is configured as a base, uses the GPS and GLONASS constellations, and the base has a static position:

$PASHQ,CPD,MOD

$PASHR,CPD,MOD,BAS,2,0,A*5A

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,d1,d2*cc

Parameters

Parameter	Description	Range
d1	RTK network operating mode relative to GPS corrections: • 0: GPS corrections from network are not used. • 1: FKP/MAC GPS corrections from network are used when available and healthy, otherwise they are rejected.	0-1
d2	RTK network operating mode relative to GLONASS corrections: • 0: GLONASS corrections from network are not used. • 1: FKP/MAC GLONASS corrections from network are used when available and healthy, otherwise they are rejected.	0-1
*cc	Checksum	*00-*FF

Example

$PASHQ,CPD,NET
$PASHR,CPD,NET,1,0*51

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	±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 to a rover 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: Serial port • C: Bluetooth port • D: Radio • E: Modem	A, C, D, E
c3	Input port #2: • A: Serial port • C: Bluetooth port • D: Radio • E: Modem	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

CPD,VRS: VRS Assumption Mode

Function This command allows you to read the current setting of the VRS assumption mode.

Command Format **Syntax**

$PASHQ,CPD,VRS[*cc]

Response format **Syntax**

$PASHR,CPD,VRS,d*cc

Parameters

Parameter	Description	Range
d	VRS assumption mode: • 0: Automatic detection • 1: Compulsory VRS mode • 2: Never switches to VRS mode	0-2
*cc	Optional checksum	*00-*FF

Example

$PASHQ,CPD,VRS
$PASHR,CPD,VRS,1*45

Relevant Set Command $PASHS,CPD,VRS

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	±9999999.999
f5	ECEF Y coordinate, in meters	±9999999.999
f6	ECEF Z coordinate, in meters	±9999999.999
f7	Receiver clock offset, in meters	±300000
f8	Velocity vector, X component, in m/s	±9.999
f9	Velocity vector, Y component, in m/s	±9.999
f10	Velocity vector, Z component, in m/s	±9.999
f11	Receiver clock drift, in m/s	± 2000
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 from port A. If no port is specified in the command, the response message is sent back to the port that issued the query command.

Command Format

Syntax

$PASHQ,CTS[,s1][*cc]

Response Format

Syntax

$PASHR,CTS,s2*cc

Parameters

Parameter	Description	Range
s1	Queried port	A
s2	Current status of RTS/CTS handshaking protocol	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,CTS
$PASHR,CTS,ON*1D

Relevant Set Command

$PASHS,CTS

See also

$PASHQ,PRT
$PASHQ,MDP

DBN,MSI: DBEN Message Status

Function

This command is used in a base receiver to read the current settings of the DBEN messages the base currently generates and outputs.

Command Format

Syntax

$PASHQ,DBN,MSI[*cc]

Response Format

Syntax

$PASHR,DBN,MSI,d1,s2,d3,s4,d5*cc

Parameters

Parameter	Description	Range
d1	Number of DBEN messages currently output (always 2)	2
s2	Message type: “RPC” label	0
d3	“RPC” message type output rate, in seconds	0-300
s4	Message type: “BPS” label	1
d5	“BPS” message type output rate, in seconds	0-300
*cc	Checksum	*00-*FF

Example

$PASHQ,DBN,MSI
$PASHR,DBN,MSI,2,RPC,1.0,BPS,30.0*6B

See also

$PASHS,DBN,TYP
$PASHQ,BAS
$PASHQ,CPD,MOD

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	± 99999.999
f5	ECEF Y component of baseline, in meters	±99999.999
f6	ECEF Z component of baseline, in meters	±9999.999
f7	Receiver clock offset, in meters	±300000.000
f8	Velocity vector, X component, in m/s	±9.999
f9	Velocity vector, Y component, in m/s	±9.999
f10	Velocity vector, Z component, in m/s	±9.999
f11	Receiver clock drift, in m/s	±2000.000
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	IP address: 000.000.000.000 to 255.255.255.255 or host name
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.ashtech.com,PRT,8080*62

Relevant Set Command $PASHS,DIP

See also $PASHQ,MDM

DPO: Delta Position

Function This command is used to output a DPO message containing the components of the last computed vector (baseline) 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	±9999999.999
c5	North label	N
f6	Easting coordinate difference, in meters	± 9999999.999
c7	East label	E
f8	Ellipsoid height difference, in meters	± 99999.999
c9	Reserved	±9.999
f10	COG: Course Over Ground, in degrees	0-359.9
f11	SOG: Speed Over Ground, in m/s	0-9.999
f12	Vertical velocity, in m/s	± 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-character 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,DRI[*cc]

Response Format

Syntax

$PASHR,DRI,f1*cc

Parameters

Parameter	Description	Range
f1	Current raw data recording rate	0.05 s 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
$PASHQ,REC

DSY: Daisy Chain Status

Function

This command queries the receiver for the status of the daisy chain function.

Command Format

Syntax

$PASHQ,DSY[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,DSY,OFF*59
or
$PASHR,DSY,c1,c2*cc

Parameters

Parameter	Description	Range
c1	Source port: • A: Serial port • C: Bluetooth port • D: Radio • E: Modem	A, C, D, E
c2	Destination port: • A: Serial port • C: Bluetooth port • D: Radio • E: Modem	A, C, D, E
*cc	Checksum	*00-*FF

Example

Command reporting data on port A forwarded to port C:

$PASHQ,DSY
$PASHR,DSY,A,C*38

Relevant Set Command $PASHS,DSY

DTM: Querying for the Content of the DTM Message

Function This command asks the receiver to output the content of the DTM message.

Command Format

Syntax

$PASHQ,DTM[*cc]

Parameters

None.

Response Format

Syntax

$GPDTM,s1,,f2,c3,f4,c5,f6,s7*cc

Parameters

Parameter	Description	Range
s1	Local datum code: • W84: WGS84 used as local datum • 999: Local datum computed using the parameters provided by the RTCM3.1 data stream.	W84, 999
f2	Latitude offset, in meters	0-59.999999
c3	Direction of latitude	N, S
f4	Longitude offset, in meters	0-59.999999
c5	Direction of longitude	E, W
f6	Altitude offset, in meters	±0-99.999
s7	Reference datum code	W84
*cc	Checksum	*00-*FF

Example

$PASHQ,DTM
$GPDTM,999,2.324525,N,1.499476,W,1.365,W84*37

See Also

$PASHS,NME

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 • 9: User-defined	1-9
*cc	Checksum	*00-*FF

Example

$PASHQ,DYN
$PASHR,DYN,8*33

Relevant Set Command $PASHS,DYN

See also $PASHS,UDP

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

Relevant Set Command $PASHS,ELM

See also $PASHQ,PEM

FIL,CUR: Information On G-File Being Recorded

Function This command allows you to read information about the G-file currently being recorded.

Command Format

Syntax

$PASHQ,FIL,CUR[*cc]

Response Format

Syntax

General form:

$PASHR,FIL,CUR,s1,d2,s3,s4,d5*cc

If no G-file recording is in progress:

$PASHR,FIL,CUR,NONE*79

Parameters

Parameter	Description	Range
s1	Filename (including path)	255 characters max.
d2	Size in bytes	0-134217728
s3	Date (ddmmyyyy)	
s4	Time (hhmmss)	000000-235959
d5	Memory location: • 0: Internal memory. • 2: USB key.	0, 2
*cc	Checksum	*00-*FF

Example

$PASHQ,FIL,CUR
$PASHR,FIL,CUR,GazerA09.123,1769897,14032009,130850,0*63

See Also $PASHS,REC
$PASHS,MEM

FIL,LST: Listing Files in Receiver Memory or USB Key

Function

This command allows you to list the names of the files stored in the receiver's internal memory or on the USB key connected to the receiver.

Command Format

Syntax

$PASHQ,FIL,LST[,c][,s][*cc]

Parameters

Parameter	Description	Range
c	Memory type: • c=0 (or c omitted): Internal memory • c omitted: Memory is as defined with $PASHS,MEM • c=2: USB key	0, 2
s	Path name	
*cc	Optional checksum	*00-*FF

Response format

Syntax

$PASHR,FIL,LST,d1,d2,s3,d4,s5,s6[,c7]*cc

Parameters

Parameter	Description	Range
d1	Number of files	
d2	File index	
s3	File name or directory name	255 characters max.
d4	Size in bytes	0-134217728
s5	Date (ddmmyyyy)	
s6	Time (hhmmss)	000000-235959
c7	=D when s3 is a directory name	D
*cc	Optional checksum	*00-*FF

Example

$PASHQ,FIL,LST*53

```
$PASHR,FIL,LST,4,0,GazerA09.123,1769897,14032009,130850*74
$PASHR,FIL,LST,4,1,GazerB09.123,1769876,10032009,110952*7C
$PASHR,FIL,LST,4,2,GazerC09.123,1769787,01032009,181856*72
$PASHR,FIL,LST,4,3,GazerD09.123,1769787,01032009,181856*74
```

See Also

$PASHS,REC

$PASHS,MEM

$PASHQ,FLS

FLS: List of Raw Data Files

Function

This command is used to list the raw data files stored in the selected memory (cf. $PASHS,MEM). 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. If d is greater than the highest file index number, the command is "NAKed".	0-999
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,FLS,d1,d2,d3,n(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	± 99999.999,M
f10,M	Geoidal separation in meters. "M" for meters. Based on the official NATO's standard mean-sea-level algorithm (5-degree grid of height).	± 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. The message is output on the port on which the query is made. 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

GNS,CFG: Reading the GNSS Mode Used in the Receiver

Function

This command is used to query the GNSS mode used in the receiver. The GNSS mode refers to the constellations and frequencies used.

Command Format

Syntax

$PASHQ,GNS,CFG[*cc]

Parameters

None.

Response format

Syntax

$PASHR,GNS,CFG,d*cc

Parameters

Parameter	Description	Range
d	GNSS mode currently selected: • 0: GPS L1 • 1: GPS L1 and GLONASS L1 • 2: GPS L1/L2P • 3: GPS L1/L2C • 4: GPS L1/L2P and GLONASS L1/L2 • 5: GPS L1/L2C and GLONASS L1/L2	0-5
*cc	Optional checksum	*00-*FF

Example

$PASHQ,GNS,CGF*40
$PASHR,GNS,CFG,1*5D

Relevant Set Command $PASHS,GNS,CFG

GRS: GNSS Range Residuals

Function This command is used to output a GRS message containing the satellite range residuals. The message is output on the port on which the query is made. No message will be output if there is no position computed.

Command Format

Syntax

$PASHQ,GRS[*cc]

Response Format

Syntax

$--GRS,m1,d2,n(f3)*cc

Parameters

Parameter	Description	Range
"$--GRS" 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 (repeated "n" times, where n is the number of satellites 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.	±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
"$--GSA" 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
"$--GST" Header	$GPGST: Only GPS satellites are used. $GLGST: Only GLONASS satellites 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 degrees 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,154013.80,0.642,1.746,1.303,27.197,1.663,1.407,2.456*79

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,n(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
"$--GSV" Header	$GPGSV: GPS and SBAS satellites. $GLGSV: GLONASS satellites	$GPGSV, $GLGSV
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

LCS: Local Datum Computation Status

Function

This command asks the receiver to provide the status of the processing allowing it to compute a local datum based on data received from the base used.

Command Format

Syntax

$PASHQ,LCS[*cc]

Parameters

None.

Response Format

Syntax

$pASHR,LCS,s*cc

Parameters

Parameter	Description	Range
s	Processing status: • ON: Computation of local datum enabled • OFF: Computation of local datum disabled. The local datum is necessarily WGS84.	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,LCS
$PASHR,LCS,ON*05

Relevant Set Command

$PASHS,LCS

LOG: Editing a Log File

Function

This command is used to edit the specified or current log file. A log file lists all events related to IP connections with the receiver.

Command Format

Syntax

$PASHQ,LOG[,d][*cc]

Parameters

Parameter	Description	Range
d	Index number of the log file you want to edit. If d is omitted, the current log file is edited.	0-900
*cc	Optional checksum	*00-*FF

Response format

Syntax

The response is formatted as follows:

Date: <Year>-<Month>-<Day>
Maximum size: x Mb Duration: xx days
hh:mm:ss: <message 1>
hh:mm:ss: <message 2>
...
hh:mm:ss: <message n>

Parameters

- The first line contains the date when the log file was created.
- The second line indicates the maximum size (in Mb) permitted for the file as well as the time, in days, during which it is kept in memory.
- Each of the lines that follow contains a message that describes a connection event (time of event, beginning or end of connection, type of connection, identification of the connected device).

Example

$PASHQ,LOG*33
06:48:34: RST Received on port C
06:48:36: GNSS Started
07:01:19: GSM PSD: Source table requested on port E
07:01:20: GSM PSD: Connected to 83.167.156.123 on port 2101
07:01:22: GSM PSD: Source table received on port E
07:01:24: GSM PSD: Disconnected
07:01:54: GSM PSD: Connected to 83.167.156.123 on port 2101
07:01:54: GSM PSD: Connect to Mount Point:ST2 with Login:bquemener and Password:password
07:01:55: GSM PSD: Connected on Mount Point
...

See Also

$PASHS,LOG,PAR
$PASHS,LOG,DEL
$PASHQ,LOG,LST

LOG,LST: Listing Log Files

Function

This command is used to read the list of log files present in the receiver.

Command Format

Syntax

$PASHQ,LOG,LST[*cc]

Parameters

None.

Response format

Syntax

$PASHR,LOG,LST,d1,d2,s3,d4*cc

Parameters

Parameter	Description	Range
d1	Current number of log files in the receiver	0-900
d2	File index	0-900
s3	Filename	255 characters max.
d4	Size, in bytes	0-134217728
*cc	Optional checksum	*00-*FF

Example

$PASHQ,LOG,LST*54
$PASHR,LOG,LST,4,0,20090408.log,1769897*01
$PASHR,LOG,LST,4,1,20090407.log,1769876*00
$PASHR,LOG,LST,4,2,20090406.log,1769787*03
$PASHR,LOG,LST,4,3,20090405.log,1769787*01

Relevant Set Command

$PASHS,LOG,PAR
$PASHS,LOG,DEL
$PASHQ,LOG

LOG,PAR: Log File Settings

Function

This command is used to read the settings of any new log file created in the receiver.

Command Format

Syntax

$PASHQ,LOG,PAR[*cc]

Parameters

None.

Response format

Syntax

$PASHR,LOG,PAR,s1,d2,d3*cc

Parameters

Parameter	Description	Range
s1	Log file control parameter: • ON: Generation of log files enabled • OFF: Generation of log files disabled	ON, OFF
d2	Maximum size, in Mbytes	1-90
d3	Number of days during which a log file is kept in memory.	1-100
*cc	Optional checksum	*00-*FF

Example

$PASHQ,LOG,PAR*5C
$PASHR,LOG,PAR,OFF,1,20*0F

Relevant Set Command

$PASHS,LOG,PAR

MDM: Modem Status and Parameters

Function

This command is used to query the modem 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 modem option [Z] is not valid.	OFF, ON, INIT, DIALING, ONLINE, NONE

Parameter	Description	Range
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) • 1: 900/1800 (Europe) • 2: 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	Y, N
RNO=d15	Maximum number of re-dials (CSD)	0-15
*cc	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

Relevant Set Command $PASHS,MDM

See also
$PASHQ,MDM,LVL
$PASHQ,MWD
$PASHS,NTR
$PASHS,DIP
$PASHS,MDM,DAL

MDM,LVL: Modem Signal Level

Function This command is used to query the current level of the modem signal.

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 available.	0 to 100 -1
*cc	Checksum	*00-*FF

Example

$PASHQ,MDM
$PASHR,MDM,LVL,-1*7A

See also

$PASHQ,MDM

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,s*cc

Parameters

Parameter	Description	Range
s	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) • 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.

If no data is received or sent through its port over a period of time equal to this timeout, the modem will automatically hang up.

Command Format

Syntax

$PASHQ,MWD[*cc]

Response Format

Syntax

$PASHR,MWD,d1,d2*cc

Parameters

Parameter	Description	Range	Default
d1	Current timeout setting: • 1-99: Modem timeout in minutes. • 0: No timeout	0-99	0
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: Serial port • C: Bluetooth port • E: Modem • M, U: Memory • R: Automatic recording session	A, C, E, M, R, U
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,NMO,c1,d2,f3,d4,n(s5,f6)*cc
(n=18)

Parameters

Parameter	Description	Range
c1	Queried port ID: • A: Serial port • C: Bluetooth port • E: Modem • M, U: Memory • R: Automatic recording session	A, C, E, M, R, U
d2	Baud rate code	0-15 (A) 0, 1 (C, E, 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	22
s5	NMEA message type	ALM, DTM, GGA, GLL, GRS, GSA, GST, GSV, HDT, RMC, VTG, ZDA, ATT, CRT, DCR, DPO, LTN, POS, RRE, SAT, VEC, XDR, PTT

Parameter	Description	Range
f6	Output rate: • 0.05 or 0.1 to 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,6,001.00,23,ALM,0.00,DTM,0.00,GGA,0.00,GLL,0.00,GRS,0.00,GSA,0.00,GST,0.00,GSV,0.00,HDT,0.00,RMC,0.00,VTG,0.00,XDR,0.00,ZDA,0.00,ATT,0.00,CRT,0.00,DCR,0.00,DPO,0.00,LTN,0.00,POS,0.00,PTT,0.00,RRE,0.00,SAT,0.00,VEC,0.00*06

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 or host name
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=Ashtech,PWD=u6huz8,TYP=0*2D

See also

$PASHS,NTR,PAR
$PASHQ,NTR,TBL

NTR,MTP: Connection to Mount Point

Function

This command is used to read the current NTRIP mount point.

Command Format

Syntax

$PASHQ,NTR,MTP[*cc]

Response Format

Syntax

$PASHR,NTR,MTP,s*cc

Parameters

Parameter	Description	Range
s	NTRIP mount point OFF: Connection to a mount point not currently established.	100 characters max. or “OFF”
*cc	Checksum	*00-*FF

Example

$PASHQ,NTR,MTP
$PASHR,NTR,MTP,NAN2*06

Relevant Set Command $PASHS,NTR,MTP

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 NTRIP 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, P, M, L, N (See table below)
s2	Option label	
h3	Hexadecimal unlock code	13 characters max.
*cc	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	20-Hz data output rate enabled
Z	MODEM	GSM/GPRS modem enabled
S	GLONASS	GLONASS enabled
P	GNSSL2	L2 tracking enabled
M	RTK2	RTK using a proprietary data format (ATOM, DBEN or LRK) enabled. Required for a base only generating data in ATOM proprietary format.
L	RTK3	Limited RTK range enabled for a rover. Also gives full RTK capability for a base.
N	STA	RTK base 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

PAR: Receiver Parameters

Function

This command lists the currently used parameters for the specified type of receiver settings. The response is returned on the port routing the query command.

Command Format

Syntax

$PASHQ,PAR[,s1][*cc]

Parameters

Parameter	Description	Range
s1	Type of receiver settings. If s1 is omitted, the response lists the parameters for all types of settings, one after the other.	See table below.
*cc	Optional checksum	*00-*FF

Type	Description
STA	Status information
RCV	Receiver settings.
RTK	RTK and ARROW settings.
PRT	Port information
MEM	Memory information
SES	Session information
RXC	RINEX converter information
ETH	Ethernet information
CST	NTRIP caster information
RDP	Radio information
MDM	Modem information
NET	Network information
XDR	External sensor information
OUT	Output information.

Response Format

Examples

$PASHQ,PAR,STA

```
==============================+================================
 STATUS INFORMATION           |
------------------------------|
 STORED POSITION              | 5539.380104,N,03731.554854,E,270.416 | Computed posit
COMPUTED
 DATE [dd.mm.yyyy]            | 05.09.2008
 UTC TIME [hhmmss.ms]         | 083017.00
 GPS TIME SCALE               | 1495:462631000
 GLO TIME SCALE               | 10475:41417000
 SVS TRACKED                  | 18 (GPS:10 SBA:2 GLO:6)
 SVS USED                     | 13 (GPS:9 SBA:0 GLO:4)                 $PASHQ,POS
 SOLUTION STATUS              | 0
 COORDINATE SYSTEM            | WGS84
==============================+================================
```

$PASHQ,PAR,OUT

```
==============================+================================
 OUTPUT INFORMATION           |
------------------------------|

RAW:---------------------------------------------------------------
---------
    MPC DPC PBN SNV SAL ION SBD SNW SAW SNG SAG
A:  .05 OFF .05 001 OFF OFF ON  001 OFF 001 OFF
B:  OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
C:  OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
F:  OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I:  OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
M:  OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
R:  OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
U:  OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I1: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I2: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I3: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I4: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I5: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I6: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I7: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I8: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF
I9: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF

ATM: --------------------------------------------------------------
---------
    MES PVT ATR NAV DAT  EVT  RNX
A:  OFF OFF OFF OFF OFF  OFF  OFF
B:  OFF OFF OFF OFF OFF  OFF  OFF
C:  OFF OFF OFF OFF OFF  OFF  OFF
F:  OFF OFF OFF OFF OFF  OFF  OFF
I:  OFF OFF OFF OFF OFF  OFF  OFF
```

etc.

The parameters returned by $PASHQ,PAR,OUT should be interpreted as follows:

- “OFF” means the message is currently not output.
- “ON” means it is currently output with the default output rate.
- A specified output rate means this rate has been user-set through the appropriate command.

PEM: Position Elevation Mask

Function

This command is used to read the current value of the 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

POP: Reading Internal Update Rate

Function

This command is used to read the internal update rate currently used for measurements and PVT process.

Command Format

Syntax

$PASHQ,POP[*cc]

Parameters

None.

Response format

Syntax

$PASHR,POP,d*cc

Parameters

Parameter	Description	Range
d	Current update rate, in Hz. Default is 20 Hz.	10, 20
*cc	Optional checksum	*00-*FF

Example

$PASHQ,POP*38
$PASHR,POP,10*16

Relevant Set Command $PASHS,POP

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 differen-tialor 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.mmmmmm)	0-90° 00-59.999999 minutes
c5	North (N) or South (S)	N, S
m6	Longitude of position (ddmm.mmmmmm)	0-180° 00--59.999999 minutes
c7	East (E) or West (W)	E, W
f8	Altitude above the WGS84 ellipsoid	±9999.000
f9	Age of differential corrections, in seconds	0-999

Parameter	Description	Range
f10	True Track/Course Over Ground, in degrees	0.0-359.9
f11	Speed Over Ground, in knots	0.0-999.9
f12	Vertical velocity in dm/s	±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

PPS: PPS Settings

Function This command is used to read the current settings (signal period, offset and valid edge) of the PPS signal.

Command Format

Syntax

$PASHQ,PPS[*cc]

Response Format

Syntax

$PASHR,PPS,f1,f2,c3*cc

Parameters

Parameter	Description	Default	Range
f1	Period, in seconds	0	0.0-0.9; 1-60
f2	Offset in milliseconds	0	±999.9999
c3	Active edge: • R: Rising • F: Falling	R	R, F
*cc	Checksum		*00-*FF

Example

$PASHQ,PPS
$PASHR,PPS,1,500,R*5D

Relevant Set Command $PASHS,PPS

PRT: Baud Rate Settings

Function This command is used to query the baud rate setting for any of the serial ports used in the receiver.

Command Format

Syntax

$PASHQ,PRT[,c1][*cc]

Parameters

Parameter	Description	Range
c1	Port ID	A, C, D, E
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,PRT,c1,d2*cc

Parameters

Parameter	Description	Range
c1	ID of port for which baud rate setting is returned.	A, C, D, E
d2	Baud rate code	0-15 (see table below)
*cc	Checksum	*00-*FF

Code	Baud Rate	Code	Baud Rate
0	300	7	38400
1	600	8	57600
2	1200	9	115200
3	2400	10	230400
4	4800	11	460800
5	9600	12	921600
6	19200	13	1428571

Example

$PASHQ,PRT,A
$PASHR,PRT,A,6*55

Relevant Set Command $PASHS,PRT

See also $PASHQ,CTS
$PASHQ,MDP

PTT: PPS Time Tag

Function

This command asks for the PPS time tag message to be output on the specified port, or on the port on which the query is made if no port is specified.

Command Format

Syntax

$PASHQ,PTT[,c1][*cc]

Parameters

Parameter	Description	Range
c1	Port ID	A, C
*cc	Optional checksum	*00-*FF

Response Format

Syntax

$PASHR,PTT,d1,m2*cc

Parameters

Parameter	Description	Range
d1	Day of week: • 1: Sunday • 7: Saturday	1-7
m2	GPS time tag in hours, minutes, seconds	0-23:59:59.9999999
*cc	Checksum	*00-*FF

Example

$PASHQ,PTT
$PASHR,PTT,6,20:41:02.0000000*2D

Comments

- The response to this command will be sent out once, right after the next PPS pulse is generated.
- The response contains the GPS time at which the PPS pulse was sent, including the offset if an offset was set when the PPS pulse was enabled.
- Being set to a periodical output by the $PASHS,NME,PTT command, this message is independent of the NMEA period. It is only linked to the PPS period.

PWR: 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

Comments

With no internal battery in, fields f4, d5 and d7 are all empty. With no external power source applied, field f6 is empty.

Example

$PASHQ,PWR
$PASHR,PWR,6.8,9.1,2,,,11.6,,44*0D

Relevant Set Command

$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 DPC PBN SNV SNG SNW SAL SAG SAW ION SBD BAUD
PRTA:    ON  OFF  OFF OFF OFF  OFF  OFF OFF OFF  OFF OFF  6
PRTC:    OFF OFF  OFF OFF OFF  OFF  OFF OFF OFF  OFF OFF  1
MEMM: OFF  OFF  OFF OFF OFF  OFF  OFF OFF  OFF  OFF OFF 1
MEMU: OFF  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, DPC, PBN, SNV, SNG, SNW, SAL, SAG, SAW, ION, SBD
PRTA	Serial port	ON, OFF
PRTC	Bluetooth	ON, OFF
MEMM MEMU	Labels for memories M (MEMM: internal memory) and U (MEMU: USB key)	ON-OFF
BAUD	For serial port: Baud rate code For other devices, “0” if not available, else “1”	0-15 (see table below)

Code	Baud Rate	Code	Baud Rate
0	300	7	38400
1	600	8	57600
2	1200	9	115200
3	2400	10	230400
4	4800	11	460800
5	9600	12	921600
6	19200	13	1428571

Relevant Set Command $PASHS,RAW

See also $PASHS,SBA

RCP: Receiver Parameters

Function This command returns the list of pre-defined receiver names, and for user-defined receivers, their GLONASS carrier phase biases.

Command Format

Syntax

$PASHQ,RCP[*cc]
or
$PASHQ,RCP,s1[*cc]

Parameters

Parameter	Description	Range
s1	Name of the receiver (case sensitive). If s1 is omitted, the parameters for all the receivers described in the database are listed.	31 characters max.
*cc	Checksum	*00-*FF

Response Format The response is in user-readable form.

$PASHQ,RCP
PREDEFINED RECEIVER LIST (d1):
ASHTECH ProMark500
ProFlex500 MB500
PM5 MMapper100
ProMark100 ProMark200
MB100 NOVATEL
TRIMBLE SEPTENTRIO
TOPCON
USERDEFINED RECEIVER LIST (d2):
RCV10 RCV11
RCV12 RCV13
…
OWN RECEIVER: ProFlex500
REFERENCE RECEIVER:
RECEIVED RECEIVER:

Where:
- d1 is the number of pre-defined receivers
- d2 is the number of user-defined receivers

- "Own receiver" refers to the name of the receiver
- "Reference receiver" provides the name of the base receiver, as set through the command $PASHS,RCP,REF
- "Received receiver" provides the name of the base receiver, as received through the differential data stream.

$PASHQ,RCP,s1 provides the GLONASS carrier phase biases for the specified, user-defined receiver.

```
$PASHQ,RCP,MyReceiver
MyReceiver:
L1 BIAS: +0.059,+0.613 +0.671 +0.729 +0.786 +0.829 +0.898 +0.949
         +0.000 +0.059 +0.112 +0.182 +0.253 +0.312 +0.373
L2 BIAS: +0.049,+0.667 +0.714 +0.761 +0.808 +0.849 +0.893 +0.947
         +0.000 +0.044 +0.102 +0.153 +0.201 +0.254 +0.292
```

See Also

$PASHS,RCP,REF
$PASHS,RCP,GB1
$PASHS,RCP,GB2

RCP,OWN: Receiver Name

Function

This command is used to read the name assigned to the receiver.

Command Format

Syntax

$PASHQ,RCP,OWN[*cc]

Parameters

None.

Response format

Syntax

$PASHR,RCP,OWN,s1*cc

Parameters

Parameter	Description	Range
s1	Receiver name	ProMark500
*cc	Optional checksum	*00-*FF

Example

$PASHQ,RCP,OWN*4C

$PASHR,RCP,OWN,ProMark500*0E

RCP,REF: Reference Receiver Name

Function

This command is used to query the receiver for the name assigned locally to the base receiver from which the differential stream is received.

Command Format

Syntax

$PASHQ,RCP,REF[*cc]

Parameters

None.

Response format

Syntax

$PASHR,RCP,REF,s1,d2*cc

Parameters

Parameter	Description	Range
s1	Reference receiver name	
d2	Receiver name preference: • 0: s1 is ignored if the incoming reference data contain the reference receiver name • 1: s1 is always used and the decoded reference receiver name is ignored.	0, 1
*cc	Optional checksum	*00-*FF

Example

$PASHQ,RCP,REF*4B
$PASHR,RCP,REF,ASHTECH,0*38

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,n(d3,f4,f5)*cc
Or, if the channel table does not exist: $PASHR,RDP,CHT,s1,0
(Here n=d2)

Parameters

Parameter	Description	Range
s1	Radio Model: • NONE • PDL: Pacific Crest • MGL: Radio transmitter P/N 800986 • MDL: U-Link • LFE: License-free radio, Europe	UNKNOWN, PDL, ADL, MGL, MDL, LFE, NONE
d2	Total number of available channels	0-16 (0-32 for ADL)
d3	Channel index	0-15 (1-32 for ADL)
f4	Receive frequency	410-470 MHz
f5	Transmit frequency	410-470 MHz
*cc	Checksum	*00-*FF

Comments

- Running this command should always be preceded by the execution of the $PASHQ,RDP,PAR command, otherwise the receiver will not respond properly.
- The number of (d3,f4,f5) data sets in the response line is equal to the number of channels (d2).
- The US model of license-free radio (LFA) cannot be interrogated through this command.

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,LVL: Reading the Radio Reception Level

Function This command is used to read the current level of signal at the radio receiver input. Only U-Link Rx and license-free radio receivers can return the current value of this parameter.

Command Format

Syntax

$PASHQ,RDP,LVL,c[*cc]

Parameters

Parameter	Description	Range
c	Identification of the port to which the internal radio receiver is connected.	A, D
*cc	Optional checksum	*00-*FF

Response format

Syntax

$PASHR,RDP,LVL,d1*cc

Parameters

Parameter	Description	Range
d1	Signal level, in dBm	
*cc	Optional checksum	*00-*FF

Example

With U-Link Rx as the internal radio connected to port D:

$PASHQ,RDP,LVL,D*23
$PASHR,RDP,LVL,D,-100*10

See Also $PASHS,RDP,PAR
$PASHS,RDP,TYP

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[,f14][,c15][,c16][,s17][,s18]*cc

Parameters

Parameter	Description	Range
c1	The port ID you specified in the command is replicated in this field	A, D
s2	Radio Model: • NONE: No radio detected • PDL: Pacific Crest PDL RXO or PDL HPB/ LPB • ADL: Pacific Crest ADL Vantage or ADL Foundation • MGL: Radio transmitter P/N 800986 • MDL: U-Link • LFE: License-free radio, Europe (ARF7474B) • LFA: License-free radio, North America (ARF7474A) • UNKNOWN: Auto-detection in progress	PDL, MGL, MDL, LFE, LFA, ADL, NONE, UNKNOWN
s3	Radio state (if port D is queried)	ON, OFF
c4	Channel number	0-15 (PDL, MGL, MDL) 1-32 (ADL) 0-2 (LFE) 0-49 (LFA)
s5	Power management (if port D is queried) • AUT: Automatic • MAN: Manual	AUT, MAN
c6	Protocol used: • 0: Transparent (PDL and MDL only) • 1: TRIMTALK (PDL only) • 2: DSNP • 3: SATEL	0-3
c7	Air link speed	4800, 7600, 8000, 9600, 16000, 19200
s8	Radio sensitivity (for PDL, ADL and MDL)	LOW, MED, HIG, OFF

Parameter	Description	Range
f9	Receive frequency, in MHz	410-470
f10	Transmit frequency, in MHz	410-470
c11	Channel spacing, in kHz: • MGL and MDL: 12.5 only • PDL: 12.5 or 25	12.5, 25
s12	RF band, in MHz (for PDL only)	410-430, 430-450, 450-470
s13	Firmware version	
f14	Central frequency setting (MDL only)	410-470 MHz
c15	Scrambler status (PDL only): • 0: Off • 1: On	0, 1
c16	Forward Error Correction status (PDL only): • 0: FEC Off • 1: Hamming FEC On	0, 1
S17	RF output level (licence-free radios only), in mW	100, 200, 500
s18	Modulation format (PDL and ADL only)	4FSK, GMSK
*cc	Checksum	*00-*FF

Examples

If an internal PDL radio receiver is used:

$PASHQ,RDP,PAR,D
$PASHR,RDP,PAR,D,PDL,ON,0,AUT,0,4800,MED,444.5500,446.7750,12.5,430-450,V02.58,,0,0*03

If an internal U-Link Rx is used:

$PASHQ,RDP,PAR,D
$PASHR,RDP,PAR,D,MDL,ON,4,AUT,0,9600,MED,447.1000,447.1000,12.5,,V01.00,445.5500*20

If an external radio transmitter P/N 800986 is used:

$PASHQ,RDP,PAR,D
$PASHR,RDP,PAR,D,MGL,,1,,,,,0.0000,447.1000,,,TD20-EUHFV10300*01

Comments

The command will be NAKed if the receiver has not been told the radio is on the specified port using command $PASHS,RDP,TYP.

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 replicated in this field	A, D
s2	Radio Model: • NONE: No radio detected • PDL: Pacific Crest • MGL: Radio transmitter P/N 800986 • MDL: U-Link • LFE: License-free radio, Europe • LFA: License -free radio, North America • ADL: Pacific Crest ADL • UNKNOWN: Auto-detection in progress	NONE, PDL, MGL, MDL, LFE, LFA, ADL, UNKNOWN
*cc	Checksum	*00-*FF

Examples

If an external radio transmitter P/N800986 is used:

$PASHQ,RDP,TYP,A
$PASHR,RDP,TYP,A,MGL*44

If an internal PDL radio receiver is used:

$PASHQ,RDP,TYP,D
$PASHR,RDP,TYP,D,PDL*5F

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 in progress. Receiver will start recording data automatically when you next turn it on. • N: No. No data recording in progress. Receiver will not start recording data automatically when you next turn it on. • S: Stop. No data recording in progress but the receiver will start recording data automatically when you next turn it on. • R: Record. Data recording in progress but the receiver will not start recording data automatically when you next turn it on.	Y, N, S, R
*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: RTK (Unlimited RTK) • F: FASTOUTPUT • Z: MODEM • S: GLONASS • P: GNSSL2 • M: RTK2 (RTK using proprietary formats) • L: RTK3 (Limited RTK range) • N: STA (RTK base)	8 characters
s5	Not used	
s6	Serial number	9 characters
*cc	Checksum	*00-*FF

Example

$PASHQ,RID*28
$PASHR,RID,PM,30,S020G010,KFZS----,,200751223*14

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: Navigation receiver warning	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

RNX,MSI: ATOM RNX Differential Message

Function

This command allows you to read the current settings of the ATOM RNX message.

Command Format

Syntax

$PASHQ,RNX,MSI[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,RNX,MSI,d1,d2,d3*cc

Parameters

Parameter	Description	Range
d1	Scenario number	1-4, 101, 201-204, 300
d2	Output rate for observations, in seconds.	0.1-0.4 if [F] option activated. 0.5-0.9 1-1800
d3	Output rate for attributes (receiver and antenna names), in seconds.	0:Disabled 1-1800
*cc	Checksum	*00-*FF

Example

$PASHQ,RNX,MSI
$PASHR,RNX,MSI,4,1.0,31*7E

Relevant Set Command

$PASHS,RNX,TYP

RRE: Residual Error

Function

This command is used to output a range residual message. The message is not output until a position solution is computed.

Command Format

Syntax

$PASHQ,RRE[*cc]

Response Format

Syntax

$PASHR,RRE,d1,n(d2,f3),f4,f5*cc

Parameters

Parameter	Description	Range
d1	Number of satellites used to compute the position	3-27
d2	Satellite number	GPS: 1-32 SBAS: 33-64 GLONASS: 65-96
f3	Range residual	±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    9   16   18   19   20   21   22
FRQ: 0  30   0    1    1    0    0   30
TYP: 23 24  31   32   34  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:
```

MSG:No User Message

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, 31, 1001, 1002, 1003, 1004, 1009, 1010, 1011, 1012
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: • AUT, in rover mode, when the differential reception mode is "AUT" (see $PASHS,CPD,REM). • One or two ports, in rover mode, when the differential reception mode is "MAN" (see $PASHS,CPD,REM) • One or two ports, in base mode (see $PASHS,BAS). Only if RT2 or RT3 is used.	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,n(d2,d3)*cc

Parameters

Parameter	Description	Range
d1	Number of RTCM message types in the RTCM output message	32
d2	RTCM message type	1, 3, 9, 16, 18-24, 31, 32, 34, 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,32,1,0.0,3,30.0,9,0.0,16,0.0,18,1.0,19,1.0,20,0.0,21,0.0,22,30.0,23,0.0,24,0.0,31,0.0,32,0.0,34,0.0,36,0.0,1001,0.0,1002,0.0,1003,0.0,1004,1.0,1005,0.0,1006,13.0,1007,0.0,1008,0.0,1009,0.0,1010,0.0,1011,0.0,1012,1.0,1013,0.0,1019,0.0,1020,0.0,1029,0.0,1033,31.0*5C

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,n(s5,f6,c7)*cc
Where n=8

Parameters

Parameter	Description	Range
c1	The port ID specified in the command is reminded in this field: • A: Serial port • C: Bluetooth port • M, U: Memory	A, C, M, U
d2	Baud rate code for serial port. For other devices, “0” if not available, else “1”	0-9 (A). See table below 0-1 (C, M, U)
f3	Output rate defined by the last $PASHS,RAW,PER command run	0-999.9
d4	Number of raw data messages	11
s5	Raw data message types	MPC, DPC, PBN, SNV, SNG, SNW, SAL, SAG, SAW, ION, SBD
f6	Output rate 0: Message disabled	0-999.00
c7	ASCII/Binary setting. Always binary	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
4	4800	9	115200

Example

$PASHQ,RWO,A
$PASHR,RWO,A,9,001.00,11,MPC,0.00,B,DPC,0.00,B,PBN,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,SBD,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,n(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 • -: SV 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

Relevant Set Command

$PASHS,SBA

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 Set Command

$PASHS,SIT

See also $PASHQ,FLS

SNM: Signal-to-Noise Ratio Mask

Function

This command returns the current value assigned to the signal-to-noise ratio (SNR) mask. Any satellite received with an SNR value for the C/A code signal less than this mask will be rejected from the PVT computation.

Command Format

Syntax

$PASHQ,SNM[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,SNM,d1*cc

Parameters

Parameter	Description	Range
d1	Signal-to-Noise ratio mask, in dB.Hz	0-60
*cc	Checksum	*00-*FF

Example

$PASHQ,SNM
$PASHR,SNM,45*09

Relevant Set Command $PASHS,SNM

SOM: Signal Observations Masking

Function

This command is used to read the type of mask currently applied to signal observations.

Command Format

Syntax

$PASHQ,SOM[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,SOM,d*cc

Parameters

Parameter	Description	Range
s	Mask type: • 0: No masking • 1: Reference station • 2: Static base • 3: Moving base • 4: Rover • 9: User-defined	0-4, 9
*cc	Checksum	*00-*FF

Example

$PASHQ,SOM
$PASHR,SOM,4*3D

Relevant Set Command

$PASHS,SOM

SOM,CTT: Cumulative Tracking Time Mask

Function

This command is used to read the current setting of the cumulative tracking time mask applied to signal observations. This mask is active only when applying masks to signal observations has been set to be user defined (see $PASHS,SOM).

Command Format

Syntax

$PASHQ,SOM,CTT[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,SOM,CTT,d1,d2*cc

Parameters

Parameter	Description	Range	Default
d1	Mask applied to differential data, in seconds	0-255	10
d2	Mask applied to raw data, in seconds	0-255	10
*cc	Checksum	*00-*FF	

Example

$PASHQ,SOM,CTT
$PASHR,SOM,CTT,10*67

Relevant Set Command $PASHS,SOM,CTT

See Also $PASHS,SOM

SOM,NAV: Navigation Data Mask

Function This command is used to read the current setting of the navigation data mask applied to signal observations. This mask is active only when applying masks to signal observations has been set to be user defined (see $PASHS,SOM).

Command Format

Syntax

$PASHQ,SOM,NAV[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,SOM,NAV,s1,s2*cc

Parameters

Parameter	Description	Range	Default
s1	Mask applied to differential data	ON, OFF	ON
s2	Mask applied to raw data	ON, OFF	OFF
*cc	Checksum	*00-*FF	

Example

$PASHQ,SOM,NAV
$PASHR,SOM,NAV,ON,ON*50

Relevant Set Command $PASHS,SOM,NAV

See Also $PASHS,SOM

SOM,SNR: Signal-to-Noise Ratio Mask

Function This command is used to read the current setting of the signal-to-noise ratio mask applied to signal observations. This mask is active only when applying masks to signal observations has been set to be user defined (see $PASHS,SOM).

Command Format

Syntax

$PASHQ,SOM,SNR[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,SOM,SNR,d1,d2*cc

Parameters

Parameter	Description	Range	Default
d1	Mask applied to differential data, in dBHz	0-60	28
d2	Mask applied to raw data, in dBHz	0-60	28
*cc	Checksum	*00-*FF	

Example

$PASHQ,SOM,SNR
$PASHR,SOM,SNR,28,28*46

Relevant Set Command $PASHS,SOM,SNR

See Also $PASHS,SOM

SOM,WRN: Channel Warnings Mask

Function

This command is used to read the current setting of the channel warnings mask applied to signal observations. This mask is active only when applying masks to signal observations has been set to be user defined (see $PASHS,SOM).

Command Format

Syntax

$PASHQ,SOM,WRN[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,SOM,WRN,s1,s2*cc

Parameters

Parameter	Description	Range	Default
s1	Mask applied to differential data	ON, OFF	ON
s2	Mask applied to raw data	ON, OFF	OFF
*cc	Checksum	*00-*FF	

Example

$PASHQ,SOM,WRN
$PASHR,SOM,WRN,ON,ON*42

Relevant Set Command

$PASHS,SOM,WRN

See Also

$PASHS,SOM

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,d*cc

Parameters

Parameter	Description	Range
d	Station ID	0-1023 (RTCM 2.3) 0-4095 (RTCM 3.x) 0-31 (CMR & CMR+)
*cc	Checksum	*00-*FF

Example

$PASHQ,STI
$PASHR,STI,817*28

Relevant Set Command

$PASHS,STI

SVM: Satellite Use Mask

Function

This command is used to read the current setting of the satellite use mask defining the maximum number of code or Doppler observations used in the PVT calculation.

Command Format

Syntax

$PASHQ,SVM[*cc]

Parameters

None.

Response Format

Syntax

$PASHR,SVM,d1*cc

Parameters

Parameter	Description	Range	Default
d1	Maximum number of code/Doppler observations used in PVT.	0-26	14
*cc	Checksum	*00-*FF	*00-*FF

Example

$PASHQ,SVM
$PASHR,SVM,25*17

Relevant Set Command $PASHS,SVM

UDP: User-Defined Dynamic Model

Function This command is used to query the parameters of the user-defined dynamic model.

Command Format

Syntax

$PASHQ,UDP[*cc]

Response Format

Syntax

$PASHR,UDP,f1,f2,f3,f4*cc

Parameters

Parameter	Description	Range	Default
f1	Maximum expected horizontal velocity, in m/s	0-100 000	100 000
f2	Maximum expected horizontal acceleration, in m/s^2	0-100	100
f3	Maximum expected vertical velocity, in m/s	0-100 000	100 000
f4	Maximum expected vertical acceleration, in m/s^2	0-100	100
*cc	Checksum	*00-*FF	

Example

$PASHQ,UDP
$PASHR,UDP,100000.00,100.00,100000.00,100.00*35

Relevant Set Command $PASHS,UDP

See Also $PASHS,DYN

UNT: Distance Unit Used on Display Screen

Function

This command allows you to know which distance unit is currently used on the receiver display screen to express the coordinates of the computed position.

Command Format

Syntax

$PASHQ,UNT[*cc]

Response Format

Syntax

$PASHR,UNT,s*cc

Parameters

Parameter	Description	Range
s	Distance unit used: • M: Meters • F: US Survey Feet • IF: International Feet	M, F, IF
*cc	Checksum	*00-*FF

Example

$PASHQ,UNT
$PASHR,UNT,M*5A

Relevant Set Command

$PASHS,UNT

UTS: GPS Time Synchronization Status

Function

This command gives the status of the GPS time synchronization process. When enabled, this process allows all measurements and coordinates to be synchronized with GPS time, and not with the local clock.

Command Format

Syntax

$PASHQ,UTS[*cc]

Response Format

Syntax

$PASHR,UTS,s*cc

Parameters

Parameter	Description	Range
s	GPS time synchronization status	ON, OFF
*cc	Checksum	*00-*FF

Example

$PASHQ,UTS
$PASHR,UTS,ON*0B

Relevant Set Command

$PASHS,UTS

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	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

See Also $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
RECEIVER version: S402Gt21
SYST fw: S056
GNSS fw: Gt21
KERNEL: 2.6.19-pm4 #204 Fri Apr 3 14:29:24
RESCUE: 2.6.19-rescue
BOOT LOADER: 1.1.5.6
PMU: 2.31.0
API: 1.214
BSP: 1.0-200
GNSS S/N: 702100B200812104
GNSS Options: WJKLEYGSVHCP
RFS: 403
GSM: 6.63c IMEI : 354060010607238 stack IP :
Internal Radio: PDL V02.58

Comments In the GSM: information line, the GSM version will appear only after the modem has been turned on. The stack IP version will appear only after a GPRS connection has been established.

See also $PASHQ,RID

VTG: Course Over Ground and Ground Speed

Function This command is used to output a VTG message. The message is not output until a valid position is computed.

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	000.00-359.99
f2,M	COG (with respect to Magnetic North) M for “Magnetic” North: COG orientation	000.00-359.99
f3,N	SOG (Speed Over Ground) N for “knots”: SOG unit	000.00-999.99
f4,K	SOG (Speed Over Ground) K for “km/hr”: SOG unit	000.00-999-99
c5	Mode indicator: • A: Autonomous mode • D: Differential mode • N: Data not valid	A, D, N
*cc	Checksum	*00-*FF

Comments

The magnetic table used is the WMM-2005 (published Dec 2004), which is the standard model of the US Department of Defense (WMM for “World Magnetic Model”).

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 *List of Alarms on page* 189

Parameter	Description	Range
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

Example

$PASHQ,WARN
$PASHR,WARN,connect. to GPRS failed,PENDING*7F

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

NOTE: The time offset is always reported as null (d5= d6= 0).

Relevant Set Command $PASHS,ZDA

See also $PASHS,LTZ
$PASHS,NME

Appendix D. Output Message Library

ION: Ionosphere Parameters

This message contains the ionosphere and GPS-to-UTC data conversion parameters.

The message is as follows:

$PASHR,ION,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
Float	a0	4	Ionospheric parameter (seconds)
Float	a1	4	Ionospheric parameter (seconds/semi-circle)
Float	a2	4	Ionospheric parameter (seconds/semi-circle)
Float	a3	4	Ionospheric parameter (seconds/semi-circle)
Float	b0	4	Ionospheric parameter (seconds)
Float	b1	4	Ionospheric parameter (seconds/semi-circle)
Float	b2	4	Ionospheric parameter (seconds/semi-circle)
Float	b3	4	Ionospheric parameter (seconds/semi-circle)
Double	A1	8	First order terms of polynomial
Double	A0	8	Constant terms of polynomial
Unsigned long	Tot	4	Reference time for UTC data
Short	Wnt	4	UTC reference week number
Short	DtLS	2	GPS-UTC differences at reference time
Short	WnLSF	2	Week number when leap second became effective
Short	DN	2	Day number when leap second became effective
Short	DtLSF	2	Delta time between GPS and UTC after correction
Short	Wn	2	GPS week number
Unsigned long	Tow	4	Time of the week (in seconds)
Short	bulwn	2	GPS week number when message was read
Unsigned long	bultow	4	Time of the week when message was read

Type	Name	Size	Contents
Unsigned short	Check-sum	2	The checksum is computed by breaking the structure into 37 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total		76	

The GPS broadcast ionosphere model (Klobuchar) is used.

MPC: GNSS Measurements

This message contains the measurement of one satellite for one epoch.

The message is as follows:

$PASHR,MPC,<structure>

The message's binary structure is described in the table below.

Type	Size	Contents
Unsigned short	2	Sequence tag (unit: 50 ms) modulo 30 minutes
Unsigned char	1	Number of remaining structure to be sent for current epoch
Unsigned char	1	Satellite index number GPS: 1-32 SBAS: 33-51 GLONASS: 65-88
Unsigned char	1	Satellite elevation angle (degree)
Unsigned char	1	Satellite azimuth angle (2-degree increments)
Unsigned char	1	Channel ID not duplicated for the current epoch
	29	C/A code data block (29 bytes)
Unsigned char	1	Warning flag Bit1, Bit2: 0,0: Code and/or carrier phase measured but measurement was not used to compute position. 1,0: Code and/or carrier phase measured, navigation message was obtained and measurement was used to compute position but position wasn't finally computed. 0,1: Code and/or carrier phase measured, navigation message was obtained, measurement was used to compute position and position was computed successfully. Bit3: Carrier phase questionable Bit4: Code phase (range) questionable Bit5: Range not precise (code phase loop not settled) Bit6: Z tracking mode Bit7: Possible cycle slip Bit8: Loss of lock since last epoch

Type	Size	Contents
Unsigned char	1	Indicates quality of the position measurement (good/bad) 0: Measurement not available and no additional data will be sent. 23: Code and/or carrier phase measured, navigation message was obtained and measurement was used to compute position but position wasn't finally computed. 24: Code and/or carrier phase measured, navigation message was obtained, measurement was used to compute position and position was computed successfully. Other state: measurement was not used to compute position.
Unsigned char	1	Polarity of the phase tracking 0: Polarity unknown 5: Polarity known
Unsigned char	1	Signal-to-noise ratio for satellite observation (db.Hz)
Unsigned char	1	Always 0. Not used.
Double	8	Full carrier phase measurements in cycles
Double	8	Raw range to SV (in seconds), i.e. receive time - raw range = transit time
Long	4	Doppler (10^{-4} Hz)
Long	4	Smoothing Bits 0-22: magnitude of smooth correction in centimeters Bit 23: sign of smooth correction Bits 24-31: smooth count, unsigned, as follows: 0=unsmoothed 1=least smoothed 255=most smoothed
	29	**L1 block**, same format as C/A code data block (see note below)
	29	**L2 block**, same format as C/A code data block (see note below)
Unsigned char	1	Checksum, a bytewise exclusive OR (XOR)
Total of bytes	95	

NOTES:

- The sequence tag for GLONASS satellites is x seconds less than the sequence tag for GPS satellites, due to the difference between the UTC (used for GLONASS) and GPS system time scales.
- The raw range for GLONASS satellites contains a time shift of x seconds, i.e. x seconds more than for GPS

satellites in the same conditions. “x” is as defined in the previous note.

- In case of GPS L1/L2P tracking mode, the **L1 block** contains L1P data. In case of GPS L2CS tracking mode, the **L1 block** contains zero data. In case of GLONASS-M satellites, the **L1 block** contains zero data.
- In case of GPS L1/L2P, the **L2 block** contains L2P data. In case of GPS L2CS tracking mode, the **L2 block** contains L2CS data. In case of GLONASS-M satellites, the **L2 block** contains C/A data on the L2 frequency

DPC: Compact GPS Measurements

This message contains the L1/L2 measurements from all tracked GPS satellites for one epoch.

The message is as follows:

$PASHR,DPC,<structure>

The message's binary structure is described in the table below.

Type*	Size in bits	Resolution	Contents
Unsigned short	16		Message length. Number of bytes in the <packed data> section.
PACKED DATA			
Double	32	1 msec	Receiver time in GPS milliseconds of week
Char[4]	32		Receiver's four-character ID
Unsigned long	32		Mask representing satellites that are contributors to the message content. This is a bitwise indication: Starting from the least significant bit, bit1 corresponds to SV PRN#1, bit2 corresponds to SV PRN#2, and so on. Bit value "1" for a given SV PRN means the corresponding satellite is a data contributor to this message, "0" otherwise.
The data that follow are repeated for each satellite presented in the satellite mask			
Unsigned char	1		Satellite health ("0" means Sat is unhealthy)
Unsigned char	7	1 degree	Satellite elevation
Unsigned char	1		RAIM status (always zero)
Unsigned char	7	1 dBHz	SNR of L1CA observation
#L1 Data Block (L1CA in all cases)			
Double	31	0.1 nsec	Raw range in 0.1 nsec (range is smoothed by carrier). "0" means bad raw range data.
Unsigned char	1		Warning flag ("1" means bad carrier phase with possible cycle slips)
Unsigned char	1		Sign of total carrier phase ("1": negative; "0":positive)
Double	28	1 cycle	Integer part of total carrier phase in cycles
Double	11	0.0005 cycles	Fractional part of phase in 0.0005 cycles
Double	24	0.002 Hz	Doppler in units of 0.002 Hz
#L2 Data Block (L2P for CFG,2&4 and L2C for CFG,3&5) Content and data packing scheme is the same as for L1 Data			
CHECKSUM			
Unsigned short	16		Cumulative unsigned short sum of the <packed data>, after <message length> and before <checksum>

The data in this message are packed in bits rather than bytes. So the presented types of fields are just for the sake of giving a meaningful description of the original data packing.

NOTES:

- Most of the fields found in the DPC and DBEN data outputs are similar.
- DPC data are affected by the last $PASHS,UTS command run. By default, this command is set to “ON”.
- DPC data are affected by the last $PASHS,ANP,OUT command run.
- DPC data can be made available on several ports simultaneously.
- DPC data can be output at a rate of up to 20 Hz, but the throughput compared to RTCM-3, CMR and ATOM may be quite higher.
- DPC data are not considered to be used as a differential protocol, i.e. they are simply generated, and so not processed to become corrections.

PBN: Position Information

This message contains position information in binary format.

The message is as follows:

$PASHR,PBN,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
Long	pbentime	4	GPS time when data was received (ms of week)
Char	sitename	4	Site name
Double	navx	8	Station position: ECEF-X (m)
Double	navy	8	Station position: ECEF-Y (m)
Double	navz	8	Station position: ECEF-Z (m)
Float	navt	4	Clock offset (m)
Float	navxdot	4	Velocity in ECEF-X (m/s)
Float	navydot	4	Velocity in ECEF-Y (m/s)
Float	navzdot	4	Velocity in ECEF-Z (m/s)
Float	navtdot	4	Clock drift (m/s)
Unsigned short	pdop	2	PDOP multiplied by 100
Unsigned short	checksum	2	The checksum is computed by breaking the structure into 27 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total of bytes		56	

When for example after a cold start, the receiver has no correct time tag, the PBN message is output with a fixed "zero" time tag.

Unlike all the other position messages, the position provided in a PBN message *cannot* be an RTK position. It can only be a standalone, SBAS or DGNSS position.

SBA,DAT: SBAS Data Message

This message is output in response to $PASHQ,SBD,... It is in the form:

$PASHR,SBA,DAT,d1,m2,d3,d4,s5*cc

Where

Parameter	Description	Range
d1	SBAS SV ID number	33-51
m2	Time tag: hhmmss.hh The SBA,DAT message contains the time tag of the beginning of WAAS message transmission (WAAS message transmission time is 1 second)	000000.00-235959.99
d3	RTCA message ID	0-63
d4	Error flags (in HEX): bit0-preamble error, bit1-parity error	0-2
s5	RTCA message: 250 bit in 63 HEX numbers. The data lie from left to right and from high-order to low-order bits. The two low-order bits in the 63rd number are not used.	
*cc	Checksum, computed by "exclusive-ORing" all of the bytes in the message between, but not including, the "$" and the "*". The result is "*cc" where c is a hexadecimal character.	*00-*FF

SAL: GPS Almanac Data

This message contains almanac data for one GPS satellite. The message is as follows:

$PASHR,SAL,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
Short	prn	2	Satellite PRN number minus 1 (0-31)
Short	health	2	Satellite health
Float	e	4	Eccentricity
Long	toe	4	Reference time for orbit (sec)
Float	i0	4	Inclination angle at reference time (semi-circles)
Float	w dot	4	Rate of right ascension (semi-circles/sec)
Double	A1/2	8	Square root of semi-major axis (meters1/2)
Double	w0	8	Longitude of ascending node (semicircles)
Double	w	8	Argument of perigee (semicircles)
Double	M0	8	Mean anomaly at reference time (semi-circle)
Float	Af0	4	Clock correction (sec)
Float	Af1	4	Clock correction (sec/sec)
Short	wna	2	Almanac week number
Short	wn	2	GPS week number
Long		4	Seconds of GPS week
Unsigned short	Check-sum	2	The checksum is computed by breaking the structure into 34 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total		70	

SAG: GLONASS Almanac Data

This message contains almanac data for one GLONASS satellite.

The message is as follows:

$PASHR,SAG,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
Short	prn	2	Satellite number 1-24
Short	frq	2	Satellite GLONASS frequency number [-7,…,6]
Short	health	2	Satellite health 0=bad, 1=good
Float	e	4	Eccentricity
Long		4	Reference day number (days in range 1 to 1461)
Float		4	Correction to inclination (semicircles)
Float	w0	4	Longitude of first ascending node (semicircles)
Float		4	Reference time of longitude of first node (seconds)
w	Float	4	Argument of perigee (semicircles)
Float	Af0	4	Correction to mean value (43200 s) of Draconic period
Float	Af1	4	Af1=d(Af0)/dt(sec/sec)
Float		4	Satellite clock offset (seconds)
Unsigned short	Checksum	2	The checksum is computed by breaking the structure into 21 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total		44	

SAW: SBAS Almanac Data

This message contains almanac data for one SBAS satellite. The message is as follows:

$PASHR,SAW,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
char	Id	1	Data ID
char	Health	1	Satellite Health&Status bitwise meaning is: Bit0 – Ranging On(0), Off(1) Bit1 – Corrections On(0), Off(1) Bit2 – Broadcast Integrity On(0), Off(1) Bit3 – Reserved Bit4-7 – SBAS provider ID (0-15): 0 – WAAS, 1 – EGNOS, 2 – MSAS, 3-13 – Not assigned yet, 14-15 – Reserved
long	T0	4	Almanac data reference time within the day expressed in the SBAS time scale (seconds)
float		3*4	Satellite ECEF X,Y,Z coordinates (meters)
float		3*4	Satellite ECEF velocity X', Y', Z' coordinates (m/s)
long	Tow	4	Time within week in GPS time scale when SBAS almanac was received
char	Wn	1	Week number in GPS time scale modulo 256 when SBAS almanac was received
char	Prn	1	Satellite number (33 to 51)
Unsigned short	Check-sum	2	The checksum is computed by breaking the structure into 18 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total		38	

SNG: GLONASS Ephemeris Data

This message contains the GLONASS ephemeris data for one satellite.

The message is as follows:

$PASHR,SNG,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
Long		4	Start time of 30-second frame in satellite time scale tk from which the ephemeris data is derived; time modulo one day (seconds)
Short		2	Day number of 30-second frame; modulo four-year period counting from beginning of last leap year, which corresponds to parameter tb (tb is set within this day number). This parameter varies within the range 1 to 1461. If day number=0, the day number is unknown (absent in navigation frame)
Long		4	Ephemeris data reference time within the day expressed in GLONASS system time scale = UTC + 3 hours (seconds)
Float		4	Frequency offset gh of the on-board frequency standard at tb (dimensionless)
Float		4	Bias tn between satellite time scale and GLONASS system time scale at tb (seconds)
Double		3*8	Satellite ECEF (PZ-90) X, Y, Z coordinates (km)
Float		3*4	Satellite ECEF (PZ-90) velocity X', Y', Z' (km/sec)
Float		3*4	Satellite perturbation acceleration X", Y", Z" due to moon and sun (km/sec/sec).
Double		8	Bias between GLONASS system time scale and UTC + 3 hours time scale tc (seconds)
Char		1	Age of ephemeris parameter En (interval from moment when ephemeris data was last uploaded to tb)
Char		1	Combined 3-bit flag (contains Ï1, Ï 2, Ï 3)
Char		1	Satellite health status flag (0=good, 1=bad)
Char		1	Satellite frequency channel number [-7,…,6]
Short		2	Satellite system number (satellite number [1,…,24])

Type	Name	Size	Contents
Unsigned short	Check-sum	2	The checksum is computed by breaking the structure into 40 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total		82	

SNV: GPS Ephemeris Data

This message contains the GPS ephemeris data for one satellite.

The message is as follows:

$PASHR,SNV,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
Short	Wn	2	GPS week number
Long	Two	4	Seconds in GPS week
Float	Tgd	4	Group delay (sec)
Long	Aodc	4	Clock data issue
Long	Toc	4	Clock data reference time (sec)
Float	af2	4	Clock correction (sec/sec^2)
Float	af1	4	Clock correction (sec/sec)
Float	af0	4	Clock correction (sec)
Long	Aode	4	Orbit data issue
Float	Dn	4	Mean anomaly correction (semicircles/sec)
Double	M0	8	Mean anomaly at reference time (semicircles)
Double	e	8	Eccentricity
Double	$A^{1/2}$	8	Square root of semi-major axis (meters $^{1/2}$)
Long	toe	4	Reference time for orbit (sec)
Float	cic	4	Harmonic correction term (radians)
Float	crc	4	Harmonic correction term (meters)
Float	cis	4	Harmonic correction term (radians)
Float	crs	4	Harmonic correction term (meters)
Float	cuc	4	Harmonic correction term (radians)
Float	cus	4	Harmonic correction term (meters)
Double	omega0	8	Longitude of ascending node (semicircles)
Double	omega	8	Argument of perigee (semicircles)
Double	i0	8	Inclination angle (semicircles)
Float	omega dot	4	Rate of right ascension (semicircles/sec)
Float	I dot	4	Rate of inclination (semicircles/sec)
Short	Accuracy	2	User range accuracy

Type	Name	Size	Contents
Short	Health	2	Satellite health
Short	fit	2	Curve fit interval
Char	prn	1	Satellite PRN number minus 1 (0-31)
Char		1	Reserved byte
Unsigned short	Checksum	2	The checksum is computed by breaking the structure into 37 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total		76	

SNW: SBAS Ephemeris Data

This message contains the SBAS ephemeris data for one satellite.

The message is as follows:

$PASHR,SNW,<structure>

The message's binary structure is described in the table below.

Type	Name	Size	Contents
char	-	1	Spare field
char	accuracy	1	Accuracy
long	T0	4	Ephemeris data reference time within the day expressed in the SBAS time scale (seconds)
double		3*8	Satellite ECEF X,Y,Z coordinates (meters)
float		3*4	Satellite ECEF velocity X', Y', Z' coordinates (m/s)
float		3*4	Satellite ECEF acceleration X",Y",Z" (m/s2)
float	aGf0	4	Time offset between satellite time scale and SBAS system time scale (seconds)
float	aGf1	4	Time drift between satellite time scale and SBAS system time scale (seconds)
long	tow	4	Time within week in GPS time scale when SBAS ephemeris was received
char	wn	1	Week number in GPS time scale when SBAS ephemeris was received
char	prn	1	Satellite number (33 to 51)
Unsigned short	Checksum	2	The checksum is computed by breaking the structure into 34 unsigned shorts, adding them together, and taking the least significant 16 bits of the result.
Total		70	

Symbols

Z

ProMark™500

Reference Manual

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