Important Recommendations

1. Ashtech Aquarius and Aquarius² are high-precision navigation instruments. They should not however replace the need for good judgment and careful navigation using traditional methods.

2. Using and connecting Ashtech Aquarius or Aquarius² to any navigation peripheral does not make it less necessary for navigators to be cautious and continually on the watch.

3. Like for any other GPS receiver, the performance of Aquarius and Aquarius² is subject to the decisions of the US Department Of Defense, which has full control of the GPS. At any time the DOD can decide to impair the precision and availability of the GPS signals worldwide without the possibility for GPS users to claim for damages.

4. Thales Navigation and its distributors shall not be liable for errors contained herein or for incidental consequential damages in connection with the furnishing, performance, or use of this equipment.

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July 2002

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Conventions used: ♣ symbol indicates end of section.

About this manual

This manual is split into 12 sections.

Section 1 provides an accurate description of the receiver and all its accessories as well as the detail of all the possible hardware and software options.

Section 2 gives instructions on where and how to install the receiver and its antenna(s). Installation of the TRM100 PC software and the main options available is also presented.

Section 3 tells you how to get Aquarius or Aquarius² started assuming the installation phase described in Section 2 is complete. Section 3 guides you in this phase until operational status is reached.

In fact, this section describes all the functions of the TRM100. Basically, the TRM100 is the Aquarius or Aquarius² front panel. An important thing to know is that the TRM100 also comes as a software program, called TRM100 PC Software - part of the standard supply. There is however two additional functions in the TRM100 PC software allowing users to control the receiver directly via the set of available $PDAS commands or, in the case of Aquarius², to display heading measurements on a compass rose.

Section 4 reviews all the possible position processing modes, listing the requirements in terms of hardware and software and explaining the basic way to implement these modes in the receiver from the TRM100 display screen.

Another way of implementing these modes, based on the use of $PDAS commands, is also presented. This method is more particularly intended for expert users.

Section 5 is a review of the processing modes specific to Aquarius². It is built in on the same basis as Section 4.

Section 6 is an overview of the TRM100 PC Software. It tells you how to connect the PC running this software to Aquarius and how to use the Remote Display view. A thorough description of the Terminal view is also provided. This view allows you to communicate with Aquarius using $PDAS commands (the only language understood by the receiver!).

Section 7 deals with the use of Aquarius at a reference station or as a secondary mobile for which relative positioning is determined at a primary mobile.

Section 8 describes the computed data outputs that can be enabled if you use the receiver's default configuration.

Section 9 describes the raw data outputs in ASCII format.

Section 10 describes the raw data outputs in binary format.

Section 11 contains an accurate description of all the $PDAS commands and standard NMEA commands that can be sent to the receiver.

Section 12 discusses various topics gathered under the name of Appendices.

Table of Contents

1. Equipment Description

(Thales Navigation reserves the right to make changes to the list below without prior notice.)

Standard Supply

❑ Aquarius

The Ashtech Aquarius-01 (PO100751) or Aquarius-02 (PO100752) receiver is delivered in a ruggedized container in which the following items are provided:

- 1× Aquarius-01 or 02 unit - depending on purchase order - fitted with a single GNSS sensor
- 1× GPS antenna NAP001 or NAP002 depending on purchase order (NAP 001: PO76311B; NAP 002: PO101158)
- Firmware modules: RAWDAT, WAAS/EGNOS, KARTMODE, USERGEOID, FASTOUTPUT
- 1× power cord, 2 meters (PO067035)
- 2× data cord, DB9 male / DB9 female, 2 meters (PO101243)
- 1× RS232/RS422 converter cable (PO75675A)
- 1× TRM 100 unit (PO100722) consisting of the following:
  - 1× detachable keypad/display terminal (PO100599), in fact the receiver front panel
  - 1× data cord, DB15 male/DB15 female, 1 meter (PO100688)
  - 1× mounting bracket + knobs and screws (PO101297)

    (*Last two items used only if TRM100 detached from receiver to be used as remote unit.*)
- Mounting bracket for entire receiver (Aquarius + TRM100 unit)
- 1× User Manual (the present manual)
- 1× CD-ROM containing TRM 100 PC Software (for Windows 95/98/2000/NT) and User Manual in the form of PDF document.

❑ Aquarius²

The Ashtech Aquarius²-11 (PO101385), Aquarius²-12 (PO101386) or Aquarius²-22 (PO101387) receiver is delivered in a ruggedized container in which the following items are provided:

- 1× Aquarius²-11, 12 or 22 unit - depending on purchase order - equipped with two GNSS sensors (primary + secondary; see table below):

		Aquarius²-11	Aquarius²-12	Aquarius²-22
Primary	Sensor	L1 only, 16 channels	L1, 16 channels L2, 12 channels	L1, 16 channels L2, 12 channels
	Antenna	NAP 001	NAP 002	NAP 002
Secondary	Sensor	L1 only, 16 channels	L1 only, 16 channels	L1, 16 channels L2, 12 channels
	Antenna	NAP 001	NAP 001	NAP 002

- 2× GNSS antenna, a combination of NAP 001 and NAP 002 antennas (see table above), depending on purchase order (NAP 001: PO76311B; NAP 002: PO101158)
- Firmware modules:
    - All receivers: RAWDAT, WAAS/EGNOS, KARTMODE, USERGEOID, FASTOUTPUT
    - Aquarius²-12 and 22 only: HEADING firmware
    - Aquarius²-22 only: RELATIVE-OTF firmware
- 1× power cord, 2 meters (PO067035)
- 2× data cord, DB9 male / DB9 female, 2 meters (PO101243)
- 1× RS232/RS422 converter cable (PO75675A)
- 1× TRM 100 unit (PO100722) consisting of the following:
    - 1× detachable keypad/display terminal (PO100599), in fact the receiver front panel
    - 1× data cord, DB15 male/DB15 female, 1 meter (PO100688)
    - 1× mounting bracket + knobs and screws (PO101297)

      (*Last two items used only if TRM100 detached from receiver to be used as remote unit.*)
- Mounting bracket for entire receiver (Aquarius + TRM100 unit)

- 1× User Manual (the present manual)
- 1× CD-ROM containing TRM 100 PC Software (for Windows 95/98/2000/NT) and User Manual in the form of PDF document.

Firmware Options

❑ Aquarius

- LRKMODE (PO100893) (except for Aquarius-01)
- RELATIVE OTF (PO101345)
- REFSTATION (PO77252A)

❑ Aquarius²

- LRKMODE (PO100893) (except for Aquarius²-11)
- RELATIVE OTF (PO101345) (standard in Aquarius²-22)
- REFSTATION (PO77252A)

Aquarius² Upgrades

- Aquarius²-12 to Aquarius²-22 (PO101509)
- Aquarius²-11 to Aquarius²-12 (PO101510)

Aquarius & Aquarius² Hardware Options

One of the following two options is **necessary** to operate Aquarius (Aquarius² needs two of them):

- GNSS Marine 30-meter cable kit (PO76464A):
  - 1× RG223 TNC-f/TNC-f coaxial cable, low loss, 30 m long (C5050188)
  - 1× marine mounting kit (PO71448A) for NAP 00x antenna
- GNSS Marine 10-meter cable kit (PO101393):
  - 1× RG223 TNC-f/TNC-f coaxial cable, low loss, 10 m long (C5050196)
  - 1× marine mounting kit (PO71448A) for NAP 00x antenna

Radio options available:

- Rx 4812 U-Link UHF reception kit (PO101388) including 1× UHF reception module + coaxial cords for internal connections. Designed to be embedded in Aquarius
- Rx 1635 HM-Link HF/MF reception kit (PO101504) including HF/MF radio receiver designed to be embedded in Aquarius
- Tx 4800 U-Link UHF transmission kit (PO101389) including:
  - 1× U-Link Tx 4812 transmitter module (with N female output connector)
  - 1× U-Link Tx 4812 interfacing box
  - 1× RS422 data cable, 2 meters long
  - 1× Power cable, 2 meters long

Antenna kits associated with radio options:

- UHF Marine 30-meter antenna kit (PO101390):
  - 1× KX13 N-m/N-m coaxial cable, low loss, 30 meters long (C5050168)
  - 1× CXL70-3 dB UHF antenna, N-female connector + mounting parts:
    Low band (400-430 MHz): C3310145
    Medium band (420-450 MHz): C3310146
    High band (440-470 MHz): C3310175
  - 1× KX15 TNC-m/TNC-m coaxial cable (interfacing), 1 m long (PO5050156)
  - 1× TNC-f/N-f adapter (C5050216)

- UHF Marine 10-meter antenna kit (PO101391):
    - 1× KX13 N-m/N-m coaxial cable, low loss, 10 meters long (PO101131)
    - 1× CXL70-3 dB UHF antenna, N-female connector + mounting parts:
      Low band (400-430 MHz): C3310145
      Medium band (420-450 MHz): C3310146
      High band (440-470 MHz): C3310175
    - 1× KX15 TNC-m/TNC-m coaxial cable (interfacing), 1 m long (PO5050156)
    - 1× TNC-f/N-f adapter (C5050216)
- HF/MF Marine 30-meter antenna kit (PO101503):
    - 1× DHM 5000 dual-band (HF/MF) antenna (PO100084)
    - 1× marine mounting kit (PO71448A) for DHM 5000 antenna
    - 1× KX15 TNC-m/TNC-m coaxial cable, low loss, 30 m long (C5050195)
- HF/MF Marine 10-meter antenna kit (PO101505):
    - 1× DHM 5000 dual-band (HF/MF) antenna (PO100084)
    - 1× marine mounting kit (PO71448A) for DHM 5000 antenna
    - 1× KX15 TNC-m/TNC-m coaxial cable, low loss, 10 m long (C5050196)

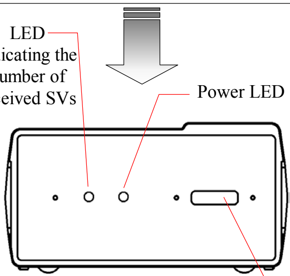
Miscellaneous:

- DB15/DB9 RS232/RS422 data cable, 2 m long (PO101587)

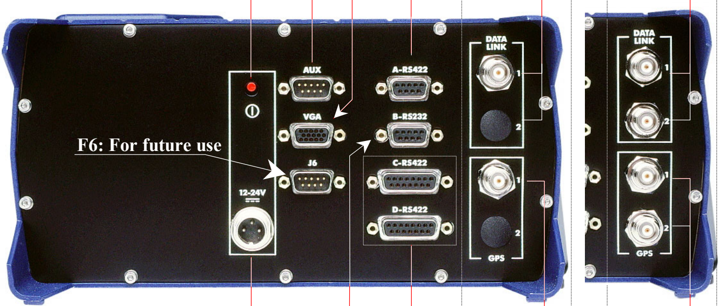
Receiver

❑ Front Panel

Receiver Front View
(After removing detachable TRM100 unit)



❑ Rear Panel

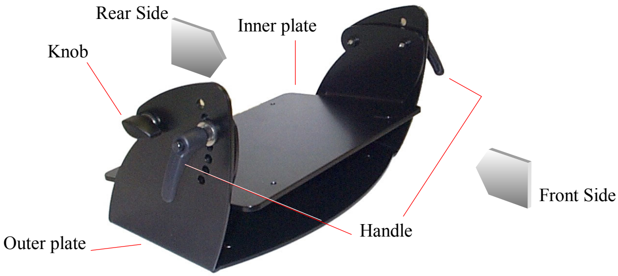


* Used for connection to the PC running the *TRM 100 PC* Software

Receiver Bracket

❑ Description

The receiver bracket basically consists of two plates fixed together by two knobs and two adjustable handles.



Mechanical Specifications:

- Weight: 4 kg (8.82 lb)
- Dimensions (H × W × P): 160 × 355 × 210 mm (6.30 × 13.40 × 8.27”)
- Approximate space occupied by bracket + receiver in horizontal position: 175 × 345 × 305 mm (6.89 × 13.59 × 12.0”) (H × W × P)

This bracket allows you to fix the receiver on a horizontal plane. Depending on how the inner plate is positioned with respect to the outer plate, the receiver will be fixed from under the bracket (table mounting) or from above (ceiling mounting).

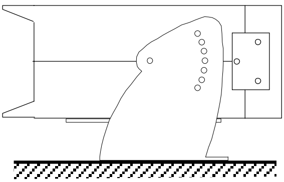
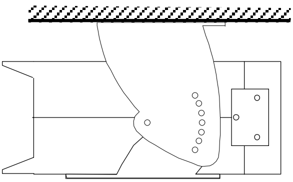


Table Mounting



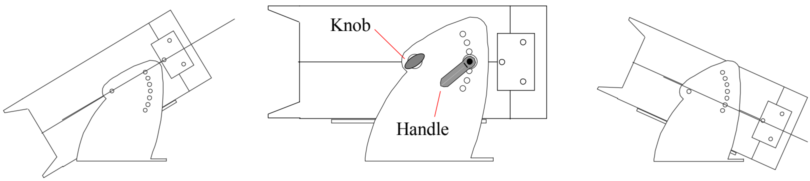
Ceiling Mounting

❑ Table Mounting

The receiver can be secured on the bracket in one of the possible 6 positions, giving an angle to the receiver from 0° (horizontal) to + 30° or -20°, depending on how you orientate the inner plate with respect to the outer plate. Note that in the extreme two positions (+ 30° and -20°), allow for the receiver case to come through the fixing plane.

Horizontal position is obtained when the handles are inserted in the 4th hole (midpoint). Do not use the lower hole.

+30° position **Horizontal position** **-20° position**



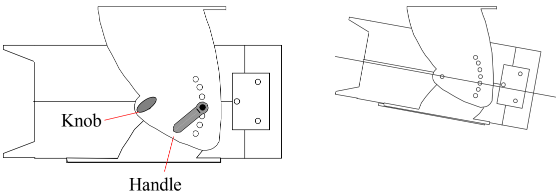
To change the orientation of the receiver on the bracket, you must first remove the two handles, rotate the inner plate with respect to the outer plate until you get the desired orientation. Then put back and tighten the handles.

The lever of each handle can then be oriented as desired by placing a thumb at the end of the handle axis, pulling the handle and rotating the lever until you get the desired position. Then let go.

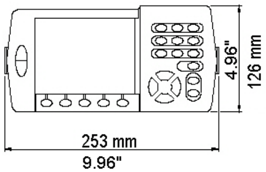
❑ Ceiling Mounting

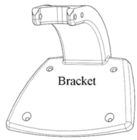
Same as previously except that the number of possible positions is limited to 2: 0° (horizontal) and -10°. A higher tilt angle can be obtained if the receiver is allowed to rotate beyond (above) the fixing plane.

Horizontal position **-10° position**



Detachable TRM 100 Keypad/Display



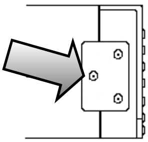


This unit is in fact the receiver's front panel. It is plugged to the receiver via a single Sub D15-f connector. It is secured on the receiver case by means of two screws located on either side of the unit.

When necessary, it can be detached from the receiver case to be used as a remote unit. A bracket is provided to allow separate installation of the TRM100 at maximum 1 meter from the receiver.

Before detaching the TRM100 from the receiver, TURN OFF the receiver. Then, you just have to loosen and remove the central screw on either side of the TRM100, as shown below:

You just have to remove this screw



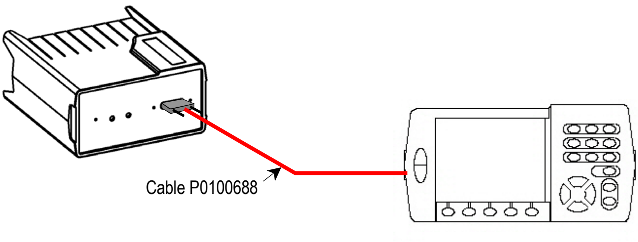
TURN OFF the receiver before plugging or un-plugging the TRM100!

Unplug the TRM100 gently from the receiver to avoid damaging the connec-tor. (**Please try to limit the number of times you have to plug or unplug the TRM100 as this might end up damaging the connector**).

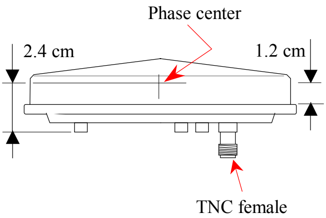
Removing the TRM100 unit unveils the "inner front panel" of the receiver. This panel is fitted with a Sub D15C-f connector receptacle, used for plug-ging the TRM100, and two LEDs. See page 63 for more information about these LEDs.

Use the cable provided (PO100688) to link this unit to the receiver.

USE EXCLUSIVELY the connector receptacle on the inner front panel to attach the TRM100 unit to the receiver!



NAP001 or NAP002 Antenna



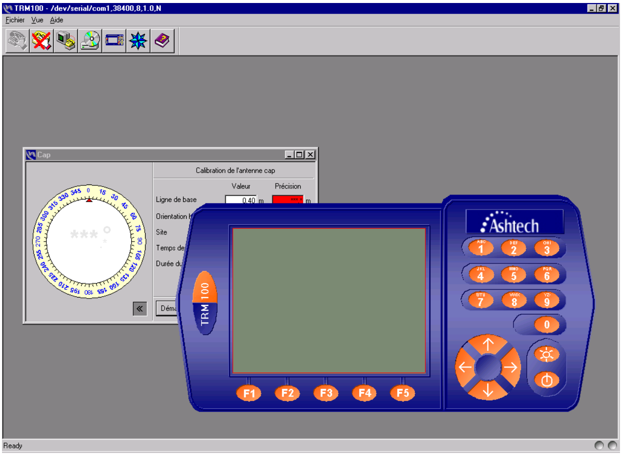
- NAP 001: single-frequency version (L1)
- NAP 002: dual-frequency version (L1/L2)

For both antennas:

- Diameter 143 mm, Height: 44 mm
- Weight: 342 g
- Power requirement: 5 to 13 V DC - 40 mA (via coax.)
- Gain: 39 dB approx.
- Admissible loss in antenna coaxial: 24 dB max., which means for example a maximum length of 30 meters with RG223-type coaxial cable
- Temperature ranges: -40°C to +65°C (operating); -40°C to +70°C (storage).

TRM 100 PC Software

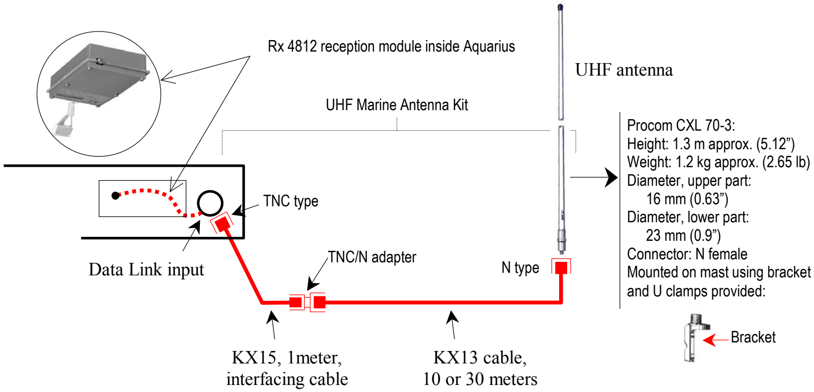
This software program delivered on CD-ROM is used to interface the Aquarius to a PC type computer (see computer requirements on page 17). Using this program, the user can communicate with the Aquarius and have all the navigation data computed by the Aquarius displayed on the computer screen.



The TRM100 Software can be used in two different ways:

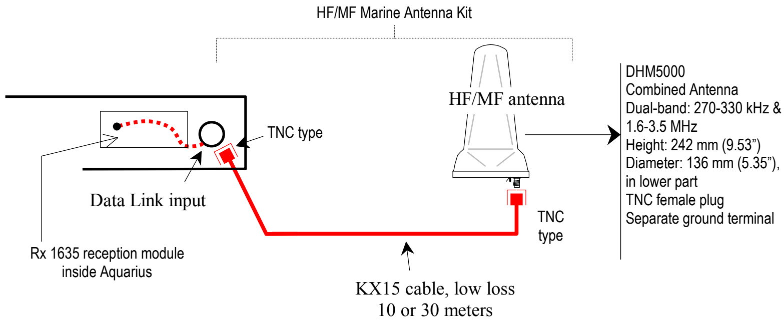
- Only as a setup tool to perform the required preliminary settings (geodetic format, speed filtering coefficient, etc.). After getting the Aquarius started, the PC can be disconnected from the Aquarius, which then operates as a black box connected to the onboard equipment
- Or as a real navigation terminal. As previously, it is first used to make the required settings and then it is used as a display terminal for navigation information.

UHF Radio Option



HF/MF Radio Option

(Product availability: mid-2002; please contact your local distributor for more information)



Tx 4800 U-Link UHF transmission kit

See page 131. ♣

2. Installation

GPS Antenna

❑ Choosing a location where to install the antenna

The antenna should be installed:

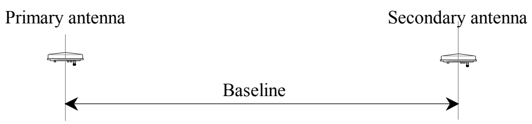
- At the best possible location for a wide-open view of the sky (to avoid the presence of large obstructing objects in the vicinity of the antenna)
- At the furthest possible distance from any sources of radio frequency interference
- At such a distance from the Aquarius unit that the coaxial cable purchased (10 or 30 meters) can normally be used to connect these two elements together.

Whenever possible, avoid exposing the antenna to smoke.

If for any reason the coaxial cable must be shortened:

- Do not cut the end of the cable connected to the antenna, as this end must remain fully waterproof
- Wire the new TNC plug according to the rules. Only qualified personnel are allowed to do this. In theory, there is no minimum length required for this cable.

If two GNSS antennas are used for heading or Relative processing (Aquarius²), follow the same recommendations as above for the two antennas. There is no need for mutual visibility between the two antennas. In heading processing, the height deviation between the two antennas should form an angle of ± 20° maximum for a given baseline length. See page 104.

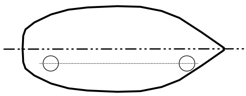


Installation

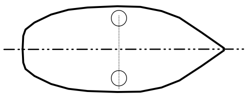
The baseline length should be chosen between 1 and 5 meters (3.28 and 16.4 feet) for Aquarius²-12, between 1 and 2 meters for Aquarius²-11. It should be greater than 2 meters (6.56 feet) – with virtually no upper limit – for Aquarius²-22.

Remember that the longer the baseline, the better the accuracy but the longer the initialization time.

In heading processing, giving the baseline a direction strictly parallel to, or perpendicular to the ship's longitudinal axis (lubber line) will allow the receiver to compute a vertical angle representative of respectively the ship's pitch or roll angle.



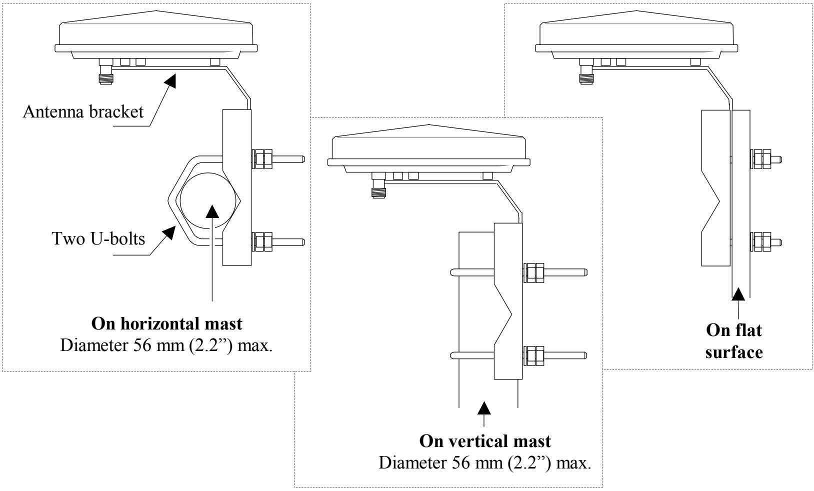
The receiver can compute the heading angle AND the pitch angle

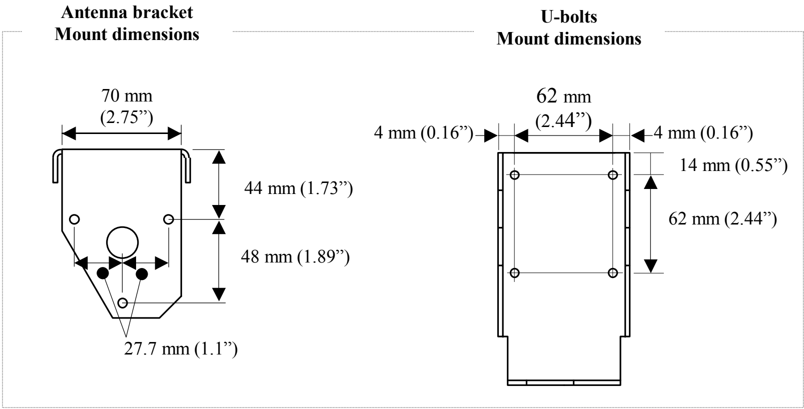


The receiver is able to compute the heading angle AND the roll angle

❑ Antenna Mounting

Use the bracket provided in one of the configurations shown below.





Receiver

Choose the installation location taking account of the following:

- Desired location in cabin
- Location of third equipment the receiver must be attached to
- Lengths of coaxial cords to antennas

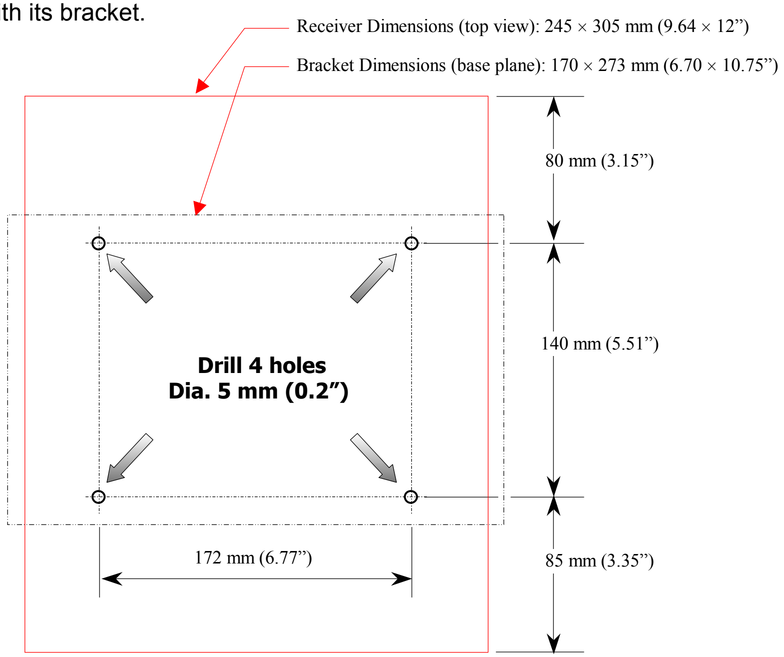
Allow for a clear space of about 25 dm^3 (H200 × W345 × D350 mm) in the cabin to install the receiver on its bracket.

The receiver should be mounted on its bracket using the 4 screws and washers provided. Use an Allen wrench No. 4 to tighten the screws. Mount the receiver on the bracket BEFORE mounting the bracket in the cabin.

The bracket should be secured on a horizontal plane in the cabin after drilling 4 holes in this plane (see drilling diagram below). Fix the bracket firmly on the plane using 4 screws/nuts/washers (NOT PROVIDED).

❑ Drilling Diagram

Drill 4 holes, Diameter 5 mm (0.2”), in the plane where to mount the receiver with its bracket.



TRM100 PC Software

Computer Requirements

- PC type computer
- Operating system: Windows 95, 98, 2000, NT, XP
- Unit: DX2-66 minimum, Pentium recommended
- RAM: 16 MB minimum, 24 MB recommended
- Space required on hard disk: 12.5 MB approx.
- 1 CD-ROM drive
- 1 RS232 serial port available

Installation Procedure

- Switch on the PC
- Insert the TRM100 CD-ROM in the CD-ROM drive
- From the Windows task bar, select **Start>Run...**
- In the dialog box that opens, specify the path to the CD-ROM and then type setup (example: type e:\setup) or browse on the CD-ROM and choose the setup.exe file. Then click **OK** to start the installation procedure
- Follow the instructions provided on the screen to complete the installation process.

Rx 4812 U-LINK & Rx 1635 HM-LINK Options

Only trained personnel can install one of these reception modules, as this requires opening the receiver case.

Radio Antenna (UHF or HF/MF)

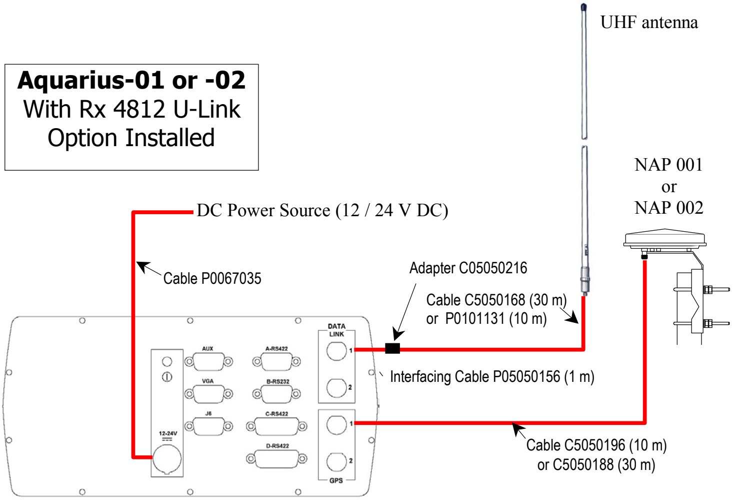
The radio antenna should be installed:

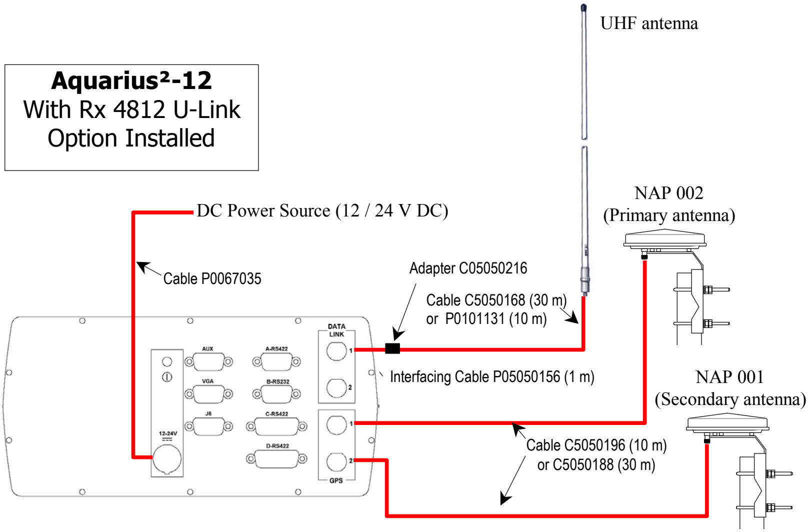
- At such a distance from the Aquarius unit that the coaxial cable purchased (10 or 30 meters) can normally be used to connect these two elements together.
- For a UHF antenna, at the highest possible location for best possible reception
- For HF/MF antenna, at a location allowing connection of its ground terminal to ship's ground. This antenna does not necessarily need to be located on top of a mast.

Tx 4800 U-LINK Option

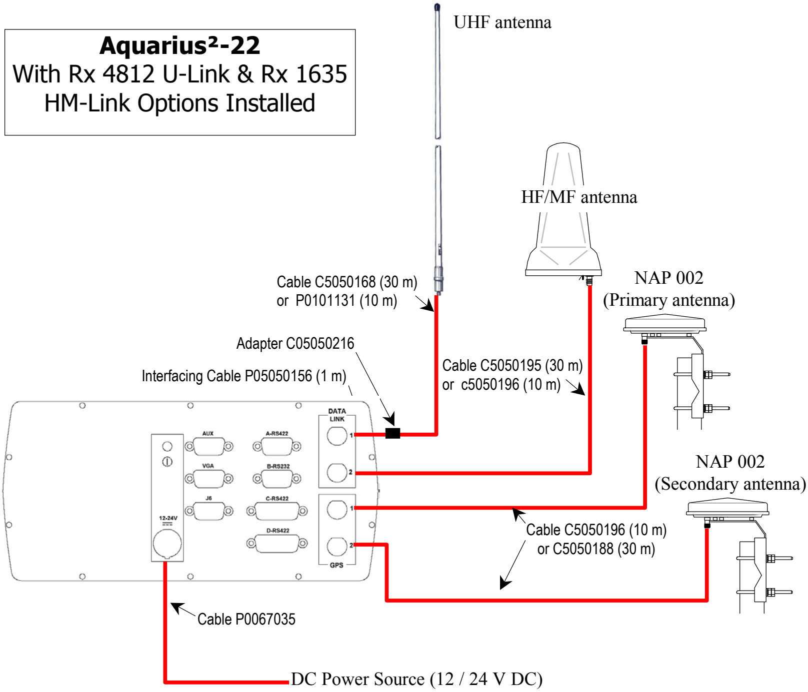
See page 131.

Connections Required in Typical Applications





Primary antenna ALWAYS connected to Input 1!


Aquarius²-22
With Rx 4812 U-Link & Rx 1635
HM-Link Options Installed
UHF antenna
HF/MF antenna
NAP 002
(Primary antenna)
NAP 002
(Secondary antenna)
Cable C5050168 (30 m)
or P0101131 (10 m)
Adapter C05050216
Interfacing Cable P05050156 (1 m)
Cable C5050195 (30 m)
or c5050196 (10 m)
Cable C5050196 (10 m)
or C5050188 (30 m)
Cable P0067035
DC Power Source (12 / 24 V DC)
DATA LINK
AUX
A-RS422
VGA
B-RS232
J6
C-RS422
D-RS422
12-24V
GPS

♣

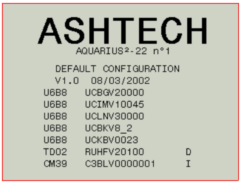
3. Operating Instructions

Switching On/Off the Receiver

- Depress to switch on the receiver.

  For about 5 seconds, the front panel screen first shows a few technical data about the receiver (BIOS used, copyright notice, etc.), followed by a “System Initialization...” message (about 20 seconds). Then an identification message is displayed (see example below) for about 5 seconds:

  Aquarius² example:



  The information provided allows full identification of the different hardware and software parts used in the receiver. Use the vertical arrow keys to scroll through the list.

  Then a data screen is displayed (see next page).

- To switch off the receiver, hold down depressed for a few seconds until a message on the screen confirms that the receiver is being switched off.

Back-light Control & Screen Contrast Adjustments

- operates as a toggle switch allowing you to alternatively turn on and off the screen back-light. After switching on the receiver, the back-light is automatically turned off before the end of initialization.
- Adjust the screen back-light by holding down while pressing one of the vertical-arrow keys.
- Adjust the screen contrast by holding down while pressing one of the horizontal-arrow keys.

Data Screens

After the initialization step, and following the display for about 5 seconds of the receiver identification screen, the receiver will display one of the possible 4 data screens (see examples opposite) and provides access to the main menu in the lower part of the screen. To change data screen, press any horizontal arrow key. The fourth data screen is accessible only if the Relative Positioning processing is enabled in the receiver

1: From left to right:

1st line: Current Date, Position processing (1), Quality Index (2), Number of Corrections received and Age of Differential Corrections

2nd line: Current Local Time (UTC displayed if local time=UTC time), processing indicator (3), number of satellites used/received

2: Current Position (latitude, longitude), computed

3: Coordinate system used & altitude

4: Heading

5: Speed Over Ground

6: Course Over Ground

7: Rate of Turn

8: Pitch or roll angle, depending on how antennas are orientated

9: Longitudinal speed

10: Transverse speed

11: Baseline length

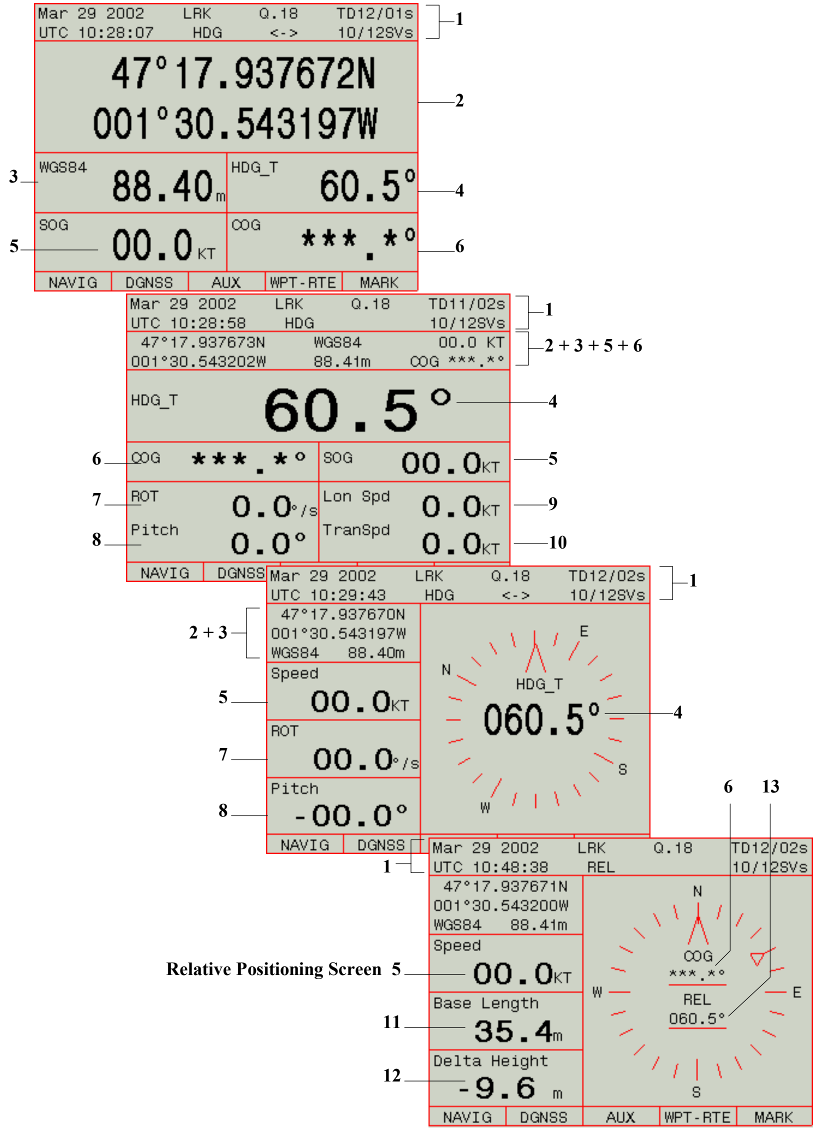
12: Altitude deviation between primary and secondary antennas

13: Angle between True North and line passing through the phase centers of the GNSS antennas

(1) This indication will flash at slow rate until the receiver reaches the desired operating mode (see MODE function in DGNSS menu on page 37).

(2) Fix Quality Index: (See also page 318)	0-3: GPS 6-9: DGPS 10-13: EDGPS 14-19: Kinematic
(3) Processing indicator:	“HDG”: Heading processing (flashing=result not available yet; On= heading result available) “REL”: Relative processing (flashing=result not available yet; On= Relative result available) “None”: No Heading or Relative processing enabled

Screen Examples:



Use Guidelines

❑ Common Tasks

Whatever the position-processing mode you intend to enable in your receiver, you will probably have to do one of the tasks listed below. All the functions allowing these tasks to be performed are gathered in the AUX menu. To use any of these functions refer to the page mentioned below with the task.

- Choose the units used on the screen (see page 46)
- Check the local date & time (see page 47)
- Choose the language used on the screen (page 48)
- Enter/check the initial position and the coordinate system used (see page 49)
- Enable/disable/modify the data messages available on the output ports page 51)
- Check/modify the port settings (see page 54)
- Check/change the speed-filtering constant used (see page 61)
- Choose a navigation mode (see page 26)
- Miscellaneous (see other function in the AUX menu Chapter in this section)

❑ Autonomous Processing Modes

For any of these modes (GPS, WAAS/EGNOS, WADGPS + Relative for Aquarius² only), you just need to do the following:

- Select and enable this mode through the **DGNSS>MODE** function (1st or 2nd row in the table; see page 37)
- On any of the data screens (see page 22), check that, after a certain time, the receiver actually operates in the desired mode.

❑ Processing modes implying the use of a data link

For these processing modes, you also have to do the following, using functions from the DGNSS menu:

- Enter the specifications of the data-transmitting source (station or other) (see pages 34 and 36)
- Select and enable the desired processing mode; select the corrections data source defined previously to be involved in that processing (see page 37)
- Check to see if the corrections data is properly acquired (see page 41)
- On any of the data screens (see page 22), check that, after a certain time, the receiver actually operates in the desired mode.

❑ Particular Case of Heading Processing

The heading processing is also a standalone-operating mode, but that can only be implemented in Aquarius². To work in this mode, you need to do the following:

- Select and enable this mode through the **DGNSS>MODE** function (see page 37)

Then, using the **AUX>INIT>HEADING** function:

- Allow the receiver to determine the baseline length (see page 56)
- Once determined, validate this length in the receiver to allow it to perform heading measurements (page 56)
- LEAVE THE RECEIVER DETERMINE THE HEADING
- Calibrate the heading measurements using one of the possible methods (page 58)
- Validate the offset angle resulting from the calibration.

  The calibration result is stored to be part of the data present in the receiver configuration. Calibrating the heading measurement is required when first installing the equipment on board, and then every time changes are made in the equipment installation.

NAVIG Menu

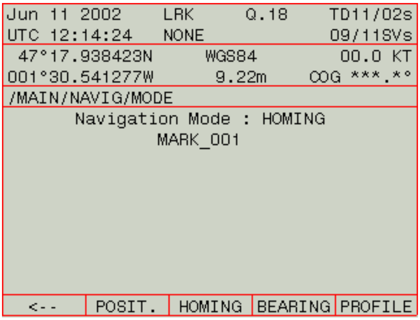
❑ Viewing the Navigation Mode Currently Used

- From the main menu (see page 23), select successively:

  F1-NAVIG
  F2-MODE

This displays the navigation mode currently active in the receiver.

For example, in the screen example below, the currently active navigation mode is “Homing”. It is set to help you head for the waypoint labeled “MARK_001”:



❑ Changing the Navigation Mode

Simply view the navigation mode being used as explained above and you have access to a menu allowing you to choose another navigation mode. See the glossary for the definitions of the available navigation modes.

Your choice of a navigation mode, whatever it is, does not impact the Data screens presented on page 23.

There is no prerequisite for selecting the Position mode. When you select this mode a message is displayed (“Quit this Navigation Mode?”) asking you to confirm your choice. Press **F5-OK** to validate your choice.

The other navigation modes are detailed in the next pages.

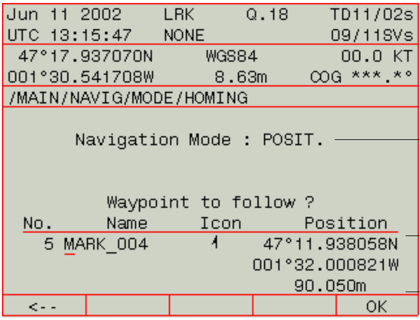
❑ Selecting the Homing or Bearing Mode

You cannot activate the Homing or Bearing mode unless there is at least one waypoint stored in the receiver (see page 64).

- Assuming "Position" is the active navigation mode. From the main menu (see page 23), select successively:

  F1-NAVIG
  F2-MODE
  F3-HOMING or **F4-BEARING**

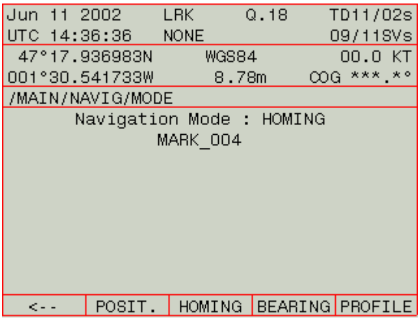
  A new screen appears asking you to specify the target waypoint. For example the following is displayed.



Currently active mode

This area gives access to the list of available waypoints. A single waypoint definition is shown at a time. Use the vertical arrow keys to scroll the list up and down

- Using the vertical arrow keys, scroll through the list of waypoints to find the desired target
- When the definition of the desired waypoint is on the screen, press **F5-OK**. The receiver then switches to the Homing or Bearing mode and the screen looks like this (Homing selected on this screen):



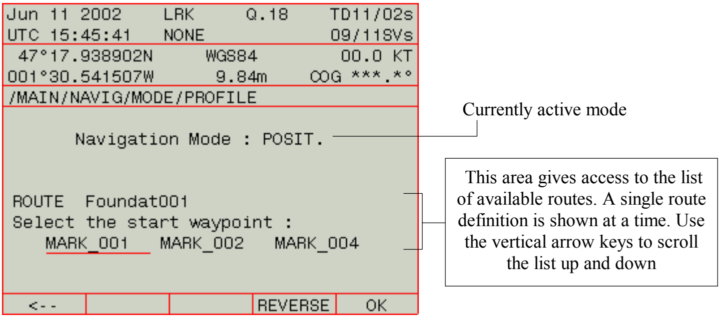
❑ Selecting the Profile Mode

You cannot activate the Profile mode unless there is at least one route stored in the receiver. As a route consists of minimum two waypoints, there must be also at least two waypoints stored in the receiver. See page 65.

- Assuming "Position" is the active navigation mode. From the main menu (see page 23), select successively:

  F1-NAVIG
  F2-MODE
  F5-PROFILE

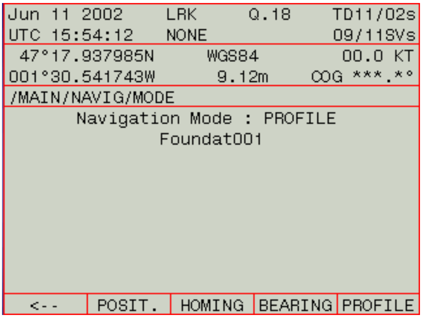
  A new screen appears asking you to specify the route along which to navigate. For example the following is displayed.



  Note that the cursor is positioned on the first waypoint in the route.

- Use the vertical arrow keys to select the desired route from the list of existing routes
- Then, if necessary, use the horizontal arrow keys to underline the waypoint to reach first before the receiver starts guiding you along the route. If necessary, you can also change the direction of travel along the path by pressing **F4-REVERSE**.

- Press **F5-OK**. The receiver then switches to the Profile mode and the screen looks like this:



❑ Displaying the Data Specific to the Navigation Mode Used

- From the main menu (see page 23), select successively:

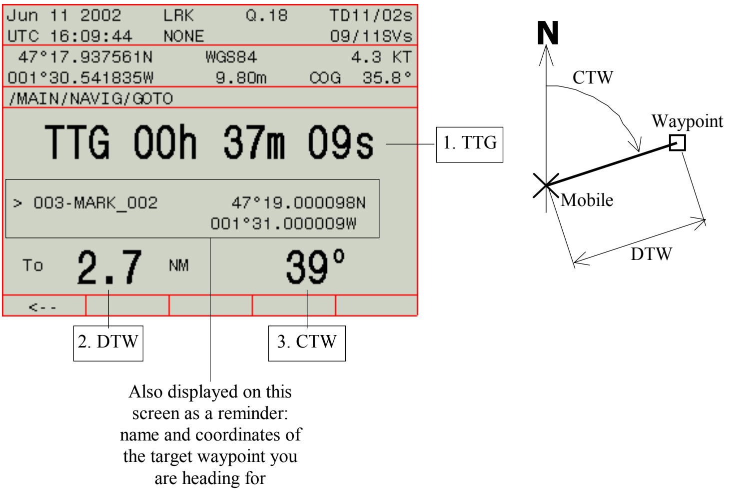
  F1-NAVIG
  F3-GOTO

  What the screen then shows depends on the active navigation mode as explained hereafter.

Position Mode Active: The screen just recalls you that you are in Position navigation mode and so you cannot expect any additional information or guidance in this mode.

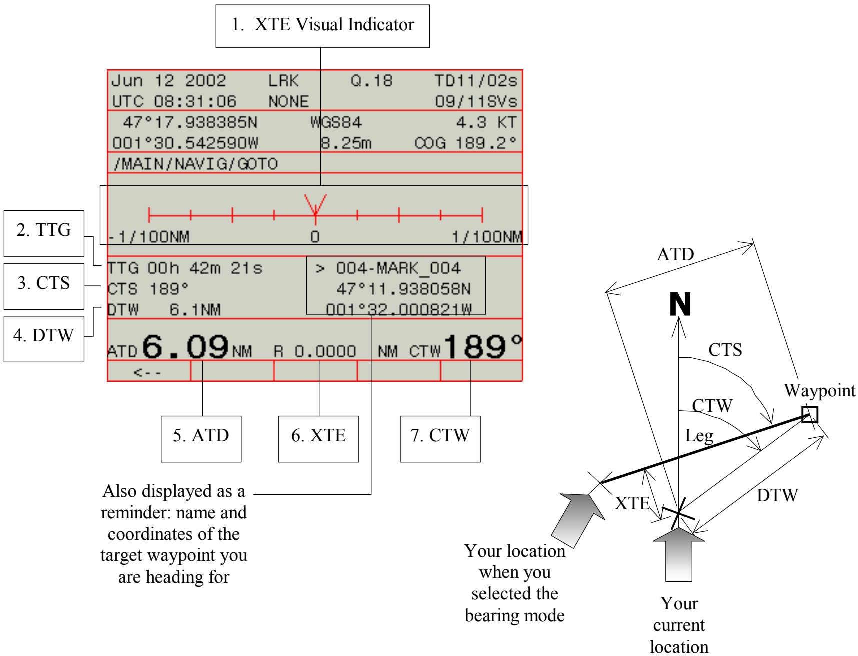
Homing Mode Active: The screen provides three additional parameters to help you head for the waypoint, as shown on the screen example below:

1. Time To Go (TTG): an estimate of the time required before reaching the target, based on the distance still to go and your current speed
2. Distance To Waypoint (DTW): the distance, measured along a great circle, still to travel before getting at the waypoint
3. Course To Waypoint (CTW): angle measured with respect to True North from your current position



Bearing Mode Active: The screen provides the following additional information:

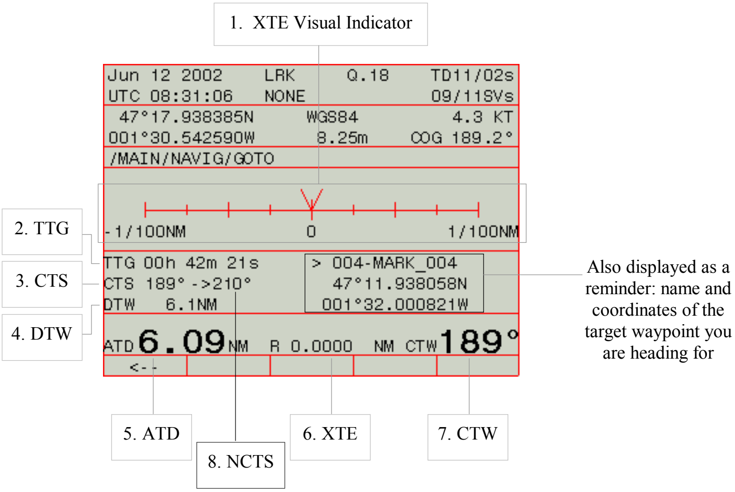
1. Visual “Left/Right” indicator of Cross-Track Error (XTE). You know at a glance where you are with respect to the leg followed (Current Position represented by a down-arrow). The scale is automatically adjusted to fit the current value of XTE
2. Time To Go (TTG): an estimate of the time required before reaching the target, based on the distance still to go and your current speed
3. Course To Steer (CTS) to head for the target waypoint along a great circle
4. Distance To Waypoint (DTW): the distance, measured along a great circle, still to travel before getting at the waypoint
5. Along Track Distance (ATD): distance still to go, projected onto the leg
6. Cross Track Error (XTE): Normal distance from the current position to the leg being followed
7. Course To Waypoint (CTW): angle measured with respect to True North from your current position.

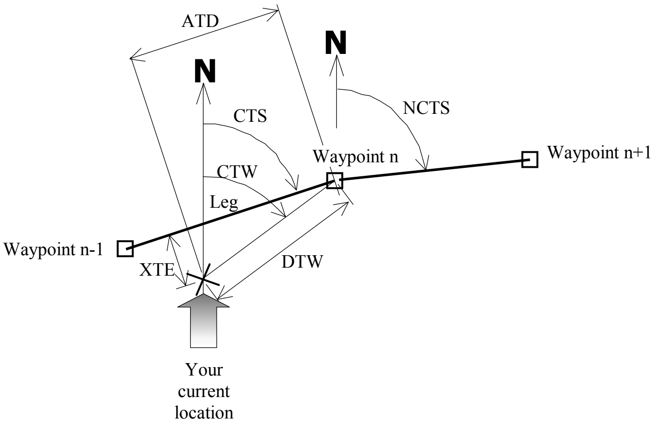


Profile Mode Active: Same as Bearing mode active, plus the following information:

8. Next Course To Steer (NCTS): This angle allows you to anticipate your navigation by indicating the next course to steer -to go to the next waypoint- once you get at the current target waypoint.

(1..7 Same as Bearing Mode; see previous page).



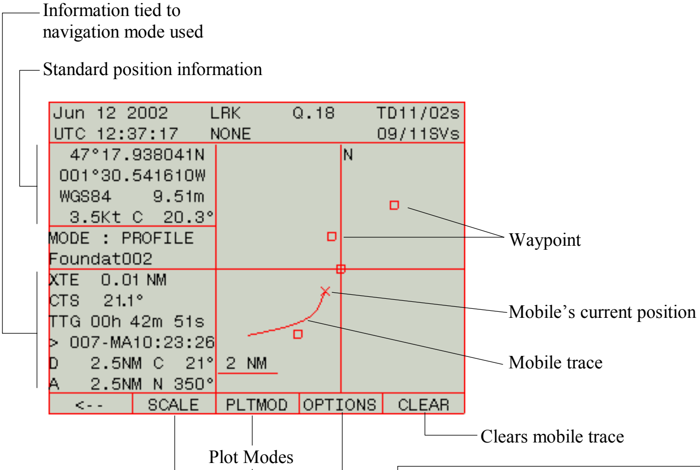


❑ Using the Graphic Screen to Navigate

- From the main menu (see page 23), select successively:

  F1-NAVIG
  F4-GRAPH

  What the screen then shows depends on the active navigation mode, the options and the plot modes used, as explained hereafter.



F4-WPT-RTE: Show/hide waypoint numbers
F5-TRAJ: Show/hide mobile trace

F3-ZOOM+: Zoom in
F4-ZOOM-: Zoom out
(Zooming range: 0.001 NM to 4 NM, or 2 m to 10 km)

F3-North:	North/West-oriented chart with no particular point or direction held fixed, first built on the basis of the mobile position when running a new mode (this position is plotted at the center point), and then re-adjusted only if the mobile moves beyond the plotting area	All modes (the North axis gives the direction of the WGS84 Geographical North)
F4-Leg:	The path to follow is represented by the central vertical line (not a North/West-oriented chart)	Bearing and Profile only
F5-Target:	Target waypoint held fixed at center point (North/West-oriented chart)	Bearing and Homing only

DGNSS Menu

❑ Entering the characteristics of one or more stations

- From the main menu (see page 23), select successively:

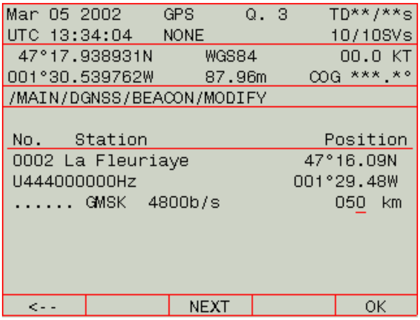
  F2-DGNSS
  F4-BEACON

- To enter the characteristics of a new station, make sure the following is displayed (blank fields)(Press ↑ or ↓ if necessary):

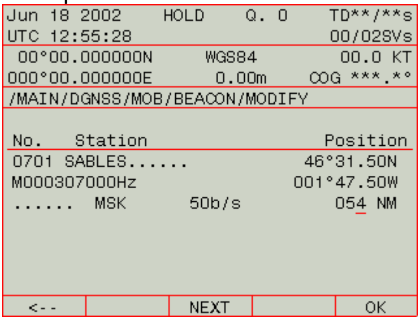
```
No.   Station                     Position
**** **********                 **°*******
**********Hz **********Hz    ***°*******
         ***** ****b/s              *** km
```

- Press **F5-MODIFY**
- Type successively the following parameters (press **F3-NEXT** to move the cursor to the next parameter):
  - Transmitter Id.
  - Transmitter Name
  - Latitude & longitude of transmitting station. NOTE: You just need to type approximate coordinates as these are only used to estimate your distance to the station
  - Frequency band & carrier, in Hz
  - For HF dual-frequency station: 2nd frequency, in Hz
  - C3 code (leave field unchanged for non-encrypted corrections)
  - Modulation type (baud rate displayed next is set according to the chosen modulation type):
    - UHF:
      GMSK at 4800 bits/s
    - MF:
      MSK at 50, 100 or 200 bits/s
    - HF:
      BCPSK at 50 bits/s
      MSKF16 at 400 bits/s
  - Maximum range, in km or NM (expected)

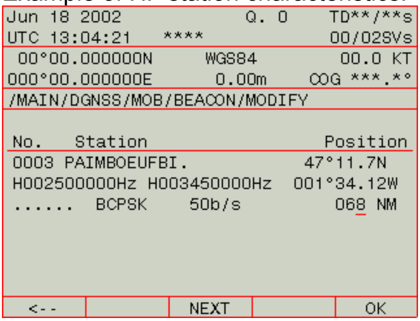
Example of UHF station characteristics:



Example of MF station characteristics:

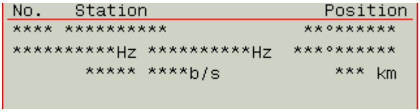


Example of HF station characteristics:



- Press **F5-OK** when you have finished defining the station to store the characteristics of the new station.

- To define another station, first have the following displayed by pressing any vertical arrow key:



- Press **F5-MODIFY** and resume from step 4 above to define a new station.

❑ Listing the stations stored in the receiver

- From the main menu (see page 23), select successively:

  F2-DGNSS
  F4-BEACON

- Press any vertical arrow key (↑ or ↓). After each press, the characteristics of the next or previous station in memory are displayed. Scrolling through the list of stations is complete when blank characteristics are shown on the screen (all fields filled with "*"). It is incidentally from this display that you can add the characteristics of a new station.

❑ Deleting or modifying the characteristics of a station

- From the main menu (see page 23), select successively:

  F2-DGNSS
  F4-BEACON

- Press repeatedly any vertical arrow key (↑ or ↓) until the characteristics of the station you want to delete or modify appear on the screen
- Press **F4-DELETE** to delete the station from the receiver memory, or press **F5-MODIFY** to edit its characteristics.

  You cannot delete a station currently used by the receiver.

❑ Choosing the desired processing in the receiver

As explained in Section 4, Aquarius can operate in one of the following modes:

1. Standalone GPS
2. WAAS/EGNOS, WADGPS
3. DGPS, EDGPS, KART or LRK using corrections data received via radio link
4. DGPS, EDGPS, KART or LRK using corrections data received via external RTCM receiver
5. RELATIVE Positioning allowing the receiver (used as the primary mobile) to know the relative position of a secondary mobile virtually configured as a station

For Aquarius², the following modes comes in addition to those listed above for Aquarius:

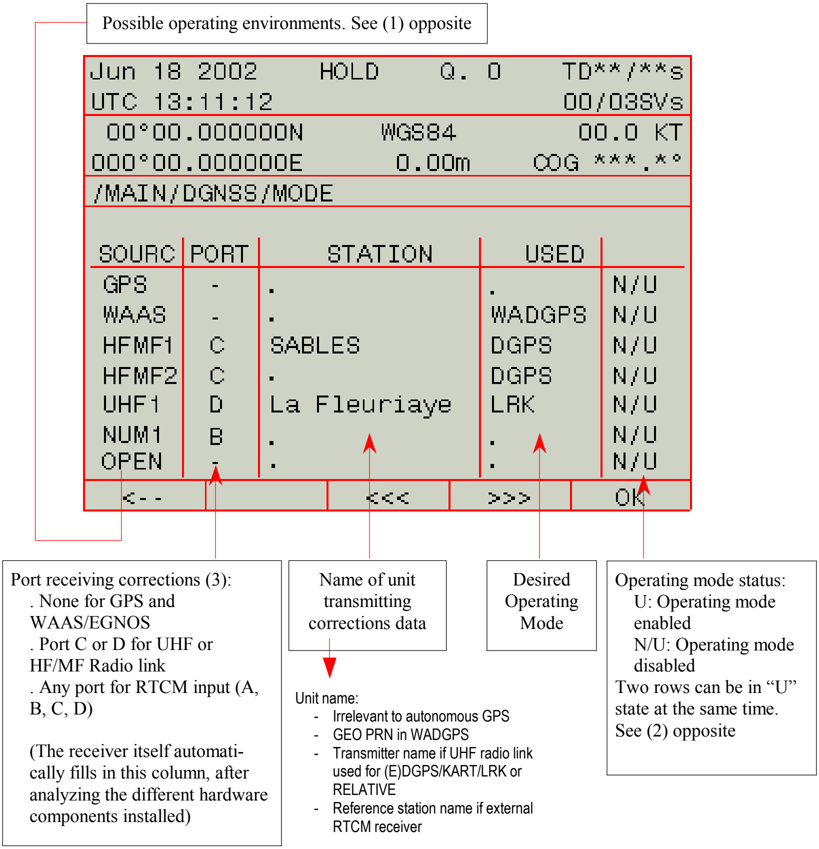
6. RELATIVE positioning between the primary and secondary antennas (as standard only for Aquarius²-22; as an option in Aquarius²-11 and 12)
7. HEADING processing using the primary and secondary antennas.

The screen described below allows you to choose the desired operating mode and specify the conditions required to let the receiver actually function in this mode.

- From the main menu (see page 23), select successively:

  F2-DGNSS
  F3-MODE

  Example of screen then obtained:



(1) Each line describes a potential, specific operating environment deduced from the hardware and firmware components attached to the receiver:

- The GPS line is always shown. If this operating mode is enabled, the receiver will only use the GPS signals received to deliver an autonomous GPS position solution
- The WAAS line is always shown. If this operating mode is enabled, the receiver will refine the GPS position using corrections (and pseudo-ranges) from the WADGPS geostationary satellites.
- The HFMF1 and HFMF2 lines are shown only if an Rx 1635 HM-Link HF/MF reception kit is installed in the receiver.

  Note that ONE HM-Link reception kit installed results in TWO lines on this screen as this kit consists of two distinct reception channels.

  The figures "1" and "2" placed after "HFMF" are only order numbers and so do not correspond to reception channels #1 and #2 in each HM-Link reception kit.

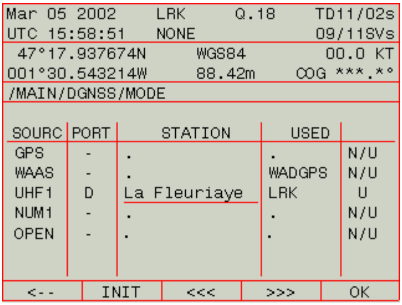
  Another very important thing to say about the HM-Link reception kit is that you cannot define an HF frequency on one channel and an MF frequency on the other. The HM-Link reception kit must be all "HF" or all "MF". For more detail, see page 70.
- The UHFx line is shown only if an Rx 4812 U-Link UHF reception kit is installed in the receiver (x is the order number of the U-Link module, i.e. 1 or 2).
- The NUM1 line is also always shown. If this operating mode is enabled, the receiver will compute a DGPS position solution using the corrections data applied in digital form to the specified port.
- The OPEN line is also always shown. If this operating mode is enabled, the receiver will automatically choose the best source of corrections data. For more detail, see page 69.

(2) For example, with Aquarius²-22, the heading processing can be enabled using the two antennas ("HDG" selected in GPS row, USED column) AND the LRK processing, or any other mode, can be enabled on the primary antenna (for example "LRK" selected in UHF1 row, USED column).

Other example: Relative processing enabled using the two antennas ("REL" selected in GPS row, USED column) + LRK, or any other mode, enabled on primary antenna (""LRK" selected in UHF1 row, USED column).

Typical use examples:

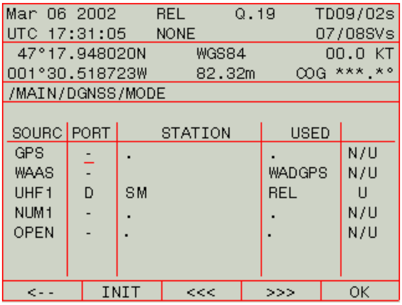
1. LRK processing, corrections data from transmitter “La Fleuriaye” via UHF radio link (input port: C or D):



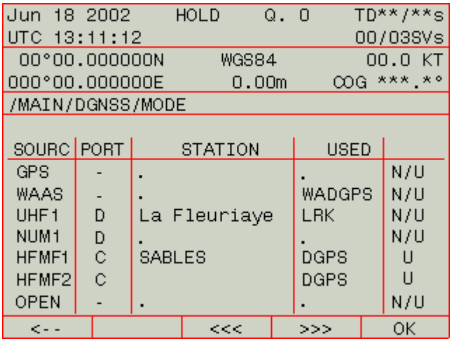
In this case of use, **F2-INIT** allows you to choose which reference station to use in priority (among the 4 possibly received). Even if there is only one station possible, it is recommended to enter its number through this function.

After selecting LRK in the USED column and before enabling it (in column on the right), **F2-INIT** allows you to choose the solution type (“real-time” or “accurate”) and the initialization mode (OTF, static, Z-fixed or POSIT.). See also page 76 for more information.

2. Relative processing, corrections data received by primary mobile from transmitter “SM” (attached to secondary mobile) via UHF radio link (input port: C or D) or via another radio medium:



3. DGPS processing, corrections data received from dual-frequency HF station “SABLES”:



❑ Monitoring the stations received

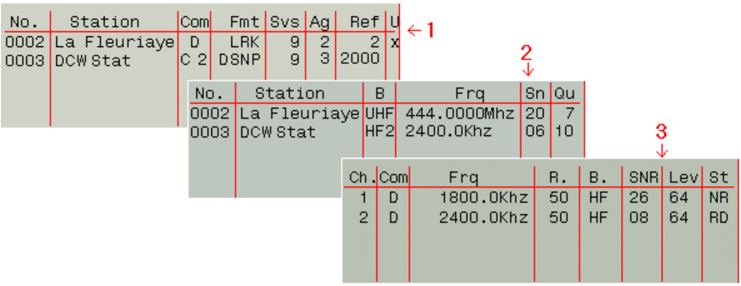
Real-time monitoring is possible for all the stations received through two different screens (for UHF stations) or three different screens (HF or MF stations)

- From the main menu (see page 23), select successively:

  F2-DGNSS

  A monitor screen is then displayed. Using the horizontal-arrow keys, you can access the other monitor screens (one additional screen in the case of a UHF station, two additional screens in the case of an HF or MF station; see below)).

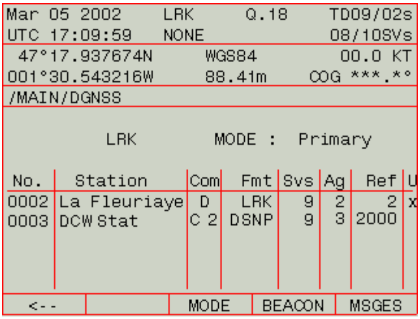
  Note that the receiver memorizes the last monitor screen displayed. This means that next time you select **F2-DGNSS**, it is the monitor screen last displayed that will be shown first.



Getting Started

Monitor screen 1/3:

Example:

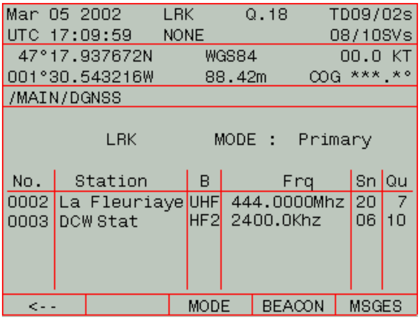


The following information is shown on this screen for each station received, from left to right:

No.	:	Transmitter Id.
Station	:	Transmitter name
Com	:	Receiver port receiving corrections data. For HF/MF stations, this parameter includes the port identification + the channel number(s). Example: C 1, C 2, C12 or C21. C21 means that channel #2 started receiving data before channel #1. C12 means the opposite
Fmt	:	Format of the corrections data received
Svs	:	Number of GPS satellites for which corrections are provided
Ag	:	Age of corrections
Ref	:	Reference station Id. HF stations have no Id. For this reason, the receiver allocates the following Id. to the possible four HF stations: 2000 for the first one received, 2001 for the second,... 2003 for the fourh
U	:	When “x” appears in this column, it means that the data received from this station is being used in the receiver. If blank, station not used

Monitor screen 2/3:

Example:



The following information is shown on this screen for each station received, from left to right:

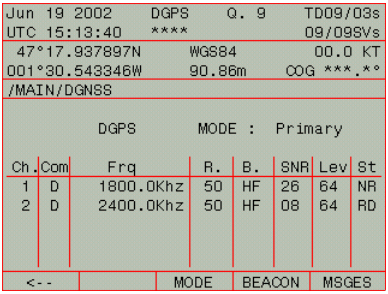
- No. : Transmitter Id.
- Station : Transmitter name
- B : Transmission frequency band
- Frq : Carrier frequency
- Sn : Signal-to-Noise Ratio, in dB
- Qu : Quality figure for a UHF station:

  -1: station not received
  0: carrier detected but no data detected
  1 to 10: carrier detected and data decoded:
  1 to 3: very poor reception (single-freq. station)
  4 to 6: intermittent reception (single-freq. station)
  7 to 10: good quality reception (single-freq. station)

  Bit error rate for an HF/MF station:

  0: bit error rate= 100%
  ...
  10: bit error rate= 0%

Monitor screen 3/3:



The following information is shown on this screen for each HF or MFstation received, from left to right:

Ch.	:	Reception channel number (1 or 2)
Com	:	Port acquiring data from this channel
Frq	:	Channel frequency
R.	:	Baud rate
B.	:	Frequency band (HF or MF)
SNR	:	Signal Noise Ratio (dB)
St	:	Status:

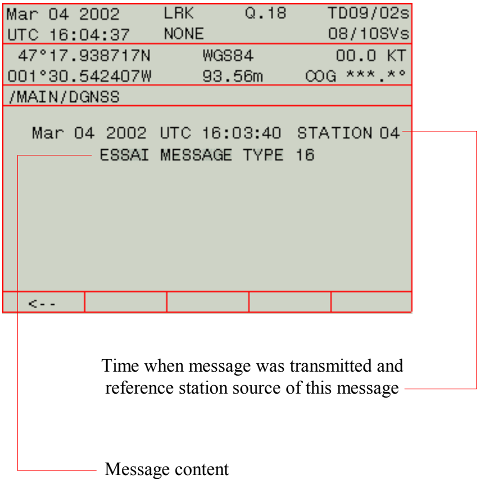
F: Free channel
NR: No Received signal
R: Received signal but data not decoded
RD: Received (decoded) Data
S:(HF stations only) Searching signal

❑ Messages

Messages can be sent by the station for user information (for example RTCM message No. 16). To check the possible presence in your receiver of one of theses messages:

- Press **F5-MSGES**
- Press **F1** to come back to the previous screen.

Message example:



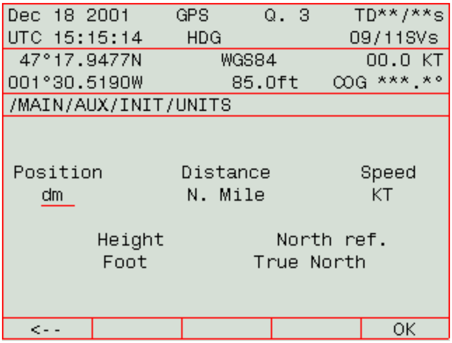
AUX Menu

❑ Choosing the Units to Be Used

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **INIT** displayed on the menu
  F2-INIT
  F5->>>, if necessary, to have **UNITS** displayed on the menu
  F2-UNITS

  Example of screen then obtained:



- The following units can be chosen:

  Position : degrees, minutes (dm) or degrees, minutes, seconds (dms)
  Distance : Nautical Miles (N. Mile), meters (m) or Miles
  Speed : Knots (KT), m/s (meters/second) or k/h (kilometers/hour)
  Height : Meters (m) or Feet (Foot)
  North Ref. : True North, Magnetic North or Grid. Only True North can be used.

- Then Press **F5-OK** to enable your choices.

❑ Entering Local Time & Local/UTC Time Deviation

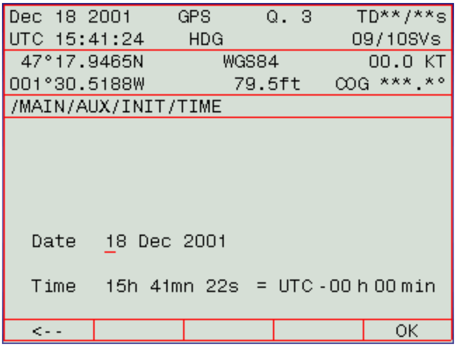
In the event of relatively long satellite search in the Aquarius when first using it, it may be useful to enter the current date & time in order to help the system speed up this phase. Otherwise, if satellites are found without any problem, which will generally be the case, the GPS receiver itself will fill in these date & time fields.

On the other hand, for the Aquarius to provide the correct local time, it is essential that you specify the deviation between UTC time and local time.

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **INIT** displayed on the menu
  F2-INIT
  F5->>>, if necessary, to have **TIME** displayed on the menu
  F3-TIME

  Example of screen then obtained:



- Enter the current date & time, then the time deviation, a positive or negative value, between local time and UTC time
- Press **F5-OK** to enable your choice.

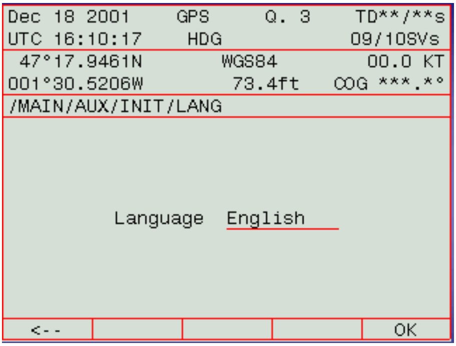
  NOTE: Local time is ALWAYS displayed on the screen (in the upper frame, top left). When Local time= UTC time, the “UTC” label is placed before. Otherwise, the local time is preceded by the “LOC” label as this time is different from UTC time.

❑ Choosing the Interface language

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **INIT** displayed on the menu
  F2-INIT
  F5->>>, if necessary, to have **LANG** displayed on the menu
  F4-LANG

  Example of screen then obtained:



- Use the vertical arrows directly, on the keyboard or on the view, to select one of the available languages:

  English
  French
  Spanish

- Press **F5-OK** to enable your choice.

❑ Initializing Position & Choosing a Coordinate System

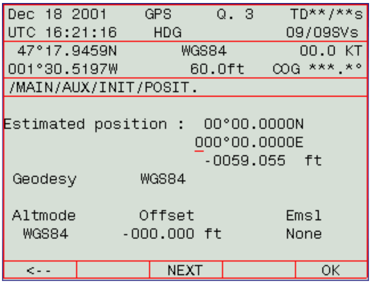
In the event of relatively long satellite search in the Aquarius when first using it, it may be useful to enter an estimate of the current position in order to help the system speed up this phase. Otherwise, if satellites are found without any problem, this operation is not required.

On the other hand, for the Aquarius to provide position data with the desired coordinates, you should specify which coordinate system must be used.

- From the main menu (see page 23), select successively:

    F3-AUX
    F5->>>, if necessary, to have **INIT** displayed on the menu
    F2-INIT
    F5->>>, if necessary, to have **POSIT.** displayed on the menu
    F2-POSIT.

Example of screen then obtained:



- Enter the 3 coordinates of the estimated position (use **F3-NEXT** to move the cursor to the next editable field)
- Choose the coordinate system to be used. Up to 10 different systems can be defined in Aquarius. At delivery, only the WGS84 is available. Use the $PDAS,GEO command or ConfigPack Software from V3.31 to add new systems (see page 250).
- Choose the desired altitude computation mode (**Altmode**): WGS84, MSL84, DATUM or USER. For more detail, see page 216 (where **Altmode** is the “a” argument described). A local geoid can be used. Use the ConfigPack software to load all or part of this local geoid into the receiver. After doing this, select “USER” in the **Altmode** field to let the receiver work with this geoid.
- Enter the antenna height (**Offset**) from the reference surface
- If a local height correction is used, select **Linear** in the **Emsl** field. Otherwise, choose **None**. See also page 216 for this parameter. Then press **F5-OK** to enable your choices.

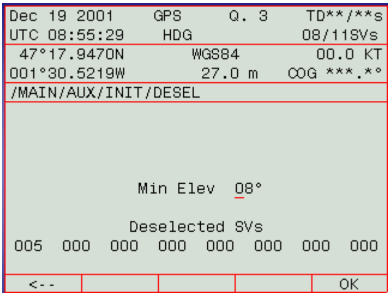
Changing the Minimum Elevation

The recommended elevation angle is 5°. You may sometimes have to change this angle. As a general rule, it can be increased if the number of visible satellites is always much greater than the minimum required. It can be reduced if this number is critical or insufficient.

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **INIT** displayed on the menu
  F2-INIT
  F5->>>, if necessary, to have **DESEL** displayed on the menu
  F4-DESEL

  Example of screen then obtained:



- Enter the desired value in the **Min Elev** field (see above screen)
- Press **F5-OK** to enable the change made. The TRM100 then comes back to the previous screen.

Rejecting Satellites from the Processing

One or more satellites (up to 8) can be rejected intentionally. This may be required if for example one of them is declared by the US Administration as temporarily non-operational, or if you only wish to use the WADGPS capability (not the ranging capability) of a WAAS/EGNOS satellite (PRN 120 to 138).

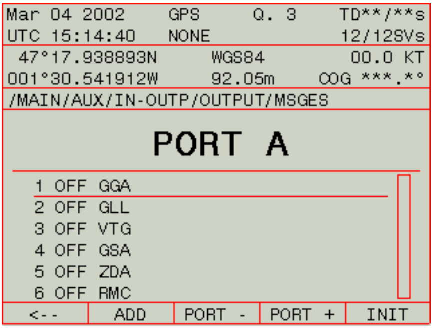
- Select **AUX>INIT>DESEL** allowing you to display the above screen
- Enter the satellite PRN to be rejected in the first of the 8 fields shown in the lower part of the screen (PRN= Number provided in the list displayed by **AUX> STATUS**, "Sv" column; see page 56). Any field containing "000" means that it does not reject any satellite
- Press **F5-OK**. On the **AUX> STATUS** screen, this satellite will now be listed as a "deselected" satellite ("d" index in "L1" column).

❑ Accessing the List of Output Messages

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **IN-OUTP** displayed on the menu
  F4-IN-OUTP
  F4-OUTPUT
  F4-MSGES

  Example of screen then obtained:



  This screen shows the operation status of a number of preset messages on port A as well as their respective contents (NMEA sentences or user-defined messages). Use the vertical arrow keys to scroll through the entire list of available messages on this port.

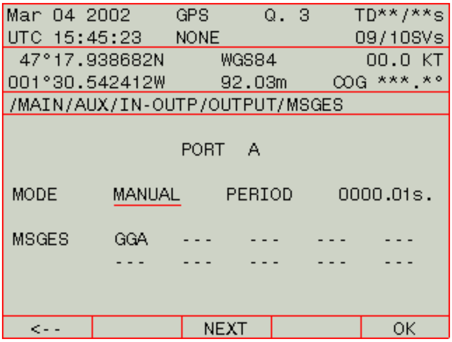
- To list the output messages defined on the other ports, use the **F3** key (Port -) or **F4** key (Port +).

  The operation status of a message can be:

  ON : message is activated (available on specified port)
  OFF : message is deactivated (not available).

❑ Modifying an Output Message

- Access the output messages screen as explained above
- Select the screen showing the message you want to modify by pressing the **F3** or **F4** key
- Using the vertical arrows, place the cursor on the desired message number
- Press **F5-INIT** to display the definition of the message.
  Example of screen then obtained:



As shown on this screen, the definition of an output message relies on the following three parameters:

MODE : Activating/deactivating the message. 2 possible values in this field:

OFF: Deactivated
TIME: Activated message, available on output at regular intervals of time, as specified in “Period” parameter below
TRIGGER: Activated message, available on output every x occurrences of an external event signal applied to pin 3 (EVT) on the AUX connector
IMMED: Activated message, generated once when validating this output mode for the message
1PPS: Activated message, generated on the active edge of the 1PPS signal
MANUAL: Activated message, generated once on keyboard request
$TR: Activated message, generated every time the $PDAS,TR command is sent through the port to which the message is routed

PERIOD : Significant only if “TIME”, “TRIGGER” or “1PPS” selected in “MODE” field above. Enter the desired interval of time between any two consecutive messages of the type being currently defined:

In seconds if TIME selected. Max. output rate (20 Hz) is obtained when PERIOD= 0.00 s

TRIGGER: in number of occurrences of external event

1PPS: in number of 1PPS cycles

MSGES : This parameter defines the content of the output message. It consists of 10 different fields. Each of these fields can contain the name of an NMEA sentence or the first three letter of a user-defined sentence[1]. The chosen NMEA or user-defined sentences will be output in the indicated order. To select the desired sentence in a field, once the cursor points to this field, use the vertical arrow keys to scroll through the possible choices. To define an empty field, select ” - - -“. To know the detail of each of the available NMEA sentences, refer to Section 8, Computed Data Outputs.

- Press **F5-OK** to enter the changes made. The TRM100 then comes back to the previous screen showing the operation status of the messages on the concerned port, including the one you have just changed.

❑ Adding an output message

- Access the output messages screen as explained on page 51.
- Press **F2-ADD**. This gives access to the same screen as the one normally accessed when you want to modify an existing output message. Refer to the previous paragraph.
- After defining the new message, press **F5-OK** to enable the new message.

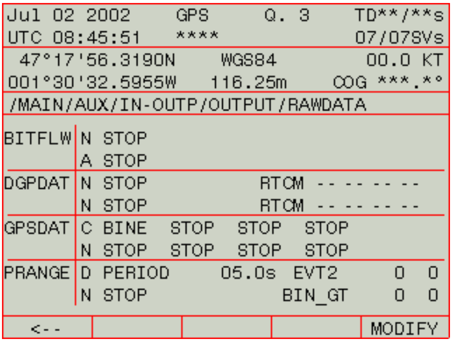
[1] User-defined sentences can be created using ConfigPack Software

❑ Setting Raw Data Outputs

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **IN-OUTP** displayed on the menu
  F4-IN-OUTP
  F4-OUTPUT
  F5-RAWDATA

  Example of screen then obtained:



  This screen allows you to define two different messages for each type of raw or differential data the receiver can deliver on its output ports. In fact each line on this screen reflects the syntax of the corresponding $PDAS command described in Section 11 (BITFLW: page 221, DGPDAT: page 237, GPSDAT: page 262 and PRANGE: page 277). Note the following differences on this screen compared with the $PDAS commands: “N” is used in the port field for “no output” and “STOP” is used in the raw data fields for “no data”.

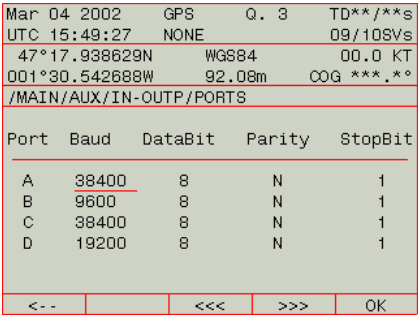
- Press **F5-MODIFY** and define your messages as needed using **F3->>>** to change line and the arrow keys to move the cursor horizontally and select a value in each field.
- Click **F5-OK** when you have finished defining the outputs

❑ Changing Serial Port Settings

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **IN-OUTP** displayed on the menu
  F4-IN-OUTP
  F3-PORTS

  Example of screen then obtained:



- Press the Up or Down arrow key to select the port you want to change. Press the Left or Right arrow key to move the cursor to the previous or next parameter in the line
- For each parameter in a line, press **F3-<<<** or **F4->>>** to choose one of the possible values for this parameter. As shown on the above screen, the following parameters have to be defined when setting a port:

  Port : Port name
  Baud : Baud rate. 6 different values are possible: 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200
  DataBit : Number of data bits. 4 different values are possible: 5, 6, 7 or 8
  Parity : Parity check. 5 possible values in this field: None (N), forced to “0” (S for “space”), forced to “1” (M for “mark”), even (E) or odd (O)
  StopBit : Number of stop bits (1 or 2)

- Press **F5-OK** to enable your changes.

If a U-Link or HM-Link reception kit is installed, port C or D must be set to 19200 baud, 8 data bits, no parity and 1 stop bit.

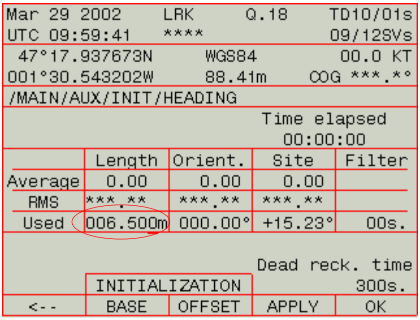
❑ Determining the Baseline Length (Aquarius²)

This task is required as the first prerequisite for heading processing. After enabling this mode through **DGNSS>MODE**, (see page 37) do the following:

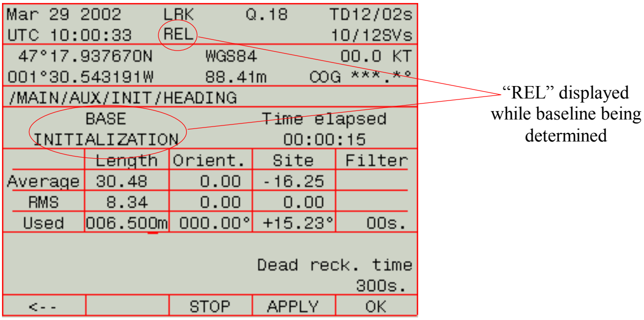
- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have INIT displayed on the menu
  F3-HEADING

- You may enter an estimate of the baseline in the field shown below.



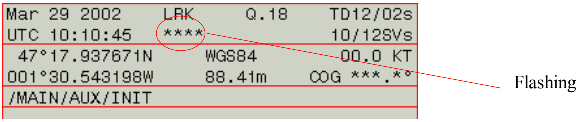
- Press **F2-BASE** to start the baseline computation. The screen then looks like this:



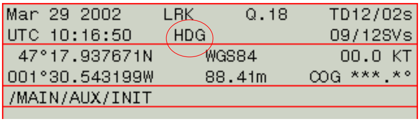
- When the Average value of baseline gets stable (denoted by low RMS), press successively:

  F3-STOP to stop the initialization phase
  F4-APPLY to make the measured length of baseline the "Used" length of baseline
  F5-OK to allow the receiver to start computing the heading

As a result, the receiver is now allowed to start determining the heading. The following is displayed in the upper part of the screen as long as no heading value is available:



After a certain time, the receiver can determine the heading, as indicated on top of the screen. The heading value is displayed on one of the data screens.



❑ Calibrating the Heading Processing (Aquarius²)

Prerequisite: After letting the receiver determine the base line length, validate this value as the baseline used in the heading processing. Select the **AUX>INIT>HEADING** function and check that the calibration value is "000.00°" (in **Orient.** column, **Used** row). Let the receiver determine the heading. (See previous chapter.)

• Manual static calibration (see principles on page 109) or manual dynamic calibration based on alignment with seamarks (see principles on page 110):

- Read the heading measured by the receiver
- Compute the calibration value (computed heading – true known heading)
- Select the **AUX>INIT>HEADING** function
- Enter the calibration value in the **Orient.** column, **Used** row
- Press **F4-APPLY**, **F5-OK**
- Check that the receiver now displays the expected value of heading. End of calibration.

• Automatic calibration (see principles on page 111)

- Select the **AUX>INIT>HEADING** function
- Press **F3-OFFSET**
- Navigate according to the instructions given in page 111

  After a certain time, when the average value of heading (**Orient.** column, **Average** row) gets stable (denoted by low RMS), then the calibration value is assumed to be valid
- Press **F3-STOP** to stop the calibration sequence and then **F4-APPLY** to enter the computed calibration value as the **Used** value
- Press **F5-OK** to quit. End of calibration

❑ Defining the Dead Reckoning Time in Heading Processing

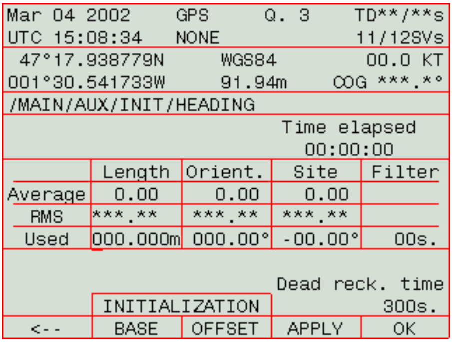
In case of momentary loss of satellite reception (typical case: going under a bridge), the receiver may not be able to provide heading measurement. In this case, the last valid heading value computed will be updated using the COG (Course Over Ground). This operating status is denoted by the term “HDG_E” (E for Estimated) appearing on all heading screens, associated with the estimated heading value. Example:

The time during which the COG is allowed to update the heading value is adjustable from 0 to 600 seconds. If at the end of this time, Aquarius² is still unable to deliver heading measurements, then it will stop displaying the estimated heading value and instead will display “***.*°”.To modify the dead reckoning time applied to the heading:

- From the main menu, select successively:

  F3-AUX
  F5->>>, if necessary, to have **INIT** displayed on the menu
  F2-INIT
  F5->>>, if necessary, to have **HEADING** displayed on the menu
  F3-HEADING

  Example of screen then obtained:



- Select the **Dead reck. time** field located bottom right in the table
- Enter the desired value, in seconds, in this field
- Press **F5-OK** to enable your choice.

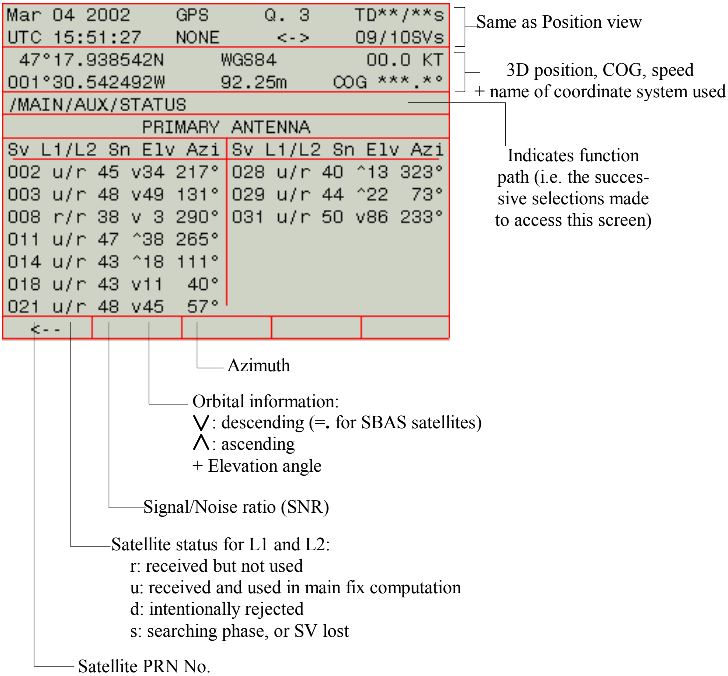
❑ Viewing the visible GPS constellation

This function allows you to display information on the satellites currently received by the NAP 00x primary antenna. This information is both qualitative and quantitative.

- From the main menu (see page 23), select successively:

  F3-AUX
  F5->>>, if necessary, to have **STATUS** displayed on the menu
  F2-STATUS

  Example of screen then obtained (with dual-frequency receiver):



- Press one of the horizontal-arrow keys to read the same data for the secondary antenna.
- Press the same key once more to access a third screen providing information about the master oscillator drift, the DOP, LPME, etc.

❑ Changing Speed Filtering

This function allows you to change the time constant in the filtering process applied to both the speed and the course over ground (COG).

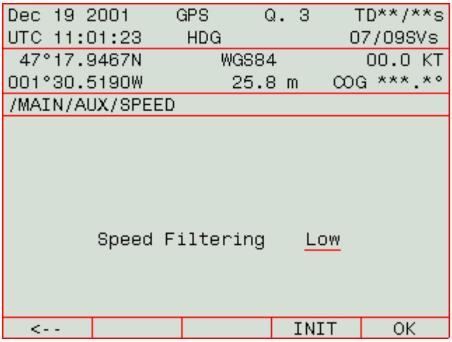
Filtering the speed enhances the stability of the speed result by smoothing the successive values computed by the receiver.

The filtering value should be chosen to adapt to both the type of navigation performed and the weather conditions (default value: 2 seconds).

For example, if numerous maneuvers (turns, etc.) must be performed at moderate or high speed on a calm sea, we recommend low filtering, or even no filtering at all. On the contrary, if you try to navigate with constant heading on a rough sea, medium or even high filtering is recommended for better readability of the speed measurement.

- From the main menu (see page 23), select successively:
  F3-AUX
  F5->>>, if necessary, to have **SPEED** displayed on the menu
  F4-SPEED

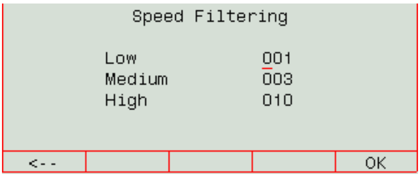
Example of screen then obtained:



- Use the vertical arrow keys directly, on the keyboard or on the view, to select one of the possible 3 choices:
  - Low (default: 6 second)
  - Medium (default: 20 seconds)
  - High (default: 60 seconds)
- Press **F5-OK** to enable your choice.

You can change the filtering values associated with the available three filtering options:

- On the previous screen, select **F4-INIT**. The following is displayed:



- Make the changes required and then press **F5-OK**.

❑ Other functions

The following functions are also available from the AUX menu:

- Testing keyboard and screen (**AUX>IN-OUTP>TEST**)
- Listing possible anomalies (**AUX>ANOMALY**). An acknowledge key (**F5**) is present in this function allowing you to delete the report of a past anomaly from the list of anomalies. Refer to page 313 to know the list and identification of all possible anomalies.
- Listing the different versions of the Aquarius internal parts (**AUX>VERSION**) (same information as that obtained on the Remote Display view when starting the receiver).

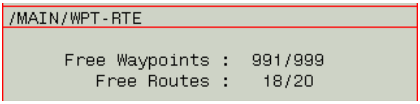
WPT-RTE Menu

❑ Listing the Waypoints and Routes Stored in the Receiver

- From the main menu (see page 23), select:

  F4-WPT-RTE

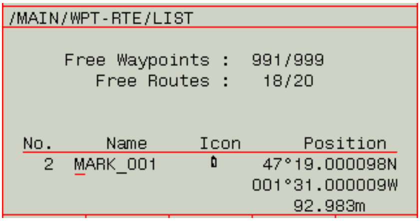
  The screen indicates the number of free waypoints and routes out of the total number of possible waypoints and routes. For example, if the following is displayed, this means that 8 waypoints and two routes are currently stored in the receiver.



- To access the list of existing waypoints, select:

  F4-WPTS

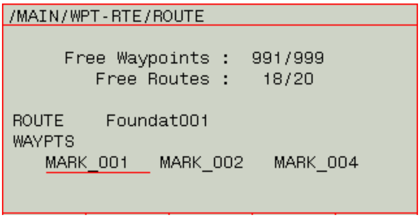
  The screen shows the definition of a single waypoint at a time:



- To scroll the list of waypoints up and down, use the vertical-arrow keys
- To access the list of existing routes, select:

  F1-<– – to come back to the parent menu
  F5-ROUTES

  As said previously, the screen shows the definition of a single route at a time. Use the vertical-arrow keys to scroll the list up & down:

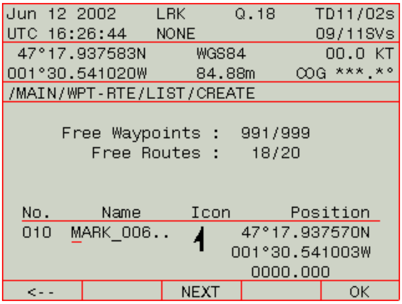


❑ Creating a waypoint

- From the main menu (see page 23), select successively:

  F4-WPT-RTE
  F4-WPTS
  F4-CREATE

  The screen then automatically switches to the Edit mode to allow you to type the definition of a new waypoint:



  Note that the cursor is directly positioned on the waypoint name, not on the waypoint number. This is because the receiver automatically fills in this field after scanning the list of waypoints to determine the next available waypoint number. For example, if the last waypoint in the list is No. 10, then the receiver will prompt No. 11 for the waypoint you are creating.

- If however the prompted waypoint number does not suit, move the cursor to this field using the Left key and type the desired number.
- Press **F3-NEXT** to move the cursor to the next parameter in the way-point definition.
- Likewise there is a default waypoint name prompted by the receiver. The form is "**MARK_<order number>**" where **<order number>** is automatically incremented by the receiver. Also in this case, you can type a completely different name if you wish.
- Press **F3-NEXT** and select an icon for the waypoint. Up to 20 different icons are available. Use the vertical-arrow keys to choose one.
- Press **F3-NEXT** and type the first coordinate of the waypoint.
- Press **F3-NEXT** and type the second coordinate of the waypoint. (Do the same for third coordinate if a 3D waypoint.)
- Press **F5-OK** to save the definition of the new waypoint.

❑ Modifying/Deleting a Waypoint

- From the main menu (see page 23), select successively:

  F4-WPT-RTE
  F4-WPTS

- Using the vertical-arrow keys, scroll the waypoints list up or down to access the desired waypoint, i.e. the one you want to modify or delete
- Once this waypoint is displayed on the screen, select:

  F2-MODIFY to change one or more parameters in the definition of the waypoint
  or
  F3-DELETE, then **F5-OK** to delete the waypoint.

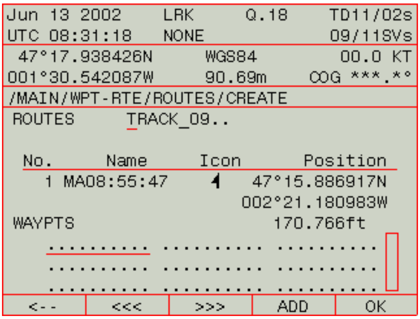
❑ Creating a Route

Warning! Unless there are at least two waypoints stored in the receiver, you will not be allowed to create a route.

1. From the main menu (see page 23), select successively:

   F4-WPT-RTE
   F5-ROUTES
   F4-CREATE

   The screen then looks like this:



2. Type a name for the route you are creating

Then you must indicate each waypoint making up the route (note that the cursor is positioned in the first field prompting you to enter the route's start waypoint). As you can see, the screen also shows the definition of a waypoint. This waypoint is read from the list of available waypoints stored in the receiver.

3. To scroll the waypoints list up and down, use the vertical-arrow keys. Every time you press one of these keys, the definition of the previous or next waypoint in the list appears on the screen
4. Once the desired waypoint appears on the screen, press **F4-ADD** to choose it as the start waypoint. As a result, the name of this waypoint now appears in the first field, the cursor is automatically moved to the next field and the definition of the next waypoint in the list of waypoints is automatically shown on the screen.
5. Have the second waypoint displayed on the screen and then press**F4-ADD** again, and so on for the next points
6. When the last waypoint in your route is defined, press **F5-OK** to save the route.

You can overwrite a waypoint as indicated below:

- Use **F3-<<<** and **F4->>>** to select the field where you want to overwrite a waypoint

- Choose the waypoint from the waypoints list using the vertical-arrow keys

- Press **F4-ADD**. As a result the new waypoint appears in the selected field and the waypoint that occupied this field is removed from the route definition.

❑ Modifying/Deleting a Route

- From the main menu (see page 23), select successively:

  F4-WPT-RTE
  F5-ROUTES

- Using the vertical-arrow keys, scroll the routes list up or down to access the desired route, i.e. the one you want to modify or delete
- Once this route is displayed on the screen, select:

  F2-MODIFY to change one or more parameters in the definition of the route
  or
  F3-DELETE, then **F5-OK** to delete the route.

Through the MODIFY function, you can insert a waypoint between any two waypoints previously defined as part of the route. To do this:

- Use the horizontal-arrow keys to select the field where you want the new waypoint to be inserted

- Choose the waypoint from the waypoints list using the vertical-arrow keys

- Press **F5-OK**. As a result the new waypoint appears in the selected field and the waypoint that occupied this field as well as all those in the next fields are shifted by one position to the right.

Through the MODIFY function, you can also delete a waypoint from the route.

MARK Menu

This function allows you to quickly create a waypoint by pressing only three keys from the main menu:

F5-MARK
F1-SAVE
F5-OK

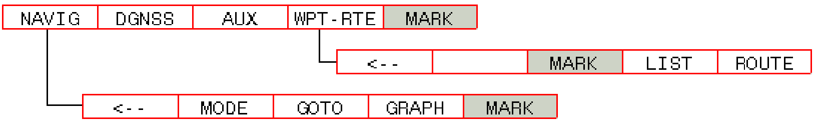
By doing this you create a waypoint defined with the following default characteristics:

- Name: MA<hh:mm:ss> where hh:mm:ss is the current time when you press **MARK**
- Icon: a vertical flag: 
- Coordinates: current location of the mobile when you press **MARK**.

You can however change these defaults before actually creating the waypoint. To do this, select:

F5-MARK
F1-SAVE
Change defaults
F5-OK

This function is available at three different levels in the TRM100, as shown in the diagram below:



"Open" Operating Mode

Corrections data used in a number of non-autonomous operating modes (DGPS, LRK, etc.) can be delivered to the receiver by different sources. These can be:

- HF, MF or UHF stations that Aquarius can directly receive thanks to its built-in reception modules
- Or any other sources received by local external corrections receivers attached to Aquarius via one of its serial ports.

❑ Source Selection Criteria

After you select the OPEN operating mode manually, the receiver continually examines all the corrections data inputs and chooses the best. The following criteria are used to decide on which source is the best, with the following decreasing order of priority:

Distance to Station ÷ SNR ratio

Reception level

Distance to corrections data source

1st source received is the best

So the receiver will preferably choose a station, provided the type of data received is compatible with the chosen processing mode.

If none of the possible stations is received properly (first two criteria not met), the receiver will try to use corrections data from an external corrections receiver, if any. As previously with stations, the type of incoming data must be compatible with the chosen processing mode otherwise the corrections data source will be discarded.

Of the possible sources meeting the third criteria, the receiver will choose the one with the shortest distance to the source (this information being normally provided by external demodulators, the receiver can easily make a choice).

Finally, if there is only one corrections data source available, then the receiver can only use it as there is no other choice possible (4th criterion).

❑ "Open" Mode Used as Backup Mode

If you select a station manually, you do not specify its reference station number and no signal is received from this station, then the receiver itself will automatically switch to OPEN mode, using a source other than the one chosen.

In this case, the receiver will instantly switch to the best source received, thus rejecting the station you initially chose. The name of this source (station or external corrections receiver) will then flash on the MODE screen (in OPEN line, STATION column).

About the HM-Link Reception Kit

❑ Use Guidelines

The reception module that is part of this kit is fitted with two independent, parallel channels. Each channel may be allocated a different reception frequency provided both frequencies are chosen in the same frequency band: both must be either HF or MF.

MF stations use a single transmission frequency, which means that if you want to work with this type of station, you can:

- Use one channel to receive this frequency and leave the other channel free
- Use one channel to receive this frequency and use the other channel to receive another MF station.

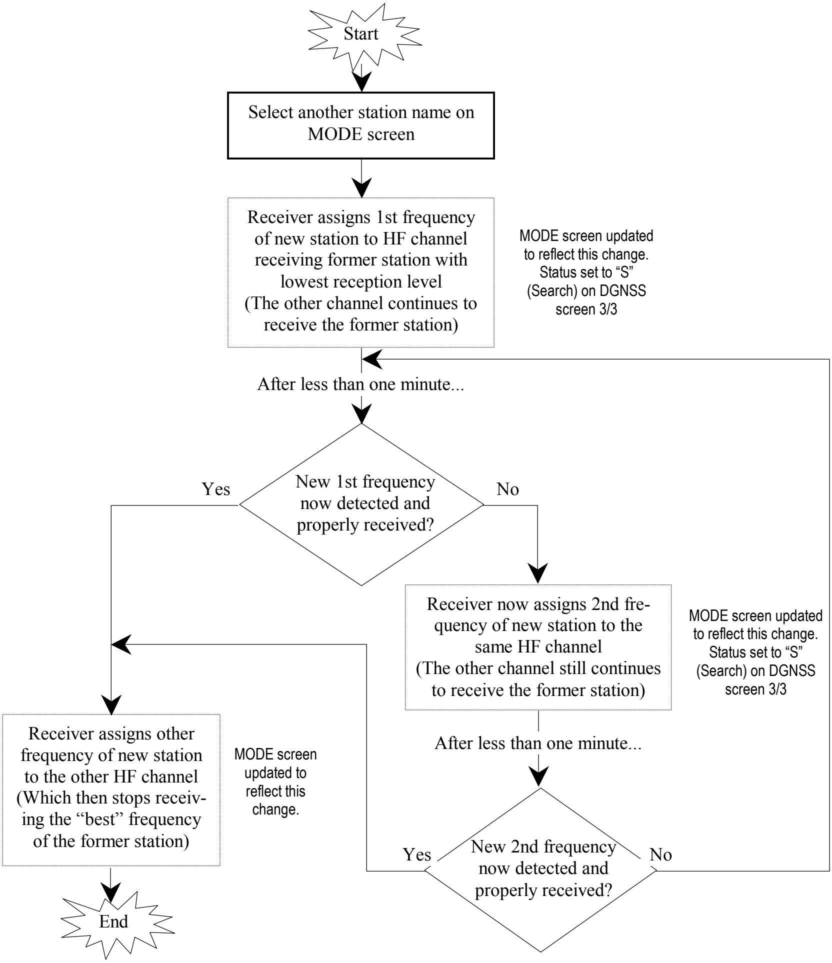
HF stations are dual-frequency stations. If you want to work with one of these stations:

- On the Mode screen (see page 38), select the name of this station in one of the lines (HFMF1 or HFMF2) resulting from the presence of the reception module in the receiver. Leave the other line blank. The receiver will manage by itself the allocation of the reception channels to the two carrier frequencies.

Working with a dual-frequency HF station does not mean that you get two distinct position fixes from your Aquarius. Fundamentally, Aquarius provides a single position fix, even in the case of DGPS operation using an HF station.

❑ Switching Over From a Dual-Frequency Station to Another

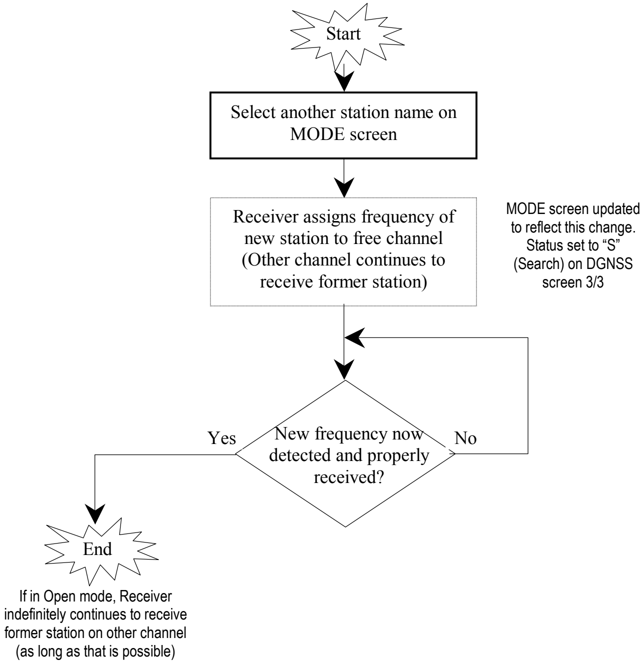
In this particular case where the HM-Link reception module has to switch over from two frequencies to two new frequencies, a routine is run to maintain smooth operation of the receiver while passing from a station to the other. This is summarized in the flowchart below.



If the Open mode is enabled, the corrections data from the new station will automatically be involved in the fix processing. Otherwise, Aquarius will indefinitely work using the former station, and obviously will fail to operate in DGPS if this station is not received any more.

Switching Over From a Single-Frequency Station to Another

In this particular case where the HM-Link reception module has only to switch over from a frequency to another, another routine is run to maintain smooth operation of the receiver while passing from a station to the other. This is summarized in the flowchart below. This routine is made possible thanks to the fact that the HM-Link reception module has two distinct reception channels and one is supposedly always free.



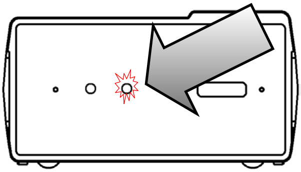
Changing Frequency Band

As the HM-Link can only be all HF or MF, whenever you ask the module to receive a station operating in a band different from that currently selected in the module, then the module stops receiving the station(s) it has been receiving until now and switches to the new frequency band to be able to receive the station you are asking it to work with.

LED Indicators on Inner Front Panel

In what follows, you will learn all about LED indicators on the inner front panel when you turn on Aquarius with the TRM100 unit detached from the receiver case.

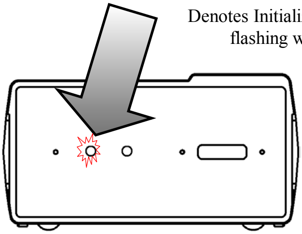
When you apply the power voltage to the receiver, the Power LED lights up straight away indicating that the unit is now on. It will stay lit as long as the receiver is correctly powered.



A few seconds after switching on the receiver, an initialization phase is started. This operating state is indicated on the “Number of received satellites” LED which then lights up.

For a single-frequency receiver, this LED will be held permanently lit throughout the initialization phase.

For a dual-frequency receiver, the LED will light up at the beginning of initialization but after a certain time, it will start blinking (with equal ON/OFF times) denoting L1 tracking by the receiver for a number of received satellites.



The end of initialization is denoted by a flashing “Number of received satellites” LED with the number of flashes reflecting the number of satellites received by the receiver.

This flashing state is the sign that the receiver will soon reach its fully operational state, i.e. as soon as the number of received satellites is sufficient (4 satellites minimum). ♣

Getting Started

4. Aquarius Processing Modes

Terminology Used

- **Reference station**: A stationary receiver, with accurately known location, that generates corrections data (5000 series receiver or later; see section 11).

The identification number of a reference station is user-defined through the $PDAS,UNIT command. In DGNSS processing mode, the mobile receiver will read this identification number from the DGPS messages received to identify the source of corrections data.

- **Beacon** (or **Transmitter** or **Transmitting station**): A transmitting unit connected to one or more reference stations. The beacon is used to transmit corrections data to users. A beacon is identified by a specific identification number, called Beacon Id, complying with the beacon numbering rule defined by the RTCM. It is important to note that a reference station and the beacon to which it is attached may have different identification numbers.

When defining a beacon, you will be asked to enter its geographical coordinates. Remember that these coordinates do not need to be very precise as they are just used by navigators to select the beacon the closest to their locations. On the contrary, the coordinates of a reference station must be known with the best possible precision, as they are essential in generating corrections data.

- **Navigator receiver**: Mobile user receiver providing users with position or/and navigation data.

- **Primary mobile:** Navigator receiver given the capability to accurately determine the vector between its antenna position and that of a secondary mobile from which it receives corrections data

- **Secondary mobile:** Mobile receiver virtually operated as a reference station, i.e. transmitting corrections data, so that the primary mobile can accurately determine the vector between its antenna position and that of the secondary mobile.

LRK Processing

❑ Precision Level

- Operating range up to 40 km (5 SVs or more) with OTF kinematic initialization
- OTF initialization time: 30 seconds, typical
- Precision:
  In KR Fast Mode (20 Hz max. and 5-ms latency):
  10 mm + 0.5 ppm, XY
  20 mm + 1.0 ppm, Z
  In KA Synchronous Mode (1 Hz and 1-s latency):
  5 mm + 0.5 ppm, XY
  10 mm + 1.0 ppm, Z

Performance figures are 1s RMS values measured in normal conditions of GPS reception (normal ionospheric activity, 5 satellites used and HDOP < 4) on clear site.

❑ Specific Requirements

Receiver: Dual-frequency receiver type, Aquarius-02

Additional Hardware: Rx 4812 U-Link reception module (option) and UHF antenna (see installation on page 18).

⇨ You can also use external equipment (such as GSM, radio modem, etc.) allowing the acquisition of RTCM messages No. 3, 18 and 19 via one of the receiver ports.

Additional Firmware: LRKMODE

Corrections Data: Pseudorange and phase measurements in LRK format at 4800 Bd

⇨ You can also use RTCM messages No. 3, 18 and 19 received by external equipment attached to the receiver.

Possible Corrections Sources: Sagitta-02 or Aquarius-02 used at stations, 5002 SK stations from the previous series of marine survey products.

⇨ Any equipment transmitting corrections data in RTCM SC104 format if you intend to work with an external receiver capable of receiving such data.

❑ Definitions

LRK® is a kinematic processing method providing real-time positioning with centimeter level precision. It can be implemented in dual-frequency receivers (Aquarius 02, 12 & 22).

To reduce the initialization time, and depending on the application, different initialization modes are possible:

- **OTF**: ("On the Fly") Initialization with receiver in motion, start point unknown
- **STATIC**: Initialization with receiver at a standstill, but point unknown
- **Z-FIXED**: Initialization with receiver in motion, start point unknown, but receiver altitude remains constant throughout the initialization phase
- **POSIT**: Initialization from a known point. this mode requires the prior entry of a reference position.

Two different types of LRK solutions are available:

- **LRK-A**: (A for "Accurate") Accurate LRK position, computed every time corrections data from the reference station is received (every 1.0 second in general)
- **LRK-R**: (R for "Real Time") LRK position, computed from extrapolated corrections data, available every 0.1 second.

Should the receiver be unable to produce a kinematic solution (during initialization phase or if insufficient amount of data), then an EDGPS solution would be provided, every 0.1 second, in place of the LRK-A or LRK-R solution.

❑ Configuration Guidelines

Use the DGNSS menu (see page 24) or use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118).

From the Terminal view, the following set of commands should be used:

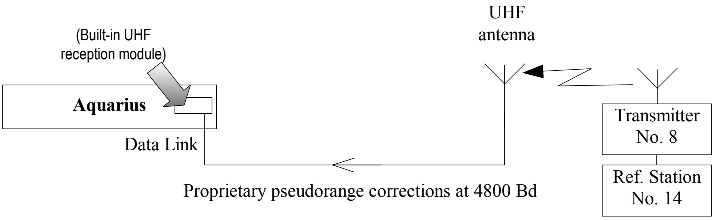
- $PDAS,DGPS,STATION (page 235) to let the receiver know the transmission specifications (carrier, modulation type, encryption) of each of the potentially usable transmitters.
- $PDAS,DGPS,MODE (see page 233):
    - To define your receiver as a corrections user
    - To specify the corrections transmitter
    - To specify the reference station(s) generating corrections.
- $PDAS,FIXMOD (page 243) to select the processing (LRK) and the initialization mode used by the receiver.
- $PDAS,PREFLL or $PDAS,PREFNE to enter the known position from which initialization will take place (only if you have chosen this initialization mode).

The following set of commands indirectly deals with this processing mode:

- $PDAS,DGPDAT (page 237) lets you define DGPS corrections outputs
- $PDAS,NAVSEL (page 273) lets you choose the type of position solution you want to use in your navigation application.

❑ Example #1

LRK processing with LRK format and internal U-Link receiver



1. Let the receiver know the characteristics of the transmitter broadcasting the corrections:

   $PDAS,DGPS,STATION,8,LA FLEUR,4716.52,N,00129.54,W, UHF, 444550000,30,,,4800,GN

   - Transmitter Id.: 8
   - Transmitter Name: LA FLEUR
   - Reference coordinates: 47°16.52'N, 1°29.54'W
   - Transmission band: UHF
   - Carrier: 444.55 MHz
   - Range: 30 km
   - (2 blank fields)
   - Baud rate: 4800
   - Modulation type: G (GMSK)
   - Encryption: N (none)

2. Configure the built-in UHF reception module so that it can receive and decode the data from reference station No. 14 (attached to beacon No. 8):

   $PDAS,DGPS,MODE,1,D,R,8,,,14

   - Command line No.: 1
   - Port: D (allows acquisition of corrections data via built-in UHF reception module)
   - Receiver defined as DGPS corrections receiver: R
   - Beacon Id.: 8
   - (2 blank fields)
   - Identification of the reference station generating corrections: 14

3. Select the LRK processing mode with OTF initialization:

   $PDAS,FIXMOD,7,1,14

   - Fix mode: LRK, OTF initialization (7)
   - Source of corrections: LRK (1)
   - Identification of reference station used (14)

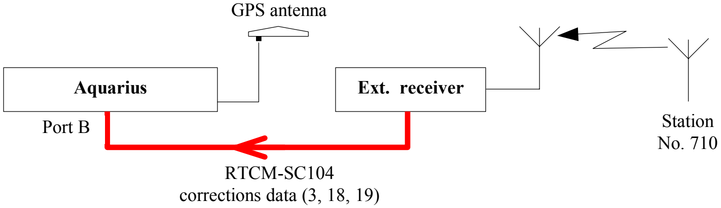
5. Choose the KART-A position solution for your navigation needs:

   $PDAS,NAVSEL,3,1

   - Fix used for navigation: KART-A (3)
   - Navigation mode: none (1)

❑ Example #2

LRK processing using RTCM format and external corrections receiver



Assuming port B on Aquarius has been properly set to receive data from the external receiver:

1. Let the receiver acquire and decode the RTCM-SC104 corrections data provided by the external receiver (data from station No. 710) via Aquarius's B port:

   $PDAS,DGPS,MODE,1,B,R,,,,710

   - Command line No.: 1
   - Port: B (allows acquisition of corrections data from external rec.)
   - Receiver defined as DGPS corrections receiver: R
   - (Next parameter (Beacon Id.) omitted to let the receiver acquire corrections from the specified serial port (B))
   - Identification number of the reference station received: 710. If this argument is omitted, all corrections will be acquired without testing the reference station Id.

2. Choose the desired fix mode:

   $PDAS,FIXMOD,7,1,710

   - LRK with OTF initialization: 7
   - Source of corrections: 1 (DGPS/KART/LRK)
   - Identification of the reference station: 710. If this argument is omitted, the processing will use the only set of corrections available.

❑ Corrections Data Outputs

The corrections data received on the Data link input can be routed to a serial port for archival or post-processing purposes.

Four output formats are available:

Acquisition format	Possible output formats			
	Proprietary UHF	LRK	RTCM	SVAR!D
Proprietary UHF	✓			✓
LRK		✓		✓
RTCM			✓	✓

- For example, to let the receiver output data on its B port, in immediate mode and LRK format, use the following command:

  $PDAS,DGPDAT,1,B,3,,2

KART/EDGPS Processing

❑ Precision Levels

Real-Time Centimeter KART Mode (RTK L1)

- Operating range up to 12 km (5 SVs or more) with OTF kinematic initialization
- OTF initialization time: 10 minutes, typical
- Precision:
  In KR Fast Mode (20 Hz max. and 5-ms latency):
    10 mm + 0.5 ppm, XY
    20 mm + 1.0 ppm, Z
  In KA Synchronous Mode (1 Hz and 1-s latency):
    5 mm + 0.5 ppm, XY
    10 mm + 1.0 ppm, Z

EDGPS

- No operational limits of distance
- Data convergence time: 2 minutes, typical
- Precision: 20 cm + 2 ppm, XYZ

Performance figures are 1s RMS values measured in normal conditions of GPS reception (normal ionospheric activity, 5 satellites used and HDOP < 4) on clear site.

❑ Specific Requirements

Receiver: Single-frequency receiver type, Aquarius-01

Additional Hardware: Rx 4812 U-Link reception module (option) and UHF antenna (see installation on page 18).

⇨ You can also use external equipment (such as GSM, radio modem, etc.) allowing the acquisition of RTCM messages No. 3, 18 and 19 via one of the receiver ports.

Additional Firmware: None (required firmware KARTMODE is provided as standard)

Corrections Data: Pseudorange and phase measurements in LRK format at 4800 Bd. In this case the LRK format may not contain any L2-related data (but the data organization strictly remains that of the LRK format). In this case, i.e. when there is no L2 data included, we sometimes refer to this data string as being in “KART format”. Fundamentally, it is still in fact data transmitted in LRK format.

⇨ You can also use RTCM messages No. 3, 18 and 19 received by external equipment attached to the receiver.

⇨ EDGPS processing can specifically be obtained working with corrections data in proprietary UHF format transmitted at 1200 Bd.

Possible Corrections Sources: Sagitta-01 or Aquarius-01 used at stations, 5001 SK stations from the previous series of marine survey products. Dual-frequency stations would do the job as well.

⇨ Any equipment transmitting corrections data in RTCM SC104 format if you intend to work with an external receiver capable of receiving such data.

⇨ Corrections data in proprietary UHF format transmitted at 1200 Bd comes exclusively from NDS100 MkII stations (former series of UHF stations).

❑ Definitions

KART is a kinematic processing method providing real-time positioning with centimeter level precision. It can be implemented in single-frequency receivers (Aquarius-01 & 11).

To reduce the initialization time, and depending on the application, different initialization modes are possible:

- **OTF**: ("On the Fly") Initialization with receiver in motion, start point unknown
- **STATIC**: Initialization with receiver at a standstill, but point unknown
- **Z-FIXED**: Initialization with receiver in motion, start point unknown, but receiver altitude remains constant throughout the initialization phase
- **POSIT**: Initialization from a known point. This mode requires the prior entry of a reference position.

Two different solutions are available:

- **KART-A** : (A for "Accurate") Accurate KART position, computed every time corrections data from the reference station is received (every 1.0 second in general)
- **KART-R**: (R for "Real Time") KART position, computed from extrapolated corrections data, available every 0.1 second.

Should the receiver be unable to produce a kinematic solution (during initialization phase or if insufficient amount of data), then an EDGPS solution would be provided, every 0.1 second, in place of the KART-A or KART-R solution.

❑ Configuration Guidelines

Use the DGNSS menu (see page 24) or use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118).

From the Terminal view, the following set of commands should be used:

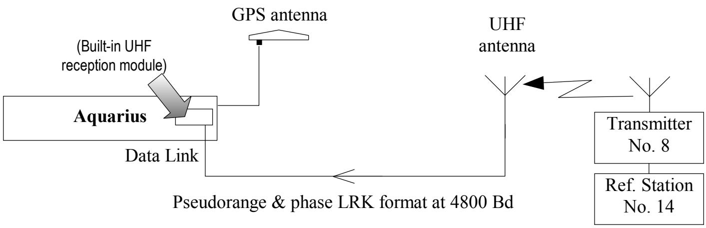
- $PDAS,DGPS,STATION (page 235) to let the receiver know the transmission specifications (carrier, modulation type, encryption) of each of the potentially usable transmitters.
- $PDAS,DGPS,MODE (see page 233):
  - To define your receiver as a corrections user
  - To specify the corrections transmitter
  - To specify the reference station(s) generating corrections.
- $PDAS,FIXMOD (page 243) to select the processing (KART) and the initialization mode used by the receiver.
- $PDAS,PREFLL or $PDAS,PREFNE to enter the known position from which initialization will take place (only if you have chosen this initialization mode).

The following set of commands indirectly deals with this processing mode:

- $PDAS,DGPDAT (page 237) lets you define DGPS corrections outputs
- $PDAS,NAVSEL (page 273) lets you choose the type of position solution you want to use in your navigation application.

❑ Example #1

KART processing with LRK/KART format and with U-Link internal receiver



1. Let the receiver know the characteristics of the transmitter broad-casting the corrections:

   $PDAS,DGPS,STATION,8,LA FLEUR,4716.52,N,00129.54,W, UHF, 444550000,30,,,4800,GN

   - Transmitter Id.:8
   - Transmitter Name: LA FLEUR
   - Reference coordinates: 47°16.52'N, 1°29.54'W
   - Transmission band: UHF
   - Carrier: 444.55 MHz
   - Range: 30 km
   - (2 blank fields)
   - Baud rate: 4800
   - Modulation type: G (GMSK)
   - Encryption: N (none)

2. Configure the built-in UHF reception module so that it can receive and decode the data from reference station No. 14 (attached to transmitter No. 8):

   $PDAS,DGPS,MODE,1,D,R,8,,,14

   - Command line No.: 1
   - Port: D (allows acquisition of corrections data via built-in UHF reception module)
   - Receiver defined as DGPS corrections receiver: R
   - Transmitter Id.: 8
   - (2 blank fields)
   - Identification of the reference station generating corrections: 14

Aquarius Processing

3. Enter a reference position for KART initialization at a known point (centimeter accuracy required):

   $PDAS,PREFLL,0,4716.1043533,N,00129.4543000,W,48.752

   - Position: latitude, longitude, height

4. Select and initialize the KART processing mode from a known point, using the data received:

   $PDAS,FIXMOD,10,1,14

   - Fix mode: KART, initialization from known point (10)
   - Source of corrections: KART (1)
   - Identification of reference station used (14)

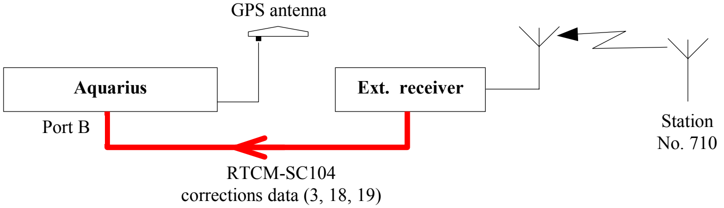
5. Choose the KART-R position solution for your navigation needs:

   $PDAS,NAVSEL,1,1

   - Fix used for navigation: KART-R (1)
   - Navigation mode: none (1)

❑ Example #2

KART processing using RTCM format and external corrections receiver



Assuming port B on Aquarius has been properly set to receive data from the external receiver:

1. Let the receiver acquire and decode the RTCM-SC104 corrections data provided by the external receiver (data from station No. 710) via Aquarius's B port:

   $PDAS,DGPS,MODE,1,B,R,,,,710

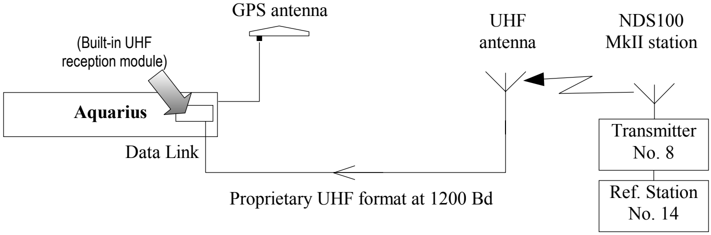
   - Command line No.: 1
   - Port: B (allows acquisition of corrections data from external rec.)
   - Receiver defined as DGPS corrections receiver: R
   - (Next parameter (Beacon Id.) omitted to let the receiver acquire corrections from the specified serial port (B))
   - Identification number of the reference station received: 710. If this argument is omitted, all corrections will be acquired without testing the reference station Id.

2. Choose the desired fix mode:

   $PDAS,FIXMOD,28,1,710

   - KART with STATIC initialization: 28
   - Source of corrections: 1 (DGPS/KART/LRK)
   - Identification of the reference station: 710. If this argument is omitted, the processing will use the only set of corrections available.

❑ Example #3 (EDGPS with NDS100 MkII station)



1. Enter the definition of the transmitter broadcasting corrections in the proprietary UHF format:

   $PDAS,DGPS,STATION,8,LA FLEUR,4716.52,N,00129.54,W, UHF, 444550000,30,,,1200,DN

   - Transmitter Id.: 8
   - Transmitter Name: LA FLEUR
   - Reference coordinates: 47°16.52'N, 1°29.54'W
   - Transmission band: UHF
   - Carrier: 444.55 MHz
   - Range: 30 km
   - (2 blank fields)
   - Baud rate: 1200
   - Modulation type: D (DQPSK)
   - Encryption: N (none)
2. Configure the built-in UHF reception module in order to let the receiver acquire and decode the corrections data generated by the reference station used (in this example, station No. 14 used):

   $PDAS,DGPS,MODE,1,D,R,8,,,14

   - Command line No.: 1
   - Port: D (allows acquisition of corrections data via built-in UHF reception module)
   - Receiver defined as DGPS corrections receiver: R
   - Transmitter Id.: 8
   - (2 blank fields)
   - Identification of the reference station generating corrections: 14. This argument can be omitted if there is only one reference station attached to the transmitter.

3. Choose the desired fix mode:

   $PDAS,FIXMOD,6,1,14

   - Kinematic processing with EDGPS initialization: 6
   - Source of corrections: 1 (DGPS/KART/LRK)
   - Identification of the reference station: 14. This argument can be omitted if there is only one set of corrections available.

4. Choose the differential position solution for your navigation needs:

   $PDAS,NAVSEL,1,1

   - Differential position solution used for navigation: 1
   - Navigation mode: none → 1

❑ Corrections data outputs

The corrections data received on the serial port or Data link input can be routed to a serial port for archival or post-processing purposes.

Three output formats are available:

Acquisition format	Possible output formats		
	RTCM-SC104	LRK or proprietary UHF	SVAR!D
RTCM-SC104	✓		✓
LRK or proprietary UHF		✓	✓

- For example, to let the receiver output DGPS data on its A port, in time mode, every 10 seconds, in the SVAR!D format, use the following command:

  $PDAS,DGPDAT,1,A,1,100,4

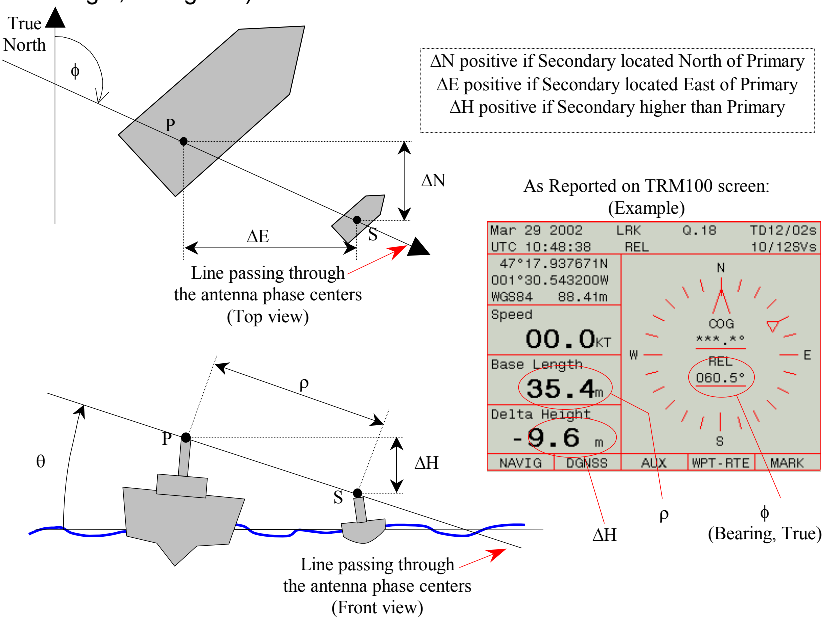
Relative Positioning Processing

❑ Definition

This advanced function is used to determine the location of a remote secondary mobile (S) in relation to the location of a primary mobile (P). Relative 3D positioning is then achieved between the secondary and primary mobiles. The corresponding positioning information is available at the primary mobile only.

The following two sets of three components are determined for the secondary mobile:

- ΔN, ΔE, ΔH, in meters
- ρ (vector length, in m), ϕ (horizontal azimuth, in degrees), θ (site angle, in degrees)



Basically, this processing type is implemented by configuring the secondary mobile exactly as if it were virtually a reference station, although obviously not stationary. This means that the secondary mobile transmits data in LRK format via a radio link (typically UHF) and the primary mobile receives and processes this data to deliver the above results.

❑ Primary Mobile Specific Requirements

Hardware: Rx 4812 U-Link reception module (option) and UHF antenna (see installation on page 18). You can also use external equipment (such as GSM, radio modem, etc.) for the reception of GPS data in LRK format via one of the receiver ports.

Firmware: In addition to standard firmware (DGPS, EDGPS, KARTMODE), you need the following:

- RELATIVE firmware

The precision obtained for Relative Positioning depends on the presence or absence of the other firmware options:

- With standard firmware, you can only get “REL” processing, equivalent to KART in terms of precision
- With LRK® firmware, you can get “REL” processing, equivalent to LRK® in terms of precision.

❑ Secondary Mobile Specific Requirements

Hardware: Tx 4800 U-Link transmission module (option) and UHF antenna (see installation on page 18). You can also use external equipment (such as GSM, radio modem, etc.) for the transmission of GPS data in LRK format via one of the receiver ports.

Firmware: In addition to standard firmware (DGPS, EDGPS, KARTMODE), you need the following options:

- LRKMODE (if dual-frequency), REFSTATION

❑ Primary Mobile Configuration Guidelines

Use the DGNSS menu (see page 24) or use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118).

From the Terminal view, the following set of commands should be used for the primary mobile:

- $PDAS,DGPS,STATION (page 235) to let the primary mobile know the transmission specifications (carrier, modulation type, encryption) of the secondary mobile.
- $PDAS,DGPS,MODE (see page 233):
  - To define your receiver as a corrections user
  - To specify the secondary mobile's transmitter Id.
  - To specify the secondary mobile's station Id.
- $PDAS,FIXMOD (page 243) and $PDAS,FIXTYP to select the Relative processing in the primary mobile.

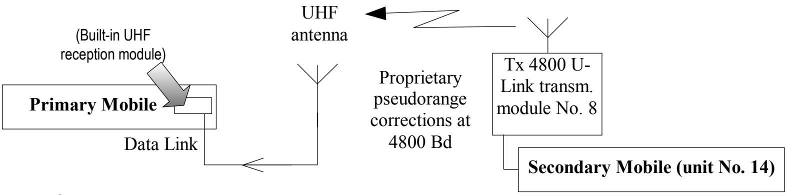
❑ Secondary mobile Configuration Guidelines

Use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118) or use the DGNSS menu (see page 24).

From the Terminal view, the following set of commands should be used for the secondary mobile:

- $PDAS,UNIT (page289) to define the identification number of the secondary mobile.
- $PDAS,DGPS,STATION (page 235) to define the transmission specifications of the secondary mobile (carrier, modulation type, encryption).
- $PDAS,DGPS,MODE (see page 233):
  - To define the secondary mobile as a corrections generator
  - To define the secondary mobile's transmitter Id.
- $PDAS,PRANGE (page 277) to enable the receiver to output GPS data in LRK format on the chosen port (port C or D for U-Link or another port if another data link is used)
- $PDAS,FIXMOD to select "straight GPS mode" if the secondary is a mobile (non-stationary) or "Single-station" if used as a stationary unit.

❑ Example



Secondary:

1. Define its Unit Id.:

   $PDAS,UNIT,14

   - Unit Number: 14

2. Define the transmission specifications of the transmitter attached to the secondary mobile

   $PDAS,DGPS,STATION,8,ESCORT,4716.52,N,00129.54,W, UHF, 444550000,30,,,4800,GN

   (Transmitter position entered not involved in the process)

3. Ask the secondary mobile to transmit GPS data via port D:

   $PDAS,DGPS,MODE,1,D,E,8,

   - Command line No.: 1
   - Output port for GPS data: D
   - Secondary mobile used as source of data: E ("E" for "emission" or transmission)
   - Transmitter Id.: 8

4. Choose "straight GPS" as the fix mode and "LRK" as the type of transmitted data:

   $PDAS,FIXMOD,3

   - Straight GPS fix mode: 3 (you could choose any other fix mode)

5. Define the content of the data output on port D:

   $PDAS,PRANGE, 1,D,1,10,7

   - Command line No.: 1
   - Output port for GPS data: D
   - Output mode: Time (1)
   - Output rate: 10 units of 0.1 s, or 1.0 s
   - Data type: SBIN@R Data in LRK format (7)

Primary:

1. Let the primary mobile know the characteristics of the transmitter broadcasting data from the secondary mobile:

   $PDAS,DGPS,STATION,8,ESCORT,4716.52,N,00129.54,W, UHF, 444550000,30,,,4800,GN

   - Transmitter Id.:8
   - Transmitter Name: ESCORT

     (Transmitter position entered not involved in the process)
   - Transmission band: UHF
   - Carrier: 444.55 MHz
   - Range: 30 km
   - (2 blank fields)
   - Baud rate: 4800
   - Modulation type: G (GMSK)
   - Encryption: N (none)

2. Configure the built-in UHF reception module so that it can receive and decode the data from the secondary mobile, unit No. 14 (attached to transmitter No. 8):

   $PDAS,DGPS,MODE,1,D,R,8,,,14

   - Command line No.: 1
   - Port: D (allows acquisition of corrections data via built-in UHF reception module)
   - Receiver defined as DGPS corrections receiver: R
   - Transmitter Id.: 8
   - (2 blank fields)
   - Identification of the secondary mobile unit: 14

3. Select the RELATIVE processing mode:

   $PDAS,FIXTYP,1,P,,N,,80,1,14

   - Command line No.: 1
   - P: for Primary point
   - N: for normal direction of relative positioning (Secondary in relation to Primary)
   - Fix mode: RELATIVE (80)
   - Source of corrections: LRK (1)
   - Identification of secondary mobile (14)

   $PDAS,FIXMOD,5,,1

   - Multi-mode processing (5)
   - Reference to FIXTYP command line number (1)

DGPS Processing

❑ Precision Level

Metric, depending on constellation status (GDOP, etc.).

❑ Specific Requirements

Hardware: U-Link or HM-Link built-in reception module or external receiver/demodulator attached to Aquarius via one of its serial port

Firmware: Aquarius standard version (no additional firmware option required)

Corrections data: RTCM-SC104 data in “6 of 8” character format, 1200 or 4800 Bd, type 1, 2, 3, 9.

❑ Configuration Guidelines

Use the DGNSS menu (see page 24) or use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118).

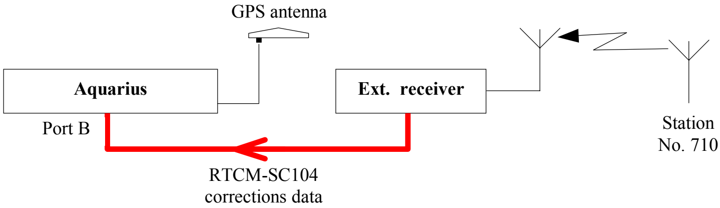
From the Terminal view, the following set of commands should be used:

- $PDAS,HARDRS (page 264) to set the receiver port attached to the external demodulator
- $PDAS,DGPS,MODE (see page 233):
  - To specify the port that the RTCM receiver is attached to
  - To define your receiver as a corrections "consumer"
  - To specify the identification of the reference station generating the corrections.
- $PDAS,FIXMOD (page 243) to select the computation mode (single-station DGPS) and the reference station used by the receiver.

The following set of commands indirectly deals with this processing mode:

- $PDAS,NAVSEL (page 273) lets you choose the type of position solution you want to use in your navigation application.
- $PDAS,AGECOR (page 214) lets you specify the maximum age permitted for corrections. Any corrections exceeding this age will be discarded from the differential processing.

❑ Example with external receiver/demodulator



Assuming port B on Aquarius has been properly set to receive data from the external receiver:

1. Let the receiver acquire and decode the RTCM-SC104 corrections data provided by the external receiver (data from station No. 710) via Aquarius's B port:

   $PDAS,DGPS,MODE,1,B,R,,,,710

   - Command line No.: 1
   - Port: B (allows acquisition of corrections data from external rec.)
   - Receiver defined as DGPS corrections receiver: R
   - (Next parameter (Beacon Id.) omitted to let the receiver acquire corrections from the specified serial port (B))
   - Identification number of the reference station received: 710. If this argument is omitted, all corrections will be acquired without testing the reference station Id.

2. Choose the desired fix mode:

   $PDAS,FIXMOD,4,1,710

   - Single-station DGPS fix mode: 4
   - Source of corrections: 1 (DGPS/KART/LRK)
   - Identification of the reference station: 710. If this argument is omitted, the processing will use the only set of corrections available.

3. Choose the differential position for your navigation needs:

   $PDAS,NAVSEL,1,1

   - Differential position solution used for navigation: 1
   - Navigation mode: none → 1

4. For example, enter "40 seconds" as the maximum age not to be exceeded by the DGPS corrections received:

   $PDAS,AGECOR,40

WAAS/EGNOS Processing

❑ Precision Level

- Service area as defined for the system of satellites used. The different systems available are: WAAS in North America, EGNOS in Europe and MSAS in Japan
- Precision: 1 to 2 meters, XY - 3 meters, Z

Performance figures are 1s RMS values measured in normal conditions of GPS reception (normal ionospheric activity, 5 satellites used and HDOP < 4) on clear site.

❑ Definition

This processing is used to refine the GPS position computed by the receiver, using the WADGPS corrections, and possibly the WAAS/EGNOS pseudo-ranges, broadcast by a geostationary satellite (GEO) of the WAAS, EGNOS or any other compatible SBAS system. Please, refer to pages 310 and 311 for more information about these systems.

❑ Specific Requirements

Hardware: Aquarius standard version (no additional hardware option required)

Firmware: Aquarius standard version (no additional firmware option required)

Corrections data: from geostationary satellite, received on GPS reception channel

❑ Configuration Guidelines

Use the DGNSS menu (see page 24) or use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118).

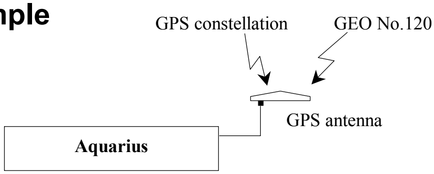
From the Terminal view, the following set of commands should be used:

- $PDAS,GNOS to choose either automatic or manual selection of the GEO to be received. If manual selection is chosen, this command must also include the PRN of the GEO to be received.
- $PDAS,FIXMOD to enable the use of the WADGPS corrections in the position processing
- $PDAS,SVDSEL to disable the use of WAAS/EGNOS pseudoranges in the position processing

The following set of commands indirectly deals with the implementation of a WAAS/EGNOS processing:

- $PDAS,GEODAT to configure WAAS/EGNOS data outputs
- $PDAS,DGPDAT to configure DGPS data outputs

❑ Example



1. Enable the tracking of the WAAS or EGNOS system by specifying the PRN number of the GEO used and choosing a selection mode (Auto or Manual). Example:

   $PDAS,GNOS,2,120

   2: enables the tracking of WAAS/EGNOS and requests manual selection of a GEO

   120: is the GEO PRN (Inmarsat III F2-AOR-E)

   Running this command will cause a WAAS/EGNOS-reserved channel in the receiver to be allocated to SV PRN 120.

2. If needed, disable the use of the GEO pseudoranges in the position processing:

   $PDAS,SVDSEL,5,120

   5: minimum elevation required of SVs (GPS & GEO) to be used in the position processing

   120: is the PRN of the GEO from which pseudoranges should be rejected

3. Enable the receiver to use the received WAAS/EGNOS data in the position processing:

   $PDAS,FIXMOD,4,2,120

   4: selects “single-station DGPS” as the current GPS fix mode

   2: selects WAAS/EGNOS to be the source of corrections

   120: is the PRN of the GEO used

4. Choose the differential position solution for your navigation needs:

   $PDAS,NAVSEL,1,1

   - WADGPS position solution used for navigation: 1
   - Navigation mode: none → 1

GPS Processing

❑ Precision Level

5 m RMS, depending on constellation status (GDOP, etc.).

❑ Specific Requirements

Hardware: Standard

Firmware: Aquarius standard version (no additional firmware option)

Corrections data: None required

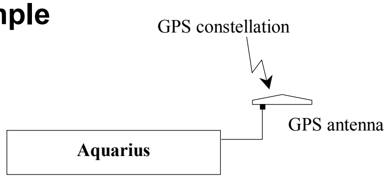
❑ Configuration Guidelines

Use the DGNSS menu (see page 24) or use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118).

From the Terminal view, the following set of commands should be used:

- $PDAS,FIXMOD (page 243) to select the computation mode (autonomous or “straight GPS).
- $PDAS,NAVSEL (page 273) lets you choose the type of position solution you want to use in your navigation application.

❑ Example



1. Enable the “Straight” GPS processing in the receiver:

   $PDAS,FIXMOD,3,0

   3: selects “straight GPS” as current fix mode
   0: deselects any possible source of corrections

2. Choose the straight GPS position solution for your navigation needs:

   $PDAS,NAVSEL,1,1

   - GPS position solution used for navigation: 1
   - Navigation mode: none → 1♣

5. Aquarius² Processing Modes

Introduction

The processing mode specific to Aquarius² is the heading processing. This processing type is detailed on the next pages.

In addition to the heading processing, Aquarius² offers the same processing modes as Aquarius, namely:

- GPS processing
- (E)DGPS processing
- WAAS/EGNOS processing (WADGPS)
- KART processing
- LRK processing
- Relative Positioning processing (only as standard in Aquarius²-22). With Aquarius² however, not only can this mode be implemented between two remote receivers as explained for Aquarius on page 101, but also between two GNSS antennas, each being connected to a specific GNSS input on the same Aquarius² receiver.

  In this type of application, the Relative Positioning processing is used for example to measure the baseline variations due to ship deformation or to monitor the movements of a mobile part on the ship (a crane for example) with respect to any fixed point on the ship structure.

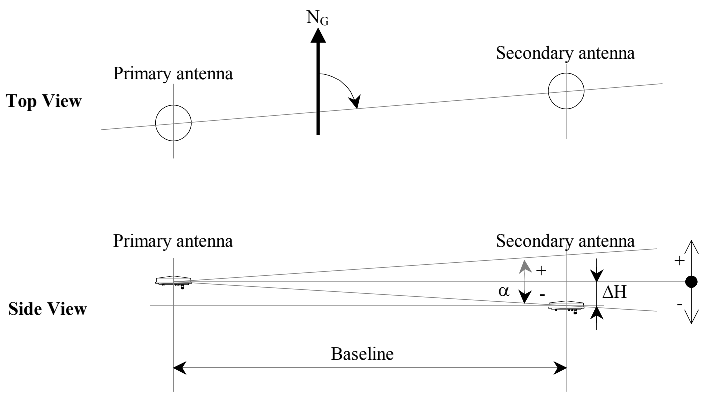
Heading Processing Principles

❑ Introduction

The heading processing is typically used to determine the ship's heading angle.

In the heading processing, two GNSS antennas are used. One is called the primary antenna, attached to GPS input #1 on the receiver; the other is called the secondary antenna, attached to GPS input #2. Two fundamental parameters are involved in this processing, resulting from the way the two antennas have been installed:

- Baseline: horizontal distance between phase centers. Knowing this distance is a prerequisite for heading computation. In a preliminary step, Aquarius² will compute this distance, which you will have to enter, before heading computation can actually take place
- Direction of the line passing through the two phase centers with respect to the ship's longitudinal axis. Knowing this angle is also a prerequisite for valid heading computation. In another preliminary step, called calibration, Aquarius² will compute this angle, which you will have to enter, thus validating the heading angle measured by Aquarius².



Unlike the Relative Positioning processing, there is a maximum altitude deviation (ΔH) between the two antennas not to be exceeded for a given baseline length. The angle (α) formed by the two antennas in the vertical plane should not exceed 20 °.

❑ Determining the Baseline Length

Knowing the baseline is essential if you want the receiver to be able to make heading measurements.

The baseline can be determined as follows after enabling the Heading processing in the **DGNSS>MODE** function:

- Select the **AUX>INIT>HEADING** function
- In the **Length** column, enter an estimate of the baseline length in the **Used** cell
- Select **F2-BASE** and watch the **Average** and **RMS** parameters in the **Length** column as time passes (time elapsed indicated on the right, on top of the table).

  Wait till the **RMS** value approaches or is equal to 0.00. The computed value of baseline, displayed in the **Average** cell, is then assumed to be valid.
- Select **F3-STOP**, and then **F4-APPLY** to enter the computed value as the new **Used** value
- Select **F5-OK** to allow the receiver to compute the heading angle.

❑ Calibrating the heading measurement

In a second step, once the baseline is determined and heading measurements are available, a calibration must take place to compensate for the intentional or unintentional non-alignment of the antennas with the ship's horizontal axis.

Several methods are proposed to do this as described below. The reason why calibration is necessary is also explained.

Computing the calibration value (offset) is achieved in a way much similar to that of the baseline, provided a dynamic calibration method is used:

- Select the **AUX>INIT>HEADING** function
- In the **Orient.** column, enter "000.00" in the **Used** cell
- Select **F3-OFFSET** and watch the **Average** and **RMS** parameters in the **Orient.** column as time passes (time elapsed indicated on the right, on top of the table).

  Wait till the **RMS** value approaches or is equal to 0.00. The computed value of heading, displayed in the **Average** cell, is then assumed to be valid. Compare this value to the known value provided by the conditions of calibration (see next pages). Calculate the difference (if it is negative, see page 107), and then enter this difference into the **Used** cell.

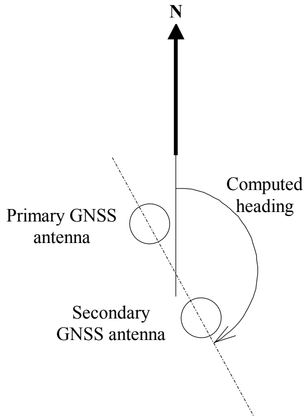
With the static (manual) method, there is no such computation phase. You just have to enter the calibration value (offset) after deducing it from the value of heading measured by Aquarius², once available, and from the exact value of heading in which the ship's longitudinal axis is currently pointing to.

About the height deviation between the two antennas:

When the heading processing is valid, Aquarius² also determines the angle resulting from the baseline length and the height deviation between the two antennas (angle $\propto$, as described on page 104). On the display screen, this angle can be read in the **Site** column, **Average** row.

It is important to note that the value of the $\propto$ angle does not interfere with the determination of the roll or pitch angle as the receiver automatically corrects its results for the value of this angle (if different from 0°).

❑ Need for calibration



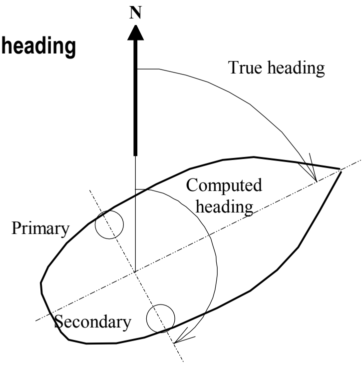
The diagram opposite shows the angle actually measured by Aquarius². Obviously, this angle depends on the orientation given to the two GNSS antennas.

If the antennas are in a direction different from that of the ship's axis, which will necessarily be the case if you want that Aquarius² also measures the roll angle, a correction must be made to the measured angle so that the receiver can provide the true heading. Correcting the measured angle is achieved by entering a value, called *calibration value*, into Aquarius².

❑ What is the calibration value?

It is the deviation, observed BEFORE calibration, between the heading computed by Aquarius² and the ship's true heading (see diagram below):

calibration value= computed heading – true heading



AFTER calibration, i.e. after having entered the calibration value, Aquarius² can apply the correction to the computed heading in such a way that:

Aquarius² output heading = true heading

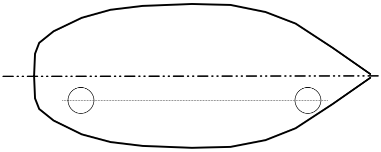
The calibration value can only be positive. If a negative value is obtained, it must be transformed into a positive value by calculating its 360°'s complement.

Example: In the above diagram, the true heading is 70 degrees. The computed heading is 160 degrees. Therefore, the calibration value is: 160 – 70 = 90°. Being positive, this value can be used directly.

On the other hand, if the obtained calibration value is for example – 24.5°, the calibration value actually entered in Aquarius² will be its 360°'s complement, i.e. 360 – 24.5 = 335.5°.

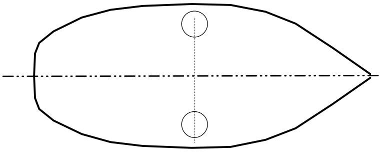
The two diagrams below show the typical values of calibration as a function of two typical orientations of the antennas with respect to the ship:

- Parallel to the ship's longitudinal axis:



Calibration value= 0 ° or close to 0° if there is some uncertainty on the orientation

- Perpendicular to the ship's longitudinal axis:



Calibration value= 90 ° or close to 90° if there is some uncertainty on the orientation

❑ When to perform or resume calibration?

At equipment delivery, the calibration value in Aquarius² is 0°. Consequently, if you are absolutely sure to have oriented the antennas in the same direction as the ship's longitudinal axis, you can conclude that no calibration is required.

On the contrary, a calibration procedure will be necessary in ALL other cases of orientation, whether you accurately know this orientation or not.

Likewise, if you accurately know the direction of the two antennas and in the same time, you do not know which calibration value was entered in Aquarius², then you must check this value and change it if it is wrong.

There are two different methods possible for calibrating Aquarius²:

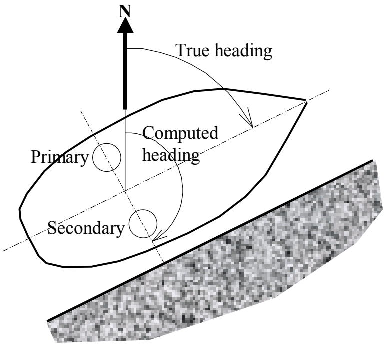
- Manual calibration (2 procedures: a static one and a dynamic one)
- Automatic calibration (a dynamic procedure).

❑ Manual Calibration along a Quay

Measurement conditions:

- Dock the ship to keep her immobile in a known direction (for example, align the ship along a quay with accurately known orientation) (⇒ true heading).
- Check that the calibration value currently used by Aquarius² is 0°
- Read the heading measured by the receiver (⇒ computed heading)
- Calculate the calibration value (computed heading – true heading)[2]
- Enter the calibration value in the receiver
- Confirm the use of this value
- Then check that the heading provided by Aquarius² is now the true heading

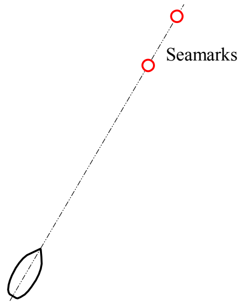
  End of procedure.



[2] If it is negative, take the 360°'s complement to make it positive. If for example you get - 65° for the calibration value, the actual calibration value will be 360° - 65°= 295°. If it is positive, use it directly.

❑ Manual Calibration Based on Alignment with Seamarks

Measurement conditions:



- Navigate to align the ship's longitudinal axis with seamarks. By definition, the resulting heading followed is known (⇒ true heading)
- Navigate at constant speed
- Check that the calibration value currently used by Aquarius² is 0°
- After a certain time of navigation in these conditions, read the heading measured by the receiver (⇒ computed heading)
- Calculate the calibration value (computed heading – true heading)[3]
- Enter the calibration value in the receiver
- Confirm the use of this value
- Then check that, with the ship's longitudinal axis still aligned with the seamarks, the heading provided by the receiver is now the true heading.

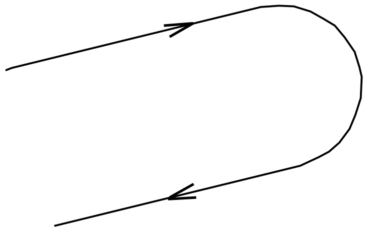
  End of procedure.

[3] Same as previously if the calculated value is negative.

❑ Automatic Calibration Computation while Navigating

Measurement conditions:

- Start navigating in a set direction at a minimum speed of 4 knots
- Start the automatic calibration procedure on the receiver
- Keep on navigating in the given direction until you get steady measurements and then make a 180° turn to navigate in the opposite direction (there is no particular navigation instructions during the half-turn as the calibration procedure automatically rejects this phase in the process provided the turn rate is greater than 1°/second). This maneuver allows the receiver to eliminate any undesired effects interfering with the process, such as currents and ship's attitude.



- After a certain time, the receiver indicates that a calibration has been determined with sufficient accuracy and displays this value. The processing time can be prolonged for as long as you wish providing you continue to navigate according to the specified conditions. In fact, the longer the traveled distance, the better the calibration
- When you think the calibration is accurate enough (for example value of RMS precision less than a certain level), stop the calibration procedure
- Confirm the use of this value

End of procedure.

Important: NEVER go astern during an automatic calibration operation.

Heading Processing Implementation

❑ Specific Requirements

Hardware: Standard, with two antennas

Firmware: Aquarius² standard version (no additional firmware option)

Corrections data: None required

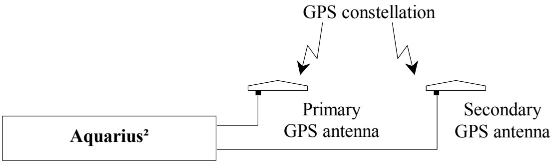
❑ Configuration Guidelines

Use the DGNSS menu (see page 24) or use the TRM100 PC Software to send the adequate commands to the receiver from the Terminal view (see pages 117 and 118).

From the Terminal view, the following set of commands should be used:

- $PDAS,FIXMOD to enable the heading processing, combined with a position processing mode at your convenience

❑ Example



$PDAS,FIXMOD,43,0

- Heading processing + standalone GPS fix mode
- (0: Corrections data source=none)

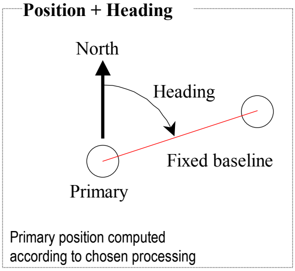
Multi-Mode Operation

The table below summarizes the possible four cases of multi-mode operation in which two processing modes can be used concurrently.

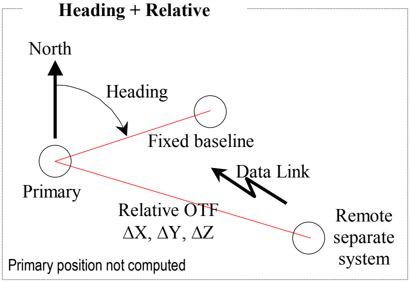
Multi-Mode \ Processing	Standalone				Using external data (Proprietary UHF or RTCM)			
	Heading	Relative OTF	GPS	WADGPS	Relative OTF	DGPS	EDGPS	KART or LRK
Position + Heading	✓		•	•		•	•	•
Position + Relative		✓	•	•		•	•	•
Heading + Relative	✓				✓			
Heading (Rel) + Relative		✓			✓			
			On Primary Antenna			On Primary Antenna		

Heading or Relative OTF processing may be run simultaneously with one of these 5 processing modes

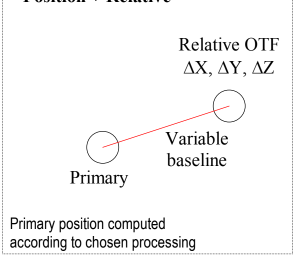
Position + Heading



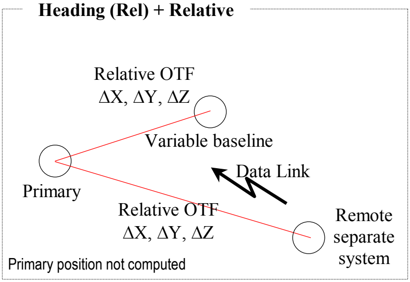
Heading + Relative



Position + Relative



Heading (Rel) + Relative



♣

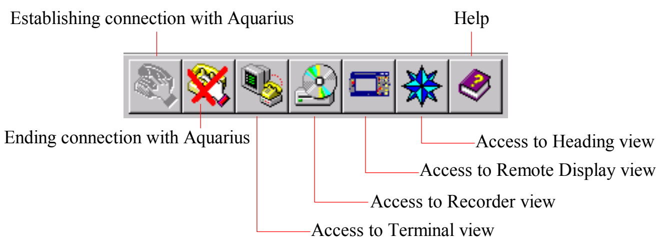
6. TRM100 PC Software Overview

Purpose

Associated with Aquarius or Aquarius², the TRM100 software for PC can perform the following functions:

- Emulating the TRM100 unit (Remote Display view)
- Sending NMEA commands to the receiver for monitoring & control purposes (Terminal view).
- Controlling the receiver's outcoming data recorded on an external medium (Recorder view)
- Display heading measurements (Heading view, Aquarius² only)

The toolbar provides direct access to these 4 views:



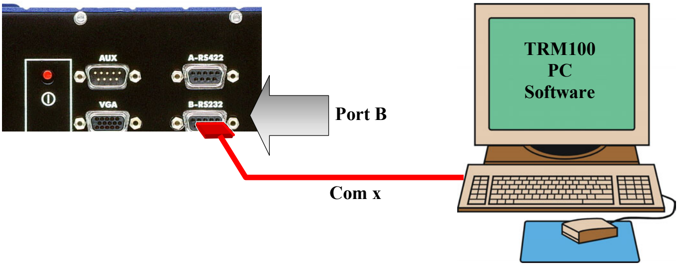
The views can be displayed together within the TRM100 software window:

Lit while the TRM100 software sends data to the Aquarius (green color)

Lit while the TRM100 software receives data from the Aquarius (red color)

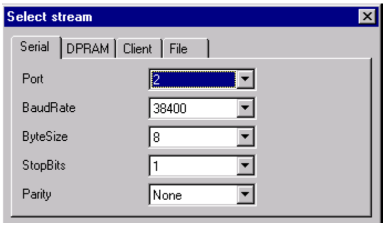
Connecting & disconnecting the TRM100 software

Connect the RS232 cord provided between a serial port on the PC and the RS232 port on Aquarius (port B):



After launching the TRM100 software, only two buttons in the toolbar can be activated:

- Click . In the dialog box that opens, enter the settings for the port used on the PC. The standard settings are provided in the screenshot below. Obviously, the port number (1st field) depends on which port is used on PC side



- Click **OK** to start the serial line between PC and Aquarius

- To end this connection, click . If you do not do this when leaving the TRM100 software, connection will automatically be re-established next time you run the software.

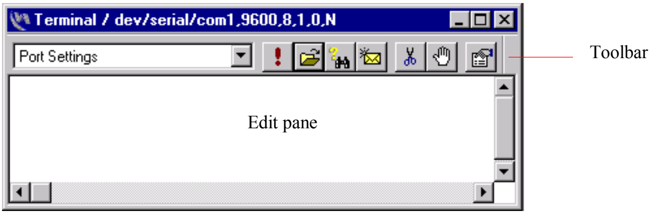
Working Environment

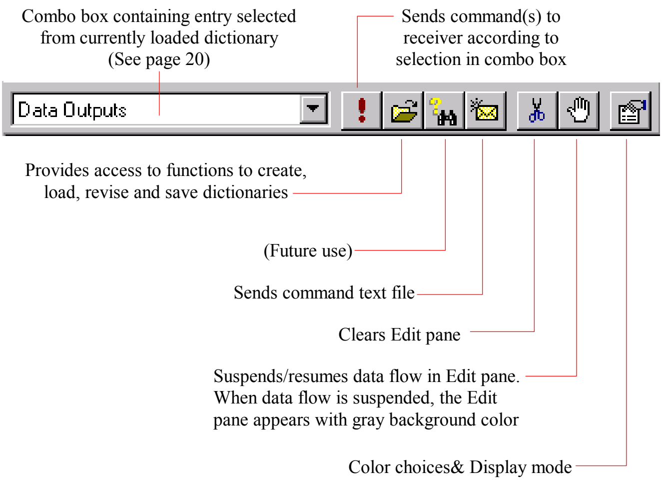
Use the **File>Properties** command to define the interface language and specify whether the working environment should be saved before leaving the program so that it can be restored when next running the program.

Terminal view

This function allows you to communicate with Aquarius through a number of commands using any of the possible three methods described hereafter. All possible commands are described in Section 8 in this manual.

In the TRM100 window, click  to open the Terminal view, which looks like this:



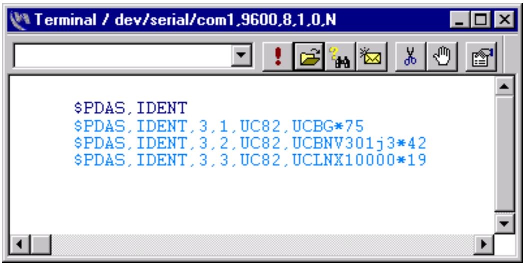


❑ Basic Way of Sending a Command to the Receiver

- Click anywhere on the Edit pane inside the window. The cursor –a flashing vertical bar– appears at the bottom of the Edit pane.
- Type the desired command. For example, type **$PDAS,IDENT**:

- Then press the **Enter** key to send the command to the receiver. As a result, your command line now appears at the top of the Edit pane and the reply from the receiver appears just below. The default colors used are dark blue for your command line, and blue for the receiver reply. To change colors, see page 124.

Example of receiver reply:



❑ Sending Commands to the Receiver from a Dictionary

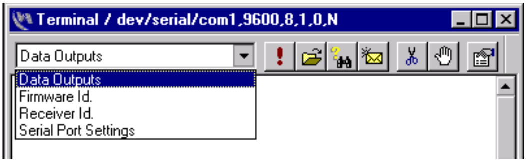
Another way of sending a command to the receiver is to work from a dictionary.

A dictionary is a file, with .ude extension, containing a number of entries. Each entry consists of a label associated with one or more proprietary or standard NMEA commands. The label should be defined to depict as clearly as possible the function performed by the associated command set.

All the entries in the currently loaded dictionary are listed in the combo box located in the left-upper part of the Terminal window. When opening the Terminal view, the default dictionary (default.ude) is loaded.

To send a command from the dictionary to the receiver, do the following:

- On the right of the combo box, click the down-arrow key to display the list of entries and choose one from the list. Example:



- Click  to send the associated command to the receiver. As a result, the command line appears in the Edit pane followed by the receiver reply. For example if you select **Receiver Id.** in the combo box, the content of the Edit pane will look like this:

```
$PDAS,UNIT
$PDAS,UNIT,801*39
```

(Receiver Id= 801)

❑ Creating a New Dictionary

- In the Terminal toolbar, click  to open the **Dictionary Editor** dialog box

  (You can also click  located in the lower part of the terminal view to open this dialog box.)
- Click the **Save** button
- Type a filename for the new dictionary and then click **Save**.

You can create a new dictionary only by saving the currently loaded dictionary under a different name. This operation is equivalent to running the usual **Save As...** function, which further means that the newly created dictionary also becomes the currently loaded dictionary.

After creating a new dictionary, you will probably want to delete all the entries from the copied dictionary. To do this, select each of these entries and select the **Cut** function from the popup menu. In that sense, it is a good idea to create a new dictionary from the default dictionary, as this dictionary is empty.

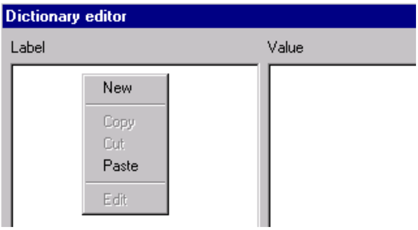
The default directory where your dictionaries are saved is **...\TRM100\Dictionary**.

❑ Making New Entries in a Dictionary

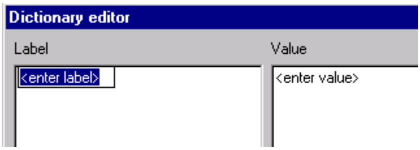
(Continued from previous paragraph).

Suppose your new dictionary is now empty and you wish to create an entry allowing you for example to read the receiver time. To do this:

- Position the mouse cursor anywhere in the left pane (Label pane) and then click with the right mouse button. This displays the following pop-up menu:



- On this menu, select **New**. The dialog box now prompts you to define a label depicting the new entry.

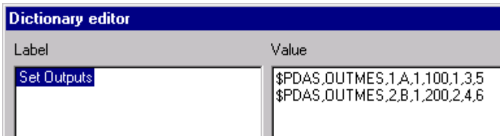


- Choose a label that clearly explains what the associated command will be supposed to do. For our example, enter **Receiver time** and then press **Enter**
- In the right pane (Value pane), drag the mouse cursor to highlight **<enter value>** and then type the corresponding command (**$GPGPQ,ZDA**) followed by a press on the **Enter** key.

  Please note that pressing the **Enter** key is essential, as this will enable the command to be sent to the receiver when using the entry.

- Repeat the previous 4 steps as many times as the number of entries you wish to create, then click **OK** to close the dialog box. The new entries will then be available from the combo box in the Terminal window and also as buttons in the lower part of the Terminal window.

As already mentioned, an entry may consist of several command lines. The example below shows an entry labeled **Set Outputs** containing 2 command lines:



The receiver will respond to a series of commands by returning a reply, if any, to each of these commands after it has received the complete series of commands.

❑ Loading a Dictionary

- In the Terminal toolbar, click  to open the **Dictionary Editor** dialog box
- Click the **Load** button
- In the dialog box that appears, select the .ude file corresponding to the dictionary you wish to load
- Click **Open**. This makes the selected dictionary active in the Terminal window and all its entries are now listed in the Label pane, in the **Edit Dictionary** dialog box.

❑ Revising a Dictionary

The following changes can be made to the loaded dictionary using the context-sensitive menu in the Label pane of the **Edit Dictionary** dialog box:

New Adds a new entry (label + command) and prompts you to define a label for the new entry

Copy Copies the entry (label + command) corresponding to the highlighted label

Cut Deletes the entry (label + command) corresponding to the highlighted label

Paste Creates a new entry by pasting the last copied entry. Prompts you to rename the label for this entry. You should also change the command(s) in this entry (Value pane)

Edit Allows you to change the highlighted label.

The same type of pop-up menu also exists from within the Value pane to help you make your changes:

Every time you revise a dictionary, do not forget to save it after revision, using the **Save** button in the **Edit Dictionary** dialog box, otherwise all your changes will be lost!

❑ Sending a series of commands from a text file

There is a third method allowing you to send commands to the receiver:

- Create a text file containing all the commands you would like the receiver to execute. The commands can be pasted from any other text file. Each line in this file should contain a single command. Commands should be listed one after the other without creating any blank line. Save the file.

Then:

- In the Terminal toolbar, click . This opens a classic **Open** dialog box listing the files present in the current directory
- Select the text file containing the desired set of commands
- Click the **Open** button. As a result, the file is open an all the commands it contains are directly sent in succession to the receiver and displayed in the Edit pane. All replies, if any, to these commands will be returned to the Edit pane only after the receiver has received the complete set of commands.

❑ Color and Display Mode choices

The following parameters can be customized in the Terminal view:

- Font colors used in the Edit pane for each type of command or message.
- Display mode for each type of command or message. Four choices are available:

  None Command or message not displayed

  Label A short label appears to indicate that a command or message has been sent or received

  Raw Command or message shown as sent or received

  Dump Command or message in hexadecimal notation

  Decode Command or message displayed in clear text

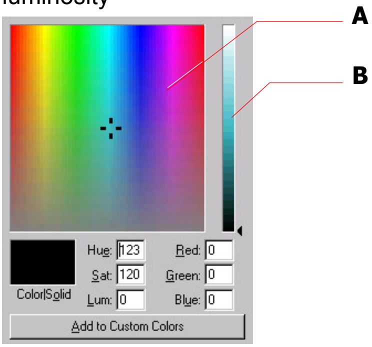
To change one of these parameters, do the following

- In the Terminal toolbar, click  to open the **Terminal Option** dialog box
- Highlight the item you want to modify in the **Message** column

- Right-click on the corresponding item in the **Mode** column and select the desired display mode on the pop-up menu. The **Mode** column is then updated to reflect your choice.
- Right-click on the corresponding color bar in the **Color** column. This opens the **Color** dialog box.
- Choose the desired basic color or create and choose the desired custom color and then click **OK**. (To create custom colors, see below). The **Color** column is then updated to reflect your choice.

❑ Creating custom font colors

- In the **Color** dialog box, click on **Define Custom Colors>>**. This extends the current dialog box to show the range of possible colors
- Click inside the color chart (A area below) on the desired color
- Click inside the right-hand strip (B area below) to choose the luminosity, or drag the left arrow vertically so that it points to the desired luminosity



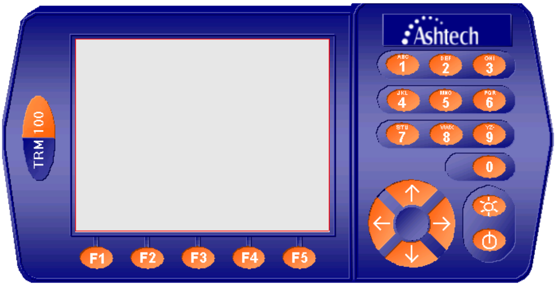
The resulting color is shown in the **ColorSolid** rectangle and the values of its components are automatically set in the six fields nearby

- When you agree with the color, click on the **Add to Custom Colors** button to create the custom color. The newly created color is now available from the **Custom colors: palette** on the left. Use it (select it) in the same way as you would for a basic color.

To delete a custom color, re-define it as white color.

Remote Display view

This view is in fact an emulation of the receiver front panel (plug-in TRM100 unit). It simulates both its screen and its keyboard. It offers all the functions available in this unit.



Using this emulation is however different compared to the TRM100 unit as explained below.

• To activate one of the function keys F1 to F5 or to use the numeric pad (including horizontal and vertical arrows):

- Click on the left mouse button after positioning the mouse pointer on the desired button. For the function keys F1 to F5, you can also click inside the corresponding frame in the lower part of the screen, just above the key
- Or, on the PC keyboard, depress the corresponding key (F1 to F5, numeric key or direction keys).

  Later in this manual, when we ask you to “press a key”, keep in mind the couple of possibilities presented here to let you perform this operation.

• To adjust the contrast of the simulated screen, click  repeatedly, or hold it depressed, until you get the desired contrast.

• To display the properties of the view, left-click . In the menu that appears, select **Properties**. The dialog box that opens allows you to adjust:

- The sound heard when pressing any key with the mouse (a sound when pressing + a sound when releasing the key). A sound is defined by its frequency, in Hz, and its duration, in ms. The higher the frequency, the higher the note produced

- The background color of the simulated screen. Click inside the field showing the color currently used to access the color palette and choose one
- The **Restore Connection** option is not used.

• About the editable fields shown on the screen:

- When accessing any screen containing this type of field, a cursor is shown (a red line) under the first editable field.
- To go to the next editable field, if any on this screen, press the horizontal right arrow. You can also click on the editable field directly to move the cursor under this field.
- There are two different cases to change the content of an editable field:
  - In the preset fields, press any vertical arrow key directly to scroll through the possible values and to display the desired one. There are some exceptions however in which you will have to use dedicated **Fx** keys to scroll through the possible values, the vertical arrow keys being in those cases used to move the cursor vertically
  - In purely numerical fields, type the new value directly over the displayed one

• To move the emulation within the TRM100 window, left-click on any non-active point (in the blue part of the "case"), hold the mouse button depressed and drag the emulation to the desired location. Then release the mouse button.

• To close the view, left-click . In the menu that appears, select **Close**.

All functions in the Remote Display view are discussed in Section 3 in this manual.

Recorder View

See on-line documentation provided with TRM100 PC Software.

Heading View

This view is dedicated to displaying information relative to the heading measurements performed by Aquarius². It is irrelevant to Aquarius.

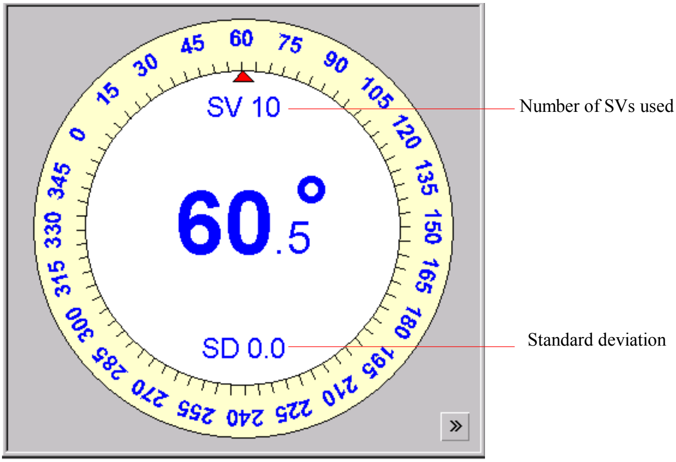
This view is divided into two distinct panes:

1. The left pane shows a compass rose to be used for displaying the computed value of heading together with the associated value of standard deviation and the number of satellites used in the processing.

   To have this information displayed on the view, you have to define an output message containing the HRP and HDT macros. You also have to route this message to the receiver port connected to the PC running TRM100PC Software and choose the output rate that suits your application. Example of output message routed to the view:

   $PDAS,FMT,15,HDT:4:1,HRP:3:1
   $PDAS,OUTMES,1,B,1,10.0,15

   Example of resulting display:



   The heading value is displayed in two different forms: compass rose pointing to this value as well as the value itself displayed at the center of the compass rose.

2. The right pane is displayed only after clicking ». It is made up of two tabs (**Offset calibration** and **Base calibration**) showing the important data involved in determining the baseline length and calibrating the heading processing.

   If you prefer to use this environment, follow the same instructions as those given on pages 56 and 58. The table below gives the correspondence between fields and buttons on the Heading view and those in the **AUX>INIT>HEADING** function:

	Heading view	Corresponding item on AUX>INIT>HEADING screen
Fields	Base length	Length, Average
	Horizontal offset	Orient., Average
	Vertical offset	Site, Average
	Filtering time	Filter, Used
	Duration	Time elapsed
	Precision, base length	Length, RMS
	Precision, horizontal offset	Orient., RMS
	Precision, vertical offset	Site, RMS
Buttons	Start	OFFSET (F3)
	Stop	STOP (F3)
	Apply	APPLY (F4)
	Threshold	-
	-	OK (F5)

Heading view (on right area)(two tabs)

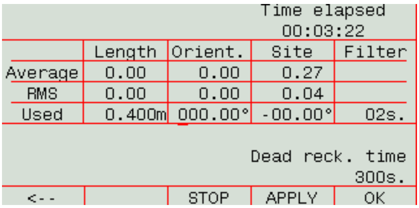


Table on AUX>INIT>HEADING screen. ♣

7. Aquarius Used with U-Link Transmitter

Introduction

There are two mains applications in which Aquarius can be used attached to a U-Link transmitter:

- When it is used as a UHF reference station
- Or when it is used as a transmitting secondary mobile

In both cases, the hardware and software requirements are the same (see below). The two applications only differ on the type of data that are transmitted.

❑ Additional Hardware Options Required

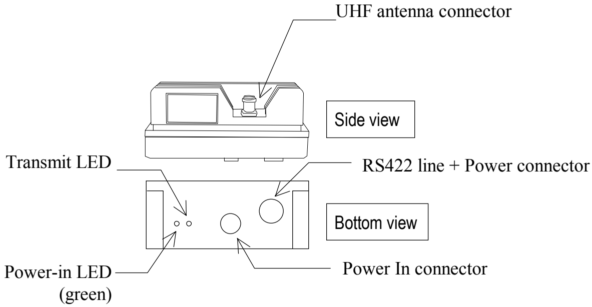
Tx 4800 U-Link UHF Transmission Kit

UHF Marine Antenna Kit with 10 or 30 m coaxial cable

❑ Additional Firmware Option Required

REFSTATION

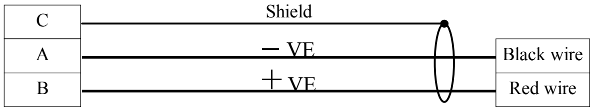
Transmitter Description



Specifications:

- Input Voltage: 10 to 16 V DC, non floating
- Input protections from: polarity reversal, power surge up to ± 60 V, current surge up to 2.8 A
- The power circuitry will not start if the input voltage is less than 9.5 V DC or greater than 16.5 V DC
- On/Off control: from receiver
- Indicator lights: The Power-in LED lights up when the receiver is turned on. It stays lit until you turn off the receiver. ON states for the transmit LED coincide with those times during which the unit transmits data.

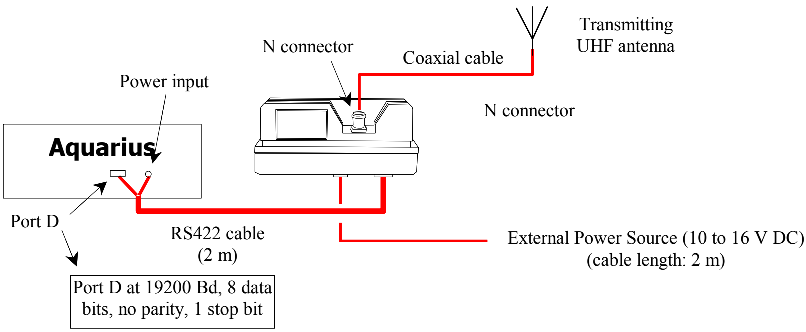
Power In connector & cable:



RS422+Power connector:

1	RX+
3	RX-
5	TX+
6	PPS+
7	TX-
8	PPS-
9	Carrier Detected
11	GND
12	GND
13	GND
14	VEPIS
15	VEPIS

Connecting the Transmitter to Aquarius



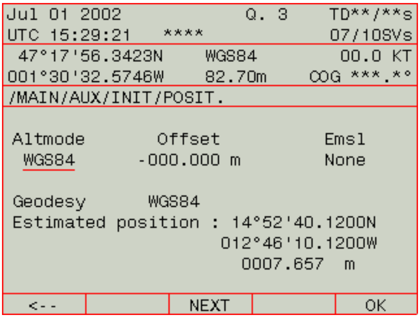
Setting Aquarius as a UHF Reference Station

❑ Entering the Precise Coordinates of the Station

- From the main menu (see page 23), select successively:

  F3-AUX
  F2-INIT
  F2-POSIT.

- Enter all the information relative to the location of the station: geodesy, coordinates to within 1/10 000th of a second



- Click **OK** to validate your entries.

❑ Allowing the Station to Transmit its Corrections Data

- From the main menu (see page 23), select successively:

  F2-DGNSS
  F4-FIX.REF
  F3-INIT

  The following is now displayed:

```
Jun 17 2002     GPS      Q. 3     TD**/**s
UTC 16:23:51    ****              07/09SVs
 47°17.938356N      WGS84         00.0 KT
001°30.541945W      90.14m     COG ***.*°
/MAIN/DGNSS/FIX.REF/INIT
 No.    Station
 **** **********
 **********Hz **********Hz
        ***** ****b/s             *** km
DATA            LRK
TYPE      0       0       0       0
REFERENCE       0000   PORT   A
RATE synchron.  NO  PERIOD  00.0s.
TRANSMISSION  OFF
  <--                             MODIFY
```

- Press **F5-MODIFY** to define the characteristics of the transmitter and reference station:
  - Transmitter Id.
  - Transmitter Name
  - Frequency band used: select “U” for UHF
  - Carrier frequency in Hz
    (Skip next parameter)
  - Modulation type (GMSK). The resulting baud rate is software-set
  - Maximum range (estimated coverage)
  - Transmitted data format: LRK, proprietary UHF (code) or RTCM
  - Message types (if RTCM selected) (up to 4 different types)
  - Reference station number (reference station= corrections source)
  - Port providing corrections data to transmitter: select port D
  - Station operation: Multi-station (Rate synchron.= Yes) or single-station (Rate synchron.= No). See theory of multi-station operation on page 139
  - Transmission rate: a slot number (1 to 6) if “multi-station” is selected, or a time interval in seconds if “single-station” is selected
  - Enable the transmitter to transmit by setting the TRANSMISSION field to “ON”

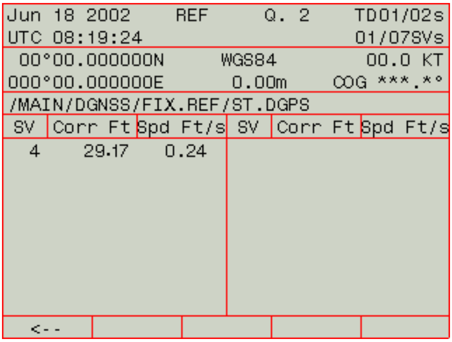
- Press **F5-OK** to store all these characteristics in the receiver. The receiver then starts operating as a reference station, determining DGPS corrections for each satellite received and transferring them via port D to the transmitter to be broadcast to users on the specified carrier frequency.

❑ Checking the Corrections Generated by a Reference Station

- From the main menu (see page 23), select successively:

  F2-DGNSS
  F4-FIX.REF
  F4-DGPS ST.

  Below is an example of what the screen shows once the receiver is able to compute corrections for the first satellite received:

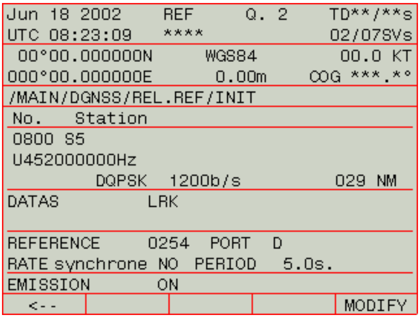


Setting Aquarius as a Secondary Mobile

- From the main menu (see page 23), select successively:

  F2-DGNSS
  F3-REL.REF
  F3-INIT

  The following is now displayed:



- Press **F5-MODIFY** to define the characteristics of the transmitter and secondary mobile:
  - Beacon number (beacon= transmitter)
  - Beacon name (12 characters max.)
  - Frequency band used ("U" for UHF)
  - Carrier frequency in Hz
    (Skip next parameter)
  - Modulation type (GMSK). The resulting baud rate is software-set
  - Estimated maximum range between secondary and primary mobiles
  - Transmitted data format: LRK necessarily
  - Secondary mobile number (reference station= corrections source)
  - Port providing corrections data to transmitter: select port D
  - Station operation: Select Rate synchron.= No
  - Transmission rate: a time interval in seconds
  - Enable the beacon to transmit by setting the TRANSMISSION field to "ON"
- Press **F5-OK** to store all these characteristics in the receiver. The receiver then starts operating as a secondary mobile, generating pseudorange corrections and transferring them via port D to the transmitter to be broadcast to the primary mobile on the specified carrier frequency.

Examples

❑ Transmitting Secondary Mobile

See example on page 95.

❑ Reference Station Transmitting Data in LRK Format

The characteristics of the reference station should be for example the following:

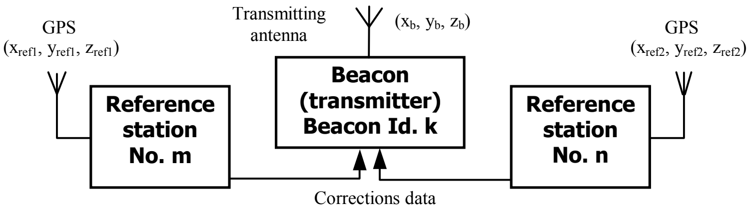
- Station Id number: 22
- WGS84 Reference Position: 47°16.1043533'N, 1° 29.4543'W, Altitude 48.752 m
- Beacon Id: 30
- Frequency: UHF band, 444.55 MHz
- Modulation: 4800 Bd, GMSK
- Transmission spec.: Free mode every 1 second
- Format: LRK
- Messages: Pseudorange corrections and phase measurements.

Programming Steps:

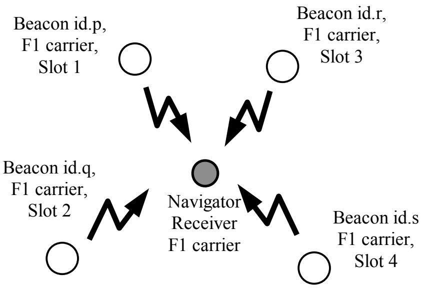
```
$PDAS,UNIT,22
$PDAS,PREFLL,0,4716.1043533,N,00129.4543000,W,48.752
$PDAS,FIXMOD,1,1
$PDAS,DGPS,STATION,30,LRK-
30,4716,N,00129,W,UHF,444550000,30,,,4800,GN
$PDAS,DGPS,MODE,1,D,E,30,0
$PDAS,DGPDAT,1,D,1,10,2
```

Multi-Station Operation

1. A number of reference stations can use the same beacon to transmit their corrections (USCG beacon, Inmarsat transmission):



2. In UHF band, up to 6 beacons can use the same carrier frequency. In this case, a specific transmit time slot is assigned to each beacon so that corrections from each beacon can be transmitted and received in sequence.



Corrections will be received on the same reception frequency. The receiver will be able to sort out the corrections as a function of the source by analyzing the identification number of the reference station contained in the corrections messages.

With a navigator receiver from the Aquarius series, up to 4 different sets of corrections data can be received concurrently, one of which being chosen to be involved in the fix processing.

This "time sharing" scheme is not recommended if you work with the high-accuracy KART or LRK kinematic method.

Transmitted Correction Data

❑ Correction data string, general form

02xxxxyyyy... yyyyy03

End of block: [etx] in ASCII notation (last byte)

Correction data message. Tied to message identifier (2nd byte) present in the data string. See message descriptions below

Reference station Id. number (3rd byte) in BCD notation (00 to 99). If greater than 99 (which will be the case with RTCM-SC104), this number will be defined as “Reference station Id. number modulo 100” as defined using command $PDAS,UNIT

Message identifier (2nd byte). One of the following characters in ASCII notation:
- C: Proprietary pseudorange corrections (same code corrections as in former NDS100 Mk II stations)
- P: L1 phase, C/A code (same phase corrections as in former NDS100 Mk II stations)
- R: RTCM
- T: LRK L1/L2 (or L1 only) format

Start of block: [stx] in ASCII notation (1st byte)

❑ LRK Format Message

Message identifier (2nd byte) in data string: T

mmTTxxxxxxppnnnnnnn... nnnnxxxxxyyyyyzzzzzbbbbxxxx

- Message length (one byte), as measured between first ([stx]) and last ([etx]) bytes in data string, including these bytes, in binary notation, from 1 to 65535
- Transmit rate (one byte), in seconds, from 01 to 99, BCD notation
- GPS time in week, in 1/10th of a second
- C/A & P/Y & L1/L2 filtering indicator. Same as in single- or dual-frequency SBIN@R format
- N×14 or 27 bytes: Satellite raw data on L1 C/A or L1/L2 P/Y. Same as in single- or dual-frequency SBIN@R format
- XYZ of station position (BCD notation, 15 bytes) on ECEF (same as RTCM #3) For each component: field = ± 2 147 483 647 (in BCD), units: 0.01 m, sign is Most Significant bit in first byte (80_h= –)
- Battery output voltage at station (in BCD); units: 10^{-1} V (2 bytes)
- Checksum (binary) computed from [stx] (2 bytes)

In L1 C/A, transmission capability: up to 16 channels (254 bytes at 4800 Bd ⇒ 529 ms)

In L1/L2, transmission capability: up to 14 channels (408 bytes at 4800 Bd ⇒ 850 ms)

❑ Proprietary Pseudorange Corrections Message

(Message **not transmitted** by Tx4800 U-Link transmitter option **but still accepted by mobile equipped with Rx4812** U-Link receiver option).

Message identifier (2nd byte) in data string: C

mmTTzzzzzzsvcrcrcrsvcrcrcr... svcrcrcrxxxx

- **xxxx**: Checksum (binary) computed from [stx] (2 bytes)
- **svcrcrcrsvcrcrcr... svcrcrcr**: N×4 bytes where N: number of SVs, max. 10
  sv (BCD notation): SV No. + 80_h if correction<0,
  or SV No. + 40_h if ephemeris change
  crcrcr (BCD notation): correction value, in cm, max. 999 999 cm
- **zzzzzz**: Z counter output (3 bytes) modulo 49152, in 10^{-1} units of a second, in BCD notation
- **TT**: Transmit rate (one byte), in seconds, from 01 to 99, BCD notation
- **mm**: Message length (one byte), as measured between first ([stx]) and last ([etx]) bytes in data string, including these bytes, in BCD notation, from 00 to 99

L1 phase, C/A Code Message

(Message **not transmitted** by Tx4800 U-Link transmitter option **but still accepted by mobile equipped with Rx4812** U-Link receiver option).

Message identifier (2nd byte) in data string: P

mmTTzzzzzzsvphphphcq... svphphphcqxxxxxyyyyyzzzzzxxxx

- **mm**: Message length (one byte), as measured between first ([stx]) and last ([etx]) bytes in data string, including these bytes, in BCD notation, from 00 to 99
- **TT**: Transmit rate (one byte), in seconds, from 01 to 99, BCD notation
- **zzzzzz**: Z counter output (3 bytes) modulo 49152, in 10^{-1} units of a second, in BCD notation
- **svphphphcq... svphphphcq**: N×5 bytes where N: number of SVs, max. 10
  sv (BCD notation): SV No
  ph (BCD notation): phase value, in 1/100th of a cycle, modulo 10 000 cycles
  c: continuity indicator (4 bits from 0 to F), incremented by 1 every time phase measurement is not equal to 0
  q: 0
- **xxxxxyyyyyzzzzz**: XYZ of station position (BCD notation, 15 bytes) on ECEF (same as RTCM #3)
  For each component:
  field = ± 2 147 483 647 (in BCD), units: 0.01 m, sign is Most Significant bit in first byte (80_h= –)
- **xx**: Checksum (binary) computed from [stx] (2 bytes)

❑ RTCM Message

(Message **not transmitted** by Tx4800 U-Link transmitter option **but still accepted by mobile equipped with Rx4812** U-Link receiver option).

Message identifier (2nd byte) in data string: R

mmTTnnnnnnnn... nnnnxxxx

- **xxxx**: Checksum (binary) computed from [stx] (2 bytes)
- **nnnnnnnn... nnnn**: N×bytes where N depends on baud rate used at UHF transmission input (1200 or 4800 baud for a maximum transmission time of 900 ms)
  nnnn... nnnn: RTCM message in 6×8 character format. All values less than 80_h. Any RTCM word 30 bits long is transformed into 5 bytes
- **TT**: Transmit rate (one byte), in seconds, from 01 to 99, BCD notation
- **mm**: Message length (one byte), as measured between first ([stx]) and last ([etx]) bytes in data string, including these bytes, in binary notation, from 1 to 255

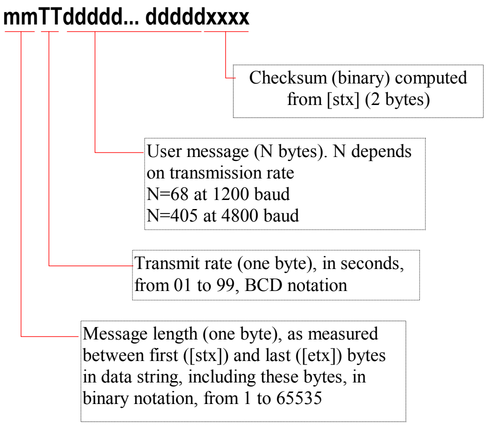
- RTCM-SC104 messages are described in the document referenced "RTCM RECOMMENDED STANDARDS FOR DIFFERENTIAL GNSS - RTCM SPECIAL COMMITTEE No. 104"
- Reference stations using receivers from the Aquarius series can transmit the following types of RTCM messages, depending on the choice made using the $PDAS,DGPDAT command:

1 or 9	:	PRC's corrections
2	:	Delta PRC's corrections
3	:	Reference station position
5	:	Constellation Health
16	:	User message
18	:	Carrier phase measurement
19	:	Code measurement

❑ User Message

(Message **not transmitted** by Tx4800 U-Link transmitter option **but still accepted by mobile equipped with Rx4812** U-Link receiver option).

Message identifier (2nd byte) in data string: X



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8. Computed Data Outputs

Conventions used

In all messages:

***hh**	:	checksum
[CR][LF]	:	“0D” “0A” Hex characters (End Of Line)

Representation of variables:

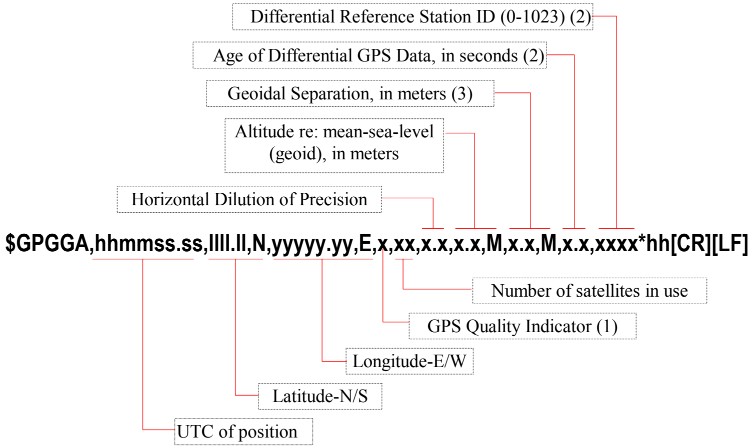
xx	:	numeric value, fixed length
x.x	:	numeric value, integer or floating decimal, variable length
c--c	:	text, variable length

Preset Fields:

hhmmss.ss	:	UTC time in hours, minutes, seconds and 1/100th of a second
a	:	any field with preset content
A	:	a single character (A or V) indicative of data validity
llll.llN	:	latitude, N or S
yyyyy.yyE	:	longitude, E or W
M	:	Used after some variables (heading, speed) to qualify the variable as “magnetic”, not “true”. Also used as distance unit (meters)
N	:	Speed Unit (N for Knots)
K	:	Speed Unit (K for km/hr)
T	:	Used after some variables (heading, speed) to qualify the variable as “true”, not “magnetic”

As stipulated in the NMEA183 standard, the length of NMEA messages can be in excess of 80 characters for the receiver to reach the level of precision expected from a kinematic processing.

Sentence No. 1: $GPGGA

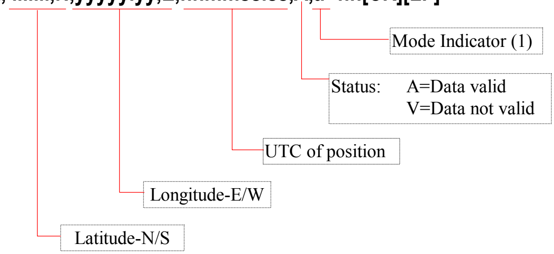


(1) GPS Quality Indicator:
- 0: Fix not available or invalid
- 1: GPS SPS Mode, fix valid
- 2: Differential GPS, SPS Mode, fix valid
- 4: Real Time Kinematic (KART, LRK)
- 5: EDGPS
- 6: Estimated (Dead Reckoning) Mode

(2) Null (empty) field if DGPS Mode invalid
(3) Difference between the WGS84 earth ellipsoid surface and mean-sea-level (geoid) surface.”-“ sign = mean-sea-level surface below WGS84 ellipsoid surface.

Sentence No. 2: $GPGLL

$GPGLL, llll.ll,N,yyyyy.yy,E,hhmmss.ss,A,a *hh[CR][LF]

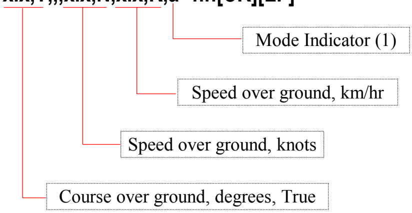


(1) Mode Indicator:

A = Autonomous Mode
D = Differential Mode
E = Estimated (Dead Reckoning) Mode
N = Data not valid

Sentence No. 3: $GPVTG

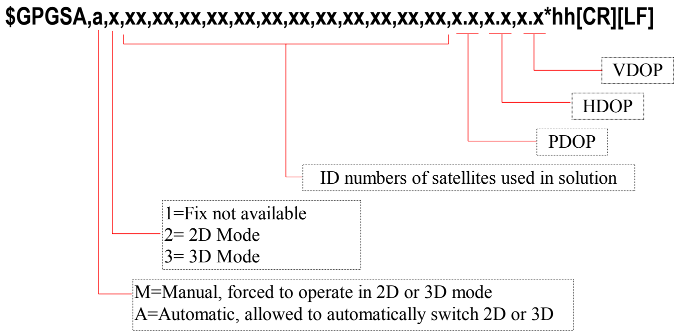
$GPVTG, x.x,T,,,x.x,N,x.x,K,a *hh[CR][LF]



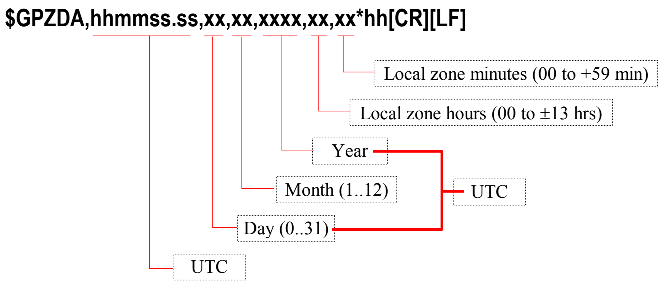
(1) Mode Indicator:

A = Autonomous Mode
D = Differential Mode
E = Estimated (Dead Reckoning) Mode
N = Data not valid

Sentence No. 4: $GPGSA

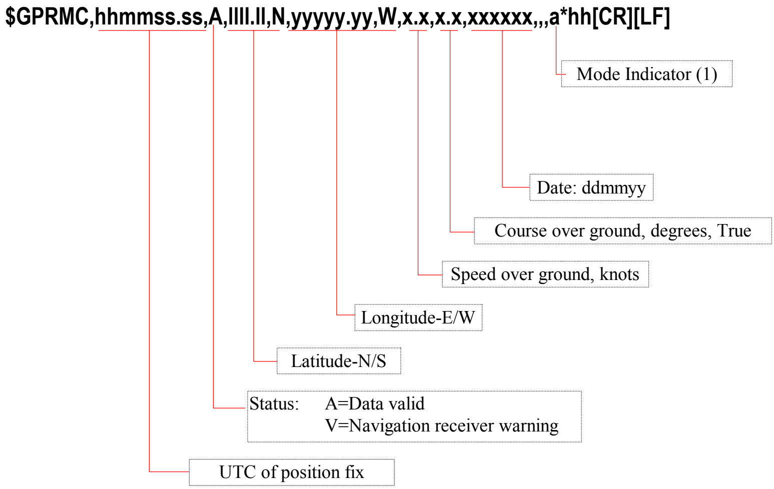


Sentences No. 5 & 18: $GPZDA



The two sentences only differ by the way they are output: in time mode for No. 5, in 1PPS mode for No. 18.

Sentence No. 6: $GPRMC



(1) Mode Indicator:

A = Autonomous Mode
D = Differential Mode
E = Estimated (Dead Reckoning) Mode
N = Data not valid

Sentence No. 7: $GPGRS

$GPGRS,hhmmss.ss,x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh[CR][LF]

- Range residuals, in meters, for satellites used in the navigation solution
- Mode : 1= residuals were recomputed after the GGA position was computed
- UTC time of the GGA fix associated with this sentence

(1) If the range residual exceeds ± 99,9 meters, then the decimal part is dropped, resulting in an integer (maximum value: ± 999)

(2) The sense or sign of the range residual results from:

Residual= calculated range - measured range

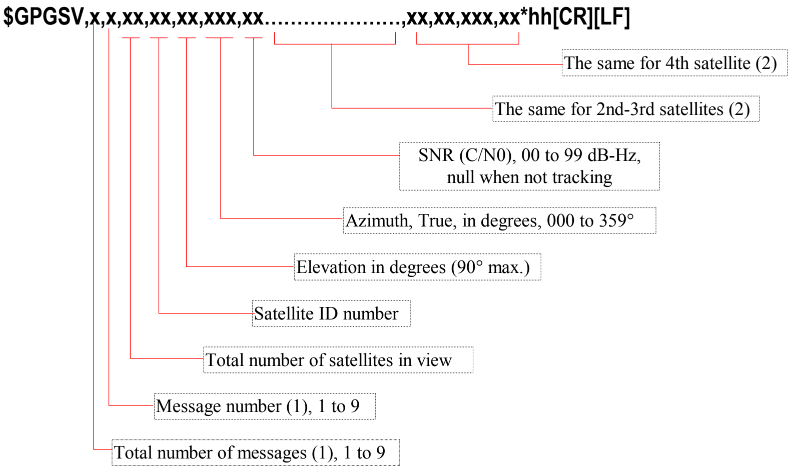
Sentence No. 8: $GPGST

$GPGST,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh[CR][LF]

- Standard deviation of altitude error, meters
- Standard deviation of longitude error, meters
- Standard deviation of latitude error, meters
- Orientation of semi-major axis of error ellipse (1)
- Standard deviation of semi-minor axis of error ellipse (1)
- Standard deviation of semi-major axis of error ellipse (1)
- RMS value of the standard deviation on pseudo-ranges (1)
- UTC time of the GGA fix associated with this sentence

(1) Fields not computed in this version

Sentence No. 9: $GPGSV

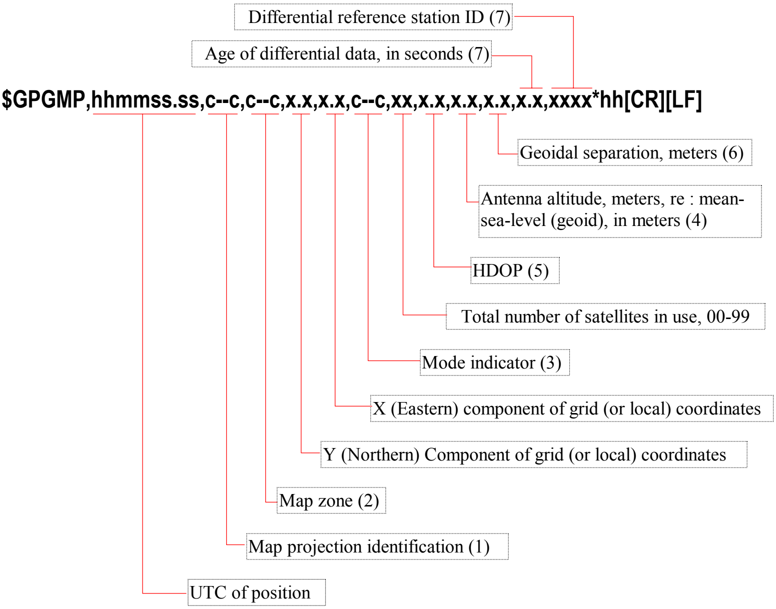


(1) Satellite information may require the transmission of multiple messages all containing identical field formats. The first field specifies the total number of messages (minimum value=1). The second field identifies the order of this message (message number) (minimum value=1).

For efficiency, null fields are used in the additional sentences when the data is unchanged from the first sentence.

(2) If the number of satellites is less than 4, only the fields for these satellites are sent. In this case, the message is shorter as the null fields at the end of the message are not sent.

Sentence No. 10: $GPGMP



(1) = UTM (Universal Transverse Mercator) or LOC (local coordinate system)
(2) Designation of coordinate system
(3) Mode indicator:

- A = Autonomous Mode
- D = Differential Mode
- E = Estimated (Dead Reckoning) Mode
- R = Real Time Kinematic (KART, LRK)
- F = EDGPS (Float solution)
- N = Data not valid

(4) Referenced to mean-sea-level for UTM map projections or to local coordinates if LOC map projections are specified
(5) Calculated using all the satellites used in computing the position solution
(6) The difference between the earth ellipsoid surface and mean-sea-level (geoid) surface. Negative ("-" sign) if mean-sea-level below WGS84 ellipsoid
(7) Null (empty) fields if no DGPS received.

Sentence No. 11: $GPHDT

$GPHDT,x.x,T*hh[CR][LF]

- x.x: Heading, True, degrees

Sentence No. 12: $GPHDG

$GPHDG,x.x,x.x,a,x.x,a*hh[CR][LF]

- x.x,a (third field group): Magnetic variation, degrees, E/W (1)
- x.x,a (second field group): Magnetic deviation, degrees, E/W (1)
- x.x (first field): Magnetic sensor heading, degrees

(1) Values of magnetic variation & deviation are forced to 0 ⇒ magnetic heading = true heading

Sentence No. 13: $GPROT

$GPROT,x.x,A*hh[CR][LF]

- A: Validity: A= Data valid, V= Data invalid
- x.x: Rate of turn in degrees/minute, "-" if bow turns to port

Sentence No. 14: $GPVBW

$GPVBW,,,,x.x,x.x,A,,V,,V*hh[CR][LF]

- Status, ground speed, A= Data valid
- Transverse ground speed, in knots (1)
- Longitudinal ground speed, in knots (1)

(1) Transverse speed "-" = port
Longitudinal speed "-" = astern

Sentence No. 15: $GPVHW

$GPVHW,x.x,T,,,x.x,N,x.x,K*hh[CR][LF]

- Speed in km/hr
- Speed, in knots
- Heading, degrees, true

Sentence No. 16: $GPOSD

$GPOSD,x.x,A,x.x,a,x.x,a,,,K*hh[CR][LF]

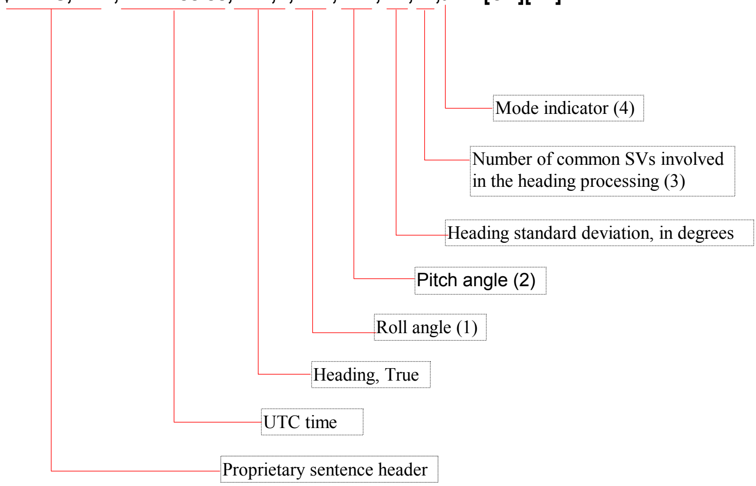
- Speed reference (1)
- Vessel speed
- Course reference (1)
- Vessel Course, degrees, true
- Heading status: A= data valid
  V= data invalid
- Heading, degrees, true

(1) Reference system on which the calculation of vessel course and speed is based, derived directly from the referenced system. Here, it is ALWAYS “P” (Positioning system ground reference).

Sentence No. 17: $PDAS,HRP

Message length: 57 characters max.

$PDAS,HRP,hhmmss.ss,x.xx,T,x.xx,x.xx,x.x,xx,a*hh[CR][LF]



(1) ± 90°, positive if port up & starboard down, not signed if positive, blank field if invalid
(2) ± 90°, positive if bow up & stern down, not signed if positive, blank field if invalid
(3) Number of satellites received concurrently by the two GPS antennas
(4) Mode indicator
- A = Autonomous Mode
- E = Estimated (Dead Reckoning) Mode
- N = Data not valid

Example:

$PDAS,HRP,090144.10,270.15,T,,-3.45,0.40,08,A*hh

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9. Raw Data Outputs in ASCII Format

Notation rules

❑ Reserved characters

	(02$_h$)	<stx>	Beginning of message
!	(21$_h$)		Format indicator
,	(2C$_h$)		Field delimiter
@	(40$_h$)		Checksum delimiter
.	(2E$_h$)		Decimal separator
"	(22$_h$)		Beginning and end of label
	(0D$_h$,0A$_h$)	<eoln>	End of line
	(03$_h$)	<etx>	End of message

Subscript letter $_h$ at the end of a character string means that this string is in hexadecimal notation.

❑ Conventions used

field	Generic term representing one or more data
data	Numerical value or label
< >	Surrounds a field name
<stx>	Beginning of message (02$_h$)
<sobk>	Beginning of block: one or more characters, identifies beginning of block
<soln>	Beginning of line: one or more characters, identifies beginning of line in a block
<eoln>	End of line, 2 characters: CR,LF (0D$_h$ 0A$_h$)
<etx>	End of message (03$_h$)

The term "block" stands for a group of data of the same nature.

The term "numerical value" encompasses all types of possible coding types: binary, decimal or hexadecimal.

The term "number" used without any further indication stands for a decimal number (base 10).

The term "label" stands for an ASCII character string.

❑ General form

<stx> <eoln>
<sobk> <,> <time tagging line> <eoln>
<soln> <,> <1st data line> <eoln>
...
<soln> <,> <nth data line> <eoln>
<etx>

The count and type of data in any given line are predefined, which means that the number of separators <,> is invariable.

Any data missing or replaced by one or more spaces means that this data is not available at that time.

❑ Rule about numerals

All "zero" values are valid data. Spaces placed before or after numerals are not significant. There cannot be spaces within a numeral. The following formats are usable:

Decimal: decimal separator is the "." symbol. It is always preceded by at least one figure (.25 appears as 0.25) and followed by at least one figure, otherwise the integer notation is used.

Integer: particular case of decimal notation without separator.

Floating: exponent character is 'E' (example: 6.2512E3 = 6251.2)

Signed: signs are placed at the beginning of the mantissa and after the exponent character. A numeral with no sign is assumed to be positive. There cannot be spaces between the sign and the first figure.

❑ Rule about labels

Labels are denoted by <"> characters surrounding them. They can take any ASCII value except <">, <stx> and <etx>.

Labels can optionally be associated with a numeral. In this case:

- They are placed just before or after the <,> field delimiter
- They are separated from the numeral by a <space> character.

❑ Error check rule

An optional checksum can be placed at the end of every line (except for the <stx> and <etx> lines), between the last data in the line and <eoln>.

The presence of the checksum is denoted by the @ character followed by the two end-of-line characters.

The checksum results from exclusive-OR gating all the characters in the line, excluding the @ character. The resulting 8-bit checksum is converted into 2 $\times$ 4 bits in hexadecimal notation and then the two half-bytes are ASCII-encoded. The most significant character is transferred first.

❑ L1 carrier quality indicator

This 8-bit indicator appears repeatedly in the data described in this section as well as in Section 10. This indicator complies with RTCM message #18. The meaning of bits 5 to 7 (“data quality indicator”) is given below:

"000": phase error ≤ 0.00391 cycle
"001": phase error ≤ 0.00696 cycle
"010": phase error ≤ 0.01239 cycle
"011": phase error ≤ 0.02208 cycle
"100": phase error ≤ 0.03933 cycle
"101": phase error ≤ 0.07006 cycle
"110": phase error ≤ 0.12480 cycle
"111": phase error > 0.12480 cycle

❑ C/A code quality indicator

This 8-bit indicator appears repeatedly in the data described in this section as well as in Section 10. This indicator complies with RTCM message #19. The meaning of bits 4 to 7 (“pseudo-range data quality indicator”) is given below:

"0000": pseudorange error ≤ 0.020
"0001": pseudorange error ≤ 0.030
"0010": pseudorange error ≤ 0.045
"0011": pseudorange error ≤ 0.066
"0100": pseudorange error ≤ 0.099
"0101": pseudorange error ≤ 0.148
"0110": pseudorange error ≤ 0.220
"0111": pseudorange error > 0.329
"1000": pseudorange error ≤ 0.491
"1001": pseudorange error ≤ 0.732
"1010": pseudorange error ≤ 1.092
"1011": pseudorange error ≤ 1.629
"1100": pseudorange error ≤ 2.430
"1101": pseudorange error ≤ 3.625
"1110": pseudorange error ≤ 5.409
"1111": pseudorange error > 5.409

SVAR!D: Differential Data

General Form

<stx> <eoln>
<!D>,<time tagging> <eoln>
<soln>,<parameters> <eoln>
<soln>,<1st line of differential corrections> <eoln>
...
<soln>,<nth line of differential corrections> <eoln>
<etx>

Time tagging line

!D,<GPS week>,<GPS time><eoln>

<GPS week>	GPS week number
<GPS time>	Time in week, in sec. Reference time is Jan 6 1980 at 0hr00
<eoln>	

Parameters line

Pseudorange corrections:

<soln>, 2 char	<**%S**>: Proprietary-type corrections (includes ionospheric corrections) <**%R**>: RTCM-type corrections (does not include ionospheric corrections) <***#n***>: Message other than corrections (further use to be notified at a later date)
<Station number>	Read from the receiver configuration or from the RTCM 104 message
<Reception Quality>	0 to 10, corresponds to the ratio of the messages received correctly; 10 = 100%
<Iono/tropo flag>	0: Iono/tropo corrections are not included in differential corrections 1: Iono/tropo corrections are included in differential corrections
<eoln>	

Code and carrier phase measurements or corrections:

<soln>, 2 char	<**%K**> Phase measurements in proprietary UHF format <**%T**> Phase & code measurements in LRK UHF format <**%Q**> Phase & code measurements in RTCM 18/19 format <**%C**> Phase & code measurements in RTCM 20/21 format
<Station number>	Read from the receiver configuration or from the message
<Reception Quality>	0 to 10, corresponds to the ratio of the messages received correctly; 10 = 100% (Empty field in the case of a transmitter)
<Measurement type>	0: Single frequency (L1) 1: Reserved 2: Single frequency (L2) 3: Reserved 4: Dual frequency (L1+L2)
<Code filtering>	Filtering time constant, in seconds, used in the process of smoothing the code by the carrier
<eoln>	

Reference position:

<soln>, 2 char	<**%N**> Position of reference station
<Station number>	Read from the receiver configuration or from the RTCM 104 message
<ECEF X>	ECEF X coordinate (WGS84) of reference station
<ECEF Y>	ECEF Y coordinate (WGS84) of reference station
<ECEF Z>	ECEF Z coordinate (WGS84) of reference station
<eoln>	

In the case of RTCM-SC104 data, this line contains the position provided by message Type 3.

Example of a block issued separately providing the reference position received in RTCM-SC104 format from station No. 99 (message type 3):

```
!D,1153,568084.8
%N,99,4331877.920,-114119.160,4664433.510
```

❑ Pseudorange correction line

<soln>	3 characters: * and SV number
<C/A code correction>	PRC, in meters, at time To of message; Positive correction means it must be added to pseudorange
<Correction speed>	RRC, in m/s
<Correction age>	In seconds, algebraic difference between time of message and time of GPS measurements from which corrections were generated
<IOD>	Issue Of Data, for proprietary corrections, counter output modulo 256, incremented by 1 every time IOD changes state
<UDRE>	User Differential Range Error, in meters
<eoln>	

Time correction value (T) = PRC + RRC (T-To)

Data block example:

```
!D,1153,567911.4
%R,99,10,0
*2,-30.48,0.008,0.0,101,0
*3,-13.00,0.000,0.0,88,0
*6,-34.06,0.004,0.0,127,0
*15,-10.34,0.002,0.0,123,0
*17,-10.26,0.006,0.0,222,0
*18,-25.32,0.004,0.0,15,0
*21,-45.32,0.022,0.0,170,0
```

❑ Phase measurement line, in proprietary UHF format

<soln>	1 or 2 characters: * and channel number in hexadecimal (optional)
<SV No.>	Satellite PRN number
<Blank field>	
<L1$_{C/A}$ carrier phase>	In 10^{-3} units of a cycle, modulo 10^4 cycles
<Blank field>	
<Blank field>	
<L1, L2 channel status>	Coded in 4 bits (1 ASCII character 0 to F) bit 0=0 (free) bit 1=0 (free) bit 2=1 if L1 C/A phase measurement invalid bit 3=1 (free)
<L1 carrier quality index>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: “cumulative loss of continuity indicator”, as in RTCM message #18 bits 5 to 7: “data quality indicator”, as in RTCM message #18
<eoln>	

Example of L1 phase measurements and station position issued in the same block, information received in proprietary UHF format from station No. 99:

```
!D,1153,569492.4
%N,99,4331877.920,-114119.170,4664433.510
%K,99,10,0
*,2,,1545,,,0,24
*,3,,4761,,,0,04
*,15,,6026,,,0,0F
*,17,,6216,,,0,06
*,18,,2352,,,0,08
*,21,,8062,,,0,05
*,22,,9411,,,0,10
```

❑ Code & phase measurement line, in LRK UHF format

<soln>	1 or 2 characters: * and channel number in hexadecimal (optional)
<SV No.>	Satellite PRN number
<C/A code pseudorange>	In 10^{-10} units of a second, modulo 10 s
<L1$_{C/A}$ carrier phase>	In 10^{-3} units of a cycle, modulo 10^4 cycles
<L1$_{C/A}$ carrier speed>	In 10^{-3} units of a cycle per second
<L1$_{C/A}$ C/No>	In dB.Hz
<L1, L2 channel status>	Coded in 4 bits (1 ASCII character 0 to F) bit 0=0 (free) bit 1=0 if P code, or bit 1=1 if Y code (anti-spoofing) bit 2=1 if L1$_{C/A}$ phase measurement invalid bit 3=1 if L2$_{P/Y}$ phase measurement invalid
<L1 carrier quality index>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: “cumulative loss of continuity indicator”, as in RTCM message #18 bits 5 to 7: “data quality indicator”, as in RTCM message #18
<C/A code quality index>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 3: “pseudorange multipath error indicator”, as in RTCM message #19 bits 4 to 7: “pseudorange data quality indicator”, as in RTCM message #19
<L1$_{P/Y}$ - L1$_{C/A}$ carrier phase deviation>	In 10^{-3} units of a cycle, modulo 1 cycle. Centered at 0
<P$_{L1}$ - C/A$_{L1}$ code deviation>	In 10^{-10} units of a second
<P$_{L2}$ - C/A$_{L1}$ code deviation>	In 10^{-10} units of a second
<L2$_P$ carrier phase>	In 10^{-3} units of a cycle, modulo 10^8 L2 cycles
<L2$_P$ carrier speed>	In 10^{-3} units of a cycle per second

<L2 carrier quality index>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: “cumulative loss of continuity indicator”, as in RTCM message #18 bits 5 to 7: “data quality indicator”, as in RTCM message #18
<P/Y code quality index>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 3: “pseudorange multipath error indicator”, as in RTCM message #19 bits 4 to 7: “pseudorange data quality indicator”, as in RTCM message #19
<eoln>	

In single frequency, the last fields in the line - starting from $L1_{P/Y}$ - $L1_{C/A}$ carrier phase deviation - are not output.

Example of dual-frequency phase measurements and station position issued in the same block, information received in LRK UHF format from station No. 99:

```
!D,1153,571099.0
%N,99,4331877.920,-114119.170,4664433.510
%T,99,10,4,2
*,2,484740591,5093712,-1265884,44,2,04,9F,16,140,311,7737689,-986300,
4A, 7F
*,17,455439381,5645472,4000356,47,2,06,8F,31,-47,63,9287226,3117032,
27,6F
*,22,411294821,6905432,3722104,49,2,10,7F,16,44,133,3326949,2900312,31,
5F
*,15,412998657,9628744,3503412,49,2,0F,7F,-4,71,127,2129487,2729928,
30,5F
*,21,476769846,1106023,-1217796,46,2,05,8F,12,103,288,6685297,-949040,
47,7F
*,18,451824524,9774291,380780,47,2,08,8F,12,49,124,9463630,296676,27,6F
*,3,397692932,3483616,213300,50,2,04,7F,20,-148,-102,7192714,166200,3A,
5F
*,27,528966670,6088217,104580,39,2,2A,AF,121,53,316,2126443,81368,8C,A
F
```

❑ Code & phase measurement line, in RTCM-SC104 format, type 18 or 19

<soln>	1 or 2 characters: * and channel number in hexadecimal (optional)
<SV No.>	Satellite PRN number
<P or C/A code pseudorange>	In 10^{-10} units of a second
<P or C/A carrier phase>	In 10^{-3} units of a cycle, modulo 10^4 cycles
<Blank field>	
<Blank field>	
<Channel status>	Coded in 4 bits (1 ASCII character 0 to F) bit 0=0 (free) bit 1=0 if C/A code or phase, or bit 1=1 if P code or phase bit 2=0 (free) bit 3=0 (free)
<Carrier quality index>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: “cumulative loss of continuity indicator”, as in RTCM message #18 bits 5 to 7: “data quality indicator”, as in RTCM message #18
<Code quality index>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 3: “pseudorange multipath error indicator”, as in RTCM message #19 bits 4 to 7: “pseudorange data quality indicator”, as in RTCM message #19
<eoln>	

Depending on the type of message, only the useful fields are filled. Data pertaining to messages #18 and #19 for a given time and frequency may be grouped in the same lines. Likewise, data pertaining to messages #18 or/and #19 for a given time and for frequencies L1 and L2 may be grouped in the same message.

Example of L1 C/A phase & code measurements and L2 P code issued in the same block (Information received in RTCM-SC104 format, in messages #18 and #19, transmitted by station No. 99 for the same time):

```
!D,1153,573626.000000
%Q,99,10,0,30
*,3,673602451,8856059,,,2,04,5F
*,8,817636071,3039258,,,2,3D,AF
*,15,741874452,9346352,,,2,0F,7F
*,17,789526891,6427801,,,2,26,8F
*,18,735902003,1914227,,,2,08,6F
*,21,730101508,9517164,,,2,05,6F
*,22,744255081,92875,,,2,10,6F
*,23,838267849,4961914,,,2,3A,AF
*,26,840897988,8028918,,,2,22,AF
*,27,807057691,5086488,,,2,2A,AF
*,31,713302477,7309574,,,2,15,7F
%Q,99,10,2,30
*,3,673602463,7875656,,,2,1A,5F
*,8,817636430,671855,,,2,BF,AF
*,15,741874584,4889773,,,2,50,7F
*,17,789527119,1833066,,,2,47,8F
*,18,735902041,2822996,,,2,27,6F
*,21,730101608,5719453,,,2,27,6F
*,22,744255213,7491117,,,2,31,6F
*,23,838268133,5442711,,,2,9B,AF
*,26,840898292,9111465,,,2,B1,AF
*,27,807057928,568055,,,2,8C,AF
*,31,713302553,5219383,,,2,3A,7F
```

SVAR!R : Single-frequency GPS/WAAS/EGNOS pseudoranges in satellite time

❑ General Form

<stx> <eoln>
<!R>,<time tagging> <eoln>
<soln>,<parameters> <eoln>
<soln>,<1st line of raw data> <eoln>
...
<soln>,<nth line of raw data> <eoln>
<etx>

❑ Time tagging line

!R,<GPS week>,<GPS time><eoln>

<GPS week>	GPS week number
<GPS time>	Time in week, in seconds. Reference time is Jan 6 1980 at 0hr00 (assuming the modulo 2^{10} ambiguity has been solved)
<eoln>	

❑ Parameter line

<soln>	1st character: <&> (data type 2)
	2nd character: <C> (L1 phase measurement, C/A code)
<filter. time constant>	In seconds (code smoothed by carrier)
<Antenna identification>	<0> primary antenna (by default) <1 | 2 | 3> secondary antennas
<eoln>	

❑ Raw data lines

<soln>	2 characters: * and channel No. (in hexadecimal)
<SV No.>	Satellite PRN number
<C/A code pseudorange>	In 10^{-10} units of a second, modulo 10 s

<L1$_{C/A}$ carrier phase>	In 10^{-3} units of a cycle, modulo 10^4 cycles
<L1$_{C/A}$ carrier speed>	In 10^{-3} units of a cycle per second
<C/A L1 C/No>	In dB.Hz
<L1 channel status>	Coded in 4 bits (1 ASCII character 0 to F) bit 0 = 0 (not used) bit 1 = 0 (reserved) bit 2 = 1 if invalid L1 phase measurement bit 3 = 0 (reserved)
<L1 carrier quality indicator>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: "cumulative loss of continuity indicator", (complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost) bits 5 to 7: "data quality indicator". See page 161.
<C/A code quality indicator>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 3: "pseudo-range multipath error indicator", (complies with RTCM message #19): "1111":multipath error not determined bits 4 to 7: "pseudorange data quality indicator". See page 161.

<eoln>

❑ Data block example

```
!R,1134,126617.0
&C,0.0,0
*0,28,68923091353,363866,-3215172,42,0,24,9F
*1,24,68878747407,9349799,2775656,45,0,3A,8F
*2,27,68835925174,3657665,1423244,50,0,1A,7F
*3,26,68919677583,2027685,-3159436,42,0,31,9F
*5,8,68793941770,3362615,-514468,50,0,17,7F
*6,10,68810541880,5252323,-1178488,49,0,19,7F
*7,13,68905898850,959909,2909440,45,0,33,8F
*9,2,68933290713,4760641,-3009252,42,0,3A,9F
```

Owing to the fact that they are received later, pseudoranges from WAAS/EGNOS satellites are output in a separate block.

SVAR!R: Dual-frequency GPS pseudoranges in satellite time

General Form

<stx> <eoln>
<!R>,< time tagging > <eoln>
<soln>,< parameters > <eoln>
<soln>,< 1st line of raw data> <eoln>
...
<soln>,< nth line of raw data > <eoln>
<etx>

Time tagging line

!R,< GPS week>,< GPS time><eoln>

<GPS week>	GPS week number and time in week, in sec.
<GPS time>	Reference time is jan 6 1980 at 0hr00 (assuming the modulo 2^{10} ambiguity is removed)
<eoln>	

Parameter line

<soln> 1st char	<&>
	<P> L1 and L2 phase measurements, C/A, P/Y codes
<Filter. time constant>	in seconds (C/A code smoothed by carrier)
<Antenna identification>	<0> primary antenna (by default) <1 | 2 | 3> secondary antennas
<eoln>	

❑ Dual-frequency raw data lines

<soln>	2 characters: * and channel No. (in hexadecimal)
<SV No.>	
<C/A code pseudorange>	in 10^{-10} s, modulo 10 s
<$L1_{C/A}$ carrier phase>	in 10^{-3} cycles, modulo 10^4 cycles
<$L1_{C/A}$ carrier speed>	in 10^{-3} cycle/s
<C/A L1 C/No>	in dB-Hz
<L1, L2 channel status>	coded in 4 bit s (1 ASCII character 0 to F) bit 0 = 0 *(not used)* bit 1 = 0 if code P; 1 if code Y (antispoofing) bit 2 = 1 if $L1_{C/A}$ phase measurement not valid bit 3 = 1 if $L2_{P/Y}$ phase measurement not valid
<L1 carrier quality indicator>	coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: "cumulative loss of continuity indicator", (complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost) bits 5 to 7: "data quality indicator". See page 161.
<C/A code quality indicator>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 3 : "pseudo-range multipath error indicator", (complies with RTCM message No. 19): "1111": multipath error not determined bits 4 to 7: "pseudorange data quality indicator". See page 161. "1101": pseudorange error ≤ 3.625 "1110": pseudorange error ≤ 5.409 "1111": pseudorange error > 5.409
<$L1_{P/Y}$ - $L1_{C/A}$ carrier phase deviation>	In 10^{-3} units of a cycle, modulo 1 cycle, centered around zero
<P_{L1} - C/A_{L1}code deviation>	In 10^{-10} units of a second
<P_{L2} - C/A_{L1}code deviation>	In 10^{-10} units of a second
<$L2_P$ carrier phase>	In 10^{-3} units of a cycle, modulo 10^4 L2 cycles
<$L2_P$ carrier speed>	In 10^{-3} units of a cycle

<L2 carrier quality indicator> Coded in 8 bits (2 ASCII characters 0 to F, MSB first)

bits 0 to 4: "cumulative loss of continuity indicator", (complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost)

bits 5 to 7: "data quality indicator". See page 161.

<P/Y code quality indicator> Coded in 8 bits (2 ASCII characters 0 to F, MSB first)

bits 0 to 3: "pseudo-range multipath error indicator", (complies with RTCM message #19): "1111": multipath error not determined

bits 4 to 7: "pseudorange data quality indicator". See page 161.

<eoln>

❑ Data block example

```
!R,945,409517.0
&P,30
*0,3,2137408867,7051638,-1159380,51,2,0B,8F,-23,50,-45,50D76954,-
903432, 01,6F
*1,6,2275926394,9438843,3673120,39,2,60,BF,-43,17,-18,5496814,2862292,
81,DF
*2,19,2259497283,5974953,-13A74584,39,A,43,BF,0,-208,,0,,A1,EF
*3,17,2155976904,3988834,2716264,48,2,21,8F,-23,-143,-211,1373394,
2116524,01,7F
*4,21,2242445140,6696450,-2660704,47,2,46,9F,-20,64,28,5048311,-
2073184, 21,8F
*5,22,212381893S3,1570001,1821372,51,2,42,7F,-12,-158,-234,1893847,
1419264,01,5F
```

SVAR!Q: Single-frequency GPS/WAAS/EGNOS pseudo-ranges in receiver time

General form

<stx> <eoln>
<!Q>,<time tagging> <eoln>
<soln>,<parameters> <eoln>
<soln>,<1st line of raw data> <eoln>
...
<soln>,<nth line of raw data> <eoln>
<etx>

Time tagging line

!Q,< GPS week>,< GPS time>,<delay><eoln>

<GPS week>	GPS week number
<GPS time>	Time in week, in seconds. Reference time is Jan 6 1980 at 0hr00 (assuming the modulo 2^{10} ambiguity has been solved)
<Delay>	GPS time of measurement – GPS time in week (Z count), in µseconds.
<eoln>	

Parameter line

<soln>1st char	1st character: <&> (data type 2)
	2nd character: <C> L1 phase measurement, C/A code
<Filter. time constant>	in seconds (code smoothed by carrier)
<Antenna identification>	<0> primary antenna (by default) <1 | 2 | 3> secondary antennas
<eoln>	

Raw data lines

<soln>	2 characters: * and channel No. (in hex)
<SV No.>	SV number

<C/A code pseudorange> — In 10^{-10} units of a second, ≅ propagation time corrected for clock error (minus clock error)

<L1$_{C/A}$ carrier phase> — In 10^{-3} units of a cycle, modulo 10^{4} cycles, minus clock error

<L1$_{C/A}$ carrier speed> — In 10^{-3} units of a cycle/s

<C/A L1 C/No> — In dB.Hz

<L1 channel status> — Coded in 4 bits (1 ASCII character 0 to F)

bit 0 = 0 (not used)
bit 1 = 0 (reserved)
bit 2 = 1 if invalid L1 phase measurement
bit 3 = 0 (reserved)

<L1 carrier quality indicator> — Coded in 8 bits (2 ASCII characters 0 to F, MSB first)

bits 0 to 4: "cumulative loss of continuity indicator", (complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost)

bits 5 to 7: “data quality indicator”. See page 161.

<C/A code quality indicator> — Coded in 8 bits (2 ASCII characters 0 to F, MSB first)

bits 0 to 3: "pseudo-range multipath error indicator", (complies with RTCM message #19):

"1111":multipath error not determined

bits 4 to 7: "pseudorange data quality indicator". See page 161.

<eoln>

❑ Data block example

```
!Q,1154,219648.0,100000
&C,0.0,0
*0,22,669594947,7516076,-2171784,49,0,0A,7F
*1,25,774437743,915744,1618380,45,0,05,8F
*2,10,834559315,8754675,387152,40,0,23,AF
*3,6,784199046,8248591,1286532,44,0,18,9F
*4,15,680587687,7941127,-2636064,49,0,02,7F
*5,2,864959475,1448632,-4779648,37,0,5E,BF
*6,17,695573168,7695579,-1539468,48,0,03,7F
```

Owing to the fact that they are received later, pseudoranges from WAAS/EGNOS satellites are output in a separate block.

SVAR!Q: Dual-frequency GPS pseudoranges in receiver time

General Form

<stx> <eoln>
<!Q>,<time tagging> <eoln>
<soln>,<parameters> <eoln>
<soln>,<1st line of raw data> <eoln>
...
<soln>,<nth line of raw data> <eoln>
<etx>

Time tagging line

!Q,<GPS week>,<GPS time>,<Delay><eoln>

<GPS week>	GPS week number
<GPS time>	Time in week, in seconds. Reference time is Jan 6, 1980 at 0hr00 (assuming the modulo 2^{10} ambiguity has been solved)
<Delay>	GPS time of measurement – GPS time in week (Z count), in µseconds.
<eoln>	

Parameter line

<soln>	1st character: <&> 2nd character: <P> L1 and L2 phase measurements, C/A, P/Y codes
<Filter. time constant>	In seconds (C/A code smoothed by carrier)
<Antenna identification>	<0> primary antenna (by default) <1 | 2 | 3> secondary antennas
<eoln>	

❑ Dual-frequency raw data lines

<soln>	2 characters: * and channel No. (in hexadecimal)
<SV No.>	Satellite PRN number
<C/A code pseudorange>	In 10^{-10} units of a second, ≅ propagation time corrected for clock error (minus clock error)
<$L1_{C/A}$ carrier phase>	In 10^{-3} units of a cycle, modulo 10^4 cycles, minus clock error
<$L1_{C/A}$ carrier speed>	In 10^{-3} units of a cycle/s
< $L1_{C/A}$ C/No>	In dB.Hz
<L1, L2 channel status>	Coded in 4 bits (1 ASCII character 0 to F) bit 0 = 0 *(not used)* bit 1 = 0 if code P; 1 if code Y (antispoofing) bit 2 = 1 if $L1_{C/A}$ phase measurement not valid bit 3 = 1 if $L2_{P/Y}$ phase measurement not valid
<L1 carrier quality indicator>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: "cumulative loss of continuity indicator", (complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost) bits 5 to 7: “data quality indicator”. See page 161.
<C/A code quality indicator>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 3: "pseudo-range multipath error indicator", (complies with RTCM message #19): "1111": multipath error not determined bits 4 to 7: "pseudorange data quality indicator". See page 161.
<$L1_{P/Y}$ - $L1_{C/A}$ carrier phase deviation>	In 10^{-3} units of a cycle, modulo 1 cycle, centered around zero
<P_{L1} - C/A_{L1}code deviation>	In 10^{-10} units of a second
<P_{L2} - C/A_{L1}code deviation>	In 10^{-10} units of a second
<$L2_P$ carrier phase>	In 10^{-3} units of a cycle, modulo 10^4 cycles of L2, minus clock error
<$L2_P$ carrier speed>	In 10^{-3} units of a cycle

<L2 carrier quality indicator>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 4: "cumulative loss of continuity indicator", (complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost) bits 5 to 7: “data quality indicator”. See page 161.
<P/Y code quality indicator>	Coded in 8 bits (2 ASCII characters 0 to F, MSB first) bits 0 to 3: "pseudo-range multipath error indicator", (complies with RTCM message #19): "1111": multipath error not determined bits 4 to 7: "pseudorange data quality indicator". See page 161.
<eoln>	

❑ Data block example

```
!Q,1154,219640.0,100000
&P,0.0,0
*0,22,669625664,2355927,-2176540,49,2,0A,7F,8,-110,-260,214820,-
1696244,29,5F
*1,25,774275720,5423682,1616432,44,2,05,9F,-
23,71,168,7525845,1258840,8E,9F
*2,10,834460029,3120363,383036,40,2,23,AF,78,13,141,3302024,298328,CA,
CF
*3,6,784054033,5408867,1285588,44,2,18,8F,-
4,99,150,4777000,1001792,B5,AF
*4,15,680642097,6497373,-2641408,49,2,02,7F,0,-41,-161,7834773,-
2058344,59,7F
*5,2,865122419,7131997,-4779036,36,A,5E,BF,,,,,,,
*6,17,695571879,7478529,-1544504,48,2,03,7F,23,-40,-168,3490676,-
1203408,42,7F
```

SVAR!M: Event Time-Tagging

General Form

<stx> <eoln>
<!M,<time tagging> <eoln>
<soln>,<GPS vernier> <eoln>
<soln>,<UTC Time> <eoln>
<soln>,<source> <eoln>
<etx>

Time tagging line

!M,<GPS week>,<GPS time><eoln>

<GPS week>	GPS week number. Reference time is Jan 6 1980 at 0hr00
<GPS time>	GPS time, in seconds, in week at the time of the event
<eoln>	

GPS vernier line

*1,<GPS status>,<GPS vernier><eoln>

<GPS status>	1 character: 0=computed GPS time solution 1=estimated GPS time solution, to within ± 10 ms 9=undetermined GPS time solution
<GPS vernier>	GPS time in week, modulo 10 seconds at the time of the event (this data is a duplicate of the GPS time data from the time-tagging line, but in this case featuring a useful precision of 10^{-10} s).

❑ UTC time line

*2,<UTC status>,<UTC time><eoln>

<UTC status>	1 character: 0=valid UTC time 9= invalid UTC time
<UTC time>	UTC time at the time of the event. Format: hhmmss.sss (same as NMEA 0183). Useful precision: 10^{-10} s

❑ Source line

*3,<Event origin>,<Event counter><eoln>

<Event origin>	ASCII character identifying event source: 1=EVT1 2=EVT2 4=1PPS
<Event counter>	Counter modulo 256 incremented on occurrence of every event from a given source

❑ Data block example

```
!M,1154,153146.9
*1,0,6.9999999904
*2,0,183213.999
*3,4,231
```

SVAR!A: Almanac data

❑ General form

<stx> <eoln>
<!A>,<time tagging> <eoln>
<parameters> <eoln>
<Almanac line> <eoln>
<etx>

❑ Time tagging line

!A,<GPS week>,<GPS time><eoln>

- GPS week number
- Time in week, in seconds. Reference time is Jan 6 1980 at 0hr00 (assuming modulo 2^{10} ambiguity has been solved)
- <eoln>

❑ Parameter line

- Number of the SV corresponding to the transmitted almanac
- Almanac reference week number (assuming the modulo 2^{10} ambiguity has been solved)
- <eoln>

❑ Almanac data lines

- Bits 1 to 24 from words 3 to 10 in subframes 4 or 5 (depending on SV number).

  Each GPS word (bits 1 to 24) is split into six 4-bit strings which are hex-encoded to form 6 bytes (0 to 1, A to F), with the first byte corresponding to bits 1 to 4.

  The almanac line is organized as follows:

  <word 3>,<word 4>,<word 5>,<word 6>,<word 7>,<word 8>,<word 9>,<word 10>,<eoln>

❑ Message example

!A,945,414504.2
4,945
4426B6,901606,FD3F00,A10D2F,AAA009,DDC8B3,ECF6F5,01003B

SVAR!E: Ephemeris data

❑ General Form

<stx> <eoln>
<!E>,<time tagging> <eoln>
<parameters> <eoln>
< 1st line of ephemeris data> <eoln>
< 2nd line of ephemeris data> <eoln>
< 3rd line of ephemeris data> <eoln>
<etx>

❑ Time tagging line

!E,< GPS week>,< GPS time><eoln>

- GPS week number
- Time in week, in seconds. Reference time is Jan 6 1980 at 0hr00 (assuming modulo 2^{10} ambiguity has been solved)
- <eoln>

❑ Parameter line

- Number of the SV corresponding to the transmitted ephemeris
- <eoln>

❑ Ephemeris data line

- Line 1: bits 1 to 24 from words 3 to 10 in subframe 1
- Line 2: bits 1 to 24 from words 3 to 10 in subframe 2
- Line 3: bits 1 to 24 from words 3 to 10 in subframe 3.

Each GPS word (bits 1 to 24) is split into six 4-bit strings that are hex-encoded to form 6 bytes (0 to 1, A to F), with the first byte corresponding to bits 1 to 4.

Each ephemeris data line is organized as follows:

<word 3>,<word 4>,<word 5>,<word 6>,<word 7>,<word 8>,<word 9>,<word 10>,<eoln>

❑ Data block example

!E,945,414347.7
10
EC5701,73336D,D49E97,A3469F,FEEBFC,346432,000004,027605...

SVAR!U : Iono/UTC data

❑ General Form

<stx> <eoln>
<!U>,<time tagging> <eoln>
<Iono/UTC data line> <eoln>
<etx>

❑ Time tagging line

!U,< GPS week>,< GPS time><eoln>

- GPS week number
- Time within week (Z count in seconds), when the receiver generates the message. Reference time is Jan 6 1980 at 0hr00 (assuming the modulo 2^{10} ambiguity has been solved)
- <eoln>

❑ Iono/UTC data line

- Bits 1 to 24 from words 3 to 10 in subframe 4, page 18.

  Each GPS word (bits 1 to 24) is split into six 4-bit strings that are hex-encoded to form 6 bytes (0 to 1, A to F), with the first byte corresponding to bits 1 to 4.

  The Iono/UTC data line is organized as follows:

  <word 3>,<word 4>,<word 5>,<word 6>,<word 7>,<word 8>,<word 9>,<word 10>,<eoln>

❑ Data block example

!U,945,414740.3
780F00,FF0136,FEFC03,000032,000000,0F90B1,0C9002,0CAAAA

SVAR!S : Health & A/S data

❑ General Form

<stx> <eoln>
<!S>,<time tagging> <eoln>
<Health & A/S data line> <eoln>
<etx>

❑ Time tagging line

!S,<GPS week>,<GPS time><eoln>

- GPS week number
- Time within week (Z count in seconds), when the receiver generates the message. Reference time is Jan 6 1980 at 0hr00 (assuming the modulo 2^{10} ambiguity has been solved)
- <eoln>

Health & A/S data line

- A/S & Health: Bits 1 to 24 from words 3 to 10 in subframe 4, page 25
- Health: Bits 1 to 24 from words 3 to 10 in subframe 5, page 25.

Each GPS word (bits 1 to 24) is split into six 4-bit strings that are hex-encoded to form 6 bytes (0 to 1, A to F), with the first byte corresponding to bits 1 to 4.

The Health & A/S data line is organized as follows:

<word 3>,<word 4>,<word 5>,<word 6>,<word 7>,<word 8>,<word 9>,<word 10>,<eoln>

Data block example

!S,945,414740.3

7F9999,999999,009999,999099,999990,999080,000FC0,000FE9

7390B1,000000,000000,000FFF,F00000,00003F,000000,AAAAAB

SVAR!B: GPS Bit Flow

General Form

<stx> <eoln>
<!B>,<time tagging> <eoln>
<soln>,<Block counter> <eoln>
<soln>,<1st line of bit flow><eoln>
...
<soln>,<nth line of bit flow><eoln>
<etx>

Time tagging line

!B,<GPS week>,<GPS time><eoln>

- GPS week number
- GPS time in week, in seconds, of last transmitted bit. Reference time is Jan 6 1980 at 0hr00
- <eoln>

❑ Block counter line

<soln>	%C
<Block counter>	Counter modulo 10 incremented by one on reception of every new message
<eoln>	

❑ GPS bit flow line

<soln>	1 or 2 characters: * and channel No. (in hexadecimal)(optional)
<SV No.>	Satellite PRN number
<Useful bits >	Number of useful bits
<GPS bit block>	n last bits received (in hexadecimal). For decoding, see document ICD-GPS-200C
<eoln>	

For a given set of N received bits, M bits all at “0” are placed after the N bits in such a way that N+M=k×4. The k hexadecimal values are ASCII-encoded and form a block. The number of useful bits (N) is sent at the beginning of the block.

The GPS data is sent without taking into account their meaning or the checksum (CRC) placed at the end of the words.

The number of bits in a block depends on the message periodicity and channel transmission speed (50 bits/s). This number is limited to a maximum of 480 bits, or 120 hex characters.

❑ Data block example

```
!B,570,209274.6
%C,3
*1,12,30,3F471A04
*2,23,30,18AC442C
```

SVAR!W: WAAS/EGNOS Data

General Form

<stx> <eoln>
<!W>,<time tagging> <eoln>
<soln><parameters> <eoln>
<soln><Data from 1st GEO> <eoln>
...
<soln><Data from nth GEO> <eoln>
<etx>

Time tagging line

!W,<GPS week>,<GPS time><eoln>

- GPS week number
- Time within week, in seconds, when generating the message. Reference time is Jan 6 1980 at 0hr00
- <eoln>

Parameter line

%C,<message counter>,<count of GEOs in the message> <eoln>

- The counter is modulo 16, incremented by 1 on arrival of a new message.
- Number of possible GEOs: from 1 to 4

❑ Pre-decoded WAAS data line

<soln>	2 characters: * and channel No. (in hexadecimal)
<GEO Number>	PRN of geostationary satellite (≥ 100)
<CRC validity flag>	0: Good; 1: Bad
<WAAS message No.>	From 0 to 63 (same as WAAS encoding)
<Preamble identifier>	From 1 to 3 (byte number in preamble)
<WAAS word>	occupies 212 bits in 53 ASCII/HEX- encoded characters (preamble and parity excluded)
<Checksum>	Optional, but recommended, checksum word
<eoln>	

❑ Data block example

```
!W,980,209274.0
%C,14,2
*D,120,0,9,1,F471A0418A0F158CD50A1B178034D586AF55127E070B10E144
F82@48
*E,132,0,9,1,8AC442C6AF0F16AF558A0F471A0410ECD500418A15837AF89
A0B4@62
```

♣

10. Raw Data Outputs in SBIN Format

Notation Rules

❑ Reserved characters

By principle, all possible binary values in a byte are allowed. However three ASCII characters are used for message identification:

ASCII byte **FE**$_h$: denotes beginning of binary block

ASCII byte **FF**$_h$: denotes end of binary block

ASCII byte **FD**$_h$: denotes intentionally altered character

If between the beginning and the end of a block, the binary string initially includes such characters, then the following modifications are made to the string to avoid misinterpretation of the data at a further stage:

FD$_h$ is converted into **FD**$_h$ **00**$_h$

FE$_h$ is converted into **FD**$_h$ **01**$_h$

FF$_h$ is converted into **FD**$_h$ **02**$_h$

When counting bytes in a message, remember that all the "doubled" characters (i.e. FD$_h$ 00h FD$_h$ 01$_h$ and FD$_h$ 02$_h$) resulting from the change of coding described above must be counted as single characters.

❑ Conventions used

- The term "field" stands for one or more parameters.
- The term "data" stands for a binary value occupying a byte.
- In a byte, bit "**0**" stands for the least significant bit, bit "**7**" for the most significant bit. The most significant bit is always placed ahead.

❑ Symbols used

< >	:	denotes a field
<stb>	:	beginning of block : ASCII character **FE_h**
<blid>	:	block type: 1 ASCII character allowing identification of the data type
<long>	:	2 bytes in binary notation specifying the count of bytes in the block, from <stb> excluded up to <checksum> excluded
<checksum>	:	2 bytes (for transmission error check)
<etb>	:	end of block: ASCII character **FF_h**

❑ General form

<stb>	:	1 byte (FE_h)
<blid>	:	1 byte
<long>	:	2 bytes
<data>	:	1 to 1023 bytes
<checksum>	:	2 bytes
<etb>	:	1 byte (FE_h)

The meaning of the data in each block type is predefined

❑ Error check rule

The message content is checked for transmission error through two "checksum" bytes the values of which result from the sum of all bytes, modulo 2^{16}, from <stb> excluded to <checksum> excluded.

❑ Rule about numerals

Unless otherwise specified:

- Numerals are expressed in binary, with fixed decimal point
- The notation of signed numbers meets the rule of the 2' s complement.

SBIN@R: Single-frequency GPS/WAAS/EGNOS pseudoranges in satellite time

General form

<stb><**R**>	2 bytes
<long>	2 bytes
<time tagging>	5 bytes
<parameters>	1 byte
<Raw Data, 1stSV>	14 bytes
...	
<Raw Data, last SV>	14 bytes
<checksum>	2 bytes
<etb>	1 byte

Time tagging

First 2 bytes : GPS week number (assuming the modulo 2^{10} ambiguity has been solved)

Last 3 bytes : GPS time in week (unit: 1/10 s). The reference time is Jan 6 1980 at 0hr00.

Parameters

A single byte:

Bits 0 and 1 : Code smoothed by carrier according to RTCM message #19

Code	Smoothing Interval
00	0 to 1 minute
01	1 to 5 minutes
10	5 to 15 minutes
11	Indefinite

Bit 2		=1
Bit 3	:	=0
Bits 4 to 6	:	(*reserved*)
Bit 7	:	=0 (single-frequency measurements)

❑ Satellite Raw Data

1st byte	:	SV number
Next 4 bytes	:	C/A code pseudorange (unit=10^{-10} s; modulo 400 ms)
Next byte	:	bits 0 to 4: Level indicator (C/No-26 dB.Hz) bits 5 to 6 not used bit 7=1 if phase measurement not valid
Next 3 bytes	:	$L1_{C/A}$ carrier phase (unit: 10^{-3} cycle, modulo 10^{4} cycles)
Next 3 bytes	:	$L1_{C/A}$ carrier speed (unit: 4×10^{-3} cycle/s, field ~ 32 Hz; MSB= sign; 800000_h=measurement not valid)
Next byte	:	$L1_{C/A}$ carrier quality indicator Bits 0 to 4: "cumulative loss of continuity indicator", complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost Bits 5 to 7: "data quality indicator". See page 161.
Last byte	:	C/A code quality indicator Bits 0 to 3: "pseudorange multipath error indicator", complies with RTCM message No. 19 "1111": multipath error not determined Bits 4 to 7: "pseudorange data quality indicator". See page 161.

Owing to the fact that they are received later, pseudoranges from WAAS/EGNOS satellites are output in a separate block.

SBIN@R: Dual-frequency GPS pseudoranges in satellite time

❑ General form

<stb><**R**>	2 bytes
<long>	2 bytes
<time tagging>	5 bytes
<parameters>	1 byte
<Raw Data, 1stSV>	27 bytes
...	
<Raw Data, last SV>	27 bytes
<checksum>	2 bytes
<etb>	1 byte

❑ Time tagging

First 2 bytes : GPS week number (assuming the modulo 2^{10} ambiguity has been solved)

Last 3 bytes : GPS time in week (unit: 1/10 s). The reference time is Jan 6 1980 at 0hr00.

❑ Parameters

A single byte:

bits 0 and 1 : C/A code smoothed by carrier, complies with RTCM message #19

Code	Smoothing Interval
00	0 to 1 minute
01	1 to 5 minutes
10	5 to 15 minutes
11	Indefinite

Bit 2=Bit 3 : =1
Bits 4 to 6 : =0 (*reserved*)
Bit 7 : =1 (dual-frequency measurements)

❑ Satellite Raw Data

1st byte : SV number

Next 4 bytes : C/A code pseudorange (unit: 10^{-10} s modulo 0.4 s)

Next byte : bits 0 to 4: Level indicator (C/No – 26), in dB.Hz

bits 5, 6 and 7: channel status

bit 5=0 if P code; =1 if Y code
bit 6=1 if $L2_{P/Y}$ phase measurement not valid
bit 7=1 if $L1_{C/A}$ phase measurement not valid

Next 3 bytes : $L1_{C/A}$ carrier phase (unit: 10^{-3} cycle, modulo 10^4 cycles)

Next 3 bytes : $L1_{C/A}$ carrier speed (unit: 4×10^{-3} cycles/s; field~32 kHz; MSB= sign;

800000_h=measurement not valid)

Next byte : $L1_{C/A}$ carrier quality indicator

Bits 0 to 4: "cumulative loss of continuity indicator", complies with RTCM message No. 18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost

Bits 5 to 7: “data quality indicator”. See page 161.

Next byte : C/A code quality indicator

Bits 0 to 3: "pseudorange multipath error indicator", complies with RTCM message No. 19

"1111": multipath error not determined

Bits 4 to 7: "pseudorange data quality indicator". See page 161.

Next byte : $L1_{P/Y}$ – $L1_{C/A}$ carrier phase deviation, centered around zero (unit=1/256th cycle; MSB= sign;

80_h=measurement not valid)

Next 2 bytes : $P_{L1} - C/A_{L1}$ code deviation (unit: 10^{-10} s; field~3.2 µs; MSB= sign; 8000_h=measurement not valid)

Next 2 bytes : $P_{L2} - C/A_{L1}$ code deviation (unit: 10^{-10} s; field~3.2 µs; MSB= sign; 8000_h=measurement not valid)

Next 3 bytes : $L2_{P/Y}$ carrier phase (unit: 10^{-3} cycles modulo 10^4 cycles of L2)

Next 3 bytes : $L2_{P/Y}$ carrier speed (unit: 4×10^{-3} cycles/s; field~32 kHz; MSB= sign; 800000_h=measurement not valid)

Next byte : L2 carrier quality indicator

Bits 0 to 4: "cumulative loss of continuity indicator", complies with RTCM message No. 18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost

Bits 5 to 7: "data quality indicator". See page 161.

Last byte : P/Y code quality indicator

Bits 0 to 3: "pseudorange multipath error indicator", complies with RTCM message #19

"1111": multipath error not determined

Bits 4 to 7: "pseudorange data quality indicator". See page 161.

SBIN@Q: Single-frequency GPS/WAAS/EGNOS pseudoranges in receiver time

General form

<stb><**Q**>	2 bytes
<long>	2 bytes
<time tagging>	9 bytes
<parameters>	1 byte
<Raw Data, 1stSV>	15 bytes
...	
<Raw Data, last SV>	15 bytes
<checksum>	2 bytes
<etb>	1 byte

Time tagging

First 2 bytes : GPS week number (assuming the modulo 2^{10} ambiguity has been solved)

Next 3 bytes : GPS time in week (unit: 1/10 s). The reference time is Jan 6 1980 at 0hr00.

Next 3 bytes : Delay (in micro-seconds) defined as “GPS time of measurement – GPS time in week (Z count)”.

Last byte : =0 (Reserved)

Parameters

A single byte:

Bits 0 and 1 : Code smoothed by carrier according to RTCM message #19

Code	Smoothing Interval
00	0 to 1 minute
01	1 to 5 minutes
10	5 to 15 minutes
11	Indefinite

Bit 2 =1

Bit 3 : =Type of time tagging:

0=time-tagging estimated from decoded navigation data

1=time-tagging computed from position & time solution (clock error subtracted from code & phase measurements)

Bits 4 and 5	:	Sensor Id .number (0 to 3). Default value: 0 for all single-sensor receivers
Bit 6		=0 (Reserved)
Bit 7	:	=0 (single-frequency measurements)

❑ Satellite Raw Data

1st byte	:	SV number
Next byte	:	=0 (Reserved)
Next 4 bytes	:	C/A code pseudorange (unit=10^{-10} s) ≅ propagation time
Next byte	:	bits 0 to 4: Level indicator (C/No – 26 dB.Hz) bits 5 to 6 not used bit 7=1 if phase measurement not valid
Next 3 bytes	:	$L1_{C/A}$ carrier phase (unit: 10^{-3} cycle, modulo 10^4 cycles)
Next 3 bytes	:	$L1_{C/A}$ carrier speed (unit: 4×10^{-3} cycle/s, field ~ 32 Hz; MSB= sign; 800000_h=measurement not valid)
Next byte	:	$L1_{C/A}$ carrier quality indicator Bits 0 to 4: "cumulative loss of continuity indicator", complies with RTCM message No. 18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost Bits 5 to 7: "data quality indicator". See page 161.
Last byte	:	C/A code quality indicator Bits 0 to 3: "pseudorange multipath error indicator", complies with RTCM message No. 19 "1111": multipath error not determined Bits 4 to 7: "pseudorange data quality indicator". See page 161.

Owing to the fact that they are received later, pseudoranges from WAAS/EGNOS satellites are output in a separate block.

SBIN@Q: Dual-frequency GPS pseudoranges in receiver time

❑ General form

<stb><**Q**>	2 bytes
<long>	2 bytes
<time tagging>	9 bytes
<parameters>	1 byte
<Raw Data, 1stSV>	28 bytes
...	
<Raw Data, last SV>	28 bytes
<checksum>	2 bytes
<etb>	1 byte

❑ Time tagging

First 2 bytes : GPS week number (assuming the modulo 2^{10} ambiguity has been solved)

Next 3 bytes : GPS time in week (unit: 1/10 s). The reference time is Jan 6 1980 at 0hr00.

Next 3 bytes : Delay (in micro-seconds) defined as “GPS time of measurement – GPS time in week (Z count)”.

Last byte : =0 (Reserved)

❑ Parameters

A single byte:

bits 0 and 1 : C/A code smoothed by carrier, complies with RTCM message No. 19

Code	Smoothing Interval
00	0 to 1 minute
01	1 to 5 minutes
10	5 to 15 minutes
11	Indefinite

Bit 2 =1

Bit 3 : =Type of time tagging:

0=time-tagging estimated from decoded navigation data

1=time-tagging computed from position & time solution (clock error subtracted from code & phase measurements)

Bits 4 and 5	:	Sensor Id .number (0 to 3). Default value: 0 for all single-sensor receivers
Bit 6		=0 (Reserved)
Bit 7	:	=1 (dual-frequency measurements)

❑ Satellite Raw Data

1st byte	:	SV number
Next byte	:	=0 (Reserved)
Next 4 bytes	:	C/A code pseudorange (unit: 10^{-10} s) ≅ propagation time
Next byte	:	bits 0 to 4: Level indicator (C/No − 26), in dB.Hz bits 5, 6 and 7: channel status bit 5=0 if P code; =1 if Y code bit 6=1 if $L2_{P/Y}$ phase measurement not valid bit 7=1 if $L1_{C/A}$ phase measurement not valid
Next 3 bytes	:	$L1_{C/A}$ carrier phase (unit: 10^{-3} cycle, modulo 10^4 cycles)
Next 3 bytes	:	$L1_{C/A}$ carrier speed (unit: 4×10^{-3} cycles/s; field~32 kHz; MSB= sign; 800000_h=measurement not valid)
Next byte	:	$L1_{C/A}$ carrier quality indicator Bits 0 to 4: "cumulative loss of continuity indicator", complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost Bits 5 to 7: “data quality indicator”. See page 161.
Next byte	:	C/A code quality indicator Bits 0 to 3: "pseudorange multipath error indicator", complies with RTCM message #19 "1111": multipath error not determined Bits 4 to 7: "pseudorange data quality indicator". See page 161.
Next byte	:	$L1_{P/Y} - L1_{C/A}$ carrier phase deviation, centered around zero (unit: 1/256th of a cycle; MSB=sign; 80_h=measurement not valid)

Next 2 bytes : $P_{L1} - C/A_{L1}$ code deviation (unit: 10^{-10} s; field~3.2 µs; MSB= sign; 8000_h=measurement not valid)

Next 2 bytes : $P_{L2} - C/A_{L1}$ code deviation (unit: 10^{-10} s; field~3.2 µs; MSB= sign; 8000_h=measurement not valid)

Next 3 bytes : $L2_{P/Y}$ carrier phase (unit: 10^{-3} cycles modulo 10^4 cycles of L2)

Next 3 bytes : $L2_{P/Y}$ carrier speed (unit: 4×10^{-3} cycles/s; field~32 kHz; MSB= sign; 800000_h=measurement not valid)

Next byte : L2 carrier quality indicator

Bits 0 to 4: "cumulative loss of continuity indicator", complies with RTCM message #18, counter modulo 32 incremented every time the continuity of the carrier phase measurement is lost

Bits 5 to 7: “data quality indicator”. See page 161.

Last byte : P/Y code quality indicator

Bits 0 to 3: "pseudorange multipath error indicator", complies with RTCM message #19

"1111": multipath error not determined

Bits 4 to 7: "pseudorange data quality indicator". See page 161.

SBIN@M: Event Time Tagging

❑ General form

<stb><**M**>	2 bytes
<long>	2 bytes
<time tagging>	5 bytes
<vernier>	4 bytes
<UTC time>	4 bytes
<parameters>	2 bytes
<checksum>	2 bytes
<etb>	1 byte

❑ Time tagging

First 2 bytes : GPS week number (assuming the modulo 2^{10} ambiguity has been solved)

Last 3 bytes : GPS time in week (unit: 1/10 s) at the time of event.

❑ Vernier

4 bytes : Time vernier (units: 10^{-10} s, modulo 0.1 s). Adds up to GPS time of event for precise time tagging of the event

❑ UTC time

First byte : Bit 7 indicates validity of UTC time:

0=valid
1=invalid

Bits 6 and 5 indicate validity of GPS time:

00=determined according to Position-Velocity-Time solution used
01=meaningless
10=estimated without using Position-Velocity-Time solution (±10 ms)
11=GPS time not determined

Bits 4 to 0: UTC time, hours (0 to 23)

Raw Data in SBIN Format

Next byte : UTC time, minutes (00 to 59)

Last 2 bytes : UTC time, seconds expressed in 1/1000th of a second (0 to 59999)

❑ Parameters

First byte : Event counter, modulo 256, incremented on every occurrence of the same type of event

Last byte : ASCII alphanumerical character identifying the type of event:

1=EVT1
2=EVT2
4=1PPS

SBIN@A: Almanac data

❑ General form

<stb><**A**>	2 bytes
<long>	2 bytes
<almanac ident.>	3 bytes
<SV almanac>	24 bytes
<checksum>	2 bytes
<etb>	1 byte

❑ Almanac identification

First byte	:	Number of the GPS satellite corresponding to the transmitted almanac (binary)
Last 2 bytes	:	Almanac *reference* week number (modulo 2^{10} ambiguity solved)

❑ Almanac data

- Bits 1 to 24 from words 3 to 10 in subframes 4 or 5 (depending on SV number)

SBIN@E: Ephemeris data

❑ General form

<stb><**E**>	2 bytes
<long>	2 bytes
<ephemeris ident.>	1 byte
<words 3 to 10, subfr 1>	24 bytes
<words 3 to 10, subfr 2>	24 bytes
<words 3 to 10, subfr 3>	24 bytes
<checksum>	2 bytes
<etb>	1 byte

Ephemeris identification

A single byte : Number of the GPS satellite corresponding to the transmitted ephemeris (binary)

Ephemeris data

- Bits 1 to 24 from words 3 to 10 in subframe 1
- Bits 1 to 24 from words 3 to 10 in subframe 2
- Bits 1 to 24 from words 3 to 10 in subframe 3

SBIN@U: Iono/UTC data

General form

<stb><**U**>	2 bytes
<long>	2 bytes
<Iono/UTC data>	24 bytes
<checksum>	2 bytes
<etb>	1 byte

Iono/UTC Data

- Bits 1 to 24 from words 3 to 10 in subframe 4, page 18, declared valid by the GPS sensor.

SBIN@S: Health & A/S data

General form

<stb><**S**>	2 bytes
<long>	2 bytes
<A/S & Health data>	24 bytes
<Health data>	24 bytes
<checksum>	2 bytes
<etb>	1 byte

Health & A/S Data

A/S & Health	:	Bits 1 to 24 from words 3 to 10 in subframe 4, page 25, declared valid by the GPS sensor
Health	:	Bits 1 to 24 from words 3 to 10 in subframe 5, page 25, declared valid by the GPS sensor

SBIN@b: GPS Bit Flow

General Form

<stb><**b**>	2 bytes
<long>	2 bytes
<time tagging>	5 bytes
<Parameters>	2 bytes
<Data from 1st GPS SV>	2+N bytes
...	
<Data from nth GPS SV>	2+N bytes
<checksum>	2 bytes
<etb>	1 byte

Time tagging

First 2 bytes	:	GPS week number (assuming the modulo 2^{10} ambiguity has been solved)
Last 3 bytes	:	GPS time in week (unit: 1/10 s) of last transmitted GPS bit.

Parameters

First byte	:	Bits 7 to 5: message counter, modulo, incremented by one on reception of every new message
		Bits 4 to 0: Number of satellites in the message (0 to 31)
Last byte	:	Bits 7 to 4: =0 (Reserved
		Bits 3 to 0: Number (k) of 0.6-sec periods in the message (1 to 15)

❑ SV Data

First byte	:	Channel number in receiver (1 to 255)
Next byte	:	SV PRN number (1 to 255)
N next bytes	:	Consists of k times 30 data bits (MSB first), followed by M (0 to 6) bits set at "0" in such a way that (30k+M) results in N times 8 bits (see document ICD-GPS-200C for decoding)

❑ Comments

The presence of GPS signal is tested for every bit:

- If more than 3 bits are found while signal level less than the specified threshold, no bit flow message is issued for this SV
- If 3 bits or less are wrong, the bit flow message for this SV is issued with the possibility of further corrections.

SBIN@W: WAAS/EGNOS Data

❑ General Form

<stb><**W**>	2 bytes
<long>	2 bytes
<Time tagging>	3 bytes
<Parameters>	1 byte
<Data from 1st GEO>	29 bytes
...	
<Data from nth GEO>	29 bytes
<checksum>	2 bytes
<etb>	1 byte

❑ Time tagging

3 bytes	:	GPS time in week (unit: 1/10 s). The reference time is Jan 6 1980 at 0hr00.

❑ Parameters line

A single byte:

bits 7 to 4 : Message counter (modulo 16, incremented by 1 whenever a new message is received)

bits 3 and 2 : =0 (no particular meaning)

bits 1 and 0 : Count of GEOs in the message:

Bit 1	Bit 0	GEO count
0	1	1
1	0	2
1	1	3
0	0	4

❑ GEO data line

First byte : GEO PRN

2nd byte : Message type:

- Bit 7: CRC validity flag (0: Good; 1: Bad)
- Bit 6: =0 (no particular meaning)
- Bits 5 to 0: message type (0 to 63, same as WAAS encoding)

3rd byte : Bits 7 and 6: Identifies preamble (8 bits out of 24 totally) as follows:

- “1”: 1st byte from preamble
- “2”: 2nd byte from preamble
- “3”: 3rd byte from preamble

Bits 5 and 4: = 0 (no particular meaning)

Bits 3 to 0: first 4 bytes (MSB) from the 212-bit WAAS word

Next 26 bytes The last 208 bits from the 212-bit WAAS word (excluding preamble, message number and parity)

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11. Command Library

Introduction

❑ Command Format

- The format of all the commands available complies with the NMEA 0183 standard.
- Thales Navigation, formerly DSNP, formerly Dassault Sercel NP, was assigned a manufacturer code by the NMEA 0183 Committee for all its proprietary sentences. This code is "DAS". As a consequence, the first field in any of our proprietary commands is “$PDAS”.
- The beginning of any field is denoted by a comma (,). This character is the only one required to detect and identify a new field.
- Most fields containing numerical data are of variable length.
- Although from version 2.1 of the NMEA standard the checksum field is compulsory, it is optional in all our proprietary sentences in order that commands can be sent from a simple, "non-intelligent" terminal or communications utility.
- When the checksum field is present and the test on this checksum fails, the command is rejected.
- Any command that you send can contain empty fields. If a field data is missing, it is assumed to keep its current value.

❑ Conventions Used

The following symbols and conventions are used in the description of the commands:

Square-brackets []	:	used to bound optional parameters
x.x	:	designates the format of any numerical data, signed or not, with or without decimal point and decimal places, and with an integer part of variable length
a	:	designates a one-letter parameter (example: A)
x	:	designates the format of any numerical data which is necessarily an integer
xx	:	Numerical data, fixed length

c--c : Character string, variable length
cc : Character string, fixed length
a--a : Keyword
hhmmss.ss : Time
llll.lllll : Latitude (ddmm.mmmmm)
yyyyy.yyyyyy : Longitude (dddmm.mmmmmm)
[y]x : Field containing two one-figure parameters the first of which is optional

In the examples given at the end of each description, the following fonts are used:

- **Bold Arial Narrow** for all commands sent by the user
- Normal Arial Narrow for all receiver replies.

Command summary table

Command	Function	Page
$PDAS,AGECOR	Changes/reads maximum age of corrections	214
$PDAS,ALTI	Changes/reads altitude correction mode	215
$PDAS,BITFLW	Edits the definitions of bit flow GPS data outputs	215
$PDAS,COMMNT	Reads comment present in configuration	223
$PDAS,CONFIG	Reads data from current configuration	224
$PDAS,CONFIG,INIT	Makes initial configuration the receiver's new current configuration	225
$PDAS,CONFIG,READ	Reads data from initial configuration	226
$PDAS,CONFIG,RESET	Makes default configuration the receiver's new current configuration	227
$PDAS,DEFLT	Reports/acknowledges errors, if any	228
$PDAS,DGPS,DELSTA	Cancels a DGPS transmitting station in the receiver	230
$PDAS,DGPS,MODE	Controls DGPS transmit or receive channel	231 & 233
$PDAS,DGPS,STATION	Describes/lists DGPS transmitting stations	235
$PDAS,DGPDAT	Edits definitions of DGPS raw data outputs	237
$PDAS,EVENT	Edits the definitions of time-related data outputs	240
$PDAS,FILTER	Edits the speed filtering time constant	242
$PDAS,FILTYP	Enables one of the preset 3 time constants used in speed filtering	243
$PDAS,FIXMOD	Edits the current fix mode & associated reference station or GEO	244
$PDAS,FIXTYP	Edits multi-mode settings	246
$PDAS,FMT	Lists available macros generating content of output messages	249
$PDAS,GEO	Edits the coordinate system used	250
$PDAS,GEODAT	Edits definitions of WAAS/EGNOS data outputs	252
$PDAS,GEOID,HEIGHT	Calculates the height of the geoid	253

Command	Function	Page
$PDAS,GEOID,READ	Reads the header from a geoid file	255
$_ _GPQ,GLL $_ _GLL	Edits estimated position	257 257
$PDAS,GNOS	Enables/disables operation with WAAS/EGNOS; also used to specify PRNs of GEOs tracked if chosen selection mode is "Manual"	258
$_ _GPQ,_ _ _	Returns the current value of the specified parameter (NMEA0183 compliant)	260
$PDAS,GPSDAT	Edits definition of GPS raw data outputs	262
$PDAS,HARDRS	Edits settings of serial ports	264
$PDAS,HEALTH	Edits health status of reference station	265
$PDAS,HDGINI	Edits, computes geometrical data of antenna array from which heading measurements are performed	266
$PDAS,HDGSET	Edits geometrical data of antenna array from which heading measurements are performed + filtering time constant and max. dead reckoning time	267
$PDAS,HRP	Provides set of results tied to heading processing	268
$PDAS,IDENT	Reads identification of harware and software parts	269
$PDAS,NAVSEL	Edits the currently selected navigation mode	273
$PDAS,OUTMES	Edits definitions of computed data outputs	274
$PDAS,OUTON $PDAS,OUTOFF	Respectively enables and disables data outputs on the serial ports	276
$PDAS,PRANGE	Edits/adds definitions of pseudorange-data outputs	277
$PDAS,PREFLL	Edits coordinates of reference position	279
$PDAS,PREFNE	Edits projected coordinates of reference position	280
$PDAS,QC	Deals with Quality Control in the receiver	281
$PDAS,RAZALM	Deletes the specified type of almanac	283
$PDAS,SCREEN	Sets displays tasks	284
$PDAS,SELGEO	Selects the coordinate system that should be used by the receiver	285
$PDAS,SVDSEL	Deals with rejected SVs & elevation threshold	286
$PDAS,TR	Triggers data output in RS232 mode on the specified port	288
$PDAS,UNIT	Edits receiver (or station) identification number	289
$_ _GPQ,ZDA $_ _ZDA	Respectively changes and reads receiver date & time	290 290

$PDAS,AGECOR

Function

Edits the maximum age permitted for DGPS corrections and Iono corrections transmitted in RTCM message #15.

Syntax

Set command:

$PDAS,AGECOR,a,b[*hh][CR][LF]

Query command:

$PDAS,AGECOR[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Range	Comments
a	x.x	40	[1.. 100]	Maximum age of DGPS corrections, in seconds
b	x.x	600	[1.. 1500]	Maximum age of iono corrections, in seconds
***hh**			Checksum (optional)	
[CR][LF]			End of command	

Examples

$PDAS,AGECOR	Reading current max. age of DGPS and iono corrections
$PDAS,AGECOR, 40.0,600.0*05	(40 seconds and 600 seconds respectively)
$PDAS,AGECOR,50	Changing max. age of DGPS corrections (50 s)
$PDAS,AGECOR	Checking new max. age of DGPS corrections
$PDAS,AGECOR,50.0,600.0*04	

$PDAS,ALTI

Function

Edits the altitude processing mode and the altitude correction mode.

Syntax

Set command:

$PDAS,ALTI,a,b,c[*hh][CR][LF]

Query command:

$PDAS,ALTI[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Range	Comments
a	x		0 to 3	Altitude processing mode: 0 (MSL84): $H_{user}=H_{WGS84\ ellips} - MSL_{ICD200} - EMSL_{Local}$ – offset 1 (WGS84): $H_{user}=H_{WGS84\ ellips} - EMSL_{Local}$ – offset 2 (DATUM): $H_{user}=H_{Local\ ellips.} - EMSL_{Local}$ – offset 3 (USER): $H_{user}=H_{WGS84\ ellips} - MSL_{User} - EMSL_{Local}$ – offset See detailed information on next page
b	x.x	0.00	-999.999 to +999.999	Antenna height, in meters. This parameter describes the height of the antenna phase center with respect to the reference surface.
c	x		0 to 9	$EMSL_{Local}$ altitude correction mode: 0: no altitude correction ($EMSL_{Local}$ =0.0) 1: Local, linear altimetry is used: $EMSL_{Local} = h0 + a(G - G0) + b(L - L0)$ >1: model Id used for altitude correction (future applications)
***hh**				Checksum (optional)
[CR][LF]				End of command

Examples

$PDAS,ALTI $PDAS,ALTI,0,2.000,0*3A	Reading current correction mode
$PDAS,ALTI,1,1.9,0	Changing correction mode
$PDAS,ALTI $PDAS,ALTI,1,1.900,0*31	Re-reading current correction mode

❑ Altitude Processing Modes

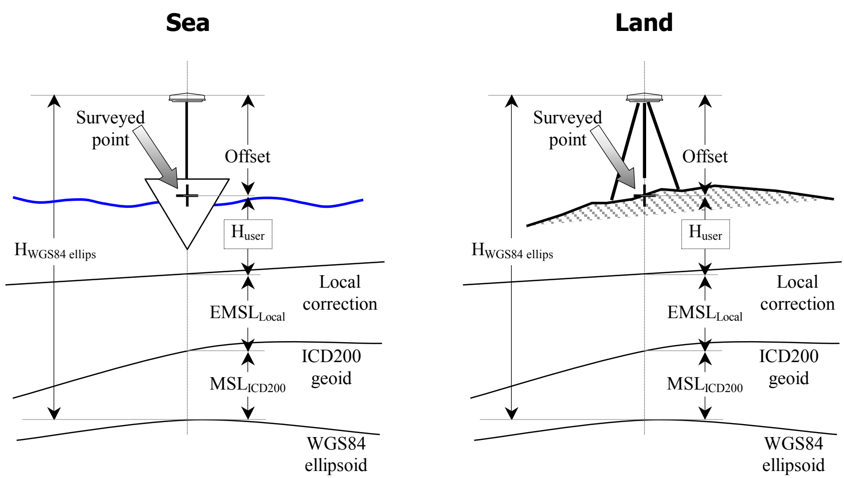
As listed for the “a” argument on the previous page, there are four different altitude processing modes:

a=0 (MSL84): Altitude referenced to WGS84 and ICD200, a geoid model that is valid worldwide (as defined in ICD200 document)

$$H_{user}=H_{WGS84\ ellips} - MSL_{ICD200} - EMSL_{Local} - \text{offset}$$

Where:

H_{user} : Altitude computation result
$H_{WGS84\ ellips}$: Altitude on WGS84
MSL_{ICD200} : Undulation between ICD200 model and WGS84
$EMSL_{Local}$: Local height correction
Offset: Antenna height

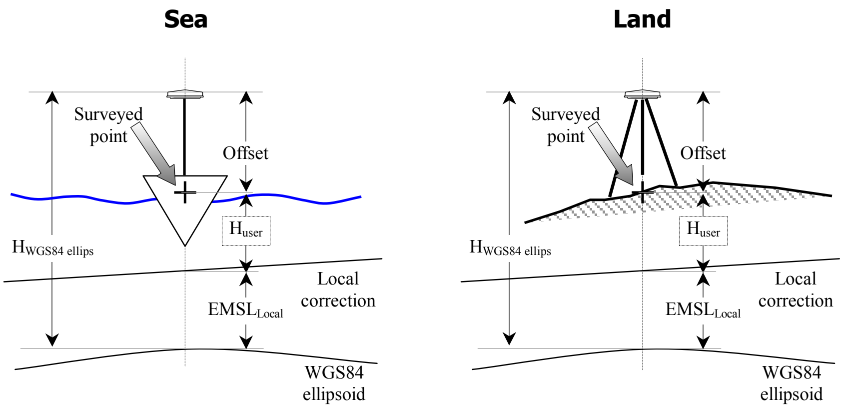


a=1 (WGS84): Altitude referenced to WGS84 only

$H_{user} = H_{WGS84\ ellips} - EMSL_{Local} - offset$

Where:

H_{user}: Altitude computation result
$H_{WGS84\ ellips}$: Altitude on WGS84
$EMSL_{Local}$: Local height correction
Offset: Antenna height

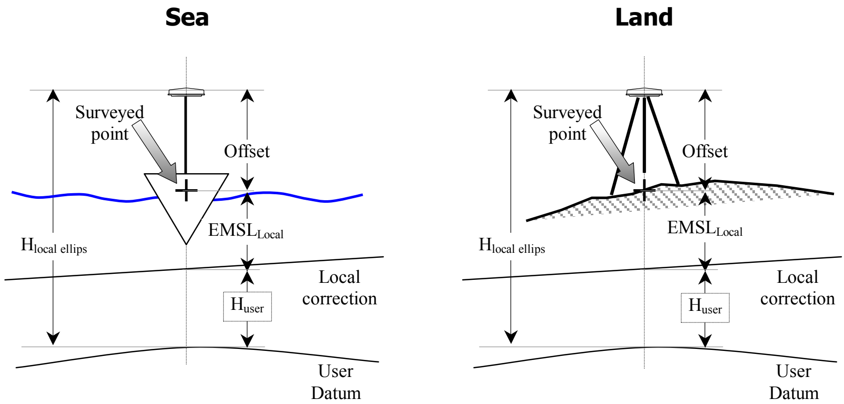


a=2 (DATUM): Altitude referenced to local ellipsoid

$H_{user} = H_{Local\ ellips.} - EMSL_{Local} - offset$

Where:

H_{user} : Altitude computation result
$H_{local\ ellips.}$: Altitude on local ellipsoid
$EMSL_{Local}$: Local height correction
Offset: Antenna height

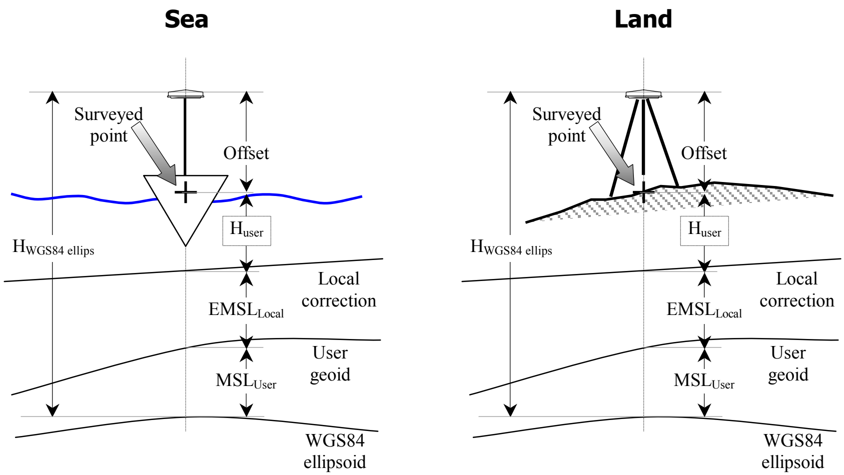


a=3 (USER): Altitude referenced to user geoid

$$H_{user} = H_{WGS84\ ellips} - MSL_{User} - EMSL_{Local} - \text{offset}$$

Where:

H_{user} : Altitude computation result
$H_{WGS84\ ellips}$: Altitude on WGS84
MSL_{User} : Undulation between user geoid and WGS84
$EMSL_{Local}$: Local height correction
Offset: Antenna height



The example below illustrates the different processing modes available.

Altitude on WGS84:	88.408 m
Altitude on ICD200:	48.464 m
Altitude on local ellipsoid:	41.860 m
Altitude on user geoid:	47.196 m
Local height correction:	1.682 m
Antenna height:	0.0 m

$PDAS,ALTI,0,0.000,0→ Altitude: 88.408 - 48.464=39.944
$PDAS,ALTI,0,0.000,1→ Altitude: 88.408 - 48.464 - 1.682= 38.262

$PDAS,ALTI,1,0.000,0→ Altitude: 88.408
$PDAS,ALTI,1,0.000,1→ Altitude: 88.408 - 1.682= 86.726

$PDAS,ALTI,2,0.000,0→ Altitude: 41.860
$PDAS,ALTI,2,0.000,1→ Altitude: 41.860 - 1.682= 40.178

$PDAS,ALTI,3,0.000,0→ Altitude: 88.408 - 47.196= 41.212
$PDAS,ALTI,3,0.000,1→ Altitude: 88.408 - 47.196 - 1.682= 39.530

$PDAS,BITFLW

❑ Function

Allows you to edit the definitions of "bit flow" GPS data outputs generated in SBIN@b or SVAR!B format.

❑ Syntax

Set command:

$PDAS,BITFLW,a,b,c,d[*hh][CR][LF]

Query command returning all existing definitions:

$PDAS,BITFLW[*hh] [CR][LF]

Query command returning a single definition:

$PDAS,BITFLW,a[*hh] [CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
a	x.x	1	Output number (1, 2, etc.)
b	a		Identification of output port (A, B, etc.)
c	x		Format of output data: 0: no data output 1: BIN (binary SBIN@b output data) 3: ASC (ASCII SVAR!B output data)
d	x.x	1	Output rate expressed in units of 0.6 second
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

$PDAS,BITFLW,1	Query about output #1
$PDAS,BITFLW,1,A,1,1*58	Reply: output active, provides SBIN@b data on port A every 0.6 second
$PDAS,BITFLW,1,A,0	Deactivates output #1 (no reply)
$PDAS,BITFLW,1,A,3,2	

If you send the last command above via port A, then data blocks will be sent back to your terminal screen (see example below):

```
!B,1114,489612.0
%C,0
*0,19,60,0D3329E1E529FDC
*1,25,60,0D9C7AD1E529FDC
*2,7,60,0DB4F571E524AD8
*3,1,60,0C7B9595E529F3C
*5,20,60,0C8D33B9E529F50
*6,4,60,0DADC395E5250A0
*7,11,60,0DCE1235E529F3C
*A,13,60,0E1E9745E529F3C

!B,1114,489613.2
%C,1
*0,19,60,8B0168867D86BB4
*1,25,60,8B0168867D86BB4
*2,7,60,8B0168867D86BB4
*3,1,60,8B0168867D86BB4
*5,20,60,8B0168867D86BB4
*6,4,60,8B0168867D86BB4
*7,11,60,8B0168867D86BB4
*A,13,60,8B0168867D86BB4
```

Data described in pages 186 (SVAR!B) and 207 (SBIN@b).

$PDAS,COMMNT

❑ Functions

Reads the "comment" field from the current configuration (one or more lines). This field generally provides a brief description of the configuration.

❑ Syntax

$PDAS,COMMNT[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
(none)			
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,COMMNT
$PDAS,COMMNT,3,1,AQUARIUS*0B
$PDAS,COMMNT,3,2,DEFAULT CONFIGURATION*2A
$PDAS,COMMNT,3,3,V1.0 15/01/2002*6C

$PDAS,CONFIG

❑ Function

Reads the data from the current configuration.

❑ Syntax

$PDAS,CONFIG[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
(none)			
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,CONFIG Reading the data from the current configuration

$PDAS,CONFIG,BEGIN,63*62 (Reply)
$PDAS,COMMNT,3,1,AQUARIUS*0B
$PDAS,COMMNT,3,2,DEFAULT CONFIGURATION*2A
$PDAS,COMMNT,3,3,V1.0 15/01/2002*6C
$PDAS,SELGEO,0*21
$PDAS,ALTI,1,0.000,0*39
$PDAS,SVDSEL,5.0,0*2A
$GPZDA,,,,,+00,00*63
$PDAS,FILTER,20,6,60*34$PDAS,SELGEO,0*21
…
$PDAS,CONFIG,END,0001C985*19

$PDAS,CONFIG,INIT

❑ Function

Performs internal loading of the initial configuration so as to make it the receiver's new current configuration. The "current" configuration is referred to as the active configuration in the receiver. See also page 295.

The receiver is automatically re-initialized after running this command.

❑ Syntax

$PDAS,CONFIG,INIT[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
(none)			
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,COMMNT
$PDAS,COMMNT,3,1,AQUARIUS*0B
$PDAS,COMMNT,3,2,DEFAULT CONFIGURATION*2A
$PDAS,COMMNT,3,3,V1.0 15/01/2002*6C

$PDAS,CONFIG,INIT

$PDAS,COMMNT
$PDAS,COMMNT,1,1,CONFIG PALMTOP*61

$PDAS,CONFIG,READ

❑ Function

Reads the data from the initial configuration.

❑ Syntax

$PDAS,CONFIG,READ[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
(none)			
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,CONFIG,READ
$PDAS,CONFIG,BEGIN,40*63 (Reply)
$PDAS,COMMNT,1,1,CONFIG PALMTOP*61
$PDAS,LANG,EN,f,1,1*43
$PDAS,AGECOR,040.0*31
$PDAS,ALTI,0,2.000,0*3A
$PDAS,FILTER,6.00*1E
$PDAS,DOPMAX,40.0*13
$PDAS,SVDSEL,5.0,0*2A
$PDAS,SELGEO,0*21
...
$PDAS,CONFIG,END,00015678*62

$PDAS,CONFIG,RESET

❑ Function

Performs internal loading of the default configuration so as to make it the receiver's new current configuration. The "current" configuration is referred to as the active configuration in the receiver. See also page 295.

The receiver is automatically re-initialized after running this command.

❑ Syntax

$PDAS,CONFIG,RESET[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
(none)			
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,CONFIG,RESET

$PDAS,COMMNT
$PDAS,COMMNT,1,1,CONFIG PALMTOP*61

$PDAS,CONFIG,RESET

$PDAS,COMMNT
$PDAS,COMMNT,3,1,AQUARIUS*0B
$PDAS,COMMNT,3,2,DEFAULT CONFIGURATION*2A
$PDAS,COMMNT,3,3,V1.0 15/01/2002*6C

$PDAS,DEFLT

Functions

Reports the errors, if any, detected by the receiver. Errors are listed from the latest to the earliest.

Can acknowledge these errors (they are then removed from the list), unless they are still persisting.

The list of possible anomalies or errors is provided on page 313.

Syntax

Set command:

$PDAS,DEFLT,a,b[*hh][CR][LF]

Query command:

$PDAS,DEFLT[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Range	Comments
a	x.x		1 to 104	Error code to be listed If **b** is absent and **a**=0: all errors, except those still persisting, are acknowledged
b	x.x			Error code to be acknowledged
***hh**				Checksum (optional)
[CR][LF]				End of command

❑ Receiver reply to a Query command

$PDAS,DEFLT,A,B,C,D,E,F[*hh][CR][LF]

Parameter	Format	Range	Comments
A	x	0 to 100	Error code
B	x	1 to 256	Error code to be acknowledged
C	a--a		Keyword (TD, SYSTM, CONFG, POSIT, NAVIG, I/O, CM, IHM, DGPS, INTRF, GEODY, NONE)
D	x	1 to 31	Day of first occurrence
E	hhmmss.ss		Time of first occurrence
F	hhmmss.ss		Time of last occurrence
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,DEFLT — Listing all detected errors
$PDAS,DEFLT,23,0,I/O,18,174909,174910*6C
$PDAS,DEFLT,24,0,I/O,18,174835,175045*6D
$PDAS,DEFLT,103,1,I/O,18,174827,174828*59
$PDAS,DEFLT,102,4,I/O,18,174827,174828*5D
$PDAS,DEFLT,8,1003,CM,18,174826,174827*49

$PDAS,DEFLT,103 — Reading error 103
$PDAS,DEFLT,103,1,I/O,18,174827,174828*59

$PDAS,DEFLT,0 — Acknowledging all errors

$PDAS,DEFLT — Re-listing errors (Error 24 persisting)
$PDAS,DEFLT,24,0,I/O,18,174835,175045*6D

$PDAS,DGPS,DELSTA

❑ Function

Deletes a DGPS transmitting station from the receiver.

❑ Syntax

Set command:

$PDAS,DGPS,DELSTA,a,b,... [*hh][CR][LF]

Shortened command (cancels all stations):

$PDAS,DGPS,DELSTA[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x	0 to 1023	Station number
b,...	x		Station number, etc.
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,DGPS,STATION (Listing all known stations)
$PDAS,DGPS,STATION,1,LRK1,4716.28,N,00129.23,W,UHF,
446532000.0,50.00,,,4800.0,GN*4E
$PDAS,DGPS,STATION,2,LRK2,4728.45,N,00148.19,W,UHF,
446532000.0,45.00,,,4800.0,GN*42
$PDAS,DGPS,STATION,12,PENNET,4630.00,N,00100.00,E,UHF,
443550000.0,35.00,,,1200.0,DN*3A

$PDAS,DGPS,DELSTA,2,12 (Deleting stations 2 and 12)

$PDAS,DGPS,STATION (Re-listing all known stations)
$PDAS,DGPS,STATION,1,LRK1,4716.28,N,00129.23,W,UHF,
446532000.0,50.00,,,4800.0,GN*4E

$PDAS,DGPS,MODE (E)

For receivers used as corrections generators and so connected to a transmitter.

Function

Defines the receiver's serial port as a DGPS transmit channel.

Syntax

Set command:

$PDAS,DGPS,MODE,a,b,E,d,e,f[*hh][CR][LF]

Query command:

$PDAS,DGPS,MODE,a[*hh][CR][LF]

Query command (all lines are read):

$PDAS,DGPS,MODE[*hh][CR][LF]

Parameters

Parameter	Format	Range	Comments
a	x	1 to 3	Line number
b	a		Port identification (A, B, etc.)
E	a		"E" for "Transmitter". The other setting (R) for this third parameter is discussed in the next command description
d	x		Transmitter identification number, as referenced in $PDAS,DGPS,STATION If **d** is omitted, corrections are simply made available on the specified port (no transmitter control provided)
e	x.x	0 to 6	Transmission programming (1): 0: free mode 1 to 6: transmission rate in seconds (synchronous mode)
f	x.x	1 to 6	In synchronous mode (**e**=1 to 6), **f** is the transmit slot number (1 to 6)
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

Listing all known stations:

$PDAS,DGPS,STATION
$PDAS,DGPS,STATION,1,LRK1,4716.28,N,00129.23,W,UHF,
446532000.0,50.00,,,4800.0,GN*4E
$PDAS,DGPS,STATION,11,PENNET1,4710.00,N,00030.00,E,UHF,
443550000.0,35.00,,,1200.0,DN*3B

Writing description line #1:

$PDAS,DGPS,MODE,1,D,E,1,3,2

- According to this description line (line 1), the receiver will transmit corrections via transmitter No. 1 in slot 2, at a transmit format of 3 seconds
- (No receiver reply)

Listing all the description lines:

$PDAS,DGPS,MODE
$PDAS,DGPS,MODE,1,D,E,1,3,2*05
$PDAS,DGPS,MODE,2,N*79
$PDAS,DGPS,MODE,3,N*78

Re-programming line #1:

$PDAS,DGPS,MODE,1,D,E,11,0

- According to this line (line 1), the receiver will transmit corrections via transmitting station No. 11 in free-running mode.
- (No receiver reply)

Checking the content of line #1:

$PDAS,DGPS,MODE,1
$PDAS,DGPS,MODE,1,D,E,11,3,2*34

$PDAS,DGPS,MODE (R)

For receivers processing corrections received from a reference station – via a transmitter.

Function

Defines the receiver's serial port as a DGPS receive channel.

Syntax

Set command:

$PDAS,DGPS,MODE,a,b,R,d,e,f,g,h,i,j[*hh][CR][LF]

Query command (only the specified line is read):

$PDAS,DGPS,MODE,a[*hh][CR][LF]

Query command (all lines are read):

$PDAS,DGPS,MODE[*hh][CR][LF]

Parameters

Parameter	For-mat	Range	Comments
a	x	1 to 3	Line number
b	a		Port identification (A, B, etc.)
R	a		"R" for "Receiver". The other setting (E) for this third parameter is discussed in the previous command description
d	x		Transmitter identification number, as referenced in $PDAS,DGPS,STATION If **d** is omitted, corrections are simply allowed to be fed to the specified port (no receiver control provided)
e & f	x.x		Empty fields
g	x.x	0 to 1023	Identification of the reference station from which corrections should be processed in priority. If **g** is omitted, received corrections are processed without checking the reference station number
h	x.x	0 to 1023	Identification of the reference station from which corrections should be processed in second priority, optional
i	x.x	0 to 1023	Identification of the reference station from which corrections should be processed in third priority, optional
j	x.x	0 to 1023	Identification of the reference station from which corrections should be processed in fourth priority, optional
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

Listing all known stations:

$PDAS,DGPS,STATION
$PDAS,DGPS,STATION,11,PENNET1,4710.00,N,00030.00,E,UHF,
443550000.0,35.00,,,1200.0,DN*3B
$PDAS,DGPS,STATION,12,PENNET2,4630.00,N,00100.00,E,UHF,
443550000.0,35.00,,,1200.0,DN*3A

Writing description line #1:

$PDAS,DGPS,MODE,1,D,R,11,,,11,12

- According to this line (line 1), the receiver will receive (R) corrections via its port D from transmitter No. 11. These corrections will be generated by reference stations Nos. 11 and 12.

Checking the content of description line #1:

$PDAS,DGPS,MODE,1
$PDAS,DGPS,MODE,1,D,R,11,,,11,12*21

Writing line #2:

$PDAS,DGPS,MODE,2,B,R,,,,712,713

- According to this line (line 2), the receiver will receive (R) corrections from an external receiver (4th field blank) via its port B. These corrections will be generated by stations Nos. 712 and 713.

Listing all description lines:

$PDAS,DGPS,MODE
$PDAS,DGPS,MODE,1,D,R,11,,,11,12*21
$PDAS,DGPS,MODE,2,B,R,,,,712,713*26
$PDAS,DGPS,MODE,3,N*78

$PDAS,DGPS,STATION

❑ Functions

Allows you to enter the complete description (including decryption code C3) of each of the usable transmitting stations.

Allows you to list the description of each of them (or all of them).

❑ Syntax

Set command:

$PDAS,DGPS,STATION,a,b,c,d,e,... n[*hh][CR][LF]

Query command (only the specified station is reported):

$PDAS,DGPS,STATION,a[*hh][CR][LF]

Query command (all stations are listed):

$PDAS,DGPS,STATION[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x	1 to 1023	Transmitter identification number
b	c- -c		Transmitter name (12 characters max.)
c	llll.ll		Transmitter latitude
d	a	N or S	North or South latitude
e	yyyyy.yy		Transmitter longitude
f	a	E or W	East or West longitude
g	c- -c		Band of first transmission frequency (UHF)
h	x.x		First transmission frequency, in Hz
i	x.x		Range in km
j	c- -c		Band of second transmission frequency (for future design)
k	x.x		Second transmission frequency, in Hz (for future design)
l	x.x	1200 or 4800	Baud rate
m	cc		Character string containing the following information: - Modulation type: D for DQPSK, G for GMSK - Encrypted/non-encrypted corrections: C for encrypted, N for non-encrypted
n	c- -c		If encrypted corrections, decryption code C3 (for future design)
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

Listing all known stations:

$PDAS,DGPS,STATION
$PDAS,DGPS,STATION,,NONE*56 (Reply: none)

Defining new stations:

$PDAS,DGPS,STATION,1,LRK1,4716.28,N,00129.23,W,UHF,
446532000,50,,,4800,GN
$PDAS,DGPS,STATION,11,PENNET,4710,N,00030,E,UHF,
443550000,35,,,1200,DN

Re-listing all known stations:

$PDAS,DGPS,STATION
$PDAS,DGPS,STATION,1,LRK1,4716.28,N,00129.23,W,UHF,
446532000.0,50.00,,,4800.0,GN*4E
$PDAS,DGPS,STATION,11,PENNET,4710.00,N,00030.00,E,
UHF,443550000.0,35.00,,,1200.0,DN*3B

$PDAS,DGPDAT

❑ Function

Edits the definitions of the DGPS raw data outputs.

❑ Syntax

Set command:

$PDAS,DGPDAT,a,b,c,d,e,f,... [*hh][CR][LF]

Query command:

$PDAS,DGPDAT,a[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x	1 or 2	Output number. If **a**=0, all description lines are cleared
b	a		Output port identification (A, B, etc.)
c	x	0 to 3	Output mode: 0: Deactivated 1: Period (time) 2: Trigger 3: Immediate
d	x.x		Output rate: If **c**=1 (period), d is the data output rate expressed in units of 0.1 seconds If **c**=2 (trigger), then: **d**=1: next data block following EVENT is output **d**=3: next data block following 1PPS is output
e	x	1 to 5	Data type: 1: RTCM 2: LRK 3: Code (proprietary UHF) 4: ASC (ASCII SVAR) 5: Relayed User Data
f, g, ...	x	1 to 19	If **e**=1, RTCM messages of the type **f, g,...** are generated (see next page) If **e**=3, Proprietary UHF messages of the type **f, g,...** are generated (see next page)
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ RTCM correction types

Type		Data
1 and 9	:	PRC's corrections
2	:	Delta PRC's corrections
3	:	Parameters of reference station
5	:	Constellation Health
16	:	User Message
18	:	Carrier phase measurement
19	:	Code measurement

❑ Proprietary UHF correction types

Type		Corrections
1	:	Code corrections (type C)
2	:	Phase corrections (type P)

❑ Examples

Listing DGPS raw data outputs:

$PDAS,DGPDAT
$PDAS,DGPDAT,1,N*57 (Reply: none)
$PDAS,DGPDAT,2,N*54

Defining DGPS raw data output #1:

$PDAS,DGPDAT,1,D,1,10,3,1,2

- To port D (to UHF transmitter), "Time" output mode, 1-sec. output rate, Proprietary UHF data, type C and P

Checking definition of output #1:

$PDAS,DGPDAT,1
$PDAS,DGPDAT,1,D,1,10,3,1,2*71

Defining DGPS raw data output #2:

$PDAS,DGPDAT,2,A,1,100,4

- To port A, "Time" output mode, 10-sec. output rate, SVAR data

Listing definitions of outputs #1 & #2:

```
$PDAS,DGPDAT
$PDAS,DGPDAT,1,D,1,10,3,1,2*71
$PDAS,DGPDAT,2,A,1,100,4*43
```

If a display terminal is connected to port A (this may be the terminal from which you sent the preceding commands), then data blocks of the following type are now received:

```
!D,945,329190.1
%R,14,,0
*3,5.9,0.33,0.0,201
*17,8.0,-0.19,0.0,183
*19,32.2,-0.28,0.0,224
*21,-40.5,0.14,0.0,204
*22,-2.6,-0.39,0.0,51
*23,-17.9,0.51,0.0,75
*27,-23.3,-0.22,0.0,228
*31,29.8,0.12,0.0,153
*15,12.5,0.13,0.0,50
```

Re-defining output #2:

```
$PDAS,DGPDAT,2,A,1,50,1,2,3,5,9,16
```

- To port A, "Time" output mode, 5-sec. output rate, RTCM-SC104 data, messages Nos 2, 3, 5, 9, 16

Re-listing definitions of outputs #1 & #2:

```
$PDAS,DGPDAT
$PDAS,DGPDAT,1,D,1,10,3,1,2*71
$PDAS,DGPDAT,2,A,1,50,1,2,3,5,9,16*54
```

Again, if a display terminal is connected to port A, then data blocks of the following type are now received:

```
fAC\fEr~fRXnzdUO|orxDs~lCSnYOnY^}cTzCiXaOOu{MouRjpL@]Z
PN@CzPM@ml_puAOulCosdYn}cp
ET{bo{|}Ym[qfLi@Dp{\GpzWyC@KsMfQB\jEXsb_DCBey[pfLZGDD
bxOEhFL_L_fQB\OzoB]lDCbpZLL
YsOGNDDGpzW\t^LdYn}cpy_tblDCbVcpfLRGMDQGpzWy[AlswYn
}cUFhG]@DCbcXTMlss`cWJgxOEhFX
]vLJfQB\jy[pbj{|m_cgpvLY_bdFnxOEhF`lpLQfQB\OF\@]w{|m}y[svLy
`MXe`xOEX]WNwL~
```

(Data described from pages 162 to 170).

$PDAS,EVENT

Function

Edits the definitions of accurate time data outputs (in SBIN@M or SVAR!M format) triggered on occurrence of chosen events.

Syntax

Set command:

$PDAS,EVENT,a,b,c,d,e[*hh][CR][LF]

Query command (all output definitions returned):

$PDAS,EVENT[*hh][CR][LF]

Query command (only specified output definition returned):

$PDAS,EVENT,a[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Comments
a	x.x	1	Output number (1, 2, etc.)
b	a		Output port identification (A, B, etc.)
c	x		Triggering event: -3: 1PPS, deactivated output -1: External event, deactivated output 0: No output (deactivated) 3: 1PPS, activated output 1: External event, activated output
d	x.x		Triggering event division ratio (?????)
e	x.x		Data type: 2: SBIN@M data output 4: SVAR!M data output
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,EVENT,1	Query about output #1 definition
$PDAS,EVENT,1,A,1,1,2*08	Reply: output # 1 activated, provides SBIN@M data on port A on every occurrence of the external event
$PDAS,EVENT,1,A,3,2,4	Redefining output #1 so that it delivers SVAR!M data on port A on every other occurrence of the 1PPS

If the last command -above- was sent via port A, then data blocks will appear on the terminal screen (see example below):

```
□□
!M,1114,495792.9
*1,0,2.9999999831
*2,0,174259.999
*3,4,44
□□
!M,1114,495794.9
*1,0,4.9999999892
*2,0,174301.999
*3,4,46
□□
```

Page 180 (or 203 for binary format) details the format of the data displayed on the screen.

$PDAS,FILTER

❑ Function

Edits the time constant of the filtering applied to the speed over ground.

❑ Syntax

Set command:

$PDAS,FILTER,a,b,c[*hh][CR][LF]

Query command:

$PDAS,FILTER[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Range	Comments
a	x.x	20	[0.. 999]	Preset medium time constant
b	x.x	6	[0.. 999]	Preset low time constant
c	x.x	60	[0.. 999]	Preset high time constant
***hh**		Checksum (optional)		
[CR][LF]		End of command		

❑ Examples

$PDAS,FILTER Query
$PDAS,FILTER,20,6,60*34 (Reply)

$PDAS,FILTYP

❑ Function

Enables one of the available three preset time constants for the filtering of the speed over ground.

❑ Syntax

Set command:

$PDAS,FILTYP,a [*hh][CR][LF]

Query command:

$PDAS,FILTYP[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Range	Comments
a	x.x	1	[1.. 3]	Selected time constant: 1: medium 2: low 3: high
***hh**		Checksum (optional)		
[CR][LF]		End of command		

❑ Examples

$PDAS,FILTYP Query
$PDAS,FILTTYP,1*29 (Reply)

$PDAS,FIXMOD

❑ Function

Edits the fix mode and the associated DGPS reference station or WAAS/ EGNOS GEO.

About the selection of the associated reference station, this command will require prior execution of $PDAS,DGPS,MODE.

To decide on whether pseudoranges from GEO SVs should be used in the position processing or not, use the $PDAS,SVDSEL command.

Wherever a reference position is required (for example at a reference station or for KART or LRK initialization), use $PDAS,PREFLL or $PDAS, PREFNE to enter that position.

❑ Syntax

Set command:

$PDAS,FIXMOD,a,b,c,... [*hh][CR][LF]

Query command:

$PDAS,FIXMOD[*hh][CR][LF]

❑ Parameters

<table>
<tr><th>Parameter</th><th>Format</th><th>Range</th><th>Comments</th></tr>
<tr><td>a</td><td>x.x</td><td>[1.. 110]</td><td>Selects GPS fix mode:
0: no fix computation
1: Residuals computation in transmitting reference station mode
3: "Straight" GPS fix mode
4: DGPS fix mode using WAAS/EGNOS data or data from a reference station
5: Multi-mode position processing
6 to 30: Kinematic processing; see table below:
<table>
<tr><th>Initialization</th><th>KART/LRK</th><th>Wide Lane LRK</th><th>KART</th></tr>
<tr><td>EDGPS</td><td>6</td><td>16</td><td>26</td></tr>
<tr><td>OTF</td><td>7</td><td>17</td><td>27</td></tr>
<tr><td>STATIC</td><td>8</td><td>18</td><td>28</td></tr>
<tr><td>Z-FIXED</td><td>9</td><td>19</td><td>29</td></tr>
<tr><td>KNOWN POINT</td><td>10</td><td>20</td><td>30</td></tr>
</table>
40 to 70 :Position processing above + HEADING processing
80 to 110: Position processing above + RELATIVE processing</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Format</th><th>Range</th><th>Comments</th></tr>
<tr><td>b</td><td>x</td><td>[0..2]</td><td>Selects the source of differential data:
0: None
1: Differential data source other than WAAS/EGNOS
2: WAAS/EGNOS differential data</td></tr>
<tr><td>c,...</td><td>x.x</td><td></td><td>Identification of differential data source:
If b=1, c,...: Identification(s) of DGPS reference station(s)
If b=2, c,...: PRN Nos. of WAAS/EGNOS GEOs
Or identification of FIXTYP command line if a=5 (multi-mode position processing)
The table below summarizes the possible meanings of arguments c, d, etc. as a function of arguments a and b.
<table>
<tr><td></td><td colspan="6">a=</td></tr>
<tr><td></td><td>0
40
80</td><td>1</td><td>3
43
83</td><td>4
44
84</td><td>5</td><td>6-30
46-70
86-110</td></tr>
<tr><td>b=0</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>b=1</td><td></td><td></td><td></td><td>Reference station No.</td><td></td><td>Reference station No.</td></tr>
<tr><td>b=2</td><td></td><td></td><td></td><td>WAAS/EGNOS PRN</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>FIXTYP command line No.</td><td></td></tr>
</table></td></tr>
<tr><td colspan="3">*hh</td><td>Checksum (optional)</td></tr>
<tr><td colspan="3">[CR][LF]</td><td>End of command</td></tr>
</table>

❑ Examples

$PDAS,FIXMOD	Query
$PDAS,FIXMOD,3,1*39	(Reply: "Straight" GPS fix mode, DGPS station)
$PDAS,FIXMOD,1,1	Changing fix mode
$PDAS,FIXMOD	Query
$PDAS,FIXMOD,1,1*3B	(Reply: transmitting reference station)
$PDAS,FIXMOD,4,1,12	Changing fix mode
$PDAS,FIXMOD	Query
$PDAS,FIXMOD,4,1,12*11	(Reply:Single-station DGPS mode, DGPS station No. 12)
$PDAS,FIXMOD,4,2,128	Changing fix mode. WADGPS selected using GEO PRN No. 128, WAAS/EGNOS pseudoranges involved in position processing unless rejected via command $PDAS,SVDSEL

$PDAS,FIXTYP

Function

Deals with multi-mode position processing.

Syntax

Set command:

$PDAS,FIXTYP,a,b,c,d,e,f,g,h... [*hh][CR][LF]

Query command:

$PDAS,FILTYP[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Range	Comments
a	x		[1.. x]	Command line number
b	a			P: Primary mode S: Secondary mode B: Backup mode for primary mode
c	x	-2	[-2.. N]	Entry mode used for station position: -2: As transmitted via radio link (default choice if blank field) -1: Through command $PDAS,PREFLL or $PDAS,PREFNE 0.. N: Number of command line containing the station position entered through command $PDAS,REFSTA,N or $PDAS,PREFLL or $PDAS,PREFNE
d	a		[N/R]	N: Normal mode (default choice if blank field) R: Reverse mode
e	x.x	0	[1.. 86 400]	Time during which computed data is averaged (in seconds). No averaging if blank field

<table>
<tr><th>Parameter</th><th>Format</th><th>Default value</th><th>Range</th><th>Comments</th></tr>
<tr><td>f</td><td>x.x</td><td></td><td>[1.. 110]</td><td>Selects GPS fix mode (same as a in FIXMOD):
0: no fix computation
1: Residuals computation in transmitting reference station mode
3: "Straight" GPS fix mode
4: DGPS fix mode using WAAS/EGNOS data or data from a reference station
5: Multi-mode position processing
6 to 30: Kinematic processing; see table below:
<table>
<tr><th>Initialization</th><th>KART/LRK</th><th>Wide Lane LRK</th><th>KART</th></tr>
<tr><td>EDGPS</td><td>6</td><td>16</td><td>26</td></tr>
<tr><td>OTF</td><td>7</td><td>17</td><td>27</td></tr>
<tr><td>STATIC</td><td>8</td><td>18</td><td>28</td></tr>
<tr><td>Z-FIXED</td><td>9</td><td>19</td><td>29</td></tr>
<tr><td>KNOWN POINT</td><td>10</td><td>20</td><td>30</td></tr>
</table>
80 to 110: Same Position processing as above + RELATIVE processing</td></tr>
<tr><td>g</td><td>x</td><td></td><td>[0.. 2]</td><td>Selects the source of differential data (same as b in FIXMOD):
0: None
1: Differential data source other than WAAS/EGNOS
2: WAAS/EGNOS differential data</td></tr>
<tr><td>h</td><td>x.x</td><td></td><td>[0.. 1023]
[120.. 138]</td><td>Identification of data source, depending on arguments f and g as explained in the table below:
<table>
<tr><th></th><th colspan="7">f=</th></tr>
<tr><th></th><th>0</th><th>1</th><th>3</th><th>4</th><th>5</th><th>6-30</th><th>80</th></tr>
<tr><td>g=0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>g=1</td><td></td><td></td><td></td><td>Reference station No.</td><td></td><td>Reference station No.</td><td></td></tr>
<tr><td>g=2</td><td></td><td></td><td></td><td>WAAS/EGNOS PRN</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>FIXTYP command line No.</td><td></td><td>Id. of data to be processed</td></tr>
</table></td></tr>
<tr><td colspan="4">*hh</td><td>Checksum (optional)</td></tr>
<tr><td colspan="4">[CR][LF]</td><td>End of command</td></tr>
</table>

Comments

This command can only be used in conjunction with $PDAS,FIXMOD, a command that refers to the data lines defined with $PDAS,FIXTYP when its **a** argument is set to **5** (see page 244).

The Primary mode (**b**=P) refers to the nominal processing mode used. The definition of the Primary mode includes the associated degraded modes, which can be used if necessary, and the possible automatic change of DGNSS stations while using this mode. In theory, there cannot only be a single primary mode.

The Backup mode (**b**=B) replaces the Primary mode when the operating conditions do not allow the primary mode to be used.

The Secondary mode (**b**=S) is another processing mode. This mode and the Primary, or Backup, mode are run concurrently.

The Reverse mode (**b**=R) is used in DGNSS processing to allow users to determine the location of a receiver from which they receive data (via a radio link or any other means).

Unlike all the processing modes linked to $PDAS,FIXMOD - which process data produced in the receiver itself - the RELATIVE mode (**f**=80) processes data received via a radio link from an external receiver whose identification is provided in field **h**. For this reason the RELATIVE mode cannot be combined with any other mode using the data link.

$PDAS,FMT

❑ Function

Lists the names of the available macros, such as NMEA 0183 sentences GGA, GLL, etc, used to generate data outputs (see also $PDAS,OUTMES). Macros can be defined using ConfigPack software.

❑ Syntax

Query command:

$PDAS,FMT[*hh][CR][LF]

❑ Examples

$PDAS,FMT	Query
$PDAS,FMT,1,GGA:6:1*02	(Reply)
$PDAS,FMT,2,GLL:5:1*04	
$PDAS,FMT,3,VTG:2:1*00	
$PDAS,FMT,4,GSA:1:1*14	
$PDAS,FMT,5,ZDA:2:1*1C	
$PDAS,FMT,6,RMC:5:1*1B	
$PDAS,FMT,7,GRS:2:1*07	
$PDAS,FMT,8,GST:2:1*0E	
$PDAS,FMT,9,GSV:1:1*0E	
$PDAS,FMT,10,GMP:2:1*2D	
$PDAS,FMT,11,HDT:1:1*2D	
$PDAS,FMT,12,HDG:1:1*3D	
$PDAS,FMT,13,ROT:1:1*3E	
$PDAS,FMT,14,VBW:1:1*33	
$PDAS,FMT,15,VHW:1:1*38	
$PDAS,FMT,16,OSD:1:1*2A	
$PDAS,FMT,17,HRP:1:1*39	

Formatting instructions (:n:n) for data produced by the macro :
1st figure: = number of decimal places used in angles, distances and speeds
2nd figure: output data ends with (1) or without (0 or omitted) checksum

Macro name

Macro number

$PDAS,GEO

❑ Function

Edits the characteristics of the specified coordinate system (datum & projection).

Lists the characteristics of all or specified coordinate systems.

❑ Syntax

Set commands:

$PDAS,GEO,a,b,c,d [*hh][CR][LF]
$PDAS,GEO,a,b,e,f [*hh][CR][LF]
$PDAS,GEO,a,b,A,1/F,S,j [*hh][CR][LF]
$PDAS,GEO,a,b,Dx,Dy,Dz,n [*hh][CR][LF]
$PDAS,GEO,a,b,Ax,Ay,Az,r [*hh][CR][LF]
$PDAS,GEO,a,b,s,t [*hh][CR][LF]
$PDAS,GEO,a,b,u,v,w,... [*hh][CR][LF]

Query command:

$PDAS,GEO,e[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Range	Comments
a	x.x			Number of lines required to describe the specified coordinate system
b	x.x			Number of the present line
c	x.x			GPS week number (optional)
d	x.x			GPS time within week, in seconds (optional)
e	x.x	0	0 to 9	Coordinate system number
f	c- - c			Coordinate system name (10 characters max.)
A	x.x			Semi-major axis ("A," placed before)
1/F	x.x			Inverse flattening ("1/F," placed before)
S	x.x			Scale factor ("S," placed before)
j	x			Unit code (1= meter)
Dx	x.x			X deviation ("Dx," placed before)
Dy	x.x			Y deviation ("Dy," placed before)
Dz	x.x			Z deviation ("Dz," placed before)
n	x			Unit code (1= meter)
Ax	x.x			X angular deviation ("Ax," placed before)

Parameter	Format	Default value	Range	Comments
Ay	x.x			Y angular deviation ("Ay," placed before)
Az	x.x			Z angular deviation ("Az," placed before)
r	a			Unit code (e= second)
s	x.x		1 to 99	Projection number
t	c- -c			Projection name (12 characters max.)
u,...				Projection parameters
***hh**				Checksum (optional)
[CR][LF]				End of command

❑ Examples

$PDAS,GEO,2
$PDAS,GEO,8,1,0,0*6E
$PDAS,GEO,8,2,2,NTF*03
$PDAS,GEO,8,3,A,6378249.200,1/F,293.466021294,S,1.000000000000,1*23
$PDAS,GEO,8,4,Dx,-168.000,Dy,-60.000,Dz,320.000,1*5F
$PDAS,GEO,8,5,Ax,0.000000,Ay,0.000000,Az,0.000000,e*07
$PDAS,GEO,8,6,02,Lambert 2*38
$PDAS,GEO,8,7,Lori,0.81681408993,Gori,0.04079234433,Eori,600000.000,Nori,200000.000,d1*17
$PDAS,GEO,8,8,Ko,0.999877420000*5A

$PDAS,GEODAT

❑ Function

Edits the definitions of the SBIN@W or SVAR!W data outputs. This type of data is received from WAAS/EGNOS GEOs.

Adds new definitions of SBIN@W or SVAR!W data outputs.

❑ Syntax

Set command:

$PDAS,GEODAT,a,b,c[*hh][CR][LF]

Query command (all output definitions are returned):

$PDAS,GEODAT[*hh][CR][LF]

Query command (only the specified output is returned):

$PDAS,GEODAT,a[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
a	x.x	1	Output number (1, 2, etc.)
b	a		Output port identification (A, B, etc.)
c	x		Data output control: 0: No output (deactivated) 1: Output of SBIN@W data, at regular intervals of time 3: Output of SVAR!W data, at regular intervals of time
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,GEODAT,1	Query (about output #1 definition)
$PDAS,GEODAT,1,A,1	Reply: output #1 activated, delivers SBIN@W data on port A
$PDAS,GEODAT,1,A,0	Invalidates output #1 (no reply)

Data described on pages 208 (SBIN@W) and 188 (SVAR!W).

$PDAS,GEOID,HEIGHT

❑ Function

Computes the height of the geoid above the WGS84 ellipsoid for a given point location.

The geoid file is generated and downloaded to the receiver using the GEOIDS utility from the *ConfigPack* software.

Using the geoid in the receiver is controlled by the $PDAS,ALTI,3 command and in addition requires that the USERGEOID firmware option be validated in the receiver.

❑ Syntax

Set command (entering geoid height for a given point):

$PDAS,GEOID,HEIGHT,a,b,c,d,e[*hh][CR][LF]

Query command (computing geoid height for a given point):

$PDAS,GEOID,HEIGHT,a,b,c,d [*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
a	llll.llllll		WGS84 latitude for the considered point
b	a		Sign of latitude, North or South (N or S)
c	yyyyy.yyyyyy		WGS84 longitude for the considered point
d	a		Sign of longitude, East or West (E or W)
e	x.x		Height of geoid above WGS84 ellipsoid, in meters **e**= 9999 if the point location is outside of the geoid's validity area, or if there is no geoid present in the receiver
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

$PDAS,GEOID,HEIGHT,4716.0,N,00129.0,W	Asking for geoid height for point 47°16'N & 1°29'W
$PDAS,GEOID,HEIGHT,4716.000000,N, 00129.000000,W,9999.000*4C	Reply: "9999": no geoid available in the receiver

After downloading a user geoid to the receiver using the GEOIDS utility from *ConfigPack*, and after enabling the USER-GEOID firmware option in the receiver, the reply will be different as shown below:

$PDAS,GEOID,HEIGHT,4716.0,N,00129.0,W	Asking for geoid height for point 47°16'N & 1°29'W
$PDAS,GEOID,HEIGHT,4716.000000,N, 00129.000000,W,047.189*7F	Reply: geoid height is 47.189 m at the specified point

$PDAS,GEOID,READ

❑ Function

Reads the header from a geoid file previously downloaded to the receiver.

❑ Syntax

Set commands:

$PDAS,GEOID,READ,a,b,c,d,e,f,g,h,i,j[*hh][CR][LF]

$PDAS,GEOID,READ,a,b,c,d,k,l,m,n,o,j[*hh][CR][LF]

$PDAS,GEOID,READ,a,b,p[*hh][CR][LF]

Query command:

$PDAS,GEOID,READ[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
a	x		Number of lines in the reply to the command
b	x		Number of the present line
c	c- -c		Geoid name (“None” if no geoid in the receiver)
d	c- -c		Date & time of creation for the geoid file
e	llll.llllll		Lower latitude of grid
f	a		Sign of lower latitude, N (North) or S (South)
g	llll.llllll		Upper latitude of grid
h	a		Sign of upper latitude, N (North) or S (South)
i	x		Number of latitude points
j	x		Geoid version number
k	yyyyy.yyyyyy		Lower longitude of grid
l	a		Sign of lower longitude, E (East) or W (West)
m	yyyyy.yyyyyy		Upper longitude of grid
n	a		Sign of upper longitude, E (East) or W (West)
o	x		Number of longitude points
j	x		Geoid version number
p	c- -c		Comment
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,GEOID,READ	Query
$PDAS,GEOID,READ,1,1,NONE*72	Reply: No geoid in the receiver

After downloading a user geoid to the receiver using the GEOIDS utility from *ConfigPack*, and after enabling the USER-GEOID firmware option in the receiver, the reply will be different as shown below:

$PDAS,GEOID,READ	Query

$PDAS,GEOID,READ,3,1,RAF98,01/12/01
18:02:55,4200.000000,N,5130.000000,N,381,0*21
$PDAS,GEOID,READ,3,2,RAF98,01/12/01
18:02:55,00530.000000,W,00830.000000,E,421,0*31
$PDAS,GEOID,READ,3,3,France*45

$_GLL and $_GPQ,GLL

Function

Edits the estimated position used in the initial position-speed-time processing or displays the latest position solution.

Syntax

Set command:

$--GLL,a,b,c,d,e,f,g[*hh][CR][LF]

Query command:

$--GPQ,GLL[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Comments
a	llll.lll		Latitude of estimated position
b	a		Sign of Latitude (N or S)
c	yyyyy.yyy		Longitude of estimated position
d	a		Sign of Longitude (E or W)
e	hhmmss.ss		UTC time
f	a		Data status: A: data valid V: data invalid
g	a		Mode indicator (NMEA-0183 V3.0): A: Autonomous D: Differential E: Estimated (dead-reckoning) mode M: Manual input mode S: Simulator mode N: No fix
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

$ECGPQ,GLL	Query
$GPGLL,4717.937672,N,00130.543197,W,133643.16,A,A*58	(Reply)
$ECGLL,3940,N,00415,E	Initializing position
$ECGPQ,GLL	Query
$GPGLL,3940.000000,N,00415.000000,E,180731.00,A,A*06	(Reply)

$PDAS,GNOS

Functions

Enables/disables the tracking of the WAAS or EGNOS satellite.

Specifies the way WAAS/EGNOS GEOs should be selected by the receiver (Auto/Manual).

Provides the receiver with the PRNs of the GEOs to be used in case of Manual selection.

Syntax

Set command:

$PDAS,GNOS,a,b,c[*hh][CR][LF]

Query command:

$PDAS,GNOS[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Comments
a	x	1	Controls the tracking of the WAAS/EGNOS system in the receiver and the way the receiver selects GEOs: 0: Use of WAAS/EGNOS disabled 1: Automatic selection of the WAAS/EGNOS GEO: the receiver will be allowed to choose the GEOs to work with (nothing then needs to be specified in fields **b** and **c**) 2: Manual selection of the WAAS/EGNOS GEOs: the receiver will work with the GEOs whose PRNs are specified in fields **b** and **c** below
b	a		If **a**=2, **c** is the PRN of the 2nd WAAS/EGNOS GEO to be tracked ($120 \leq b \leq 138$) (irrelevant for the other values of **a**). See also comments below
c,...	a		If **b**=1, **c,...**: Identification(s) of DGPS reference station(s) If **b**=2, **c**: PRN No. of WAAS/EGNOS GEO If **c** is omitted, then the corrections data from the closest WAAS/EGNOS GEO is used (future development)
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,GNOS	Query
$PDAS,GNOS,0	Reply: Use of WAAS/EGNOS currently disabled
$PDAS,GNOS,1	Command allowing the use of the WAAS or EGNOS system; GEOs are selected automatically by the receiver
$PDAS,GNOS,2,122	Command allowing the use of the WAAS or EGNOS system; The selected GEO is PRN 122 (Manual selection mode).

$--GPQ,---

❑ Function

Returns the current values of the parameters whose generic code is part of the command. All replies are compliant with the approved sentences of the NMEA 0183 standard (version 2.30, March 1, 1998 and later).

❑ Syntax

$--GPQ,a[*hh][CR][LF]

❑ Parameters

Parameter	Format	Default value	Comments
a	c- -c		NMEA code corresponding to the parameters for which you want the receiver to return their current values. The codes list is given below (entry is also possible, in the NMEA standard, for underlined data): ALM: GPS Almanac data DTM: Datum Reference GGA: Global Positioning System Fix Data GLL: Geographic Position - Latitude/Longitude GMP: GNSS Map Projection Fix Data GRS: GNSS Range Residuals GSA: GNSS DOP and Active Satellites GST: GNSS Pseudorange Error Statistics GSV: GNSS Satellites in view RMC: Recommended Minimum Specific GNSS Data ZDA: Time & Date VTG: Course Over Ground and Ground Speed With Aquarius² only: HDT: Heading HDG: Heading and associated data ROT: Rate of Turn VBW: Ground Speed Data VHW: Heading and speed OSD: Heading, course and speed
*hh			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$ECGPQ,ALM
$GPALM,29,1,01,1115,00,2A13,4E,0E57,FD61,A10C19,BAF3D1,9C4A73,79B474,011,170*48
$GPALM,29,2,02,1115,00,AD06,4E,F9F5,FD49,A10CF6,ACBD04,EDAB30,FF47B8,FD5,FDF*4D
: : :
: : :
$GPALM,29,28,30,1115,00,2E87,4E,00A4,FD4F,A10D4D,387176,EFE06F,1565C8,008,FD0*79
$GPALM,29,29,31,1115,00,537D,4E,0251,FD49,A10CBB,236CD4,1A3CA8,A3E9C7,000,060*72

$ECGPQ,DTM
$GPDTM,W84,,0.000000,N,0.000000,E,0.000,W84*6F

$ECGPQ,GGA
$GPGGA,142938.24,4717.937677,N,00130.543208,W,2,08,1.0,88.312,M,0.000,M,2.4,0120*58

$ECGPQ,GLL
$GPGLL,4717.937689,N,00130.543202,W,142946.22,A,D*5D

$ECGPQ,GRS
$GPGRS,142951.49,1,-0.00,-0.00,0.00,-0.00,0.02,0.00,0.01,-0.01,,,,*67

$PDAS,GPSDAT

Functions

Edits the definitions of the GPS raw data outputs.

Adds new definitions of GPS raw data outputs.

Syntax

Set command:

$PDAS,GPSDAT,a,b,c,d,e,f[*hh][CR][LF]

Query command (all output definitions are returned):

$PDAS,GPSDAT[*hh][CR][LF]

Query command (only the specified output is returned):

$PDAS,GPSDAT,a[*hh][CR][LF]

Parameters

Parameter	Format	Range	Comments
a	x	1 to 2	Output number
b	a		Output port identification (A, B, etc.)
c	x	0 to 4	Ephemeris data output: 0: none 1: BINE (at regular intervals, in SBIN@E binary format) 2: BIN?E (on request, in SBIN@E binary format) 3: ASCE (at regular intervals, in SVAR!E format) 4: ASC?E (on request, in SVAR!E format)
d	x	0 to 4	Almanac data output: 0: none 1: BINA (at regular intervals, in SBIN@A binary format) 2: BIN?A (on request, in SBIN@A binary format) 3: ASCA (at regular intervals, in SVAR!A format) 4: ASC?A (on request, in SVAR!A format)
e	x	0 to 4	Iono-UTC data output: 0: none 1: BINU (at regular intervals, in SBIN@U binary format) 2: BIN?U (on request, in SBIN@U binary format) 3: ASCU (at regular intervals, in SVAR!U format) 4: ASC?U (on request, in SVAR!U format)

Parameter	Format	Range	Comments
f	x	0 to 4	Health & A/S data output: 0: none 1: BINS (at regular intervals, in SBIN@S binary format) 2: BIN?S (on request, in SBIN@S binary format) 3: ASCS (at regular intervals, in SVAR!S format) 4: ASC?S (on request, in SVAR!S format)
*hh			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,GPSDAT	Query
$PDAS,GPSDAT,1,B,-3,-3,-3,-3*4C $PDAS,GPSDAT,2,N,0,0,0,0*43	(Reply: a single output defined, output 1, on port B, all GPS data blocks programmed in this output are invalidated)
$PDAS,GPSDAT,1,B,3,3,3,3	Validating GPS data blocks in output 1
$PDAS,GPSDAT	Query
$PDAS,GPSDAT,1,B,3,3,3,3*4C $PDAS,GPSDAT,2,N,0,0,0,0*43	(Reply: 2 lines)
$PDAS,GPSDAT,2,A,0,0,4,0	Adding output 2 on port A (iono-utc data)

If a display terminal is connected to port A (this may be the terminal from which you sent the preceding commands), then data blocks of the following type will be displayed:

```
!U,945,378367.0
780F00,FF0136,FEFC03,000032,000000,0F90B1,0C9002,0CAAAA
```

Data described from pages 182 (ASCII format) and 205 (binary format).

$PDAS,HARDRS

❑ Function

Edits the settings of the receiver's serial ports.

❑ Syntax

Set command:

$PDAS,HARDRS,a,b,c,d,e,f,g[*hh][CR][LF]

Query command:

$PDAS,HARDRS[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Default value	Comments
a	x			Number of lines containing definitions of serial ports
b	x	1 to **a**		Line number
c	a			Port identification (A, B, etc.)
d	x.x		9600	Baud rate (1200, 2400, 4800, 9600, 19200)
e	x	6 to 8	8	Number of data bits
f	x.x	1, 1.5, 2	2	Number of stop bits
g	a		N	Parity control ("N" for None, "O" for Odd, "E" for Even, "M" for Mark, "S" for Space) (default: N)
***hh**				Checksum (optional)
[CR][LF]				End of command

• Examples

$PDAS,HARDRS	Query
$PDAS,HARDRS,4,1,A,9600,8,1.0,N*0A	
$PDAS,HARDRS,4,2,B,38400,8,1.0,N*3A	
$PDAS,HARDRS,4,3,C,38400,8,1.0,N*3A	
$PDAS,HARDRS,4,4,D,19200,8,1.0,N*3F	
$PDAS,HARDRS,,,B,19200,7,1,0	Changing port B settings
$PDAS,HARDRS	Query
$PDAS,HARDRS,4,1,A,9600,8,1.0,N*08	
$PDAS,HARDRS,4,2,B,19200,7,1.0,N*33	
$PDAS,HARDRS,4,3,C,38400,8,1.0,N*3A	
$PDAS,HARDRS,4,4,D,19200,8,1.0,N*3F	

$PDAS,HEALTH

(Future use).

Function

Edits the health status of the reference station (information delivered at a monitoring station).

Syntax

Set command:

$PDAS,HEALTH,a[*hh][CR][LF]

Query command:

$PDAS,HEALTH[*hh][CR][LF]

Parameters

Parameter	Format	Range	Default value	Comments
a	x	0 to 7	6 or 7	Health status. RTCM-SC104 Health conventions: 7: station not working 6: station not monitored 5: UDRE scale factor is 0.1 4: UDRE scale factor is 0.2 3: UDRE scale factor is 0.3 2: UDRE scale factor is 0.4 1: UDRE scale factor is between 0.5 & 0.75 0: UDRE scale factor is 1
***hh**				Checksum (optional)
[CR][LF]				End of command

Examples

$PDAS,HEALTH	Query
$PDAS,HEALTH,0*2A	(Reply)
$PDAS,HEALTH,6	Initializing health status for a working station
$PDAS,HEALTH	Query
$PDAS,HEALTH,6*2C	(Reply)

$PDAS,HDGINI

Function

Reads the geometrical parameters of the antenna array used to perform heading measurements, or initializes the computation of these parameters.

Syntax

Set command:

$PDAS,HDGINI,a,b,c,d,e,f,g[*hh][CR][LF]

Query command:

$PDAS,HDGINI[*hh][CR][LF]

Parameters

Parameter	Format	Range	Comments
a	x.x	[0..999]	Computation time: 0: Initializes the computation -1: Stops the computation
b	x.x	[0..999]	Baseline length in meters
c	x.x	[0..360]	Horizontal offset in degrees
d	x.x	[-90..+90]	Vertical offset in degrees (blank field if data invalid)
e	x.x	[0..999]	Baseline standard deviation in meters
f	x.x	[0..360]	Horizontal offset standard deviation in degrees
g	x.x	[-90..+90]	Vertical offset standard deviation in degrees (blank field if data invalid)
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

$PDAS,HDGINI,0 — Initializing computation of geometrical parameters

$PDAS,HDGINI — Reading current geometrical parameters

$PDAS,HDGINI,3420,0.40,90.8,,0.003,0.15,*47 — Reply

$PDAS,HDGSET

❑ Function

Edits the baseline length, the horizontal and vertical offsets of the antenna array, the time constant used in the heading filtering as well as the allowed heading dead reckoning time in case of GPS signal loss.

❑ Syntax

Set command:

$PDAS,HDGSET,a,b,c,d,e[*hh][CR][LF]

Query command:

$PDAS,HDGSET[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x.x	[0..999]	Baseline length in meters
b	x.x	[0..360]	Horizontal offset in degrees
c	x.x	[-90..+90]	Vertical offset in degrees
d	x.x	[0..60]	Heading filtering time constant in seconds (if filtering required)
e	x.x	[0..600]	Maximum heading dead-reckoning time in seconds
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,HDGSET	Reading values currently used
$PDAS,HDGSET,0.40,91.6,2.1*2A	Reply
$PDAS,HDGSET,,90.8	Changing horizontal offset
$PDAS,HDGSET	Checking new settings
$PDAS,HDGSET,0.40,90.8,2.1*47	Reply

$PDAS,HRP

Function

Provides the set of results tied to the heading processing.

Syntax

Query command only:

$PDAS,HRP[*hh][CR][LF]

Parameters in the Reply Message

Parameter	Format	Range	Comments
a	hhmmss.ss		UTC time attached to computed values
b	x.x	[0..360]	Heading, True, in degrees
c	x.x	[-90..+90]	Roll angle in degrees
d	x.x	[-90..+90]	Pitch angle in degrees
e	x.x	[..]	Heading standard deviation in degrees
f	x.x	[0..12]	Number of satellites used concurrently by the two antennas to compute the heading angle
g	c	[A, E, N]	Mode indicator: A: Autonomous E: Estimated (dead-reckoning) N: Invalid data
***hh**			Checksum (optional)
[CR][LF]			End of command

UTC time attached to computed values (Argument a above)

For Accurate heading: time of last valid heading computation (no extrapolation. Normal situation, corresponding to **g**=A, as long as:

Current time – Time of computation < 1.5 second

For real-time heading, an extrapolated heading: also the time of last valid heading computation. Normal situation, corresponding to **g**=A, as long as:

Current time – Time of computation < 1.5 second

Examples

$PDAS,HRP Query
$PDAS,HRP,170903.00,90.9,T,,-3.3,0.6,8,A*5A Reply

$PDAS,IDENT

❑ Function

Reads the identification of each of the hardware and software parts in the receiver.

❑ Command syntax (a query command only)

$PDAS,IDENT[*hh][CR][LF]

❑ Receiver Reply syntax

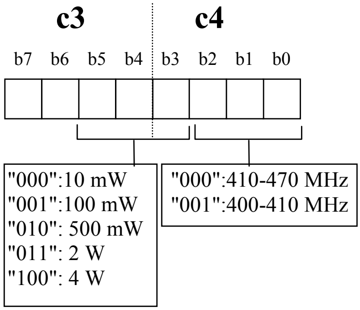
$PDAS,IDENT,a,b,c,d,e[*hh][CR][LF]

❑ Parameters in the reply

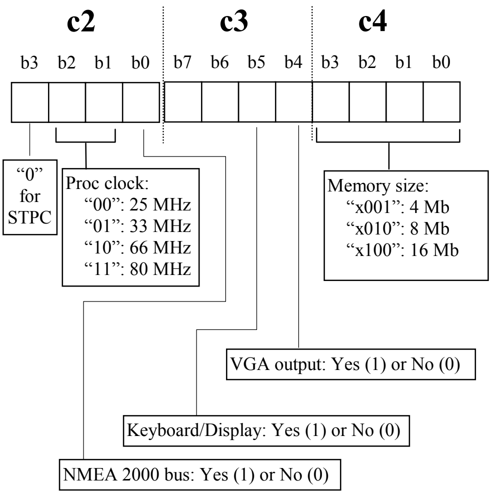
Parameter	Format	Comments
a	x.x	Total number of reply lines
b	x.x	Line number
c	cccc	Subassembly hardware identification Always 4 characters: c1, c2, c3, c4 where: • c1c2 are the 2 characters identifying the subassembly: c1c2 = CM ⇒ Core Module c1c2 = TD ⇒ Data Transmission c1c2 = Ux ⇒ Application Central Unit • c3c4 are the 2 characters identifying the hardware version of the subassembly: - If c1c2 = CM, then c3c4=30 (Core module type 1b, 3.3 V

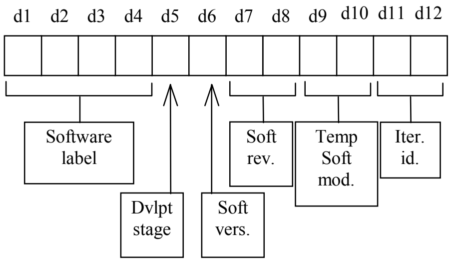
Parameter	Format	Comments
		(parameter c, continued)

- If c1c2 = TD, bits 2, 1 and 0 (character c4) identify the PCB version and bits 5, 4 and 3 the transmission power (see diagram below)



- If c1= U, c2, c3 and c4 describe the following relative to a UC STPC board:



<table>
<tr><th>Parameter</th><th>Format</th><th>Comments</th></tr>
<tr><td>d</td><td>cc</td><td>Subassembly software identification (always 10 or 12 characters) (see diagram below)


d1 to d4: Software label (Core Module Type 1b 3.3V):
C3BL: Core Module Boot Loader
C3CA: C/A L1 Core Module
C3PY: C/A & P/Y L1 & L2 Core Module

UCBG: BIOS
UCLN: STPC Central Unit Boot Loader
UCIM: "Black Box" Application
UCBK: Power board circuit breaker firmware
UCKB: Display/Keypad firmware

EUHF: UHF transmitter (data link)
RUHF: UHF receiver (data link)</td></tr>
<tr><td></td><td>cc (continued)</td><td>d5: Development stage (B for b-test version, V for production version, X for development version)
d6: Identification of software version or standard:
0: S0, S0+, S0.2 and S0.3 (Core Module)
1: E1 state (application)
2: E2 state (application)
3: E3 state (application)
d7 & d8: Revision of the software version
d9 & d10: Temporary or On-Site software modification
d11 & d12: Iteration identification (optional, applies to CM only)</td></tr>
<tr><td>e</td><td>a</td><td>Identifies the port the concerned subassembly is connected to (A, B, etc.)</td></tr>
<tr><td colspan="2">*hh</td><td>Checksum (optional)</td></tr>
<tr><td colspan="2">[CR][LF]</td><td>End of command</td></tr>
</table>

❑ Examples

Query:

$PDAS,IDENT

Reply from a dual-frequency mobile:

```
$PDAS,IDENT,8,1,U698,UCBGV20000*64
$PDAS,IDENT,8,2,U698,UCIMV10045*64
$PDAS,IDENT,8,3,U698,UCLNV30000*60
$PDAS,IDENT,8,4,U698,UCBKV8_2*0A
$PDAS,IDENT,8,5,U698,UCKBV9999*5E
$PDAS,IDENT,8,6,TD02,RUHFV20100,D*60
$PDAS,IDENT,8,7,CM39,C3BLX0000001,I*01
$PDAS,IDENT,8,8,CM39,C3PYV0000007,I*01
```

$PDAS,NAVSEL

❑ Function

Edits the navigation mode currently selected.

❑ Syntax

Set command:

$PDAS,NAVSEL,a,b,c,d[*hh][CR][LF]

Query command:

$PDAS,NAVSEL[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x	1 to 4	Type of fix used for navigation: 1 (or 2 or 4): (D)GPS, WADGPS, EDGPS or KART-R 3: KART-A
b	a		Navigation mode used: 1: Position (none) 2: Homing (future use) 3: Homing along a specified direction (future use) 4: Route (future use)
c	c- -c		Navigation instructions (8 characters max.): If b= 2 or 3, c=label of target waypoint If b= 4, c=label of the route to follow
d	x		Direction of travel along the route: Direct if d= 1 Inverse if d= 0
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,NAVSEL	Query
$PDAS,NAVSEL,1,1*29	(DGPS, Position mode)
$PDAS,NAVSEL,2	Changing fix used for navigation
$PDAS,NAVSEL	Query
$PDAS,NAVSEL,3,1*2B	(KART / LRK-A, Position mode)

$PDAS,OUTMES

❑ Functions

Edits the definitions of the computed-data outputs.

Adds new definitions of computed-data outputs.

❑ Syntax

Set command:

$PDAS,OUTMES,a,b,c,d,e[,...,n][*hh][CR][LF]

Query command:

$PDAS,OUTMES,a,b[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x.x	0 to 20	Message number
b	a		Port identification (A, B, C, D, P)
c	x	-8 to +8	Trigger mode: 0: disables the output (no possibility to know what the former trigger mode was for this output, as opposed to the "-" sign; see below) 1: Time 2: External Event is the triggering signal 3: (reserved) 4: 1pps is the triggering signal 5: Manual (future development) 6: by $PDAS,TR command 7 & 8: for future development A negative value will cause the output to be disabled (but the trigger mode information will still be present in the output definition for further use)
d	x.x		If c=1, then d is the trigger rate expressed in 100-ms units If c=2 or 4, then d is the trigger rate expressed as a count of events
e,... n	x.x		Numbers of the formats (macros) that will generate the message being defined
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,OUTMES	Querying the receiver to obtain the list of its computed data outputs
$PDAS,OUTMES,1,A,-1,10.0,1*51 $PDAS,OUTMES,2,A,-1,10.0,2*51 $PDAS,OUTMES,3,A,-1,10.0,3*51 $PDAS,OUTMES,4,A,-1,10.0,4*51 $PDAS,OUTMES,5,A,-1,10.0,5*51 $PDAS,OUTMES,6,A,-1,10.0,6*51 $PDAS,OUTMES,7,A,-1,10.0,7*51 $PDAS,OUTMES,8,A,-1,10.0,8*51 $PDAS,OUTMES,9,A,-1,10.0,9*51 $PDAS,OUTMES,10,A,-1,10.0,10*51 $PDAS,OUTMES,11,B,-1,10.0,11*52 $PDAS,OUTMES,12,B,-1,10.0,12*52 $PDAS,OUTMES,13,B,-1,10.0,13*52 $PDAS,OUTMES,14,B,-1,10.0,14*52 $PDAS,OUTMES,15,B,-1,10.0,15*52 $PDAS,OUTMES,16,B,-1,10.0,16*52 $PDAS,OUTMES,17,B,-1,10.0,17*52 $PDAS,OUTMES,18,C,-4,1.0,5*5A	
$PDAS,OUTMES,2,B,4	Changing output #2
$PDAS,OUTMES,2	Checking new output #2
$PDAS,OUTMES,2,B,4,10.0,2*7A	
$PDAS,OUTMES,2,B,-4	Disabling output #2 (trigger information setting preserved)
$PDAS,OUTMES,2	Checking output #2
$PDAS,OUTMES,2,B,-4,10,2,7,8,5,11,20*5D	
$PDAS,OUTMES,2,B,0	Stopping output #2 (trigger information setting lost)
$PDAS,OUTMES,2	Checking output #2
$PDAS,OUTMES,2,B,-4,10.0,2*57	

$PDAS,OUTON and $PDAS,OUTOFF

Functions

Respectively enables/disables data outputs on the port connected to the PC for receiver control.

These commands have no effect on the port currently used as far as the dialog between PC and receiver is concerned.

Syntax

Output disabling command:

$PDAS,OUTOFF[*hh][CR][LF]

Output (re-) enabling command:

$PDAS,OUTON[*hh][CR][LF]

Parameters

Parameter	Format	Default value	Comments
(none)			
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

$PDAS,OUTOFF — All data outputs suspended (No reply)

$PDAS,OUTON — All data outputs resumed (No reply)

$PDAS,PRANGE

❑ Functions

Edits the definitions of the pseudorange-data outputs.

Adds definitions of pseudorange-data outputs.

❑ Syntax

Set command:

$PDAS,PRANGE,a,b,c,d,e,f,g[*hh][CR][LF]

Query command (only the specified line is returned):

$PDAS,PRANGE,a[CR][LF]

Query command (all output definitions are returned):

$PDAS,PRANGE[CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x	1 to 2	Output number
b	a		Output port identification (A, B, C,etc.)
c	x	0 to 2	Output mode: 0: stopped 1: Period (time) 2: trigger
d	x.x		Output rate: if c=1, d=output rate in units of 0.1 second if c=2 and: d=1, then data block following External Event is output, or d=3, then data block following 1pps is output
e	x	2 to 5	Data type (see Appendices D & E): 2: BIN_GT (SBIN@R binary data) (in satellite time) 3: BIN_RT (SBIN@Q binary data) (in receiver time) 4: ASC_GT (SVAR!R ASCII data) (in satellite time) 5: ASC_RT (SVAR!Q ASCII data) (in receiver time) 7: SBIN@R Data in LRK format
f	x.x	0 to 600	GPS & WAAS/EGNOS code/phase filtering time constant in sec.
g	x.x		SV minimum elevation, in degrees. Pseudoranges from satellites located under this elevation will not be output

Parameter	Format	Range	Comments
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,PRANGE — Query
$PDAS,PRANGE,1,B,-1,10,4,0.0,0.0*53 — (Reply, 2 lines)
$PDAS,PRANGE,2,N,0,0,0,0.0,0.0*45

$PDAS,PRANGE,1,A,1,40,4,0,5 — Validating SVAR!R data blocks on port A, in time mode every 4 seconds, no filter, 5° min. elevation

Data blocks then display on your terminal screen (if you sent the command through port A). Example:

```
!R,1115,235000.0
&P,0.0,0
*4,1,947429699,4292298,1170460,49,2,13,7F,-12,-80,-180,5239253,
911940,33,5F
*7,4,918562103,9139108,-1346052,49,2,17,7F,8,41,-115,7658103,-
1048820,2E,5F
*3,7,1046602438,8786582,2210672,41,2,3A,9F,86,-223,-35,9835197,
1722756,91,AF
*6,13,909859147,2589101,-1142872,49,2,0C,7F,16,63,-137,8788655,-
890704,10,5F
*9,20,1007778951,5712481,1976220,47,2,0F,8F,4,-78,-156,6630620,
1539736,5A,7F
*1,24,1003172324,2645942,-3789260,42,2,10,9F,4,241,213,3461349,-
2952648,4C,8F
*8,27,1026263932,2118672,-4122732,42,2,33,9F,-31,77,146,4136725,-
3212756,9B,9F
```

Data described from pages 170 (ASCII format) and 193 (binary format).

$PDAS,PREFLL

❑ Functions

In a reference station, this command allows you to enter the precise latitude and longitude of this station.

In a mobile receiver, this command allows you to enter the precise latitude and longitude of the position from which the receiver will be initialized.

In both cases, the command is used to enter a reference position. See also $PDAS,FIXMOD.

❑ Syntax

Set command:

$PDAS,PREFLL,a,b,c,d,e,f[*hh][CR][LF]

Query command:

$PDAS,PREFLL[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Default value	Comments
a	x	0 to 10	0	Coordinate system Id
b	llll.llllll			Reference station latitude (with centimeter accuracy)
c	a	N or S		Sign of latitude (North or South)
d	yyyyy.yyyyyy			Reference station longitude (with centimeter accuracy)
e	a	E or W		Sign of longitude
f	x.x			Reference station altitude, in meters (centimeter accuracy required for this parameter)
***hh**				Checksum (optional)
[CR][LF]				End of command

❑ Examples

$PDAS,PREFLL — Query
$PDAS,PREFLL, , , , , , *2B

$PDAS,PREFLL,0,3835.448532,S,01020.993478,E,93.833 — Changing the coordinates of the reference station

$PDAS,PREFLL — Query
$PDAS,PREFLL,0,3835.448532,S,01020.993478,E,93.833*2B

$PDAS,PREFNE

❑ Function

In a reference station, this command allows you to enter the precise projected coordinates of this station.

In a mobile receiver, this command allows you to enter the precise projected coordinates of the position from which the receiver will be initialized.

In both cases, the command is used to enter a reference position. See also $PDAS,FIXMOD and $PADS,PREFLL.

❑ Syntax

Set command:

$PDAS,PREFNE,a,b,c,d[*hh][CR][LF]

Query command:

$PDAS,PREFNE[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Default value	Comments
a	x	0 to 10	0	Coordinate system Id
b	x.x			Reference station Northing (centimeter accuracy required)
c	x.x			Reference station Easting (centimeter accuracy required)
d	x.x			Reference station altitude, in meters (centimeter accuracy required)
***hh**				Checksum (optional)
[CR][LF]				End of command

❑ Examples

$PDAS,PREFNE	Query
$PDAS,PREFNE,0,0.000,0.000,93.933*0C	(No projection)
$PDAS,SELGEO,2	Changing coord. syst
$PDAS,PREFNE,2,259127.688,310500.551,48.752	Changing station's coordinates
$PDAS,PREFNE	Checking new coordinates
$PDAS,PREFNE,2,259127.688,310500.551,48.752*0A	

$PDAS,QC

(For future use).

Functions

Enables Quality (Integrity) Control in the receiver and simultaneously chooses the type of Quality Control used (internal or external).

Disables Quality Control

Reports the type of Quality Control currently used, if any

Of the two types of Quality Control possible, only the external one, relying on the WAAS/EGNOS system, is operational to date.

Syntax

Set command:

$PDAS,QC,a,b,c[*hh][CR][LF]

Query command:

$PDAS,QC[*hh][CR][LF]

Parameters

Parameter	Format	Range	Comments
a	x	0 to 1	Internal (or autonomous) Quality Control: 0: No internal Quality Control 1: UKOOA Control
b	a	0 to 2	External Quality Control: 0: No external Quality Control 1: WAAS/EGNOS Quality Control 2: RTCM-SC104 Quality Control, message type 5
c	x		Provider of external Quality Control: if b = 1, PRN of the GEO to be received if b = 2, Number of the RTCM-SC104 reference station to be received
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

$PDAS,QC	Query
$PDAS,QC,0,0,*38	No Quality Control currently used
$PDAS,QC,0,1,138	Selecting External Quality Control using WAAS/EGNOS GEO PRN 138
$PDAS,QC	Checking new setting
$PDAS,QC,0,1,138*2F	(Reply)

$PDAS,RAZALM

❑ Function

Deletes the specified almanacs from the receiver's memory.

❑ Syntax

$PDAS,RAZALM,a[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x	0 to 2	Defines the type of almanacs you want to delete: 0 (or a omitted): all 1: GPS almanacs only 2: WAAS/EGNOS almanacs only
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,RAZALM	Deletes all almanacs

$PDAS,SCREEN

❑ Function

Enables/disables the built-in or external screens attached to the receiver, or reads the current settings.

❑ Syntax

Set command:

$PDAS,SCREEN,a,b,c[*hh][CR][LF]

Query command:

$PDAS,SCREEN[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Default value	Comments
a	x	1 to 2		Command line number
b	xx	A to D, V		Identification of the port to which the screen is attached: Use A, B, C or D if external display attached to one of these receiver ports "V" designates both the built-in TRM100 LCD screen AND the external VGA screen, if any, attached to the receiver via the VGA connector If **b** is omitted, it is assumed to be the identification of the port routing the command
c	c--c			Action on addressed screen: ON: Screen active OFF: Screen inactive
***hh**				Checksum (optional)
[CR][LF]				End of command

❑ Examples

$PDAS,SCREEN	Query
$PDAS,SCREEN,1,V,ON	
$PDAS,SCREEN,2,B,OFF	(Only the VGA/LCD screen is active)

$PDAS,SELGEO

❑ Function

Of the coordinate systems defined with the $PDAS,GEO command, selects one to be the current coordinate system in the receiver.

❑ Syntax

Set command:

$PDAS,SELGEO,a[*hh][CR][LF]

Query command:

$PDAS,SELGEO[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Default value	Comments
a	x	0 to 10	0	Id number of the coordinate system to be used
***hh**				Checksum (optional)
[CR][LF]				End of command

❑ Examples

$PDAS,SELGEO	Query
$PDAS,SELGEO,0*21	(Reply: coordinate system #1)
$PDAS,SELGEO,2	Selecting coord. system #2
$PDAS,SELGEO	Query
$PDAS,SELGEO,2*23	(Reply: coordinate system #2 used)

$PDAS,SVDSEL

❑ Functions

Allows intentional rejection of satellites from the position processing in the receiver. Satellites may be GPS SVs or GEOs.

Lists the intentionally rejected satellites

Reads/changes the elevation threshold (minimum elevation angle) required of a non-rejected satellite to be involved in the position processing.

❑ Syntax

Command relative to rejected satellites:

$PDAS,SVDSEL,a,b,c,d,...[*hh][CR][LF]

Command relative to elevation threshold:

$PDAS,SVDSEL,a [*hh][CR][LF]

Query command:

$PDAS,SVDSEL[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x.x		Elevation threshold (in degrees)
b	x.x	$0 \leq$ **b** ≤ 210	Indicates whether the PRNs that follow (**c,d,...**) are those of the only satellites you want to reject (this will be obtained by setting **b** to 0), or are added to the list of rejected satellites (in which case **b** will also designate one of these satellites). In short: **b** = 0 ⇒ No satellite is rejected except those specified in the next fields (**c,d,...**) **b** ≠ 0 ⇒ PRN of a satellite you want to reject
c	x.x	$1 \leq$ **c** ≤ 210	PRN of other satellite you want to reject
d,...	x.x	$1 \leq$ **d** ≤ 210	PRN of other satellite you want to reject, etc. (up to 12 SVs)
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,SVDSEL	Query
$PDAS,SVDSEL,20.0,2,6,8*11	Elevation threshold is 20 °; SVs PRN 2, 6 ,8 are currently rejected
$PDAS,SVDSEL,,5	Adding SV PRN 5 to the list of rejected satellites
$PDAS,SVDSEL	Query (checking the change made)
$PDAS,SVDSEL,20.0,2,5,6,8*08 (Reply)	
$PDAS,SVDSEL,,0,2,7	Clearing the list of intentionally rejected SVs. SV PRN 2 and 7 will now be the only SVs that are rejected
$PDAS,SVDSEL	Query (checking the change made)
$PDAS,SVDSEL,20.0,2,7*04	(Reply)
$PDAS,SVDSEL,15	Changing elevation threshold (15°)
$PDAS,SVDSEL	Query (checking the change made)
$PDAS,SVDSEL,15.0,2,7*02	(Reply)
$PDAS,SVDSEL,,0	Clearing the list of rejected satellites
$PDAS,SVDSEL	Query (checking the change made)
$PDAS,SVDSEL,15.0,*07	(Reply) No satellite rejected

$PDAS,TR

❑ Function

Triggers data output in terminal mode on the specified port.

❑ Syntax

$PDAS,TR,a,b[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	a		Output port identification (A, B, etc.) Placing a comma (,) behind this letter will delete the current user text to be replaced by the next one (see below).
b	c- -c		User text (60 characters max.)
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,OUTMES,1,A,6,1 — Validating output #1 on port A in TR mode

$PDAS,OUTMES — Checking output #1 definition
$PDAS,OUTMES,1,A,6,1.0,1*4B

$PDAS,TR — Asking for output #1 to be sent

Resulting data blocks (example):

```
$GPGGA,191138.30,4717.937668,N,00130.543202,W,4,11,0.8,88.321,M,0.00
0,M,1.3,0099*5F
```

$PDAS,UNIT

❑ Function

Edits the unit number, or the identification number in the case of a reference station.

❑ Syntax

Set command:

$PDAS,UNIT,a[*hh][CR][LF]

Query command:

$PDAS,UNIT[*hh][CR][LF]

❑ Parameters

Parameter	Format	Range	Comments
a	x	0 to 1023	Unit number or station identification number (4 char. max)
***hh**			Checksum (optional)
[CR][LF]			End of command

❑ Examples

$PDAS,UNIT	Query
$PDAS,UNIT,0*30	(Reply: No 0000)
$PDAS,UNIT,801	Changing unit number
$PDAS,UNIT	Query
$PDAS,UNIT,801*39	(Reply: No 0801)

$_ZDA and $_GPQ,ZDA

Function

Changes and reads respectively the receiver date & time.

Syntax

Change command:

$--ZDA,a,b,c,d,e,f[*hh][CR][LF]

Read command:

$--GPQ,ZDA[*hh][CR][LF]

Parameters

Parameter	Format	Range	Comments
a	hhmmss.ss		UTC time
b	xx	01 to 31	Day
c	xx	01 to 12	Month
d	xx		Year (4 char.)
e	xx	-13 to +13	Local time offset (in hours) with respect to UTC time
f	xx	00 to 59	Local time offset (in minutes) with respect to UTC time
***hh**			Checksum (optional)
[CR][LF]			End of command

Examples

$ECGPQ,ZDA	Query
$GPZDA,180919.00,17,2,1998,+00,00*78	(Reply)
$ECZDA,082100,18,12,1997,-1,00	Changing time
$ECGPQ,ZDA	Checking new time
$GPZDA,082117.00,18,12,1997,-01,00*4B	

♣

12. Appendices

Technical Specifications

❑ Main Features

- L1/L2 LRK® centimeter real-time positioning (Aquarius-02)
- L1 KART centimeter real-time positioning (Aquarius-01)
- User Coordinate System: local datum, projection, geoid model

❑ Configurations

	Standard Features	Additional Firmware as Standard	GNSS Antennas	Firmware Options	Hardware Options
Aquarius-01	Receiver with plug-in keypad and Display Firmware: DGPS, EDGPS, KARTMODE		1×NAP 001 complete with standard supply	REFSTATION RELATIVE OTF	One or two Rx 4812 U-Link Reception Modules One or two Rx 1635 HM-Link Reception Modules One Tx 4800 U-Link Transmission Module
Aquarius-02			1×NAP 002 complete with standard supply	LRKMODE REFSTATION RELATIVE OTF	
Aquarius^2-11		HEADING	2×NAP 001 complete with standard supply	REFSTATION RELATIVE OTF	
Aquarius^2-12		HEADING	1×NAP 001 + 1×NAP 002, both complete with standard supply	LRKMODE REFSTATION RELATIVE OTF	
Aquarius^2-22		HEADING RELATIVE OTF	2×NAP 002 complete with standard supply	LRKMODE REFSTATION	

❑ TRM100 Keypad/Display

- Front Panel Plug-In Unit
- ¼ VGA screen and keyboard terminal
- Dimensions (H × W × D): 125 × 255 × 40 mm (4.92 × 10.0 × 1.57”)
- One-meter cable for connection to receiver in case of remote use
- TRM100 mounting kit for remote use.

❑ Radio Module Options

Tx 4800 U-Link UHF Transmission Module:

- Operating in UHF band 410 to 470 MHz
- Data formats: LRK® (RTK) and RTCM
- Modulation type: GMSK at 4800 bits/s
- Radiated power: 4W or 0.5W (according to local authorization)
- CXL-70 3 dB antenna
- Norm ETS100-313 - Certified in Europe, the US and most other countries
- EMI specifications: EN60945-ETS 300279

Rx 4812 U-Link UHF Reception (1 or 2 built-in modules):

- Operating in UHF band 410 to 470 MHz
- Designed to be integrated into the receiver
- Modulation type: GMSK 4800 bits/s or DQPSK 1200 bits/s (NDS 100 type)
- CXL-70 3 dB antenna
- RTTE
- EMI specifications: EN60945-ETS 300279

Rx 1635 HM-Link HF/MF Reception (1 or 2 built-in modules):

- Designed to be integrated into the receiver
- Dual-channel in HF band 1.6 to 3.5 MHz; BCPSK modulation (NDS 200 type)
- Dual-channel in MF band 270 to 330 kHz; MSK modulation
- DHM 5000 dual-band antenna - H × Diameter: 245 × 135 mm (9.64 × 5.31”)

❑ Performance Figures

See sections 4 and 5 for all specifications relevant to the available processing modes.

Raw Data Output Rate: 10 Hz

Computed data: 20-Hz output rate and Latency < 5 ms (0.005 s)

Heading & Relative Processing Specifications (Aquarius² only):

Heading:

	Precision Range	Baseline Length	Heading Precision (RMS)	Initialization Time (s), Typical
Aquarius²- 11	0.2 to 0.04°	1 to 2 m	0.2° / D *	10 s + 30 s/m
Aquarius²- 12	0.2 to 0.04°	1 to 5 m	0.2° / D *	10 s + 30 s/m
Aquarius²-22	0.1 to 0.01°	> 2 m	0.2° / D *	5 s/m

* D= Baseline Length in meters

Relative GPS:

- OTF initialization time: 30 seconds, typical
- Same level of precision as in EDGPS, KART, LRK®

Processed data (heading & relative GPS) issued at 20-Hz output rate and latency < 5 ms (0.005 s) regardless of the mode used

❑ GPS/GNSS Characteristics

- 16 × L1 channels (Aquarius-01 & 02)- 12 × L2 channels (Aquarius-02 only)
- 32 × L1 channels (Aquarius²-11 & 12)- 24 × L2 channels (Aquarius²-12 & 22 only)
- C/A code and L1 phase, P code and L2 phase with multi-path processing
- Differential modes: WAAS/EGNOS, Numeric RTCM Version 2.2, messages 1, 3, 5, 9, 16, 18 & 19

❑ Interfaces

- GPS and Radio antenna connectors: all female TNC
- 4 two-way I/O ports (one RS232, three RS422) with baud rates from 1200 to 115200 bauds
- AUX port (1 PPS output, external event input, etc.)
- TRM100 display also available on VGA output
- NMEA 0183 messages: GGA, GLL, VTG, GSA, ZDA, RMC, GRS, GST, GSV, GMP (+HDT, HDG, ROT, VBW, VHW, OSD and proprietary $PDAS,HRP for Aquarius²)
- User messages via ConfigPack.

❑ Electrical

- Power source: 9 to 36V DC, floating input (mobile); 9 to 16 V DC, non-floating, for station operated with U-Link
- Consumption: 10 to 21 W (Aquarius), depending on configuration used; 12 to 25 W (Aquarius²), depending on configuration used.

❑ Environmental

- IP 52 compliant, rigid aluminum case
- Operating temperature range: -20 to +55°C (antennas: -40 to +70°C)
- Storage temperature range: -40 to +70°C
- Vibration: EN 60495 & ETS 300 019 (shocks)
- EMI: EN 60495

❑ Physical

- H × W × D: 125 × 245 × 305 mm (4.92 × 9.64 × 12”)
- Weight: 4.2 kg (9.26 lb)

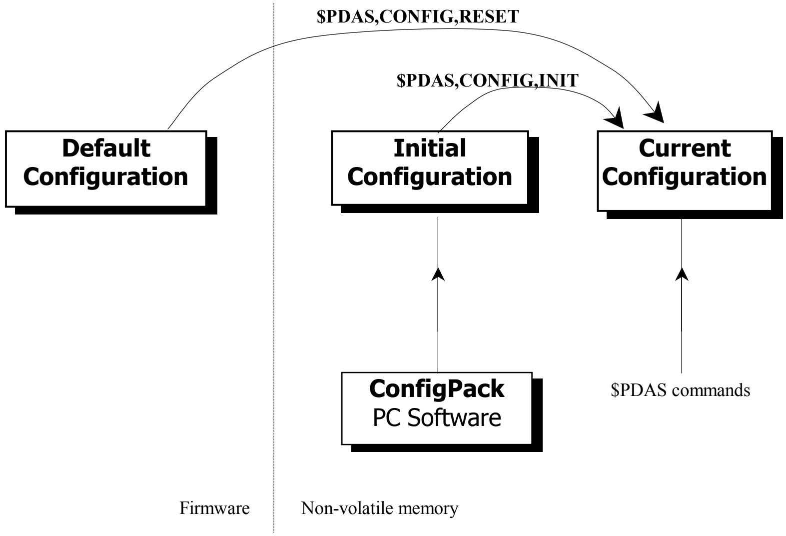
About the Three Configurations Stored in the Receiver

Three different configurations are stored in the receiver:

- Default configuration, resident in the firmware. This configuration cannot be modified. It resets all parameters in the receiver to known values (operating mode, serial port settings, output messages, etc.)
- Initial configuration, saved in a non-volatile memory. It can be modified using ConfigPack software. It contains the necessary parameter settings for the reference configuration of an application or for any particular operating mode (mobile, reference station, etc.).
- Current configuration, saved in a non-volatile memory. This configuration can be modified interactively by the user through TRM100 or proprietary $PDAS commands.

The Default configuration can be loaded in place of the current configuration by sending the command $PDAS,CONFIG,RESET. The default configuration then also becomes the current one.

The command $PDAS,CONFIG,INIT can be used to make the initial configuration the new current configuration.



Description of the Default Configuration

The main parameters held by this configuration are presented below.

Port Settings:

	Port A	Port B	Port C	Port D
Type	RS422 (NMEA0183)	RS232 (TRM100 PC Software)	RS422 (NMEA0183)	RS422 (RTCM104+TD)
Baud Rate	9600	38400	38400	19200
Data Bits	8	8	8	8
Stop Bits	1	1	1	1
Parity Check	none	none	none	none

Computed data messages:

Output Message No.	Available on port	Default status	Output mode & rate	NMEA 0183 sentence	NMEA 0183 sentence No.
1	A	Deactivated	Time, 1 s	GGA	1
2	A	Deactivated	Time, 1 s	GLL	2
3	A	Deactivated	Time, 1 s	VTG	3
4	A	Deactivated	Time, 1 s	GSA	4
5	A	Deactivated	Time, 1 s	ZDA	5
6	A	Deactivated	Time, 1 s	RMC	6
7	A	Deactivated	Time, 1 s	GRS	7
8	A	Deactivated	Time, 1 s	GST	8
9	A	Deactivated	Time, 1 s	GSV	9
10	A	Deactivated	Time, 1 s	GMP	10
11	B	Deactivated	Time, 1 s	HDT	11
12	B	Deactivated	Time, 1 s	HDG	12
13	B	Deactivated	Time, 1 s	ROT	13
14	B	Deactivated	Time, 1 s	VBW	14
15	B	Deactivated	Time, 1 s	VHW	15
16	B	Deactivated	Time, 1 s	OSD	16
17	B	Deactivated	Time, 1 s	HRP	17
18	C	Deactivated	1 pps, generated on every occurrence of the 1 pps pulse	ZDA	5

Detail in Section 8

Pseudorange data output:

Output Message No.	Available on port	Default status	Output mode & rate	Content
1	B	Deactivated	Time, 1 s	Data in SVAR!R format, no code/phase smoothing, no restriction in SV elevation (min. elevation: 0°)

Raw data output:

Output Message No.	Available on port	Default status	Output mode & rate	Content
1	B	Deactivated	At regular intervals of time	Ephemeris in ASCII format Almanac in ASCII format Iono-UTC in ASCII format Health & A/S in ASCII format

Time data output:

Output Message No.	Available on port	Default status	Output mode & rate	Content
1	B	Deactivated	External event, generated on every occurrence of the ext. event	Data in SVAR!M format

Other Parameters

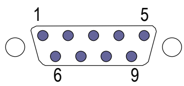
Coordinate System	WGS84
Altitude	Expressed on MSL as defined in ICD200 model, no offset
Satellite Minimum Elevation	5.0°
Intentionally Deselected Satellites	None
UTS-Local time deviation	00hr00min
Speed Filtering	20
Quality Control	None
Fix used for navigation	(D)GPS, WADGPS, EDGPS or KART-R
Fix Mode	Standalone (or “straight”) GPS
Max. Permitted DOP	10
Iono Correction Mode	According to ICD200 model
Display options	Default Interface Language: English Latitude, Longitude Format: degrees & minutes Distance Unit: Nautical Mile Angle Reference: True North
DGNSS Data Input	Port D, RTCM, numeric, all stations PRCs Time Out: 40 seconds Iono Data Time Out: 600 seconds WAAS/EGNOS: no satellite selected

Connector Pinouts

❑ AUX Connector

Sub D9-male

Pin No.	Signal	Designation
1	GND	Electrical Ground
2	SENS-EVT	Defines active edge of external event signal (rising edge if grounded, falling edge if not connected)
3	EVT	External Event Input
4	1PPS1+	1 PPS symmetrical output
5	1PPS1-	
6	NC	Not connected
7	NC	Not connected
8	NC	Not connected
9	NC	Not connected



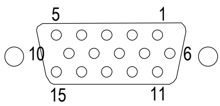
Connector shown from outside the case

❑ VGA Connector

Sub D15-female

Pin No.	Signal
1	RED
2	GREEN
3	BLUE
4	NC
5	GND
6	GND
7	GND
8	GND

Pin No.	Signal
9	NC
10	GND
11	NC
12	NC
13	HSYNC
14	VSYNC
15	NC



Connector shown from outside the case

❑ J6

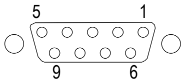
Sub D9-female

For future use

❑ Port A (RS422)

Sub D9-female

Pin No.	Signal	Designation
1	GND	Electrical Ground
2	CTS1+	RS422 CTS signal input (Clear To Send)
3	CTS1-	
4	RX1+	RS422 RX signal input (Receive Data)
5	RX1-	
6	RTS1-	RS422 RTS signal output (Request To Send)
7	RTS1+	
8	TX1+	RS422 TX signal output (Transmit Data)
9	TX1-	

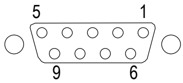


Connector shown from outside the case

❑ Port B (RS232)

Sub D9-female

Pin No.	Signal	Designation
1	DCD212	RS232 DCD input (Data Carrier Detect)
2	TX212	RS232 TX output (Transmit Data)
3	RX212	RS232 RX input (Receive Data)
4	DSR212	RS232 DSR input (Data Set Ready)
5	GND	Electrical Ground
6	DTR212	RS232 DTR output (Data Terminal Ready)
7	CTS212	RS232 CTS input (Clear To Send)
8	RTS212	RS232 RTS output (Request To Send)
9	RI212	RS232 RI input (Ring Indicator)

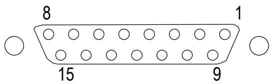


Connector shown from outside the case

❑ Port C (RS422)

Sub D15-female

Pin No.	Signal	Designation
1	TX3+	RS422 TX signal output (Transmit Data)
2	TX3-	
3	RX3+	RS422 RX signal input (Receive Data)
4	RX3-	
5	NC	Not connected
6	GND	Electrical Ground
7	GND	Electrical Ground
8	-	+12 V via R= 1 kΩ
9	CTS3+	RS422 CTS signal input (Clear To Send)
10	CTS3-	
11	1PPS2+	RS422 symmetrical output for 1 PPS signal
12	1PPS2-	
13	RTS3+	RS422 RTS signal output (Request To Send)
14	RTS3-	
15	NC	Not connected

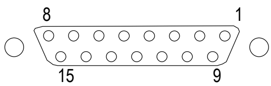


Connector shown from outside the case

❑ Port D (RS422)

Sub D15-female

Pin No.	Signal	Designation
1	TX4+	RS422 TX signal output (Transmit Data)
2	TX4-	
3	RX4+	RS422 RX signal input (Receive Data)
4	RX4-	
5	NC	Not connected
6	GND	Electrical Ground
7	GND	Electrical Ground
8	-	+12 V via R= 1 kΩ
9	NC	Not Connected
10	NC	Not Connected
11	1PPS3+	RS422 symmetrical output for 1 PPS signal
12	1PPS3-	
13	NC	Not Connected
14	NC	Not Connected
15	NC	Not connected

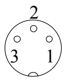


Connector shown from outside the case

❑ Power In Connector

3C connector receptacle with polarity alignment keyway

Pin No.	Signal	Designation
1	NC	
2	-	Power In -
3	+	Power In +



Shown from outside the case

❑ 1PPS Output

(On AUX connector, ports C and D).

1PPS+ output:

- 1 Hz square waveform
- Rising edge synchronous with UTC time
- Accurate to within ± 100 ns + SA if the 30-m antenna cable is used.
- Settling time: less than 30 seconds after first fix is available.
- Subject to frequency oscillator drift once fix is no longer available.

1PPS- output:

- Pin 5's complement. Same characteristics as above except that the trailing edge, instead of the rising edge, is the signal edge synchronous with UTC time.
- Using both 1PPS+ and 1PPS- signals makes the 1 pps output compatible with the signal requirements of an RS422 line.

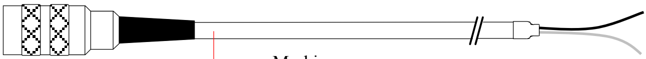
- You can also use these outputs in reference to ground, in which case you will get signal levels of respectively 0/+5 V (for 1PPS+) and 0/- 5 V (for 1PPS-).

❑ Event Input

- Input characteristics: 10-kΩ pull-up resistor tied to + 5 V DC

Cords Supplied

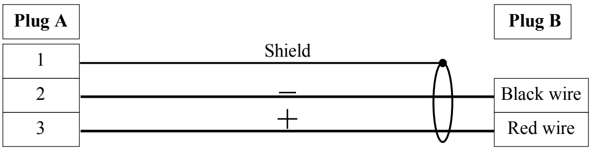
❑ Power Cord



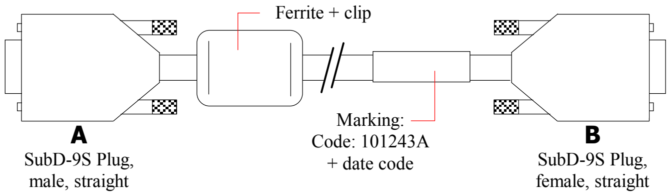
A
Plug, 681 Series, female straight, with cable clamp

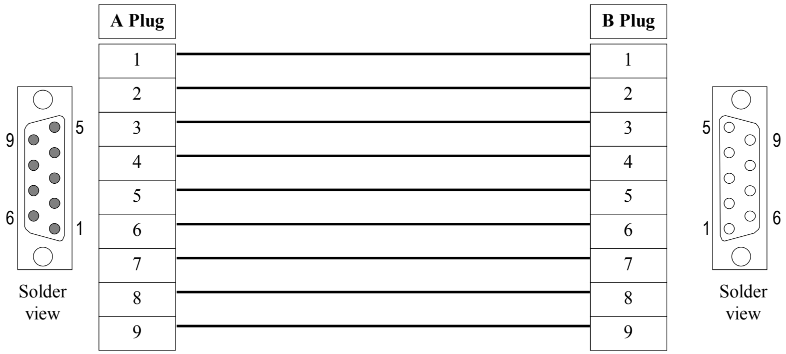
Marking:
Code: 2630067035A
+ date code

B
Flexible, shielded cable
2×0.93 mm^2 (black & red)

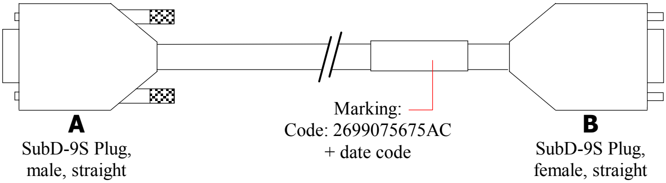


❑ RS232 / RS422 Serial Cord

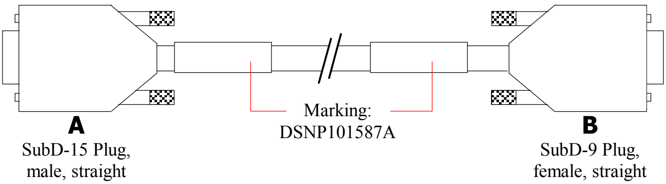


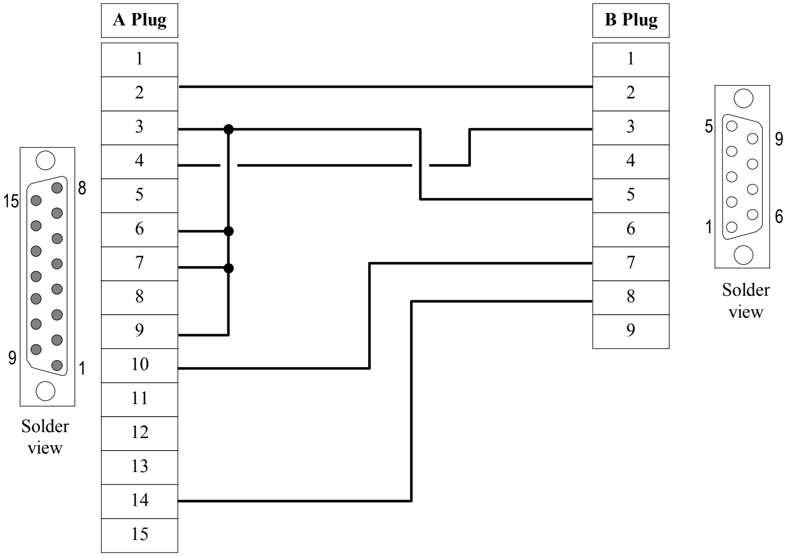


❑ RS422 / RS232 Adaptor Cable



❑ DB15/DB9 RS232/RS422 Data Cable Option





Power Supply Protections

❑ From Power Surges

In the event of a power surge (>36 V DC), the unit is turned off immediately for safety purposes (no prior warning).

When the power voltage comes back to normal, i.e. goes under the re-triggering threshold (34 V DC), Aquarius is automatically turned on.

❑ From Voltage Drops

If the power voltage drops below 9 V DC for more than 100 ms, a power-off procedure is started. Power shutdown will be effective after maximum 8 seconds.

Re-start up is automatic as soon as the power voltage exceeds 9.5 V DC.

❑ From Current Surges

If the DC current flowing across Aquarius is greater than 3 Amps for more than 100 ms, Aquarius is automatically turned off.

After a delay of 2.4 seconds, the re-start up procedure is initiated automatically.

Introduction to GNSS

GPS Constellation

The GPS system (Global Positioning System) consists of three segments:

- Space segment
- Control segment
- User segment

The Control segment is made up of monitoring stations distributed along the equator. They are used to pick up the signals from the satellites and relay the data they convey to a primary station located in Colorado Springs (USA). The data collected are processed, corrected, filtered and finally uploaded to the satellites that broadcast them through a navigation message (ephemeris, almanacs, clock corrections).

The Space segment consists of 24 satellites (often referred to as "SVs" which is an abbreviation for Space Vehicles) orbiting approximately 20200 km above the earth's surface, so that at least four satellites can be simultaneously in view, round the clock, and anywhere on earth. The satellites are distributed over 6 orbit planes inclined 55° with respect to the equatorial plane. Each satellite completes an orbit once every 12 hours approximately. From any point on earth, a satellite remains in view for 5 hours (maximum) above the horizon.

The user segment is naturally that which means most to us. It is made up of all the marine, land or air-borne applications deciphering and using the signals received from the satellites.

From a user's point of view, the user segment consists of a receiver capable of recording the GPS information so that it can be processed at a later date or a receiver computing a position in real time with an accuracy depending on the signals used.

Signals

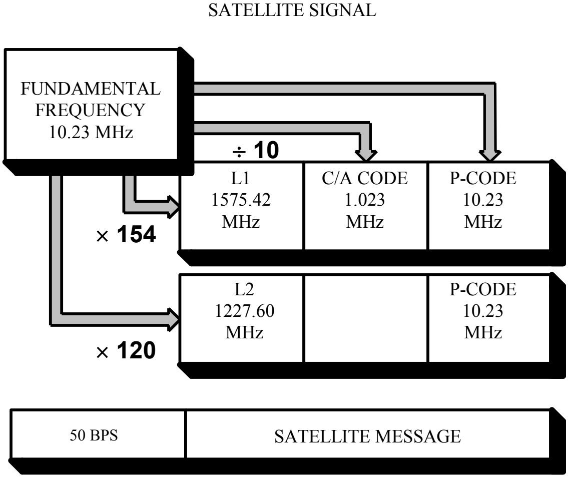
The signals transmitted by the satellites fall into two categories: signals used to control the system, and signals used for measurements within receivers (user segment).

The first type of signal is transmitted in the S-band on the following frequencies:

- 1 783.74 kHz for links from the control station to the satellites
- 2 227.5 kHz for links from the satellites to the monitoring stations.

The second type of signal is for signals known as L1 and L2, transmitted in the L-band, on the following frequencies:

- L1: 1 575.42 kHz
- L2: 1 227.6 kHz



❑ Navigation Message

The Navigation Message contains the necessary information for the description of the constellation and for the position computation. The message includes orbital Keplerian parameters precisely defining the orbits of the satellites. It also includes parameters used to partially correct system errors (e. g. signal propagation errors, satellite clock errors, etc.).

The complete message is contained in a data frame that is 1500 bits long, with a total duration of 30 seconds (i. e. the data transmission clock rate is 50 bits/second). The 1500-bit frame is divided into five 300-bit subframes, each with a 6-second duration. Each subframe consists of 10 words of 30 bits each. Each word takes 0.6 second to transmit.

The content of subframes 4 and 5 changes on a page-roll basis: it changes on every frame and repeats every 25 frames. As a result, it takes at least 12 1/2 minutes to log the entire navigation message.

❑ GNSS

General Description

Satellite navigation systems are now used in scores of applications worldwide. The best known two systems in operation as of today are:

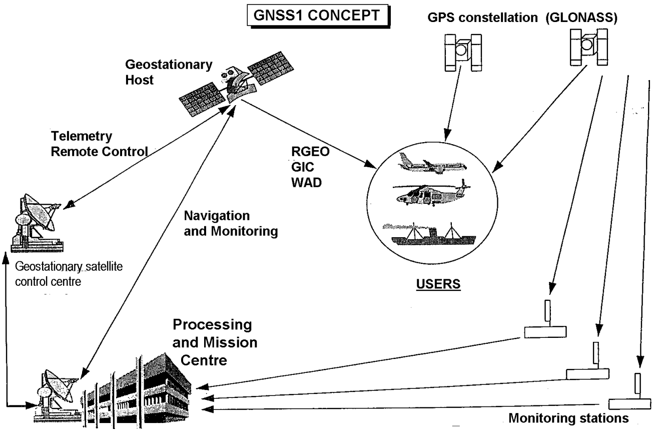
- The US GPS (Global Positioning System), which is the most, complete
- The Russian GLONASS (GLObal NAvigation Satellite System).

As both these systems are originally designed for military applications, they are entirely under the control of the respective Defense Department of the two countries. As a result, civilians cannot be sure of being allowed full access to the signals in critical periods of time. Moreover, the accuracy achieved using the non-encrypted signals is only on the order of a few tens meters.

All those aspects led the civilian community to devise a totally new system known as GNSS (Global Navigation Satellite System).

In future, a complete constellation —GNSS2— should provide civilian users with signals and data allowing them to compensate for any shortcomings in the navigation systems at sea, on land or in the air.

The current GNSS1 is the first phase in that scheme, based on the augmentation of the GPS service through geostationary satellites.



Purpose

The GNSS scheme serves three major purposes:

Complementing the range measurements with geostationary satellites (R_GEO),

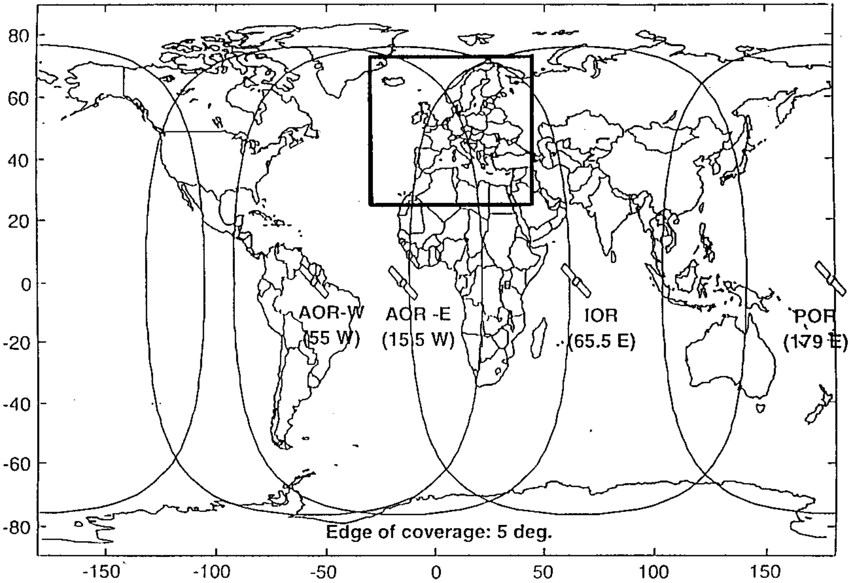
Controlling the integrity of the navigation system (GIC),

Broadcasting differential corrections over a wide area (WAD).

GNSS concept

The GNSS system consists of the following elements:

- Stations monitoring the navigation system (GPS, GLONASS), distributed over the area to be covered, allowing continuous monitoring of the system,
- A Processing and Mission Center that collects and computes the data required for the performance of the system,
- A control center for the geostationary satellites, uploading the necessary data to the geostationary satellites,
- One or more geostationary satellites broadcasting the data (R_GEO, GIC, WAD) over the area to be covered.



The different systems

Three different systems are planned, or already existing, as of today:

- For the American continent: WAAS (Wide Area Augmentation System)
- For Europe: EGNOS (European Geostationary Navigation Overlay System)
- For Asia & Pacific: MSAS (MTSAT Satellite-based Augmentation System).

❑ WAAS

Definition & Purpose

The FAA (US Federal Aviation Administration) has been developing a safety-critical navigation system, called WAAS (Wide Area Augmentation System), offering a geographically expansive augmentation to the GPS service.

The coverage includes all the United States as well as Canada and Mexico.

The purpose of the WAAS is to improve the *accuracy*, *availability* and *integrity* of the basic GPS signals. The definitions of these 3 parameters are recalled below:

Accuracy	:	Difference between position measured at any given time and actual position
Availability	:	Ability of a system to be used for navigation whenever needed
Integrity	:	Ability of a system to provide timely warnings to users, or to shut itself down when it should not be used for navigation

Description

The WAAS is based on a network of approximately 35 ground reference stations that covers a very large service area. Signals from GPS satellites are received by wide area ground reference stations (WRSs). Each of these precisely surveyed reference stations receive GPS signals and determine if any errors exist.

These WRSs are linked to form the U.S. WAAS network. Each WRS in the network relays the data to the wide area primary station (WMS) where correction information is computed. The WMS calculates correction algorithms and assesses the integrity of the system. A correction message is prepared and up linked to a GEO via a ground uplink system (GUS).

The message is then broadcast on the same frequency as GPS (L1, 1575.42MHz) to users navigating within the broadcast coverage area of the WAAS. The communications satellites also act as additional navigation satellites for users, thus, providing additional navigation signals for position determination.

The WAAS will improve basic GPS accuracy to approximately 7 meters vertically and horizontally, improve system availability through the use of geostationary communication satellites (GEOs) carrying navigation payloads, and to provide important integrity information about the entire GPS constellation.

Schedule

The delivery schedule will be accomplished in three phases by delivering an initial operating system and then upgrading the system through pre-planned product improvements (P^3I). Phase 1 WAAS will also provide the WAAS initial operating system which consists of two WMSs, 25 WR%, leased GEOs, and ground uplinks.

Shortly after the contractor completion of Phase 1, the FAA will commission the WAAS for operational use in the U.S. National Airspace System (mid 1999).

EGNOS

EGNOS is the equivalent of the WAAS for the European countries.

GEO current status (Jan 2002)

WARNING!

At the present time, only test signals are broadcast by the different administrations involved in the development of the system. These signals are not guaranteed to be reliable and accurate and so may be the source of erroneous indications.

WAAS (North American Region)

Test signals are currently broadcast for use by the FAA. This broadcasting is under control of the NSTB (National Satellite Test Bed) and takes place from the following geostationary satellites (GEOs):

- PRN 122, INMARSAT III F4 AOR-W (Atlantic Ocean Region-West), located above the Equator at 54°W longitude
- PRN 134, INMARSAT III F3 POR (Pacific Ocean Region), located above the Equator at 178°E longitude

Updated information concerning the broadcasting from these satellites is constantly available from:

`http://wwws.raytheontands.com/waas/`

EGNOS (Europe)

Test signals under control of the EGNOS Test Bed are permanently broadcast from the following geostationary satellites:

- PRN 120, INMARSAT III F2 AOR-E (Atlantic Ocean Region-East), located above the Equator at 15.5°W longitude
- PRN 131, INMARSAT III F1 IOR (Indian Ocean Region), located above the Equator at 64°E longitude (WADGPS corrections only, i.e. no pseudoranges)

Regularly updated information about these two satellites can be found on the following web site:

`http://www.esa.int/navigation/`

Information can also be obtained from EURIDIS MCC (Mission and Control Center): tel. : +33 (0) 56128 1356.

MSAS (Japan)

No information available to date concerning the availability of a signal.

The launching of MTSAT (Multi-functional Transport Satellite) geostationary meteorological satellites is planned:

- In 2003 for MTSAT-1
- In 2004 for MTSAT-2 (located at about 140° E).

These satellites should accommodate the MSAS (MTSAT Satellite-based Augmentation System), a function under control of the *Japan Civil Aviation Bureau*. This system is expected to cover the Asia/Pacific area.

List of Possible Anomalies

CM Category
- GPS Not Ready
- RAM Anomaly
- Processor Anomaly
- Timing Anomaly
- Program Memory
- Data Memory Anomaly
- Reception Circuit Anomaly
- Correlation Circuit Anom.
- Communication C/A - P/Y
- Unused Output Data

CONFG Category
- Bad Config. Integrity
- Config. Parameter Error

DGPS Category
- No Sending Station
- CPU-DIFF Overflow

GEODY Category
- Geodesy Error
- Altimetry Error

I/O Category
- Unknown Input Data
- Bad Input Data
- GPS Data Anomaly
- DPRAM Anomaly
- Bad Message Length
- EEPROM Anomaly
- Trigger Time-Tagging Error
- Unknown Command
- Bad Parameter Format
- Bad Block Format
- Bad Command Checksum
- Input Error on DPR1
- Input Error on DPR2
- Input Error on DPR3
- Bad LRK Block on COM4
- Overflow COM1
- Overflow COM2
- Overflow COM3
- Overflow COM4
- Format Interpretation
- Input Error COM1
- Input Error COM2
- Input Error COM3
- Input Error COM4
- Overflow DPR1
- Overflow DPR2
- Overflow DPR3
- Reception Error on COM1
- Reception Error on COM2
- Reception Error on COM3
- Reception Error on COM4

IHM
- IHM Error
- No Computed Position
- X Out Of Screen
- Y Out Of Screen
- String Exceeds Screen Width

INTRF
- Xilinx Load
- Low Power Command
- PCMCIA Overflow
- File System Full
- Unknown PC Card ?
- Battery Voltage
- Corrupted File System
- First Antenna Error
- Second Antenna Error
- Third Antenna Error
- Fourth Antenna Error
- File Open Error
- File Close Error
- File Write Error
- File Read Error
- Navigation Error
- Binary File Incoherent

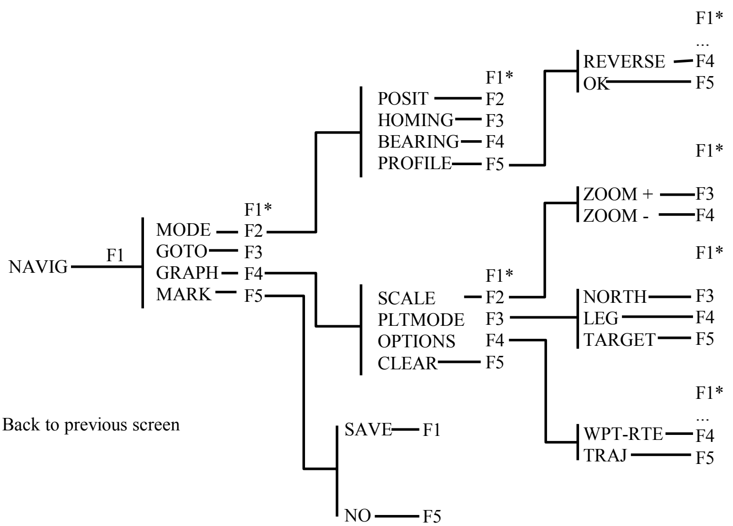
POSIT Category
- No Corrections Received
- Too Few Svs
- GDOP Too High
- LPME Too High
- No Fix Computation
- Kinematic Initialization

SYSTM Category
- Software Error
- Frozen Display
- Unknown Option Code
- Bad Checksum C3 Codes
- Bad Log Checksum
- Real Time Clock
- Dual-Port RAM
- Core Module Not Ready
- Bad Program Checksum
- Data Memory Test
- Coprocessor Test
- Error On Serial Port
- File System IDE Mount. Err.
- Option No More Available
- Max Option Tries Reached
- Full Anomalies Journal
- CMOS Date Failed
- Autotest error
- Bad Blocks
- Restarts since Autotest
- Mailbox Overflow
- PCMCIA Removed ?
- CM File Line Too Long
- CM Identification Error
- CM Card File Inconsistency
- CM Flash Clear Error
- CM Program File Load Error
- Kinematic Mode Change
- Send Error
- Appl. Soft Reload Error
- Backup RAM failure
- Stack Overflow

TRM100 Functions Summary

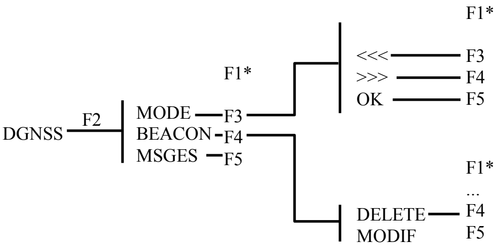
This chapter shows the organization of the functions available in the TRM100. By "TRM100", we mean either the TRM100 keypad/display terminal option (TRM100 unit), or the software emulation of this option included in the *TRM100 PC Software* (see Remote Display view). Therefore the diagrams presented below apply to either the hardware of software version of the "TRM100".

❑ NAVIG Function

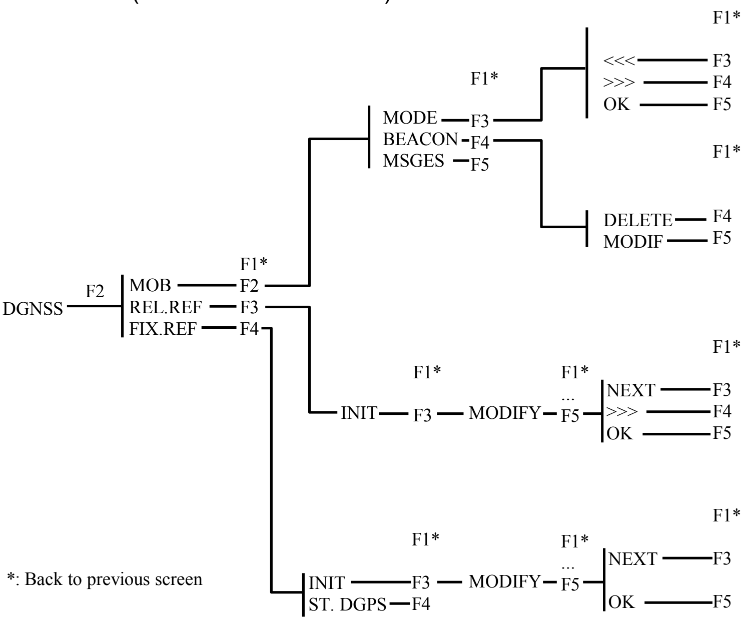


❑ DGNSS Function

In a mobile in which REFSTATION is not installed

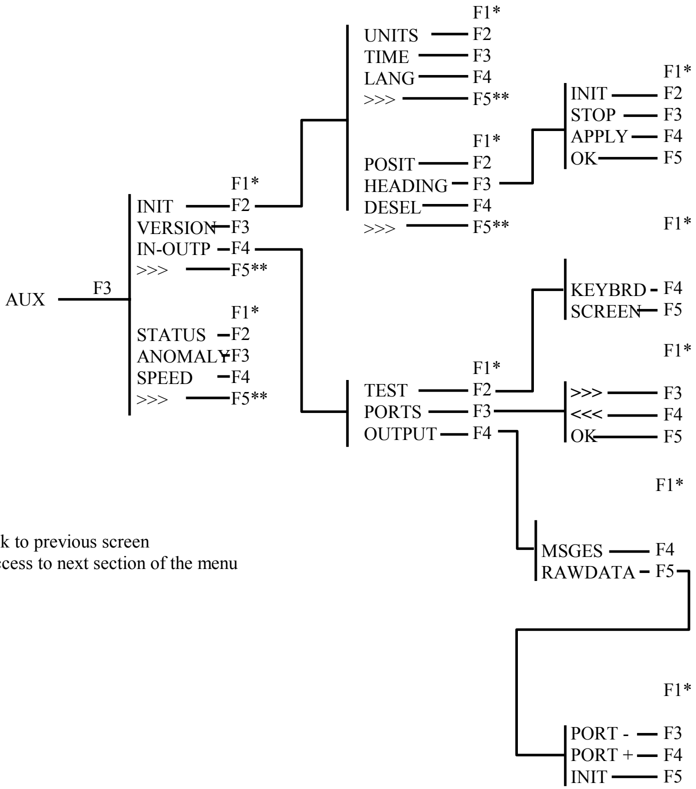


In a station (REFSTATION enabled)



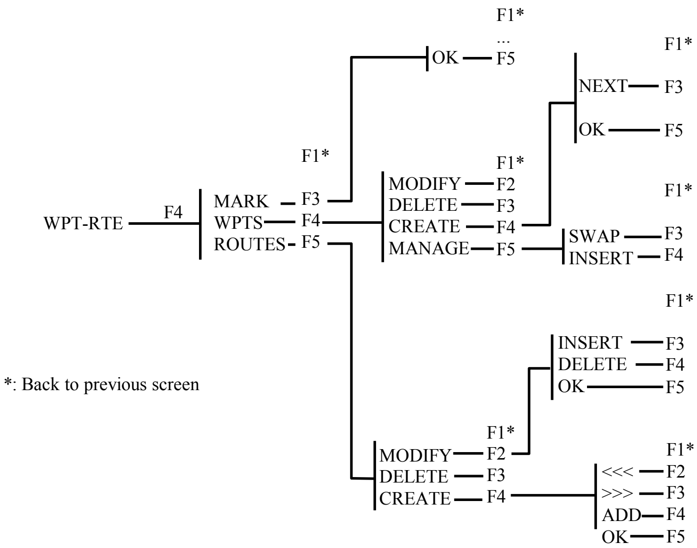
*: Back to previous screen

❑ AUX function

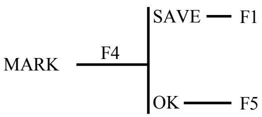


*: Back to previous screen
**: Access to next section of the menu

❑ WPT-RTE Function



❑ MARK Function



Fix Quality Index

This index ranges from 0 to 19 with the following meaning for each of the possible values:

- 0: No position solution, or straight GPS with SA, HDOP poor
- 1: Straight GPS with SA, HDOP good
- 2: Straight GPS, no SA
- 3: Straight GPS, no SA, HDOP and LPME both good.
- 4: Diff mode in 2D
- 5: Diff mode in 2D, HDOP and LPME both good
- 6: Diff mode in 3D, HDOP and Diff corrections both poor
- 7: Diff mode in 3D, HDOP poor, Diff corrections good
- 8: Diff mode in 3D, Diff corrections and HDOP both good
- 9: Diff mode in 3D, HDOP, LPME and Diff corrections all good
- 10 to 13: EDGPS from meter (10) to decimeter (13) precision after a time constant of approximately 8 minutes for a single-frequency receiver, or 3 minutes for a dual-frequency receiver
- 14 to 19: Kinematic mode

The quality index is derived from the LPME (Line of Position Mean Error) - quadratic average of weighted residuals on every computed line of position, a quantity deduced from the position solution.

The quality index is a function of both the station-to-mobile distance and the following ratio:

LPME (measured) / LPME max.

The expression of the quality index (Q) is then:

$$Q = 14+7\,[1-(LPME\ measured\ /\ LPME\ max.)]$$

Where *LPME max.* equals (expressed in millimeters):

15 + Station-to-Mobile Distance, in km (single-frequency)

20 + Distance Station -Mobile in km (dual-frequency)

As an example, for a station-to-mobile distance of 23 km and with a single-frequency receiver, we have:

LPME max =38 mm

- In kinematic, the fix quality index can range from 14 to 19.
- When it is less than 14, the position computation is re-initialized
- If only 4 satellites are used, the LPME cannot be determined and so the fix quality index is forced to 15 to warn the user.
- The quality index is maximum 19 for an accurate solution (KA)
- It is maximum 18 for a real-time solution (KR). ♣

Glossary

ATD: Along Track Distance. Distance still to go, projected onto the leg.

Bearing mode: Navigation mode based on a waypoint that you specify. This mode provides graphic information to help you reach that point according to the bearing angle defined by the waypoint location and your current location when you select this mode.

The basic positioning information (from the standard display) is recalled on the right of the chart.

CTS: Course To Steer to head for the target waypoint along a great circle.

CTW: Course To Waypoint. Angle measured with respect to True North from your current position.

DTW: Distance To Waypoint. The distance, measured along a great circle, still to travel before getting at a waypoint.

Homing mode: Navigation mode also based on a waypoint that you specify. This mode provides graphic information to help you reach this point along a great circle.

The basic positioning information (from the standard display) is recalled on the right of the chart.

Leg: The path -along a great circle- between any two successive waypoints in a route.

Position mode: Provides positioning information (position, speed, course, etc.). This mode can be used when no further navigation information is required. The mobile position and the possible waypoints nearby are however shown on the graphic screen.

Primary antenna: GPS antenna used as reference in heading or relative processing.

Primary mobile: Navigator receiver given the capability to accurately determine the vector between its antenna position and that of a secondary mobile from which it receives corrections data.

Profile mode: Navigation mode based on a route that you specify. This mode plots graphic information to help you follow this route.

The basic positioning information (from the standard display) is recalled on the right of the chart.

Reference station: A stationary receiver, with accurately known location, that generates and broadcasts corrections data. Also called *base station*.

Route: Formed by a succession of waypoints (up to 15 waypoints). The receiver will guide you along this route after you select the Profile mode configured to follow this route.

Secondary antenna: The data received by this GPS antenna are used in Aquarius to let it determine either the distance separating this antenna from the primary antenna (relative processing) or the direction in which the line passing through these two antennas point to (heading processing).

Secondary mobile: Mobile receiver virtually operated as a reference station, i.e. transmitting corrections data, so that the primary mobile can accurately determine the vector between its antenna position and that of the secondary mobile. Also called *moving base station*.

TTG: Time To Go. An estimate of the time required before reaching a target waypoint, based on the distance still to go and your current speed.

Waypoint: Any location holding interest for you. The definition of a waypoint consists of a number, a name, an icon and X-Y or L-G coordinates (a 2D position). The receiver will guide you to this waypoint after you select the bearing or homing mode configured to head for this waypoint.

XTE: Cross Track Error. This is the distance from your current position to the leg being followed, measured along the line passing through your position and perpendicular to the leg (normal distance). ♣

Index

$

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

Q

R

S

T

U

V

W

Z