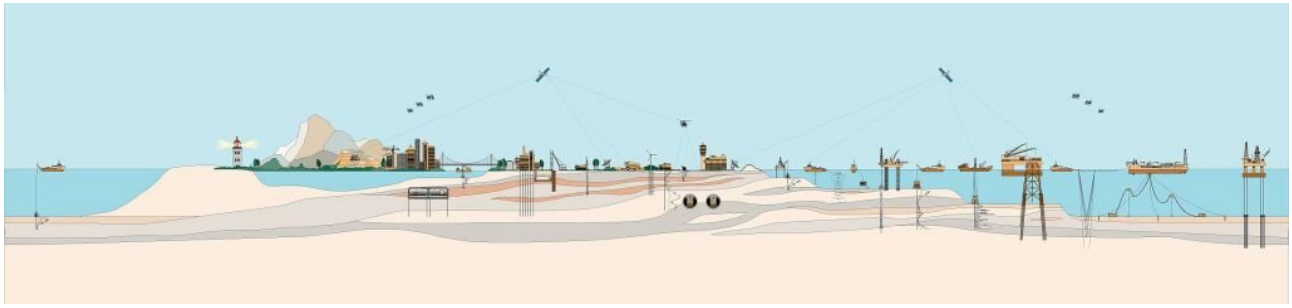
Operating Manual

Starfix-HP Mobile

SPM software Version 5.08



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1 Introduction

1.1 About the HP Mobile and SPM software

The SPM2000 with SPM 5.0 software provides single and dual frequency GPS positioning, using corrections generated by the global Fugro Starfix network of reference stations broadcast via geostationary communication satellites.

The standard single frequency service is Starfix and the dual frequency services are Starfix.Plus, Skyfix.XP (Global State Space), and Starfix.HP (High Performance).

Both, Starfix and Starfix.Plus are sub-metre level accuracy services. Starfix-Plus is the recommended service for equatorial regions where the standard service cannot achieve metre level accuracy during any peak of the solar cycle.

Starfix.HP is the Fugro positioning service with decimetre level accuracy at distances up to 1000 km from Starfix.HP reference stations making this system ideal for offshore applications requiring very precise horizontal and vertical positioning. The HP engine is now aided with the Starfix.XP engine to provide more robust and accurate position.

Skyfix.XP is Fugro's Positioning service based purely on State Space corrections.

1.2 New in HP Mobile Version 5

1. Option to use up to 4 broadcast streams, i.e. Starfix Satellite connections, see section 11.1
2. SPM software prevents the user from using Com ports which are already in use, see section 7.4.
3. HP and XP calculation engines updated to be more robust, see section 5.
4. Automatic GPS connection option which scans for the correct baud rate, see section 9.4.2.
5. Starfix.HDG: heading calculation between SPM and external GPS, see section 9.6.8.
6. New Loader software, Loader 9, with SPM FTP service, see section 13.

1.3 Using this manual

1.3.1 Hyperlinks

Throughout this manual digital hyperlinks have been used: text in dark blue color contains a link. Use a Left Mouse Click on the dark blue letters to jump to the section.

These digital hyperlinks are not available to paper-users. However the section number will be mentioned, too, and thus the paper-user can still follow the reference.

1.3.2 Reference to SPM Status displays and menu items

The SPM has two main user interfaces: through the Front panel and through the SPM full menu display (monitor or SPM Remote), see 4.2 HP mobile installation: three options. In this manual I have mostly used the full menu display as example, because the front panel only allows for limited user interface and debugging or configuration options.

The front panel Status displays are not referred to, other than under the name F1 xxx Display, e.g. F1 Position Display. Use

Figure 6: System Display - front panel, page 51 for cross reference to front panel.

1.3.3 Figures with menu overviews

In this manual the following figures provide a road map through the SPM software. Print out and keep as reference.

Figure 6: System Display - front panel, page 51

Figure 7: System Display – F1, page 52

Figure 8: SPM Menu, page 81

Figure 9: SPM Menu (hidden), page 115

Figure 10 Trouble shooting GPS failure, page 125

2 HP Mobile System Description

Starfix HP is Fugro's centimeter level GPS solution. HP stands for "High Precision". HP is a software solution. Starfix.HP is currently only deliverable including the hardware inside the Starfix.HP 'box', further called the HP Mobile.

The **Starfix HP Mobile** is the 'box' shown in the picture above.

Inside the HP Mobile one finds a **GPS card** (AshtechZ12, Topcon or Novatel), a **Starfix demodulator** for decoding the Starfix corrections and **SPM software**.

The SPM software combines the signals from the GPS and the Starfix network to form three position solutions: **Starfix.HP**, **Skyfix.XP** and **Starfix.VBS**. As a fourth position the **GPS standalone** – as calculated by the GPS card - is also available.

This is shown in the figure below. The arrow indicates input and output, a dotted arrow indicates an optional input. Note that the HP engine can use both HP and XP corrections. This is a new feature of SPM version 5, which was not available in previous SPM versions.

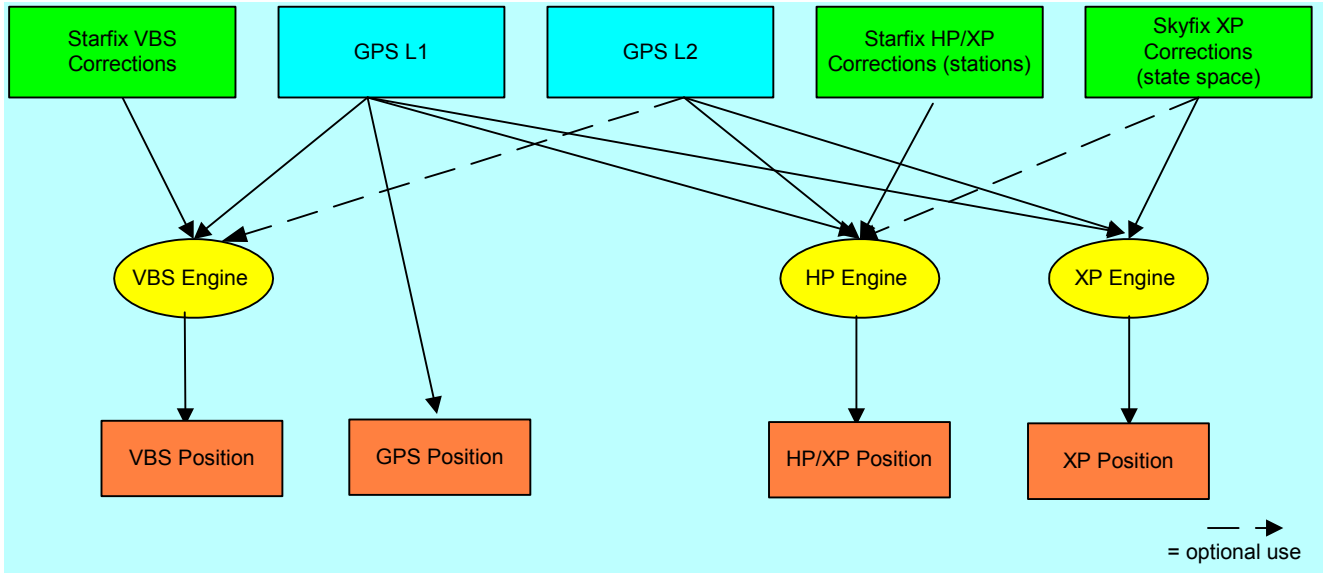


Figure 1 Four position solutions from SPM

The SPM software also is capable of computing the Heading between the HP Mobile and an external GPS receiver. This is called **Starfix.HDG**. This is new in SPM version 5.

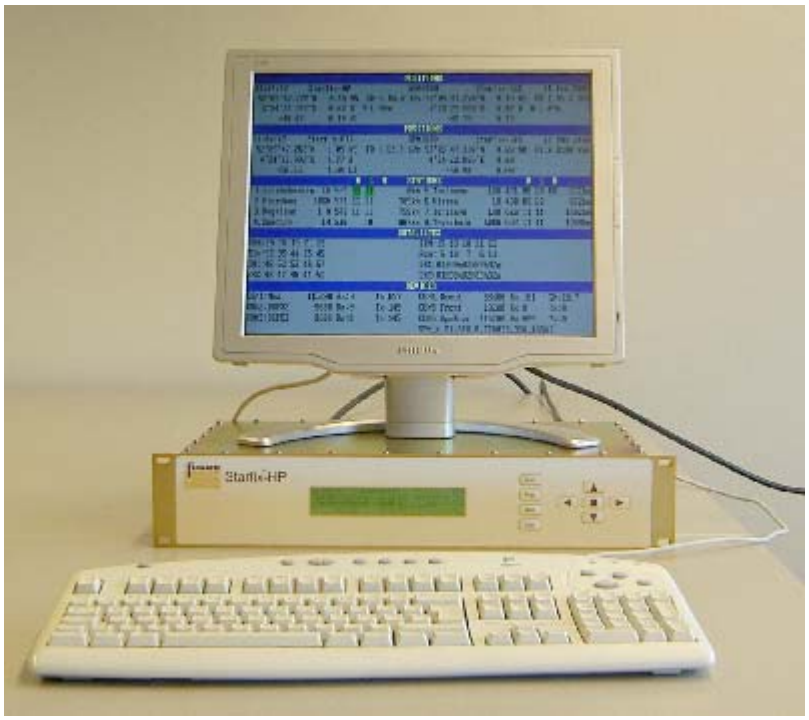
Starfix.SPM is the operational software running on the processor card inside the HP Mobile. The SPM software has the HP, XP and VBS engines embedded and controls the output ports exposed at the back of the Mobile.

The **Correction Signals** are signals broadcast on the L-band via communication satellites as part of the Starfix network. The Starfix network ensures that reliable, up-to-date, continuous HP corrections are broadcast. Apart from the HP signals, the Starfix network also broadcasts Starfix.Plus corrections, Differential GPS corrections and Differential Glonass corrections.

The **demodulator** is required to de-crypt the encoded Starfix signals.

In 2005 the Starfix network introduced **Starfix subscription**. Whilst before one simply needed a demodulator, it is now possible to allow for subscription (and hence de-subscription), thereby enabling that users can use a pay-for-use system that is enabled and disabled without the need to remove hardware.

The HP Mobile user interface can be done in three ways. The first time user is advised to set the HP up with an external keyboard and monitor: it is easy to set up and allows for a good display of all the features. Using the frontpanel only gives limited tools and visual feedback. Note: monitor must be attached on powering up.



Output can be made available through three types of Com ports: ports from the internal processor board (Com 1 to 4) , GPS ports and virtual (multiplexer) ports. In fact, more ports are available, but are internally wired and not available to the user.

Over time various hardware variations of the HP Mobile have been produced; with or without internal demodulator, different types of GPS cards and different types of demodulators. Hence this manual cannot describe exactly the configuration of the internal wiring and number of Com ports availble to the user. For example, if an internal demodulator is present, then the number of Com ports is reduced from 4 to 3 because port 4 is used for the Demodulator.

3 HP Mobile components

With the word “HP Mobile” we refer to the box as shown in the picture.

A Starfix HP mobile consists of:

1. L1/L2 GPS card (Ashtech Z12 or Topcon)
2. Demodulator (Novatel, Topcon, 3000LCE or none)
3. Processing board
4. Software on processor card
5. Loader software
6. SPM software
7. Demodulator software
8. Demodulator firmware
9. Alison490 combined GPS and L-band antenna

3.1 L1/L2 GPS card

Units can be delivered with the following GPS cards:

- Ashtech Z12
- Topcon DG80
- Novatel

The GPS cards are automatically configured when the SPM software starts up, to ensure that the configuration is correct for the HP solution.

Port A of the GPS card is used for the SPM software for HP, i.e. COM A is interfaced to Com 6 of the processing board of the mobile.

Other output ports of the GPS, e.g. GPS Port B, are wired to the back panel of the HP to allow the user to interface directly to the GPS card.

3.2 Demodulator: Novatel, Topcon or 3000LCE or none

The function of the demodulator is to receive and decode the Correction signals from the Starfix network.

HP units can be delivered with or without internal demodulators. Units delivered without internal demodulator will have 4 COM ports at the back panel of the mobile. Units delivered with internal demodulator will have only 3 COM ports, as the fourth port is internally connected with the demodulator.

Older HP units were delivered with demodulators of type 3000 LCE. Newer models (since approximately 2003) are delivered with Topcon demodulators and the latest HP Mobiles are delivered with Novatel combined GPS and Demodulator card.

It is possible to implement an internal demodulator or change demodulators after delivery.

It is possible to use an external demodulator. A new feature in SPM version 5 is that one is able to use up to 4 broadcast streams, i.e. multiple demodulators, see section 11.1.

3.3 Processing board

The processing board is a PC104 with Pentium 300 (300MHz), older types 166 MHz. The board consists of Cpu, a hard disk and 2 com ports. A Com port extender is connected for Com Ports 3 to 6.

Com port 6 is connected to the GPS card, Com Port 5 is connected to the Front Panel Display and optionally, Com port, 4, is connected to the demodulator. Com Ports 1 to 3 are available for user configurable input / output (mainly HP Position output) through the Back Panel of the HP Mobile.

The Processing board comes with several programs on it: the Loader program, the SPM software, DOS Prompt.

Future versions with larger hard discs will allow logging on the processing board hard disc. This is not available yet.

3.4 Software on the processing board

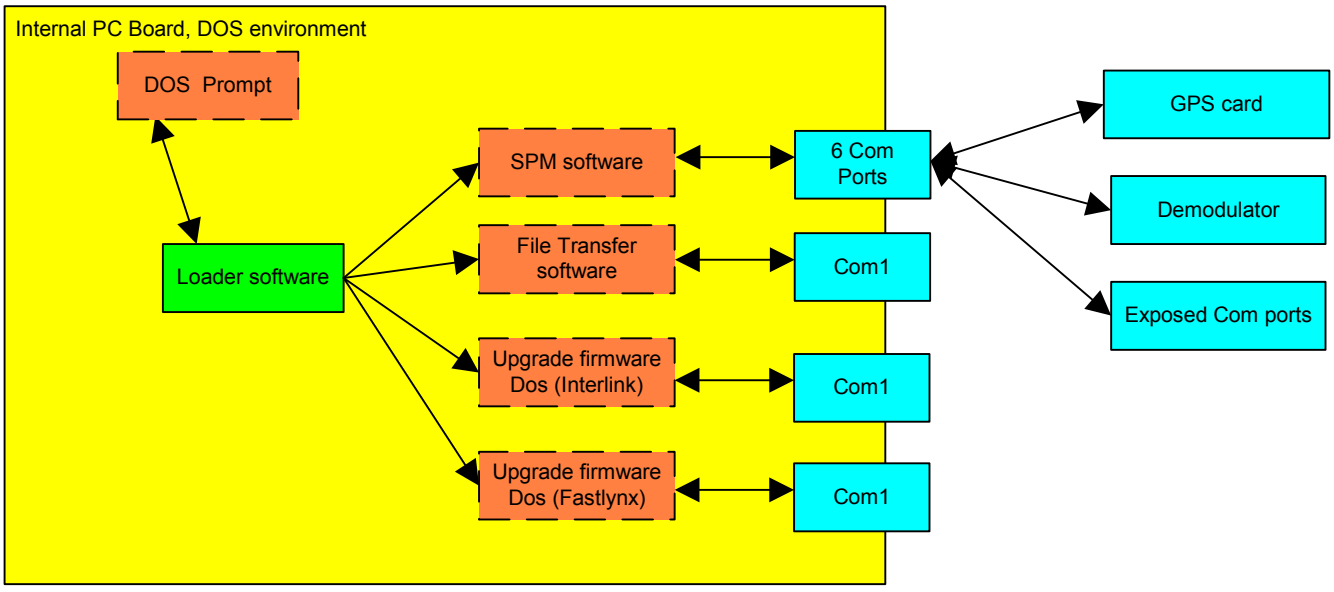


Figure 2 Software on the processing board

The internal processor board is running in a Dos environment.

The Loader software is the central program from which other programs can be started. These programs are indicated in orange with a dashed outline in the figure above, and include the SPM software and the Dos prompt. When exiting a program, the Loader is automatically started again.

When booting the HP Mobile the Loader software is automatically started. In turn the Loader software automatically starts SPM software.

The SPM software configures the Com ports of the processing board and thus the exposed Com ports at the back of the HP Mobile. The SPM software communicates with the Gps card and Demodulator.

3.5 Loader software

The Loader program allows the user to start the different software packages available on the processing board. The Loader software is usually only brieflyseen on start-up, where it automatically starts the SPM software.

3.6 SPM software

SPM stands for Starfix Plus Mobile. The SPM software calculates from the GPS data and Starfix Corrections to an HP, XP and VBS Position Solution. With the SPM software one regulates the input and output on the Com Ports. The SPM software is a Fugro Intersite B.V. product.

3.7 Demodulator Firmware

Each demodulator is running it's own firmware as provided by the manufacturer of the demodulator.

3.8 Demodulator Configuration software

The demodulator firmware needs to be configured, for the signal frequency for example. This is applicable to the 3000 LCE demodulator as well as the Topcon demodulator.

The 3000 LCE demodulator needed to be configured using the Configuration 3000L software, described in Appendix G.

The Topcon demodulator never has had dedicated configuration software. Since SPM software version 4.16 the configuration of the Topcon demodulator is integrated in the SPM software.

3.9 Alison490 combined antenna

The Alison490 antenna functions as a standard GPS antenna as well as an L-band receiver for the Starfix corrections signals.

3.10 Com Ports

There are three types of Com Ports as explained in the table below. Not all Com Ports are exposed to the user. This is illustrated in the Internal Block Diagram in Figure 3.

There are various hardware variations of the HP Mobile in circulation (with or without internal Demodulator, etc.). Thus the list below is indicative only.

Com Ports		
Type	**Com Ports**	**Exposed to user**
Internal processing board	6 Com Ports on the internal processing Board	Com1 to 3 for HP Mobile with internal Demodulator: Com1 to 4 for HP Mobile without internal Demodulator:
GPS Card	2 or 3 Ports, Port A, B, C	Port B and C, if available, includes 1pps.
Virtual Ports, MUX	6 Virtual ports are exposed to Fugro's Starfix users via the MUX (multiplexer) channel	MUX 11 through to 16, Exposed through Com1 if Com 1 is configured to MUX driver.

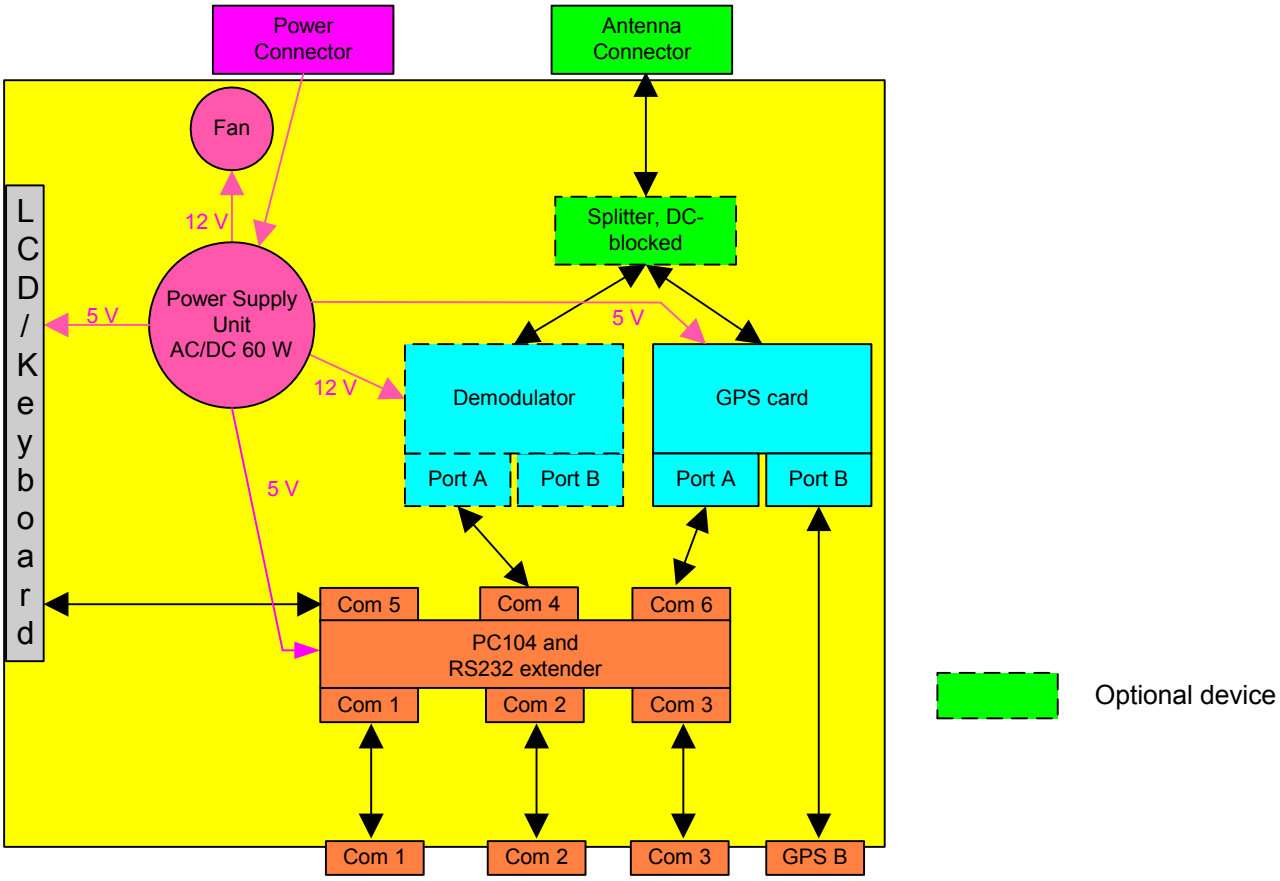


Figure 3 Internal Block diagram for HP Mobiles with internal demodulator (Topcon or LCE3000)

HP Mobiles with internal Novatel combined GPS and demodulator card are configured differently. The Novatel card is interfaced on Com 6, which frees up Com 4.

For additional information on Pin Layout, see Appendix B Back panel Pin Layout

3.11 1 pps

The 1pps from the Gps Card is available on Pin 9 of GPS Port B.

In older models of the SPM mobile this 1PPS was not capable of driving high power inputs such as Com ports, they could therefore not be used in combination with 1pps drivers that work through Com ports (such as in Starfix.Iowin), they should be buffered before being used. Newer models of SPM Mobile have internal buffering and do not have this problem.

4 Installation

A mobile system can consist of:

- A Starfix HP mobile with a GPS L1/L2 Antenna and 30 metres of RG213 antenna cable

or

- A Starfix HP mobile with integrated demodulator, Alison 490 combined L-Band & GPS antenna and 30 metres of RG213 antenna cable.

Figure 4: Starfix HP mobile

The Starfix HP mobile is a 2 unit high casing that should preferably be installed in a 19" rack with sufficient space on all sides to ensure proper cooling. The casing has a wide-input power range (85-265 Vac/50-440 Hz).

4.1 GPS Antenna and cable installation

For a proper cable installation, the following points should be considered:

- Do **NOT** connect the antenna to the top unit while it is still powered.
- Do not install the GPS antenna nearby an INMARSAT installation. A distance of 6 meters or more is recommended.
- Avoid antenna installation too close to any other transmitting antennae.
- Make sure the antenna has an unobstructed view in every direction. If the antenna view is blocked (e.g. by a mast) between the satellite and the antenna, it is possible that the signal will be lost.

- Run the cable neatly from below deck to the antenna.
- Avoid the cable to be exposed in areas where it is likely to get damaged.
- Avoid the cable hanging to the connector without support.
- The biggest cable loss occurs with corroded connectors, make sure they are taped and protected against water ingress.
- The maximum cable loss for the GPS antenna without inline amplification is specified at 15 dB (1500 MHz, 30 metres of RG213). If a longer cable is needed than supplied (30 meters RG213), an L-band in-line amplifier, or low loss cable should be used.
- Proper grounding in the cables is essential. If cables, both the GPS cable and / or the Starfix Correction cable, are not properly grounded, signal interruptions can occur. A signal interruption can cause the HP solution to be reset with new convergence required.

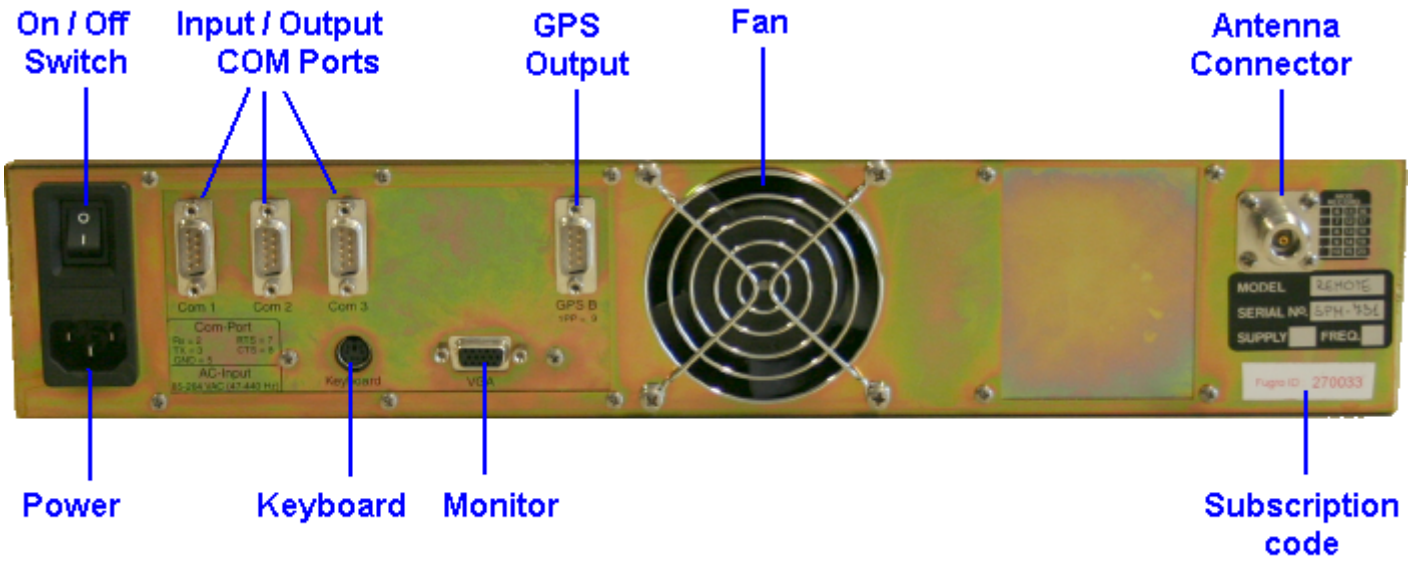
4.2 HP mobile installation: three options

There are three methods for operating the HP Mobile, as described below.

Choose your preferred method and install the top unit accordingly. One is advised to choose either option 2 or 3. Option 3 is only available for Fugro Starfix operators as it requires the Starfix software.

1. Front panel operation		Limited operation. No external hardware required, operation through push keys at the front.
2. Keyboard and monitor operation		The keyboard and monitor are connected to the back panel of the HP Mobile. Note: power cycle the HP Mobile with the monitor connected, else monitor won't be detected.
3. Remote SPM operation		Connect a null modem cable between the HP Mobile Com1 and the computer. On the computer one runs Fugro's Starfix.Iowin software with a GPS Receivers->SPM Remote driver. Fugro's Starfix.SPMMon program exposes the SPM software. The SPMMon program can be run on any pc in Fugro's Starfix.MM network.

4.3 Configure Output



Connect serial cable to Com 2 or Com 3 to get HP Position as NMEA or HP_MONITOR format. See further in manual on instructions for SPM software configuration.

5 The Position Calculations

The HP Mobile is running SPM software which is capable of calculating three Position Solutions: Starfix.HP/XP, Skyfix.XP and VBS.

5.1 Theory of the Starfix.HP/XP Position Calculation

Starfix HP is one of Fugro's high precision GNSS services. GNSS stands for Global Navigation Satellite System, which includes GPS, the Russian Glonass and European Galileo systems. HP is currently based on GPS only, but Glonass and Galileo are in the process of being implemented.

Starfix HP is based on differential techniques, using a network of reference stations to reduce or eliminate biases due to the troposphere, satellites orbits and clocks. Ionospheric effects are eliminated by forming linear combinations of L1 and L2 observations (the ionospheric effects are frequency-dependent). Data from the reference stations is transmitted to mobile users using geostationary (communication) satellites, like Easat, Amsat, etc..

Fugro's Starfix Satellite uplink yard

Shown in Appendix I is Fugro's global network of reference stations, together with the areas covered by the geostationary satellites, which provide the reference station data to users. Some stations are used for services other than HP as well, such as standard DGPS, which provide accuracies at the meter level.

The parameters we're really interested in are 3D position. In addition, other parameters have to be estimated as well, such as carrier ambiguities and tropospheric effects. Carrier ambiguities are constant (provided no cycle slip or loss of lock occurs), whereas tropospheric effects change slowly with time. As mentioned before, no attempt is made to solve for the integer values of the carrier ambiguities, as is done in RTK, because the baselines are in general too long.

One may wonder if we really need differential techniques to get decimeter level accuracies. The reason for using differential techniques is that we want to reduce or eliminate biases due to the atmosphere and satellite orbits and clocks. However, nowadays precise (10-20 cm standard deviation) orbits and clocks are available in real-time. For long baselines or when large height differences are involved, tropospheric effects have to be estimated, whereas ionospheric effects are eliminated, not by using a differential set-up, but by forming linear combinations of observations. Another reason for applying differential techniques is that convergence time can be reduced, since it allows for the resolution of the integer ambiguities; however, this will work only for relatively short baselines.

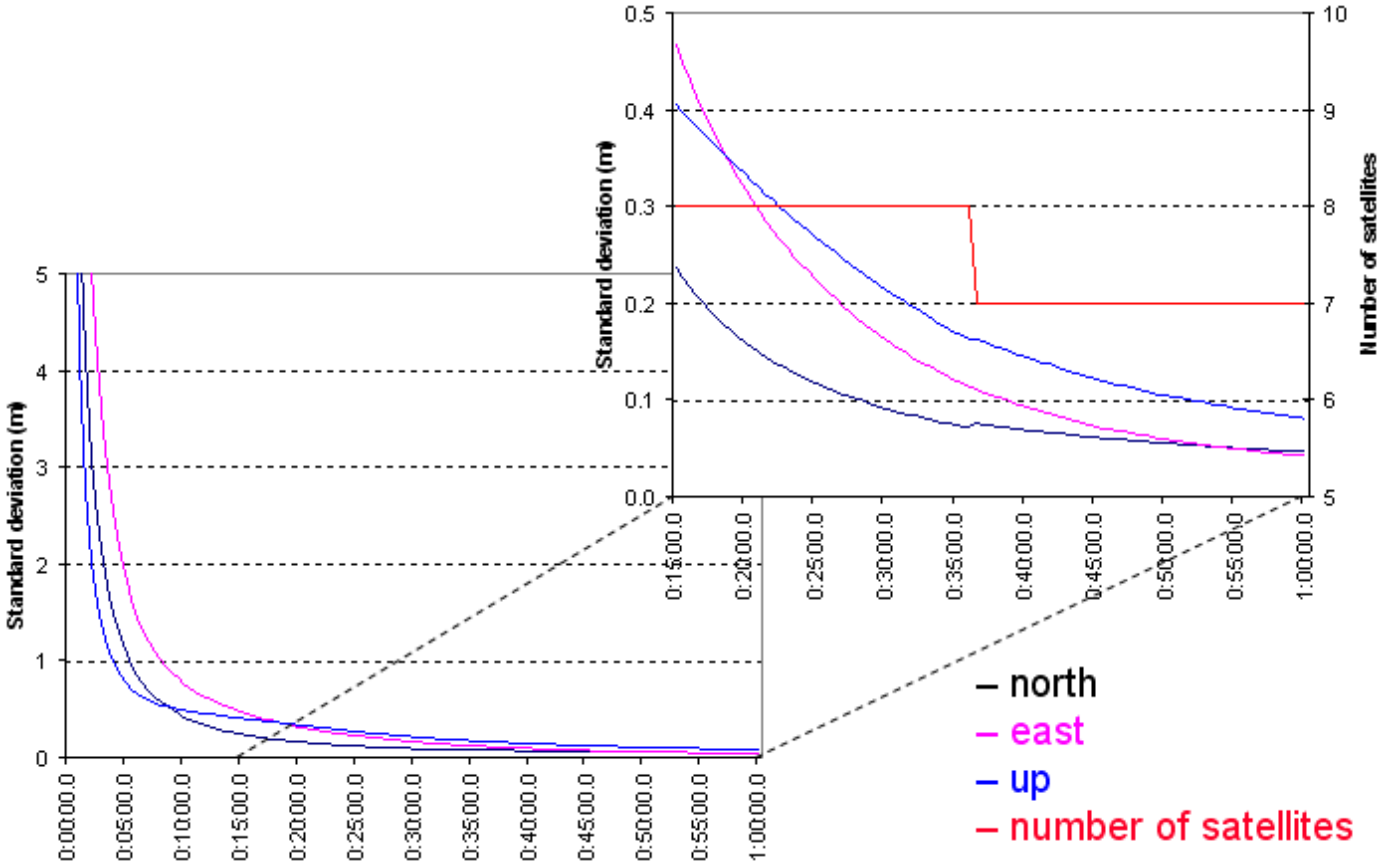
For HP, data from all reference stations should be transmitted to users, the amount of data depends on the area covered by the satellite beam – a beam servicing Europe will not transmit data from Australian reference stations.

The user must select the stations he wishes to use in the HP calculation.

From SPM version 5 onward the HP solution is aided with XP State space corrections, hence the solution has been renamed to Starfix.HP/XP. The XP engine incorporated is the engine formarly known as Starfix.GSS.

The State Space corrections consist of the differences between precise satellite positions and clock offsets, and those computed using the parameters, transmitted by the satellites in their navigation messages. In the SPM calculation engines,

these corrections are therefore added to the parameters computed using the broadcast navigation messages, resulting in precise satellite positions and clock offsets.



Example of the convergence period for a moving receiver (example for HP not using XP corrections).

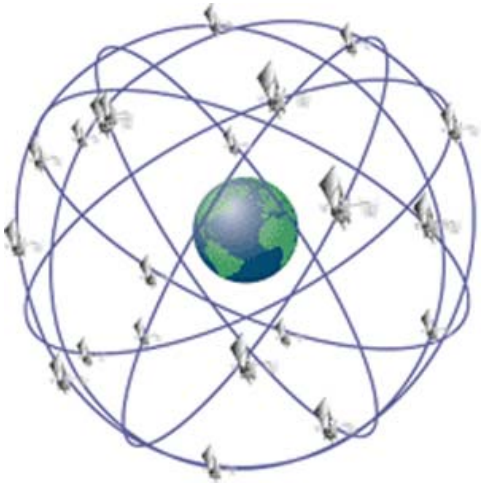
In the picture above is shown an example of a convergence period of a moving receiver. The initial precision is comparable to the one obtained from absolute positioning using code observations only. After a while, the precision improves, due to the increased weight of the carrier observations. RTK (Real-Time Kinematic) techniques take advantage of the integer nature of the carrier ambiguities, but can be applied to relatively short baselines only. For HP, the baseline are in general too long to resolve the integer ambiguities. As a result, the convergence takes a long time.

In general, a 45-60 minutes convergence period is acceptable for HP users. However, sometimes lock to the GNSS signals is lost, due to obstructions or interference. In those cases, users don't like to wait another hour before to reach decimeter accuracy. Fugro has developed and implemented a technique for fast reconvergence, which makes it possible to bridge gaps in GNSS signal reception of up to 60-90 seconds. Once the satellite signals are re-acquired after a gap, positioning will almost instantaneously revert to the high precisions available before the gap.

Note: HP will start a convergence after each GPS interruption.

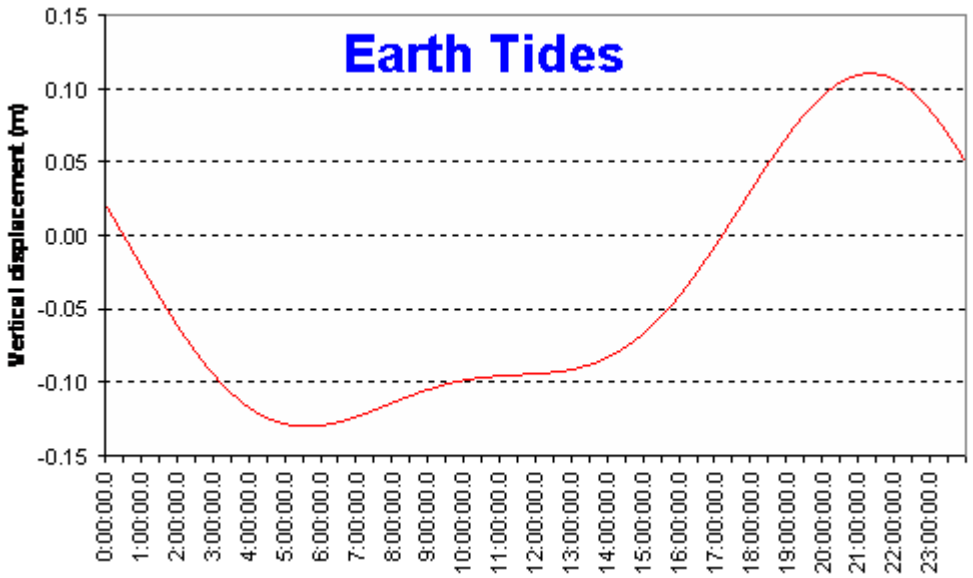
5.2 Theory of the Skyfix.XP Position Calculation

Fugro also offers a precise positioning service based on absolute positioning techniques. This techniques, developed by NASA's Jet Propulsion Laboratory (JPL) in 1997, is known as Precise Point Positioning (PPP). Instead of using network corrections, it uses corrections to the satellite orbits and clocks (which themselves were obtained from a network of tracking stations). Fugro uses corrections provided in real-time by JPL, which maintain their own network to determine precise GPS orbits and clocks.



The JPL network is not the same as the Fugro network of reference stations. Fugro wants to maintain independence between the HP and XP services and therefore does not provide data from these stations to JPL.

Since PPP is an absolute positioning technique, there are additional error sources which have to be taken into account. Fortunately, their effects can be modeled very precisely. The most important effects are due to Earth tides (up to 30 cm) and, to a lesser extent, ocean loading (up to 5 cm) and polar motion (up to 2.5 cm).



Vertical displacement due to Earth tides in Leidschendam, 9 March 2006

For Starfix.XP, the transmitted data consists of orbit and clock corrections for a limited number satellites (for GPS less than 30).

The time it takes to reach sub-dm accuracy is comparable to the convergence time of HP. The fast reconvergence technique mentioned under HP is also available for Starfix.XP.

For baselines less than 1000 km, HP is slightly more accurate than XP.

5.3 Names of the Position Calculations

The names of the positioning solutions in the SPM2000 have been adapted from software version SPM4 to SPM5.

The SPM 4 positions Starfix.HP and Starfix.GSS calculations are now merged into a single new engine named Starfix.HP/XP. This engine can operate in three user-configurable modes: Starfix.HP only, Starfix.XP only or an optimal combination of the two.

The suffix XP refers to the type of corrections: global state space. The prefix Starfix designates it is the Starfix code base.

The engine previously known as Starfix.XP has been renamed to Skyfix.XP as the code-base is 100% independent from the former Starfix.GSS (now Starfix.XP) engine.

The independence of the Starfix.HP and Skyfix.XP solutions is therefore guaranteed:

Calculation engine code bases are 100% different

Generation of corrections are 100% independent (no common reference stations)

If required, it is possible to receive the two types of corrections via two broadcast satellites

Multifix.XP uses the exact same global state space calculation engine as the Skyfix.XP solution in the SPM2000 but provides additional degree of independence in terms of hardware, operating system, application and compiler.

5.4 Theory of the VBS Position Calculation

Virtual Base Station (VBS), where the data from multiple reference stations is used in the processor software to produce enhanced corrections for the user's location. This service provides optimal position accuracy with a minimum dependence on the user's location.

With normal differential GPS the Pseudo Range Corrections (PRC's) measured at a Reference Station are broadcast to the mobile location and applied without alteration. This is based on Starfix RTCM Type 1 corrections for L1 GPS frequency.

Fugro's VBS calculation is based on the PRC's observed at multiple Reference Stations. Using a Least Squares Adjustment, which has also the Reference Station Clock errors modelled, PRC's at the user's location are derived.

Starfix Plus is also available to users with a dual frequency GPS receiver (L1 and L2). These users can use Starfix L2 corrections (annotated with a D for dual in the SPM software). The D corrections are Starfix RTCM Type 15 corrections for L2 GPS. Using the D corrections is especially advisable in situations with a lot of ionospheric and tropospheric disturbances, as the RTCM Type 15 corrections contain the ionospheric information at the reference station and can account for differences in ionosphere and troposphere between the reference station and the user location.

Differences in ionosphere and troposphere disturbance between the Reference Station and user's location are derived from Ionospheric and Tropospheric models and corrected for.

The VBS Position Calculation can be based on corrections for L1 and / or L2.

5.4.1 VBS and Height aiding

The VBS Calculation has options for Height Aiding. With the Height Aiding on, the solution is aided with Height. The Height from GPS is less reliable than the horizontal control, mainly because there are only GPS satellites above, not below the receiver. Height Aiding, i.e. using the Height as an external observation, can improve the horizontal position.

If the user elects to use Height aiding, then the Height must be set very carefully. If a wrong Height is entered, then the VBS Position will drift away from the correct position over time. Errors of hundreds of meters have been observed, when wrong heights were used.

The Height is entered in the SPM menu in SPM Menu → Positioning → Initial Position, see section 9.6.1. The Height used is a cumulative of the Antenna Height and the Geoid Height.

Not only the exact Height is of importance, but also the relative weight that this Height should get. This is controlled through the Standard Deviations that the user enters in the SPM Menu, SPM Menu → Positioning → Starfix.VBS Settings, see section 8.6.7.

Note that offshore the GPS Antenna Height is not a constant, but affected by the waves, rolling of the vessel and Tide. The Standard Deviation should take into account fluctuations in the Height due to those effects, i.e. the Standard Deviation of the Height should be increased in rough weather or areas with high Tides.

Whether Height aiding is on, can be seen in the Status Display F3, see section 8.3.

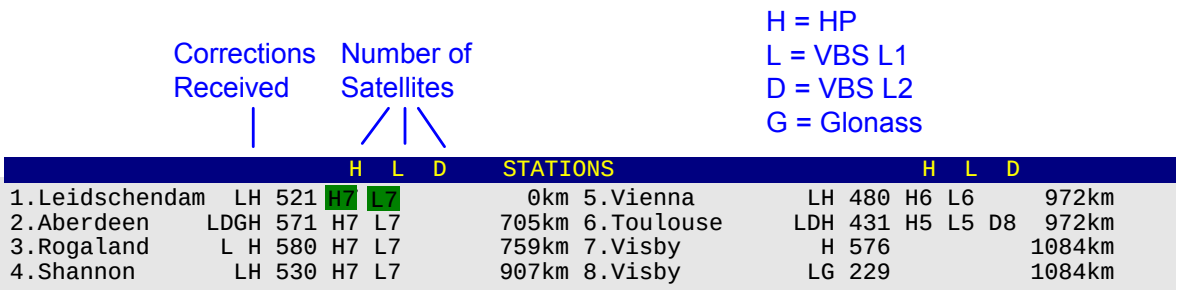
Note that in previous SPM version a 2D mode was available. This is not available as a selection anymore, but can be emulated when the Standard Deviation of the Height is set to 0.01. In this mode a position can be calculated with only 3 satellites. However this should not be standard practise.

5.5 The Starfix Network Signals

The Starfix Network broadcasts the following signals:

• HP Corrections	Station based	H
• XP Corrections (State Space)	Orbit based	X
• L1 Differential Corrections for normal DGPS or VBS (RTCM Type 1)	Station based	L
• L2 Differential Corrections (RTCM Type 15)	Station based	D
• GLONASS Differential Corrections	Station based	G

All signals, except for the XP signals, are signals from reference stations. Not all reference stations will broadcast the full list of signals. In the SPM QC Window this is indicated see picture below. For example, Rogaland does not broadcast L2 or Glonass corrections.



XP Corrections are not per reference station but for satellites, thus are not shown in the diagram above.

The corrections are broadcast in a scrambled and compressed format. The function of the demodulator is to demodulate the signal and de-scramble the data. The format that remains after de-cryption is called SCF for Super-Compressed Format (also called CBMF).

The SPM software uses the SCF data to extract the corrections and apply them in the HP, XP and VBS calculations.

The SCF corrections can be forward from the SPM software to a Com port. Fugro's Starfix.Iowin software is capable of reading the SCF format with the SuperCompressed (SuperIn) driver.

The corrections can also be forwarded to a Com port as de-compressed RTCM format, type 1, 3 and 15. Fugro's Starfix.Iowin software is capable of reading the RTCM format with the RTCMIn driver.

5.6 RSOC Control or subscription

Untill 2005 all users with a HP Mobile with demodulator have had continuous access to the Starfix corrections.

As per 2005 Fugro introduced in the Starfix Network a subscription method. The subscription method allows for switching the Starfix service on and off. This was introduced to make the placement of an HP Mobile at a clients' location more cost effective for the client.

The subscription method is called RSOC and is linked to having a demodulator with a serial number. Existing HP Mobiles have demodulators without serial number and are not affected by the introduction of RSOC: they will still have continuous access to the Starfix corrections. Now, (mid 2006) all HP Mobiles have been recalled to the workshop and work with RSOC Control.

6 HP Mobile Getting Started

6.1 Switching the HP Mobile on

To swith the HP Mobile on, press the switch on the rear panel to 1.

6.2 Switching the HP Mobile off

To swith the HP Mobile on, press the switch on the rear panel to 0. You do not have to shut down the SPM software to do this.

6.3 Start up procedure

In normal situation the user should not have to do anything. The HP Mobile is set up such that the Loader software and SPM start up automatically and that an HP calculation is started.

The following sections describe what happens.

6.3.1 Initialisation

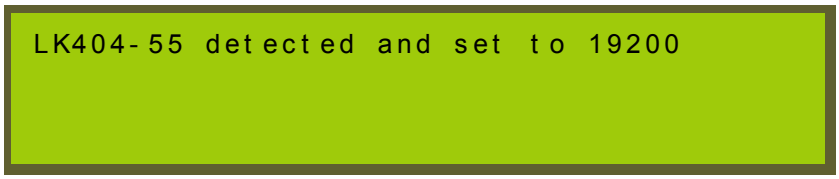
When the power is switched on, the next message will be shown on the LCD screen of the Starfix HP Mobile:

```
STARFIX-PLUS MOBILE SPM2000-A

      Initialising ...
```

The operating system is loaded during the initialisation period and is set-up to start the Loader software automatically without the need of user input.

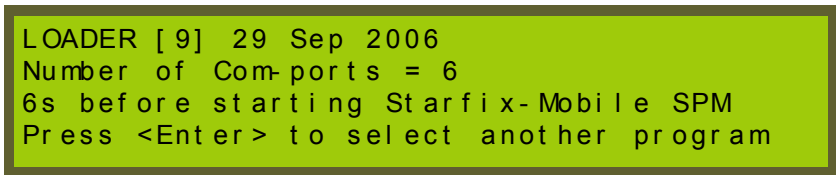
6.3.2 Loader

The Loader program will be activated. The first message it will (briefly) publish is:



This means, that the front panel display has been found. The LK404-55 refers to the model of the front panel display. The interaction from the processor board to the front panel display has been set to a baud rate of 19200.

Then the Loader software displayes the following message:

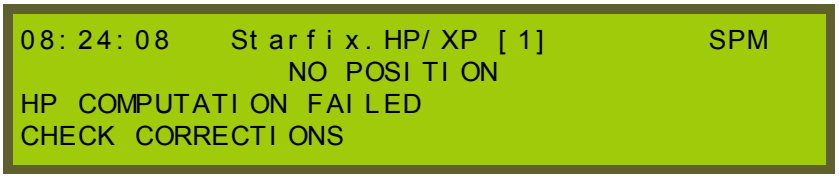


The Loader program starts the SPM software after 10 seconds. If you press Enter, then you get into the Loader software, it is described in section 13. However in most cases the operator does nothing and the SPM software is started.

6.3.3 Starfix.SPM Start - normal

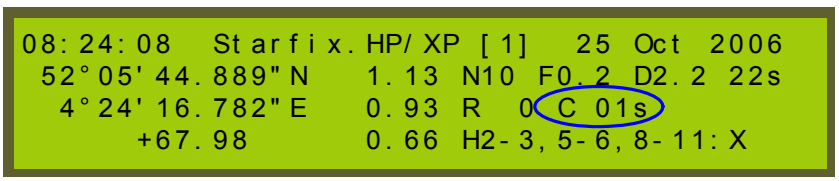
In normal situation the user should not have to do anything. The HP Mobile is set up such that the Loader software and SPM start up automatically and that an HP calculation is

Followed by



At this point the Starfix HP Mobile starts acquiring satellites and corrections. This takes about 60 seconds.

If succesfull then SPM continues by showing the HP position solution whilst converging.



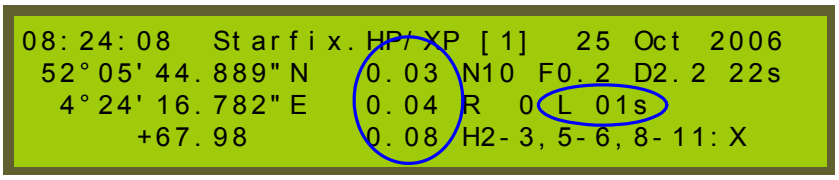
Currently there are approximately 14 status displays available on the front panel, of which the above HP position is one. See

Figure **6: System Display - front panel** for the full list and how to navigate through them.

6.3.4 HP Converging

At this moment, the HP solution is still converging, as indicated by the “C 01s” in the picture above. The position is not yet reliable.

Wait untill the solution is locked. Indicated by the L in the display and small Standard Deviations.



This may take up to 20 minutes. Read more about the convergence in section 5.1 Theory of the Starfix.HP/XP Position Calculation.

6.4 Starfix.SPM Start – at a new location

If started for the first time in a part of the world, there are two things to take care of

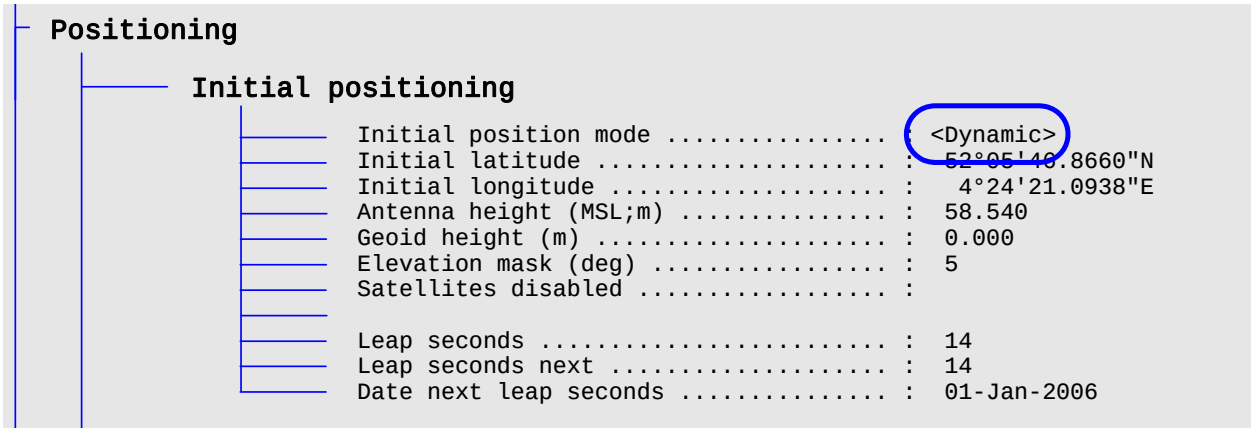
1. HP and XP need an accurate Initial Position for the calculation to converge.
2. The list of Reference Stations needs to be re-built for HP and / or VBS.

Both items depend on the Initial Position setting in SPM.

6.4.1 Initial Position

The best way to get a good Initial Position is to use the GPS position from the internal GPS card. This can be achieved with the following setting in the Initial Position menu: Initial Position Mode set to Dynamic. This tells that the GPS position will update the Initial Position automatically. The the latitude, longitude and height do not need to be entered.

The GPS will be the first position to start working. The GPS Position will then update the Initial Position, provided the menu setting SPM Menu → Positioning → Initial Position → Initial Position Mode is set to Dynamic.



This Initial Position will then be used to seed the HP, XP and VBS positions. The user will also use this Initial Position to update the distances in the list of Reference Stations, as described a bit further down in 6.4.3.

So, the first thing to do, is to verify that the GPS Position is coming in from the GPS Card, see F1 - Satellite Display. If no GPS data is coming in, then turn to section 12.1.1 Check reception of GPS.

Then verify that the Initial Position menu is correctly set to Dynamic and shows the correct Latitude and Longitude. If the Initial position mode was set to Static, then change to Dynamic and restart the SPM program (either stop and start the SPM program or switch HP Mobile off and on).

6.4.2 Check HP Corrections are received

Then the next thing to do is to verify that HP Corrections are being received. This needs to be done for two reasons.

The first reason is that the next step, re-building the Station List, cannot be done, if no corrections are received. Secondly, if one starts the HP Mobile at a new location, one may have to change the Uplink satellite as each Uplink satellite only covers a certain footprint on the Earth. Change this in SPM Menu → Devices → Demodulator, see 9.4.3.

To check the reception of Starfix corrections on a HP Mobile with an internal Demodulator use F1 – Demodulator Display:

```
                              DEMODULATOR
Type:       Topcon   Uplink:      EASAT   521:HL    480:HL    352:HLD   700: L
S/N :       270001   Freq  :1535152500   580:HL    620:HL    571:HLDG  780:HL
Days left:       1   Actual:1535150855   530:HL    632:HL    500:HLD   280:HLD
Services :   LPGHX   Qual. :     18.45   431:HLD   371:HLD   410:HLD   300: L
```

If the HP Mobile does not contain an internal demodulator, one can verify the reception of the corrections by using F6 – page 3: Message Display – DGPS Receiver / Demodulator (see 8.6.4). No front panel options available.

See section 12.1.2 for further instructions on checking the reception of corrections.

6.4.3 Re-build Station list

One should re-build the list of Reference Stations at any new location the HP Mobile is used. This is to ensure that the Station List is applicable to the new area and sorted on distance.

Go to menu item SPM Menu → Stations → Advanced Menu.

```
Stations
    Stations Advanced

        Edit cluster (Name, ID1, ID2, ....)
        RXD, 521, 571, 580, 530, 431, 480, 56, 229, 620, 632, 371, 352

        Load stations of cluster and restart  <<

        Select Cluster ......................  : RXD
        Reset cluster to stations received .. <<
        Reset cluster to stations listed .... <<

        Station list mode ..................  : Static
```

Press Enter on the item Stations → Stations Advanced → Reset cluster to stations received. This will extract from the Correction information the ID's of all Reference Stations These are sent with every update of corrections (every 10 seconds).

The downloaded Stations are sorted on distance and shown under Edit cluster, with the cluster name RXD.

Then Press Enter on the item Load stations of cluster and restart. This will send the cluster to the Station List and reboot the SPM software.

See more in section 9.5 SPM Menu → Stations.

6.4.4 HP converging

The HP Mobile is now configured for the new location. After the reboot you should see HP calculating and converging on the HP Status display.

```
08:24:08   Starfix.HP/XP [1]    25 Oct 2006
 52°05'44.889"N    1.13 N10 F0.2 D2.2 22s
  4°24'16.782"E    0.93 R  0 C 01s
      +67.98       0.66 H2-3,5-6,8-11:X
```

6.5 Monitoring HP Performance

Although the HP has been designed to perform on a standalone basis, one should monitor the following items on a regular basis.

1. Check Date and Time

   The Time must be updating every second. If it updates every five seconds, then this indicates a problem with the GPS card.

   This check cannot be done for HP Mobiles with a Novatel card, because the Novatel card always updates the time each second.

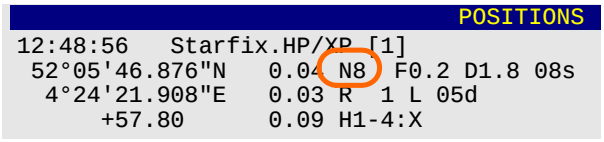
   If Date Time are not ok, then use the trouble shooting guide in section 12.1.1 Check reception of GPS.

2. Number of GPS Satellites received

   F1 - Satellite Display

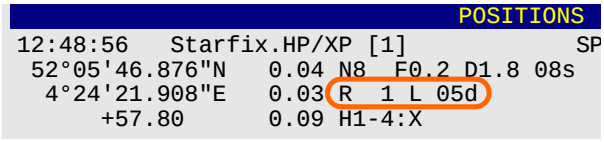
3. Number of GPS Satellites used in HP calculation

   F1 - Positions Display



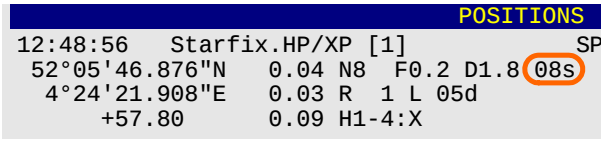
4. Lock on HP is maintained, Resets not increasing

   F1 - Positions Display



5. Age of Corrections Signal

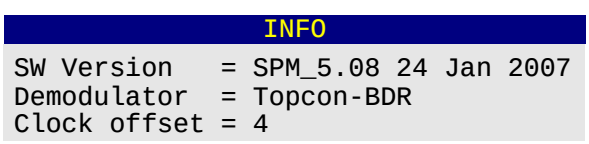
   F1 - Positions Display



6. Clock Offset

   Even though this is not a crucial issue, the Clock Offset should be between -5 and +5 seconds.

   The picture below shows the Clock Offset in SPM 4 version. In SPM 5 it will be in F1 – Info menu or the Info menu on the Front panel (5.07 onwards).



6.5.1 Hp Monitoring: example 1

```
                                POSITIONS
12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]     25 Nov 2006
 52°05'46.868"N   0.03 N5  F0.0 D2.6 09s  52°05'46.8675N   0.03 N5  F0.1 D2.6 13s
  4°24'21.904"E   0.05 R  4 L 11d          4°24'21.906"E   0.05 R  7 L 11d
      +57.69      0.08 H1                     +57.66      0.08 X
                                POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.75 N6  F0.3 D1.8 05s  52°05'46.904"N   0.00 N5  F0.0 D2.6  00s
  4°24'21.923"E   0.51 D                   4°24'21.919"E   0.00
      +57.68      1.52 L1                     +57.30      0.00
                        H  L  D    STATIONS                        H  L  D
1.Leidschendam  LH 521 H7 L7          0km 5.Vienna        LH 480 H6 L6      972km
2.Aberdeen    LDGH 571 H7 L7        705km 6.Toulouse     LDH 431 H5 L5 D8   972km
3.Rogaland     L H 580 H7 L7        759km 7.Visby          H 576           1084km
4.Shannon       LH 530 H7 L7        907km 8.Visby         LG 229           1084km
                                SATELLITES
PRN: 6 10 15 16 23 30                   PRN: 6 10 15 16 23 30
Elv:64 16 23 39 10 25                   Azm: 7  6 18 29 31 12
SN1:52 43 42 48 28 46                   LK1:03h44m35m62m07m05h
SN2:41 27 25 33  0 30                   LK2:03h44m23m58m00s05h
                                DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162    Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0      Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411    Tx:0

                               DEMODULATOR
Type:      Topcon   Uplink:     EASAT   521:HL    480:HL    352:HLD   700: L
S/N :      270001   Freq  :1535152500   580:HL    620:HL    571:HLDG  780:HL
Days left:      1   Actual:1535150855   530:HL    632:HL    500:HLD   280:HLD
Services :  LPGHX   Qual. :     18.45   431:HLD   371:HLD   410:HLD   300: L
                                INFO
SW Version   = SPM_5.08  9 feb 2007     GPS Receiver = Topcon
Demodulator  = Topcon-BDR               GPS Serno    = unknown
Clock offset = 4                        GPS Version  = unknown
```

If you don't see the lowest rows, then use the down arrow key to move the screen down.

The HP/XP solution has been in Lock for 11 days, the XP solution as well.

Since Power-on the HP solution has been Reset 4 times. The XP solution has been reset 7 times.

Resets can happen either manually through the SPM Menu or because of loss of Starix corrections or GPS signals.

The age of HP correction is 9 seconds, the age of the XP correction is 13 seconds.

Currently HP/XP is using the corrections of station 1 Leidschendam – indicated by the green highlight behind Leidschendam and by the letters H1 in the Position Display.

The HP solution can use multiple base stations, but in this case the user has selected only one. This is controlled in SPM Menu → Positioning → Starfix.HP/XP Settings, section 9.6.

No XP corrections are used, thus this is a HP only solution.

The GPS Receiver is receiving 6 GPS satellites, see the list under 'Satellites'.

For the HP Station 1, Leidschendam, corrections for 7 GPS Satellites are received, indicated by H7.

There are 5 GPS satellites used in the HP solution, indicated by N5.

It seems that the overlap between GPS satellites and corrections only results in 5 usuable satellites. That is because the Signal to Noise ratio for L2 (SN2) for Satellite 23 is 0, which means that satellite 23 cannot help in the HP solution.

The Standard Deviation of the HP solution is 3 centimeters in the Easting and 5 centimeters in the Northing.

Stations 7 and 8, both Visby, are in the list, but the corrections are not being received as indicated by the lack of satellites under H, L and D.

When the station list was made, corrections for station Visby were being received. Now they are not being sent anymore. This can happen, although this is not a common scenario. In this case, Visby is a station that is related to a certain project: if nobody is working in the area, no corrections are sent.

On Com 2 something is transmitted. Notice the Tx bytes on Com2.

The GPS Receiver is a Topcon receiver (brand name).

The communication satellite is the the EASAT, see Demodulator rows.

SPM software version is 5.06 as shown at the bottom.

6.5.2 Hp Monitoring: example 2

```
                                POSITIONS
12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]     25 Nov 2006
 52°05'46.868"N   0.23 N5  F0.0 D2.6 09s  52°05'46.8675N   0.03 N5  F0.1 D2.6 13s
  4°24'21.904"E   0.15 R  4 C 10m          4°24'21.906"E   0.05 R  7 L 11d
      +57.69      0.38 H1                      +57.66      0.08 X
                                POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.75 N6  F0.3 D1.8 05s  52°05'46.904"N   0.00 N5  F0.0 D2.6  00s
  4°24'21.923"E   0.51 D                   4°24'21.919"E   0.00
      +57.68      1.52 L1                      +57.30      0.00
                        H  L  D    STATIONS                      H  L  D
1.Leidschendam  LH 521 H7 L7          0km 5.Vienna        LH 480 H6 L6      972km
2.Aberdeen    LDGH 571 H7 L7        705km 6.Toulouse     LDH 431 H5 L5 D8   972km
3.Rogaland     L H 580 H7 L7        759km 7.Visby          H 576           1084km
4.Shannon       LH 530 H7 L7        907km 8.Visby         LG 229           1084km
                                SATELLITES
PRN: 6 10 15 16 23 30                   PRN: 6 10 15 16 23 30
Elv:64 16 23 39 10 25                   Azm: 7  6 18 29 31 12
SN1:52 43 42 48 28 46                   LK1:03h44m35m62m07m05h
SN2:41 27 25 33  0 30                   LK2:03h44m23m58m00s05h
                                DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0

                               DEMODULATOR
Type:      Topcon   Uplink:     EASAT   521:HL    480:HL    352:HLD   700: L
S/N :      270001   Freq  :1535152500   580:HL    620:HL    571:HLDG  780:HL
Days left:      1   Actual:1535150855   530:HL    632:HL    500:HLD   280:HLD
Services :  LPGHX   Qual. :     18.45   431:HLD   371:HLD   410:HLD   300: L
                                INFO
SW Version   = SPM_5.08  9 feb 2007     GPS Receiver = Topcon
Demodulator  = Topcon-BDR               GPS Serno    = unknown
Clock offset = 4                        GPS Version  = unknown
```

HP solution is still converging, as shown by the blue background colour, the C 10m (Convergencing for the last 10 minutes), and the Standard Deviations (SD Easting: 0.23 meter, SD Northing 0.15 meter and SD Height 0.38 meter).

6.5.3 HP Monitoring: example 3

```
                                    POSITIONS
12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]      25 Nov 2006
 52°05'46.868"N   0.03 N9  F0.1 D1.9 06s  52°05'46.8675N   0.03 N9  F0.0 D1.9 12s
  4°24'21.904"E   0.03 R  4 L 11d          4°24'21.906"E   0.03 R  7 L 11d
      +57.69      0.06 H1-4                    +57.66      0.05 X
                                    POSITIONS
12:48:56   Starfix.VBS [3]            SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.51 N9  F0.2 D1.5 10s  52°05'46.904"N   0.00 N9  F0.0 D1.9  00s
  4°24'21.923"E   0.40 D                   4°24'21.919"E   0.00
      +57.68      1.31 L1                      +57.30      0.00
                          H  L  D    STATIONS                      H  L  D
1.Leidschendam  LH 521 10 10          0km 5.Vienna        LH 480 H8 L9      972km
2.Aberdeen    LDGH 571 10 10        705km 6.Toulouse     LDH 431 H7 L7 D6   972km
3.Rogaland     L H 580 10 10        759km 7.Visby          H 576           1084km
4.Shannon       LH 530 H9 L9        907km 8.Visby         LG 229           1084km
                                   SATELLITES
PRN: 3 15 16 18 19 22 26 27 29          PRN: 3 15 16 18 19 22 26 27 29
Elv:73 58 42 45 33 40  9 14  8          Azm:28  6 18  8 28 14  3 31  2
SN1:52 43 42 48 28 46 35 33 35          LK1:02h03h04h02h61m78m12m26m07m
SN2:41 27 25 33 36 40 18  9  8          LK2:02h03h04h02h61m78m09m13m07m
                                    DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0

                                   DEMODULATOR
Type:      Topcon   Uplink:     EASAT   521:HL    480:HL    352:HLD   700: L
S/N :      270001   Freq  :1535152500   580:HL    620:HL    571:HLDG  780:HL
Days left:      1   Actual:1535150855   530:HL    632:HL    500:HLD   280:HLD
Services :  LPGHX   Qual. :     18.45   431:HLD   371:HLD   410:HLD   300: L
                                    INFO
SW Version   = SPM_5.08  9 feb 2007     GPS Receiver = Topcon
Demodulator  = Topcon-BDR               GPS Serno    = unknown
Clock offset = 4                        GPS Version  = unknown
```

The user has choosen to use 4 HP Base stations instead of 1. The four stations are all used as indicated by the four green fields under H.

6.5.4 HP Monitoring: example 4

```
                                POSITIONS
12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]      25 Nov 2006
 52°05'46.868"N   0.03 N9  F0.1 D1.9 06s  52°05'46.8675N   0.03 N9  F0.0 D1.9 12s
  4°24'21.904"E   0.03 R  4 L 11d          4°24'21.906"E   0.03 R  7 L 11d
      +57.69      0.06 H2-4:X                 +57.66      0.05 X
                                POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.51 N9  F0.2 D1.5 10s  52°05'46.904"N   0.00 N9  F0.0 D1.9  00s
  4°24'21.923"E   0.40 D                   4°24'21.919"E   0.00
      +57.68      1.31 L1                     +57.30      0.00
                          H  L  D    STATIONS                        H  L  D
1.Leidschendam  LH 521                    0km 5.Vienna        LH 480 H8 L9     972km
2.Aberdeen    LDGH 571 10 10            705km 6.Toulouse     LDH 431 H7 L7 D6  972km
3.Rogaland     L H 580 10 10            759km 7.Visby          H 576           1084km
4.Shannon       LH 530 H9 L9            907km 8.Visby         LG 229           1084km
                                SATELLITES
PRN: 3 15 16 18 19 22 26 27 29          PRN: 3 15 16 18 19 22 26 27 29
Elv:73 58 42 45 33 40  9 14  8          Azm:28  6 18  8 28 14  3 31  2
SN1:52 43 42 48 28 46 35 33 35          LK1:02h03h04h02h61m78m12m26m07m
SN2:41 27 25 33 36 40 18  9  8          LK2:02h03h04h02h61m78m09m13m07m
                                DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0

                               DEMODULATOR
Type:       Topcon   Uplink:     EASAT   521:HL    480:HL    352:HLD   700: L
S/N :       270001   Freq  :1535152500   580:HL    620:HL    571:HLDG  780:HL
Days left:       1   Actual:1535150855   530:HL    632:HL    500:HLD   280:H:D
Services :  LPGHX    Qual. :     18.45   431:HLD   371:HLD   410:HLD   300: L
                                 INFO
SW Version   = SPM_5.08  9 feb 2007     GPS Receiver = Topcon
Demodulator  = Topcon-BDR               GPS Serno    = unknown
Clock offset = 4                        GPS Version  = unknown
```

Station Leidschendam (521) is down for maintenance, as indicated by the red colour behind the station. If a station drops out for no clear reason, the following can be done.

- Check alternative Starfix service (communication satellite).
- Contact Starfix Network Control Centre or Fugro office to get more information.

6.5.5 HP Monitoring: example 5

```
                                    POSITIONS
12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]      25 Nov 2006
 52°05'46.868"N   0.03 N9  F0.1 D1.9 06s  52°05'46.8675N   0.03 N9  F0.0 D1.9 12s
  4°24'21.904"E   0.03 R  4 L 11d          4°24'21.906"E   0.03 R  7 L 11d
      +57.69      0.06 H2-4:X                 +57.66      0.05 X
                                    POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.51 N9  F0.2 D1.5 10s  52°05'46.904"N   0.00 N9  F0.0 D1.9  00s
  4°24'21.923"E   0.40 D                   4°24'21.919"E   0.00
      +57.68      1.31 L1                     +57.30      0.00
                          H  L  D   STATIONS                      H  L  D
1.Leidschendam  LH 521 10 10          0km 5.Vienna        LH 480 H8 L9      972km
2.Aberdeen    LDGH 571 10 10        705km 6.Toulouse     LDH 431 H7 L7 D6   972km
3.Rogaland     L H 580 H9 L9        759km 7.Visby          H 576           1084km
4.Shannon       LH 530 H9 L9        907km 8.Visby         LG 229           1084km
                                   SATELLITES
PRN: 3 15 16 18 19 22 26 27 29          PRN: 3 15 16 18 19 22 26 27 29
Elv:73 58 42 45 33 40  9 14  8          Azm:28  6 18  8 28 14  3 31  2
SN1:52 43 42 48 28 46 35 33 35          LK1:02h03h04h02h61m78m12m26m07m
SN2:41 27 25 33 36 40 18  9  8          LK2:02h03h04h02h61m78m09m13m07m
                                    DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:DGPS3    38400 Rx:145   Tx:0
COM2:DGPS1      9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS2      9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0

                                     INFO
SW Version   = SPM_5.08  9 feb 2007     GPS Receiver = Topcon
Demodulator  = Topcon-BDR               GPS Serno    = unknown
Clock offset = 4                        GPS Version  = unknown
```

The Demodulator information is not shown. This is because there is no internal Demodulator. Note that under Devices none of the drivers is Demodulator either.

To verify that indeed no internal Demodulator is available you can check if you see four Com ports at the back of the HP Mobile. If there are four Com ports (1 to 4), then you will not have an internal Democulator. One of the Com ports will have to receive corrections from an external source, for example a 4100 receiver.

If you have three Com ports (1 to 3), then most likely an internal Demodulator is available (however hardware changes after delivery are possible). If you think you have an internal Demodulator, but still see the display above, then you need to configure the SPM menu for the internal Demodulator, see

6.5.6 HP Monitoring: example 6

```
                                    POSITIONS
 12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]      25 Nov 2006
  52°05'46.868"N   0.03 N9  F0.1 D1.9 06s  52°05'46.8675N   0.03 N9  F0.0 D1.9 12s
   4°24'21.904"E   0.03 R  4 L 11d          4°24'21.906"E   0.03 R  7 L 11d
       +57.69      0.06 H1-4                    +57.66      0.05 X
                                    POSITIONS
 12:48:56   Starfix.VBS [3]            SPM         Starfix.GPS[4]     25 Nov 2006
  52°05'46.863"N   0.51 N9  F0.2 D1.5 10s  52°05'46.904"N   0.00 N9  F0.0 D1.9  00s
   4°24'21.923"E   0.40 D                   4°24'21.919"E   0.00
       +57.68      1.31 L1                      +57.30      0.00
                          H  L  D    STATIONS                      H  L  D
1.Leidschendam  LH 521 10 10          0km 5.Vienna        LH 480 H8 L9      972km
2.Aberdeen    LDGH 571 10 10        705km 6.Toulouse     LDH 431 H7 L7 D6   972km
3.Rogaland     L H 580 10 10        759km 7.Visby          H 576           1084km
4.Shannon       LH 530 10 L9        907km 8.Visby         LG 229           1084km
                                   SATELLITES
PRN: 3 15 16 18 19 22 26 27 29          PRN: 3 15 16 18 19 22 26 27 29
Elv:73 58 42 45 33 40  9 14  8          Azm:28  6 18  8 28 14  3 31  2
SN1:52 43 42 48 28 46 35 33 35          LK1:02h03h04h02h61m78m12m26m07m
SN2:41 27 25 33 36 40 18  9  8          LK2:02h03h04h02h61m78m09m13m07m
                                    DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0
```

The user has set a maximum distance of 800 km for the HP base stations. This means that station 4, Shannon, is now not being used in the HP calculation, as indicated by the red color.

The default value for maximum distance is 1500 km.

6.5.7 HP Monitoring: example 7

```
                                    POSITIONS
 12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]      25 Nov 2006
          +0.00    0.03 N5  F0.0 D2.6 09s        +0.01      0.03 N5  F0.1 D2.6 13s
          +0.00    0.05 R  4 L 11d               +0.03      0.05 R  7 L 11d
 HP       +0.00    0.08 H1                HP     -0.04      0.08 X
                                    POSITIONS
 12:48:56   Starfix.VBS [3]            SPM         Starfix.GPS[4]     25 Nov 2006
          +0.42    0.75 N6  F0.3 D1.8 05s        -0.90      0.00 N5  F0.0 D2.6  00s
          +0.92    0.51 D                        -0.08      0.00
 HP       +0.76    0.52 L1                HP    +12.83      0.00
                          H  L  D    STATIONS                      H  L  D
1.Leidschendam  LH 521 H7 L7          0km 5.Vienna        LH 480 H6 L6      972km
2.Aberdeen    LDGH 571 H7 L7        705km 6.Toulouse     LDH 431 H5 L5 D8   972km
3.Rogaland     L H 580 H7 L7        759km 7.Visby          H 576           1084km
4.Shannon       LH 530 H7 L7        907km 8.Visby         LG 229           1084km
                                   SATELLITES
PRN: 6 10 15 16 23 30                   PRN: 6 10 15 16 23 30
Elv:64 16 23 39 10 25                   Azm: 7  6 18 29 31 12
SN1:52 43 42 48 28 46                   LK1:03h44m35m62m07m05h
SN2:41 27 25 33  0 30                   LK2:03h44m23m58m00s05h
                                    DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0
```

Deltas are shown, not the absolute positions. This is regulated in SPM Menu → Positioning → Position Views, section 9.6.2.

6.5.8 HP Monitoring: example 8

```
                                    POSITIONS
12:48:56   Starfix.HP/XP [1]              SPM          Skyfix.XP [2]      25 Nov 2006
         +0.00    0.04 N10 F0.2 D1.7 13s          +0.06      0.03 N10 F0.8 D1.7 17s
         +0.00    0.02 R  1 L 68h                 +0.07      0.03 R  1 L 04h
HP       +0.00    0.06 H1-4:X            HP      +0.05      0.08 X
                                    POSITIONS
12:48:56   Starfix.VBS [3]              SPM          Starfix.GPS[4]     25 Nov 2006
      -231.42    0.45 N10  F100 D1.0 12s          +0.02      0.00 N0   F0.0 D100  00s
      -168.92    0.32 D                           -1.41      0.00
HP    -980.76    0.89 L1                 HP      -6.86      0.00
                                H  L  D    STATIONS                        H  L  D
1.Leidschendam  LH 521 10 10        0km 5.Vienna        LH 480 H6 L6      972km
2.Aberdeen    LDGH 571 11 11      705km 6.Toulouse     LDH 431 H5 L5 D8   972km
3.Rogaland     L H 580 10 10      759km 7.Visby         H 576            1084km
4.Shannon       LH 530 11 11 11   907km 8.Visby        LG 229            1084km
                                    SATELLITES
PRN: 1  2  3  4  5  6  9 14 24 30 31    PRN: 1  2  3  4  5  6  9 14 24 30 31
Elv:64 16 23 39 69 25 64 16 23 39 10    Azm:31  6 18 29 31 12 27 30 13 27  4
SN1:52 43 42 48 28 46 52 43 42 48 28    LK1:03h44m35m62m07m05h44m35m62m07m05h
SN2:41 27 25 33 38 30 41 27 25 33 45    LK2:03h44m23m58m00s05h44m35m62m07m05h
                                    DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:1257  Tx:0
```

The VBS position is clearly wrong as indicated by the large Deltas. Also F-test result (F100) indicates that VBS position is not valid. When the F-test is this high, then the standard deviations are not realistic anymore.

This wrong result was obtained with Initial position set to Static mode and more than one degree off current location.

A similar (wrong) result can be obtained if the Height Aiding is on, but a wrong Height is provided. Initially the VBS position will still be close to the HP position, but it will slip slowly and continuously.

HP and XP are converged and don't suffer.

6.5.9 HP Monitoring: example 9

```
                                POSITIONS
12:48:56  Starfix.HP/XP              SPM         Skyfix.XP [2]     25 Nov 2006
            NO POSITION                 52°05'46.8675N   0.03 N5  F0.1 D2.6 13s
                                         4°24'21.906"E   0.05 R  7 L 11d
                                             +57.66      0.08 X
                                POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.75 N6  F0.3 D1.8 05s  52°05'46.904"N   0.00 N5  F0.0 D2.6  00s
  4°24'21.923"E   0.51 D                   4°24'21.919"E   0.00
      +57.68      1.52 L1                      +57.30      0.00
                        H  L  D    STATIONS                      H  L  D
1.Leidschendam  LH 521 H7 L7          0km 5.Vienna        LH 480 H6 L6     972km
2.Aberdeen    LDGH 571 H7 L7        705km 6.Toulouse     LDH 431 H5 L5 D8  972km
3.Rogaland     L H 580 H7 L7        759km 7.Visby          H 576          1084km
4.Shannon       LH 530 H7 L7        907km 8.Visby         LG 229          1084km
                                SATELLITES
PRN: 6 10 15 16 23 30                PRN: 6 10 15 16 23 30
Elv:64 16 23 39 10 25                Azm: 7  6 18 29 31 12
SN1:52 43 42 48 28 46                LK1:03h44m35m62m07m05h
SN2:41 27 25 33  0 30                LK2:03h44m23m58m00s05h
                                 DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0
```

The text “No Position” indicates total failure of the calculation to work.

Check the settings in the appropriate menu, in this case in 9.6.4 SPM Menu → Positioning → Starfix.HP/XP Settings. In the case above the Service ID was set to a service where no corrections were coming in.

6.5.10 HP Monitoring: example 10

```
                                POSITIONS
12:48:56  Starfix.NONE               SPM         Skyfix.XP [2]     25 Nov 2006
            NO POSITION                 52°05'46.8675N   0.03 N5  F0.1 D2.6 13s
                                         4°24'21.906"E   0.05 R  7 L 11d
                                             +57.66      0.08 X
                                POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.75 N6  F0.3 D1.8 05s  52°05'46.904"N   0.00 N5  F0.0 D2.6  00s
  4°24'21.923"E   0.51 D                   4°24'21.919"E   0.00
      +57.68      1.52 L1                      +57.30      0.00
                        H  L  D    STATIONS                      H  L  D
1.Leidschendam  LH 521 H7 L7          0km 5.Vienna        LH 480 H6 L6     972km
2.Aberdeen    LDGH 571 H7 L7        705km 6.Toulouse     LDH 431 H5 L5 D8  972km
3.Rogaland     L H 580 H7 L7        759km 7.Visby          H 576          1084km
4.Shannon       LH 530 H7 L7        907km 8.Visby         LG 229          1084km
                                SATELLITES
PRN: 6 10 15 16 23 30                PRN: 6 10 15 16 23 30
Elv:64 16 23 39 10 25                Azm: 7  6 18 29 31 12
SN1:52 43 42 48 28 46                LK1:03h44m35m62m07m05h
SN2:41 27 25 33  0 30                LK2:03h44m23m58m00s05h
                                 DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0
```

In this example all is going well, still the display for positioning is saying “No Position”. This is due to the setting in the SPM menu which has set the display to “None”, notice the text above also saying “Starfix-NONE”. Change the setting back to HP, see section 9.6.2 SPM Menu → Positioning → Position Views.

6.6 SPM Com Port Quick Guide

6.6.1 Send HP, XP, VBS or GPS Position to a Com Port

1.	SPM Menu → Positioning → Position Outputs	Set format: HP_MONITOR or NMEA, etc.
2.	SPM Menu → Positioning → Position Outputs	Set output Port number. Multiple ports possible, see entry options in section 7.4 Entering Station Numbers or Output Ports.
3.	SPM Menu → Positioning → Position Outputs	Set Position Type: HP, XP, VBS or GPS
4.	SPM Menu → Devices → Port Configuration	If Com port is not a virtual MUX port, then set Com port baud rate. Baud rate is irrelevant on virtual MUX port.
5.	SPM Menu → Devices → Port Configuration	If Com port is not a virtual MUX port, then set Com Port Device Driver: DGPS or None. Driver is irrelevant on virtual MUX port.
6.	SPM Menu → Positioning → Starfix.HP/XP Settings	Check that HP Calculation is ON. Similar for XP, VBS and GPS positions.
7.	F1 - Positions Display	Check that HP Calculation is converged. Output will still work, if HP is not converged, but quality is low. If HP is not working then follow the check list for HP of section 12.2.

Important note: The menu settings in SPM Menu → Positioning → Position Outputs allow the user to configure backup positions. This means that easily the system can swap output from HP to XP, in case HP fails. The user should be aware that the receiving software may not indicate this. This means that the receiving user may THINK that they are receiving HP, whilst they are in fact receiving the backup position.

6.6.2 Send Starfix compressed corrections to a Com Port (Super Compressed Format)

1.	SPM Menu → Devices → Demodulator	Forward SCF data to a Com port. Multiple ports possible, see entry options in section 7.4 Entering Station Numbers or Output Ports.
2.	SPM Menu → Devices → Port Configuration	If Com port is not a virtual MUX port, then set Com port baud rate.

		Baud rate is irrelevant on virtual MUX port.
3.	SPM Menu → Devices → Port Configuration	If Com port is not a virtual MUX port, then set Com Port Device Driver: DGPS or None. Driver is irrelevant on virtual MUX port.
4.	F1 – Demodulator	Check in the System display that Starfix corrections are being received and that the demodulator is working.

6.6.3 Send RTCM to a Com port

1.	SPM Menu → RTCM Messages	Choose to a Com port. Multiple ports possible, see entry options in section 7.4 Entering Station Numbers or Output Ports.
2.	SPM Menu → RTCM Messages	Fill in rest of the menu.
3.	SPM Menu → Devices → Port Configuration	If Com port is not a virtual MUX port, then set Com port baud rate. Baud rate is irrelevant on virtual MUX port.
4.	SPM Menu → Devices → Port Configuration	If Com port is not a virtual MUX port, then set Com Port Device Driver: DGPS or None. Driver is irrelevant on virtual MUX port.
5.	F1 – Demodulator	Check in the System display that Starfix corrections are being received and that the demodulator is working.

6.6.4 Send Raw GPS data to a Com Port (must be GPS Port B or Port C)

1.	SPM Menu → Devices → GPS Receiver	Configure GPS Port B to output Raw GPS. Choose Command Group “Configurations”. Choose Command “Config Port B default” and execute. This configures port B to output Raw GPS with 115200 baud rate. Note: Ashtech receiver has per default RTS/CTS enabled, which means that your cable should be able to handle that (pin 7 and 8 connected). The above command disables RTS/CTS, but each time the Ashtech is reset, this is back to the default RTS/CTS being on, see also section 10.1.3 About the various GPS commands on how to disable RTS/CTS.

6.6.5 Logging

The following data streams can be logged to hard disk:

	Output port on HP Mobile	Output data type	Format	Interface driver on computer	Logging
1.	Com 2 or 3 or mux channel	Position Output of HP, XP or VBS position	NMEA	Starfix.Iowin →Position Input → NMEA in	Starfix.Logging
2.				Client software	Client software
3.	Com 2 or 3 or mux channel	Position Output of Starfix.HP, Skyfix.XP or Starfix.VBS position	NMEA or MONITOR	Starfix.Iowin →Position Input →Fugro HPIn	
4.	Com GPS B or mux channel 6	Raw GPS out	Topcon or Ashtech proprietary	Starfix.Iowin → GPS driver → AshtechZ12 or TopconGPS	Starfix.Logging
5.				Client software	Client software
6.	Com1, MUX	Raw GPS and HP corrections	Fugro's SPM MUX format	Starfix.Iowin → GPS → SPMMon	SPM Mon logging on computer hard disk

Important note:

The menu settings in SPM Menu → Positioning → Position Outputs allow the user to configure backup positions for output on Com Ports. This means that easily the system can swap output from HP to XP, in case HP fails. The user should be aware that the receiving software (e.g. Starfix.Iowin) may not indicate this. This means that the receiving user may THINK that they are receiving HP Position, whilst they are in fact receiving the backup position.

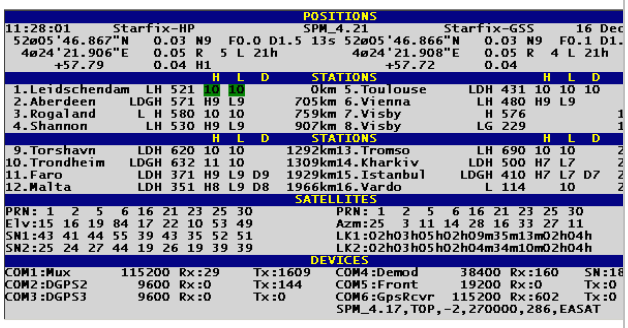
The NMEA format and HP_MONITOR format (Fugro HPIn in Starfix.Iowin) contain a field indicating which position solution was output, see also Appendix D Starfix SPM Output formats.

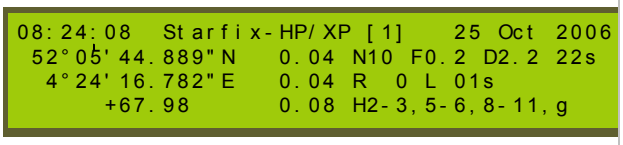
7 SPM Software

7.1 SPM Status and Menu Mode

The SPM software has two modes: Status Mode and Menu Mode.

1. SPM Status Mode



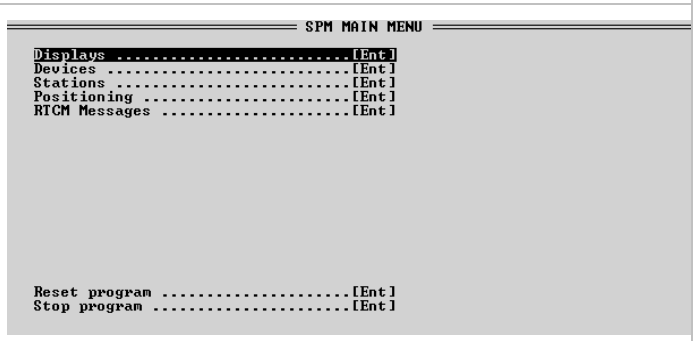


- The SPM Status Mode is the default mode.
- Press Ent or [Enter] to go from Status Mode to Menu Mode.
- See Chapter 8 for explanation on the various screens.
- On the Front Panel are 6 Status Displays, overview in
- Figure **6**.
- On the full screen the user has Status Displays, F1 to F6, overview in Figure 5.
- F1 is a compilation of the 6 Front Panel Displays.
- F2 to F6 are additional displays not available through the Front Panel.
- For Front Panel press ▼ and ▲ to step through the Status Displays.

Ent →

Esc ←

2. SPM Menu Mode

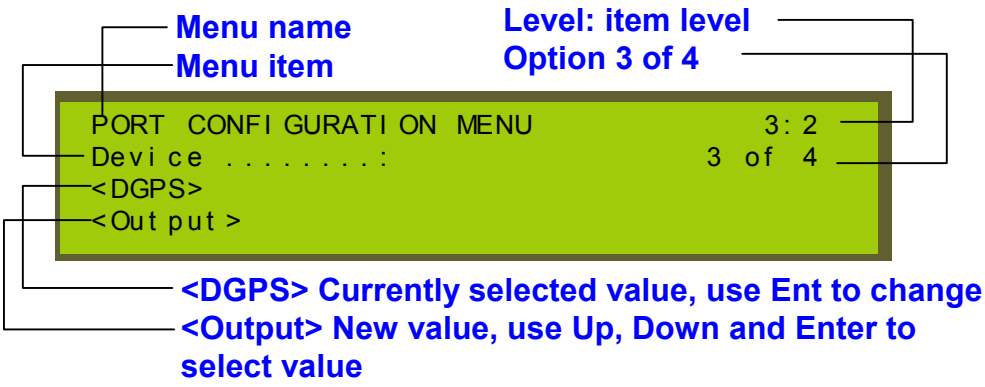


- Press Esc or F1 to go back from Menu Mode to Status Mode.
- See Chapter 9 for menu structure.
- On the Front Panel press ▼ and ▲ to step through the Menu.

7.2 Operating through the Front Panel

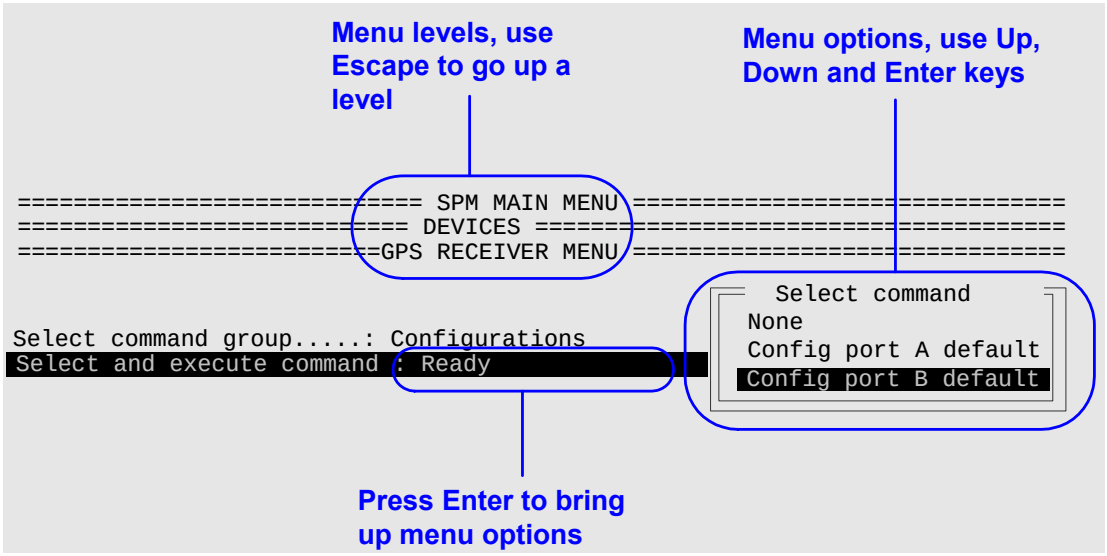
We encourage users to connect a monitor and keyboard to the HP Mobile for ease of use and improved QC feed back.

However for limited functionality it is possible to operate the HP Mobile through the front panel. Not all functionality can be operated through the front panel.



Esc	Exit this menu with saving, Back to previous menu, Cancel entry or selection.
Prev	Previous Index number
Next	Next Index number
Ent	Enter this menu, Accept entry or selection
▲	Previous menu item, Previous selection, Previous character entry
◀	Previous menu item, Previous character position
▼	Next menu item, Next selection, Next character entry
▶	Next menu item, Next character position
■	Reset / Home, Revert to initial display

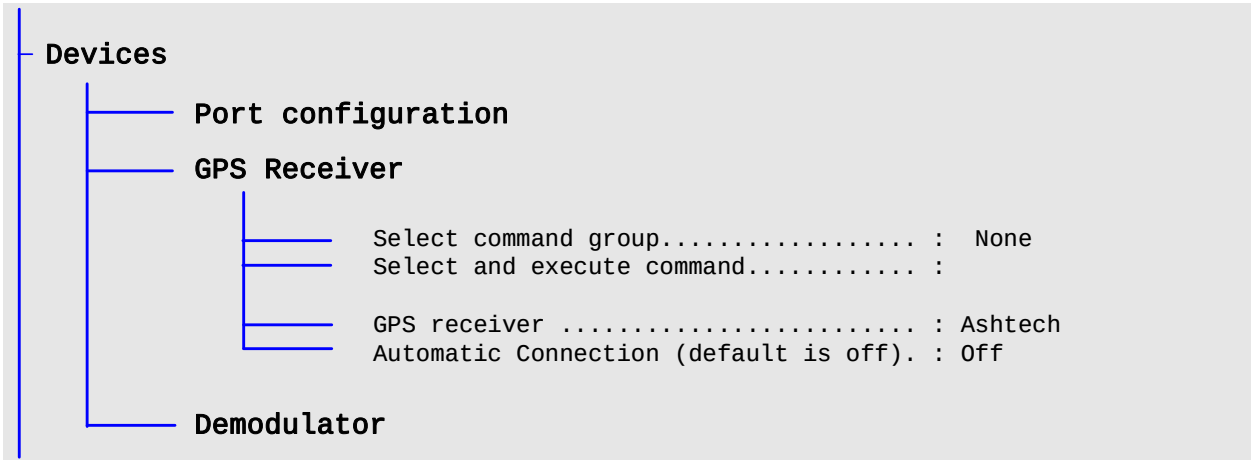
7.3 Operating through keyboard and monitor or SPMMon



When operating the SPM through a keyboard, one can use the Enter, Escape and F1 to F6 keys and well as all the numbers and characters for typing. This is an advantage over the front panel operation.

The top three lines show the levels in the SPM menu one has stepped through, in the example above one has gone from SPM Main Menu to Devices to GPS Receiver. In this manual generally described as SPM Menu → Devices → GPS Receiver, section 9.4.2. The blue indicates that this is a hyperlink (for electronic versions of this manual).

Throughout this manual we have used a tree diagram to symbolyse the SPM levels, for example:



7.4 Entering Station Numbers or Output Ports

Wherever in the SPM menu multiple stations or Com Ports can be assigned, the following strings can be typed. This can only be done from Keyboard!!

For Stations: The numbers refer to the station index in the Index list.

For ports: the number refers to the output port.

Number

1	Com Port 1
2	Com Port 2
3	Com Port 3
4	Com Port 4, internal demodulator if present
11	Mux 1, Remote Control
12	Mux 2
13	Mux 3
14	Mux 4
15	Mux 5
16	Mux 6, Raw GPS

Comma A comma separates the station indices or port numbers.

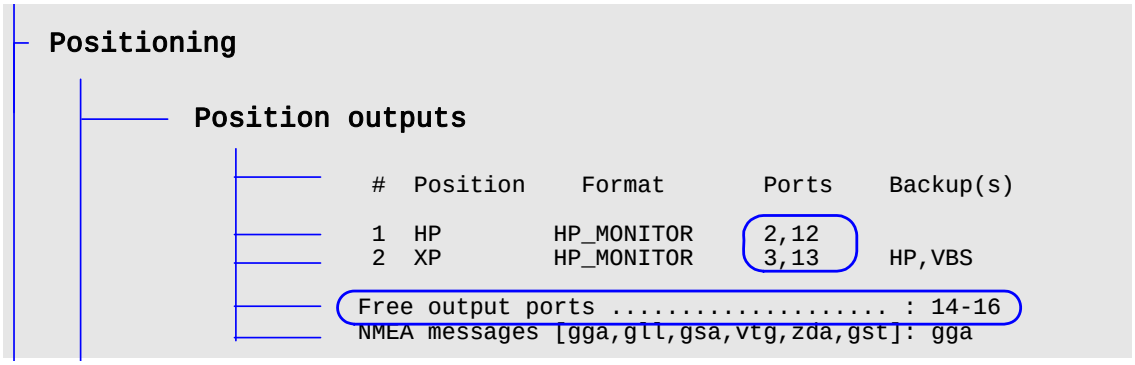
Dash A dash (minus sign or -) shows a sequential list.

Examples:

1, 3-5 Station 1 and stations 3 through to 5.

1-2, 4-16 Stations 1 through to 2 and Stations 4 through to 16.

Throughout the software a list of free ports is kept. It is displayed whenever there is an option to enter a Com port number to allow the user to easily verify if the Com port is still free.



Note for advanced users: the user can add ports to the list of free ports by typing. By adding a port to the free port list, the port becomes available for selection. This facility was implemented for the situation where the option “Relay Com ports to MUX” (in SPM Menu → Devices → Port Configuration) is switched on. In that case multiplexer ports can automatically disappear from the list, even though that Com port was used for input only, and the Mux port would still be available for output.

However, this opens up the possibility that ports are having to deal with multiple data streams and possible make the data stream corrupt.

7.5 Expanding the list of Stations or Position Outputs

The list of Stations and the list of Position Outputs have a flexible length, this means the list can be expanded or entries can be removed.

Adding an entry or reducing the length of the list is done with the number of the last entry highlighted, see picture.

Insert and Delete keys

#	Position	Format	Ports	Backup(s)
1	HP	HP_MONITOR	2,12	
2	XP	HP_MONITOR	3,13	HP,VBS

With the last number in the list highlighted, use the Insert and Delete keys to add and remove output instances.

If one deletes a row, then the information in the deleted rows is not lost. When expanding the list the entries are filled with the information that was in the list before. For example, if you delete entry 2 in the picture above, and then press insert again, then entry 2 will be filled with XP, HP_MONITOR, 3.13, etc.

7.6 SPM Menu and Status Displays

In the next two chapters detailed information about the Status Displays and Menu structure is given.

Chapter 8: Status Displays are described, both Front Panel and F1-F6 displays. The six Front panel displays are discussed under the six sections of the F1 Status Display.

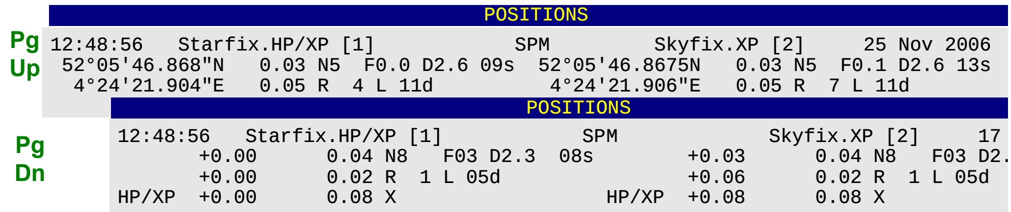
Chapter 9: SPM Menu Structure.

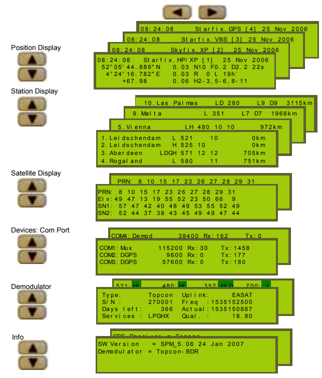
7.7 Advanced Menus

The SPM Menu has Advanced Menu items, see chapter 10.

8 SPM Status Displays F1 – F6

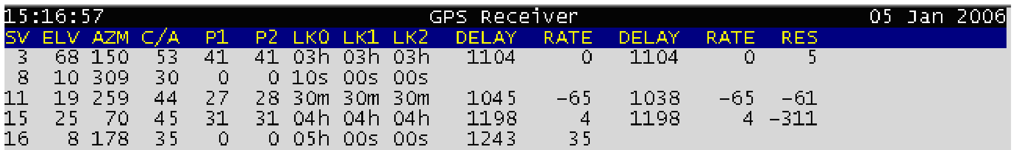
F1 – System Display


POSITIONS
Pg Up
12:48:56 Starfix.HP/XP [1] SPM Skyfix.XP [2] 25 Nov 2006
52°05'46.868"N 0.03 N5 F0.0 D2.6 09s 52°05'46.8675N 0.03 N5 F0.1 D2.6 13s
4°24'21.904"E 0.05 R 4 L 11d 4°24'21.906"E 0.05 R 7 L 11d
POSITIONS
Pg Dn
12:48:56 Starfix.HP/XP [1] SPM Skyfix.XP [2] 17
+0.00 0.04 N8 F03 D2.3 08s +0.03 0.04 N8 F03 D2.
+0.00 0.02 R 1 L 05d +0.06 0.02 R 1 L 05d
HP/XP +0.00 0.08 X HP/XP +0.08 0.08 X

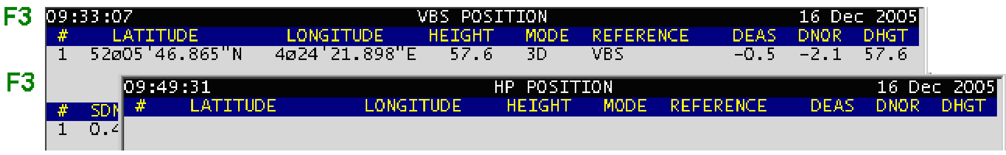


The front panel displays are all comprised in F1 Display. F2 to F6 are not available on the front panel.

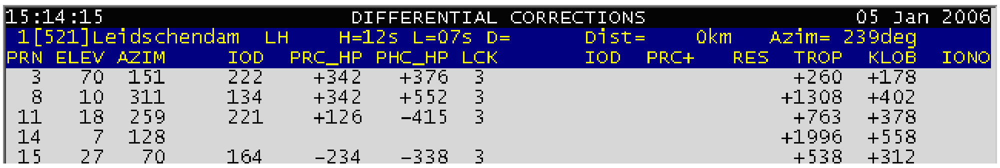
F2 – GPS Receiver


15:16:57 GPS Receiver 05 Jan 2006
SV ELV AZM C/A P1 P2 LK0 LK1 LK2 DELAY RATE DELAY RATE RES
3 68 150 53 41 41 03h 03h 03h 1104 0 1104 0 5
8 10 309 30 0 0 10s 00s 00s
11 19 259 44 27 28 30m 30m 30m 1045 -65 1038 -65 -61
15 25 70 45 31 31 04h 04h 04h 1198 4 1198 4 -311
16 8 178 35 0 0 05h 00s 00s 1243 35

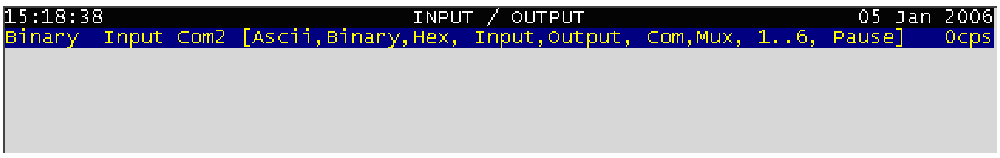
F3 - Position Display



F4 – Corrections Display


15:14:15 DIFFERENTIAL CORRECTIONS 05 Jan 2006
1[521]Leidschendam LH H=12s L=07s D= Dist= 0km Azim= 239deg
PRN ELEV AZIM IOD PRC_HP PHC_HP LCK IOD PRC+ RES TROP KLOB IONO
3 70 151 222 +342 +376 3 +260 +178
8 10 311 134 +342 +552 3 +1308 +402
11 18 259 221 +126 -415 3 +763 +378
14 7 128 +1996 +558
15 27 70 164 -234 -338 3 +538 +312

F5 – Input / Output Display



F6 – Messages Display

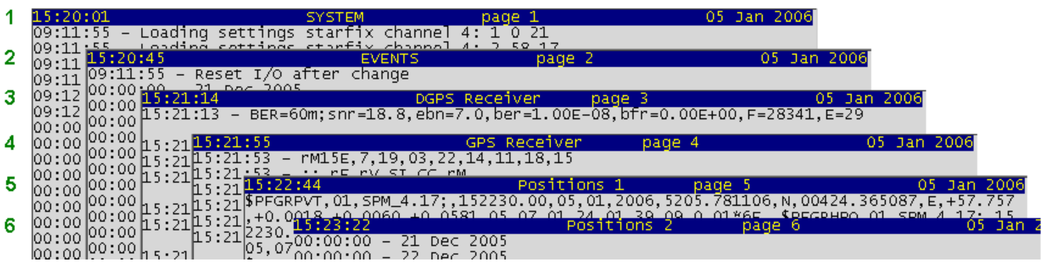

1
15:20:01 SYSTEM page 1 05 Jan 2006
09:11:55 - Loading settings starfix channel 4: 1 0 21
2
15:20:45 EVENTS page 2 05 Jan 2006
09:11:55 - Reset I/O after change
3
15:21:14 DGPS Receiver page 3 05 Jan 2006
15:21:13 - BER=60m;snr=18.8,ebn=7.0,ber=1.00E-08,bfr=0.00E+00,F=28341,E=29
4
15:21:55 GPS Receiver page 4 05 Jan 2006
15:21:53 - rM15E,7,19,03,22,14,11,18,15
5
15:22:44 Positions 1 page 5 05 Jan 2006
$PFGRPVT,01,SPM_4.17;,152230.00,05,01,2006,5205.781106,N,00424.365087,E,+57.757
6
15:23:22 Positions 2 page 6 05 Jan
00:00:00 - 21 Dec 2005

Figure 5: Overview Status Displays F1 to F6

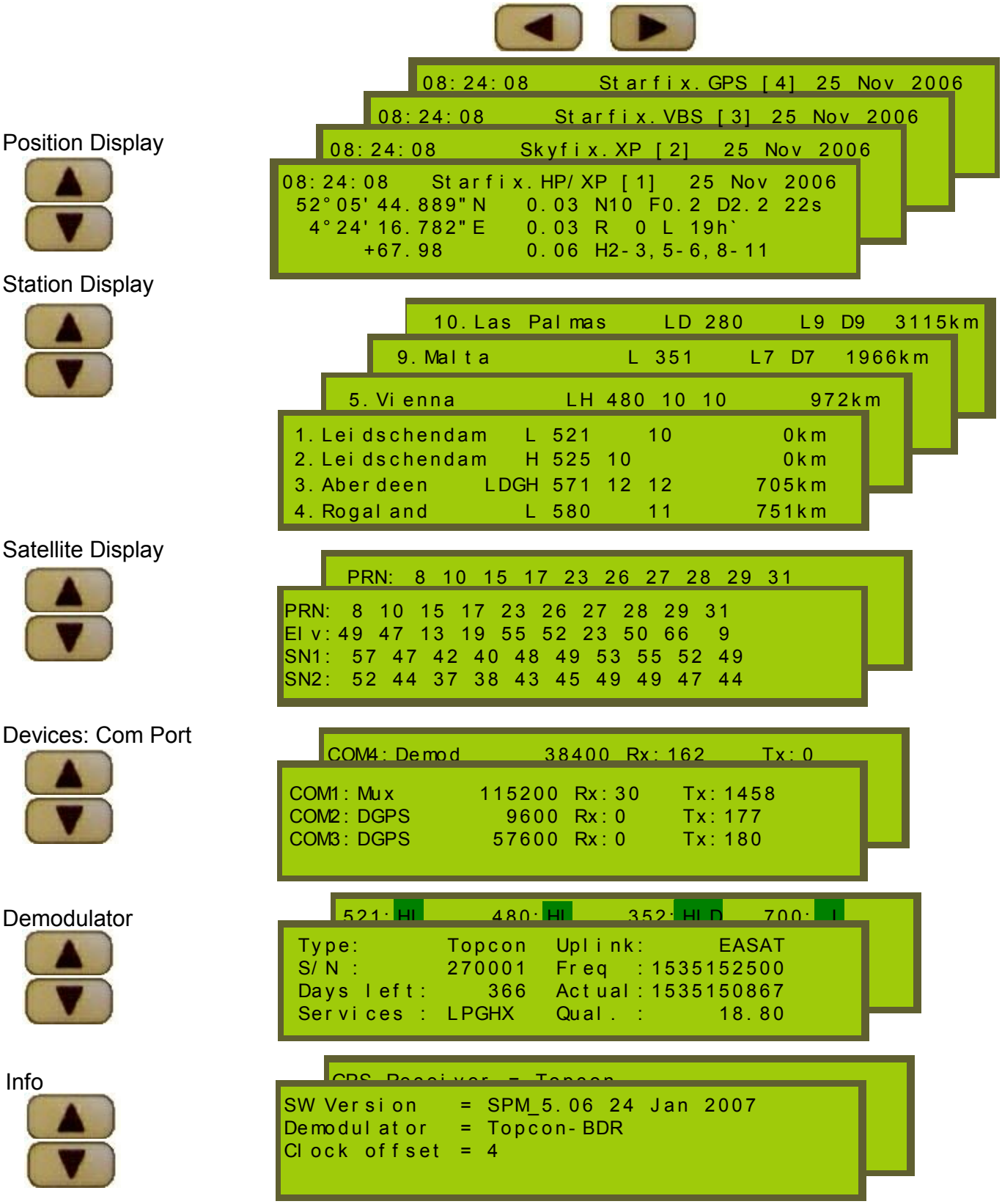


Figure 6: System Display - front panel

8.1 F1 - System Display - Front Panel Status Displays

```
                                POSITIONS
 12:48:56   Starfix.HP/XP [1]            SPM          Skyfix.XP [2]     25 Nov 2006
  52°05'46.868"N   0.03 N5  F0.0 D2.6 09s  52°05'46.8675N   0.03 N5  F0.1 D2.6 13s
   4°24'21.904"E   0.05 R  4 L 11d          4°24'21.906"E   0.05 R  7 L 11d
       +57.69      0.08 H1                     +57.66      0.08 X
                                POSITIONS
 12:48:56   Starfix.VBS [3]            SPM          Starfix.GPS[4]     25 Nov 2006
  52°05'46.863"N   0.75 N6  F0.3 D1.8 05s  52°05'46.904"N   0.00 N5  F0.0 D2.6  00s
   4°24'21.923"E   0.51 D                    4°24'21.919"E   0.00
       +57.68      1.52 L1                     +57.30      0.00
                          H  L  D    STATIONS                      H  L  D
1.Leidschendam  LH 521 H7 L7          0km 5.Vienna        LH 480 H6 L6      972km
2.Aberdeen    LDGH 571 H7 L7        705km 6.Toulouse     LDH 431 H5 L5 D8   972km
3.Rogaland     L H 580 H7 L7        759km 7.Visby          H 576           1084km
4.Shannon       LH 530 H7 L7        907km 8.Visby         LG 229           1084km
                                SATELLITES
PRN: 6 10 15 16 23 30                   PRN: 6 10 15 16 23 30
Elv:64 16 23 39 10 25                   Azm: 7  6 18 29 31 12
SN1:52 43 42 48 28 46                   LK1:03h44m35m62m07m05h
SN2:41 27 25 33  0 30                   LK2:03h44m23m58m00s05h
                                DEVICES
COM1:MUX      115200 Rx:22     Tx:1082  COM4:Demod    38400 Rx:162   Tx:0
COM2:DGPS       9600 Rx:0      Tx:419   COM5:Front    19200 Rx:0     Tx:0
COM3:DGPS       9600 Rx:0      Tx:0     COM6:GpsRcvr 115200 Rx:411   Tx:0

                               DEMODULATOR
Type:      Topcon   Uplink:     EASAT   521:HL    480:HL    352:HLD   700: L
S/N :      270001   Freq  :1535152500   580:HL    620:HL    571:HLDG  780:HL
Days left:      1   Actual:1535150855   530:HL    632:HL    500:HLD   280:H:D
Services :  LPGHX   Qual. :     18.45   431:HLD   371:HLD   410:HLD   300: L
                                  INFO
SW Version   = SPM_5.08  9 feb 2007     GPS Receiver = Topcon
Demodulator  = Topcon-BDR               GPS Serno    = unknown
Clock offset = 4                        GPS Version  = unknown
```

Figure 7: System Display – F1

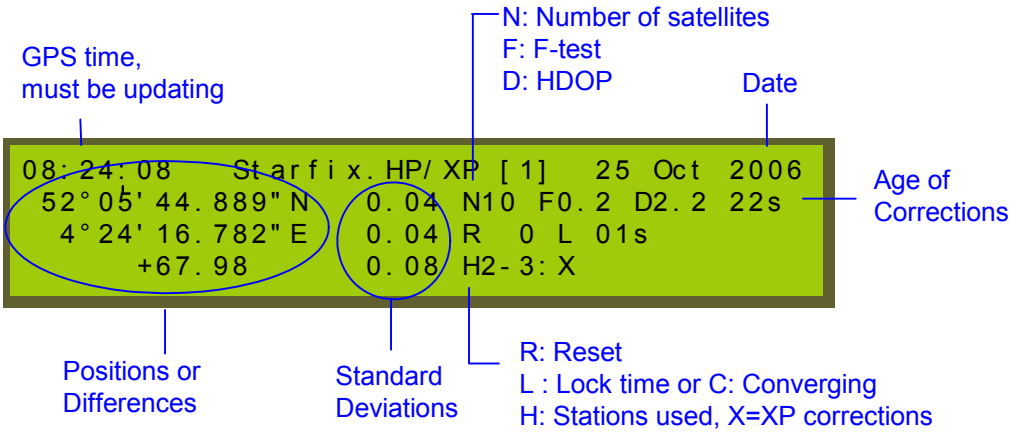
The system display shows in seven parts information on Positions, Stations, Satellites, Devices, Demodulator and Info, each section is explained in the next manual sections.

Summary of actions whilst in System Display:

Action	Impacts on F1 Display
Right / Left arrow key	Scrolls down through the display. This display is too large to show in Starfix.SpmRemote or on a 1024 by 768 monitor. With the right arrow key one can scroll through the F1 page.
SPM Menu → Displays (9.3)	The user can select to show one line with 2 Positions (as shown in Figure 7) or two lines with 4 Positions.
Page Up / Page Down	Toggles between showing Absolute Positions and Deltas in the Positions display, see 8.1.1 F1 - Positions Display.
H,x,v,g,n	Shows differences against HP, XP, VBA , GPS or Static position, see 8.1.1 F1 - Positions Display.
SPM Menu → Positioning → Position Views(9.6.2)	The user can assign calculations to 1, 2, 3 and 4. The user set the mode to Difference and select reference position.

8.1.1 F1 - Positions Display

```
                                POSITIONS
12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]     25 Nov 2006
 52°05'46.868"N   0.03 N5  F0.0 D2.6 09s  52°05'46.8675N   0.03 N5  F0.1 D2.6 13s
  4°24'21.904"E   0.05 R  4 L 11d          4°24'21.906"E   0.05 R  7 L 11d
     +57.69       0.08 H1                     +57.66       0.08 X
                                POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.75 N6  F0.3 D1.8 05s  52°05'46.904"N   0.00 N5  F0.0 D2.6  00s
  4°24'21.923"E   0.51 D                    4°24'21.919"E   0.00
     +57.68       1.52 L1                      +57.30       0.00
                                POSITIONS
12:48:56   Starfix.VBS [5]              SPM         Starfix.HDG[6]     25 Nov 2006
 52°05'46.862"N   0.52 N8  F0.1 D2.3 17s
  4°24'21.911"E   0.39 D                  Heading : 126.43deg        SD   :0.23de
     +57.91       1.21 L1-4               Dist_O-C:   0.03m          Ratio: 48.23
```

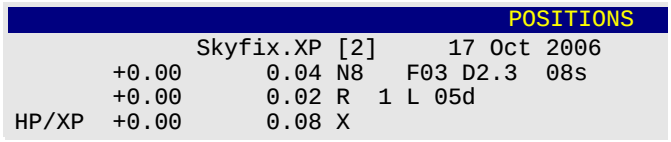


The Positions displays show the solution of HP, XP, VBS, GPS and HDG (Heading).

This menu item can show in up to 4 rows (although at the moment with 2 rows all four position solutions are shown). The number of rows can be changed in SPM Menu → Displays (9.3).

The SPM Menu → Positioning → Position Views (9.6.2) controls parts of this display: Whether it shows Positions or Differences, and which positions are assigned to 1, 2,3 and 4.

	GPS Time	GPS Time must be updating with one update per second. If time is updating once per 5 seconds only, then no satellites are tracked and local time from the processing board is shown. This check cannot be done for HP Mobiles with a Novatel card, because the Novatel card always updates the time each second.
	Positions or Differences	Antenna Position and Height in WGS84 geographical coordinates. This place can show Positions or Differences: this can be changed in SPM Menu → Positioning → Position Views (9.6.2) or by pressing Page Up / Page Down.

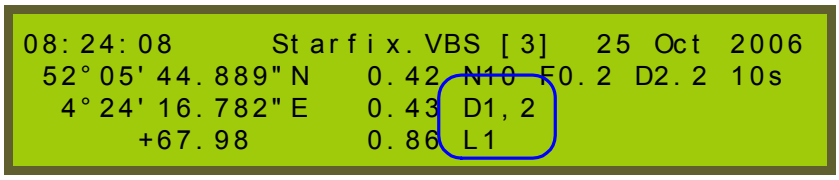
		 In the example above the difference between XP and HP is shown. Press H to see differences with respect to HP, x deltas with XP, v for deltas with VBS and n (None) for differences with a static position. If Initial Position is set to dynamic, then static doesn't work, see 9.6.1 SPM Menu → Positioning → Initial Position.
	Standard Deviation	Standard deviations for Latitude, Longitude and Height, is in metres. These values can only be trusted, if the F-test is showing good results.
N	Number of Satellites	Number of satellites used in the solution (HP, XP or VBS).
F	F-test	Quality indicator of the Position solution. Should be a low number, preferably below 5. If the F-test is 100, this means that the position calculation has failed. The Standard Deviations do not reflect true accuracy anymore.
D	HDOP	
	Age of corrections	Typically between 8 and 30 seconds. Must be less than 60 seconds, if larger than 60 seconds, the HP solution will reset and start converging again.
R	Resets	Number of resets of the HP position calculation program since start-up. Main reasons for resets are lack of common satellites, poor antenna installation (low signal to noise ratios) or maximum correction age is > 5 minutes.
H	Stations	Sequence of station ID numbers (from the reference station list) currently used for the position calculation. (e.g. 8 -11=sequence of stations with index 8 through to 11). If no Starfix HP corrections are received for one or more selected stations, the station will be removed from the sequence shown after 30 seconds. A g denotes XP corrections are used.
L C	Lock Time Converging	Lock-time in seconds (s), minutes (m) or hours (h), days (d), or years (y) since last position calculation reset. If a 'C' is show, then the HP position calculation is converging.

8.1.1.1 Actions in F1 - Positions Display

Page Up / Page Down toggles between showing Standard Deviations and showing Delta values. Press H to see Differences with respect to HP, x deltas with XP, v for deltas with VBS and n (None) for deltas with a static position.

8.1.1.2 Positions Display for VBS and XP

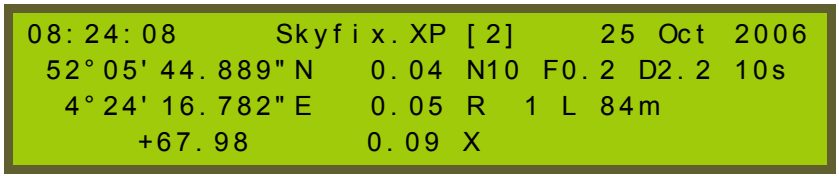
The displays for VBS and XP are slightly different:



VBS display is showing which stations the solution is using.

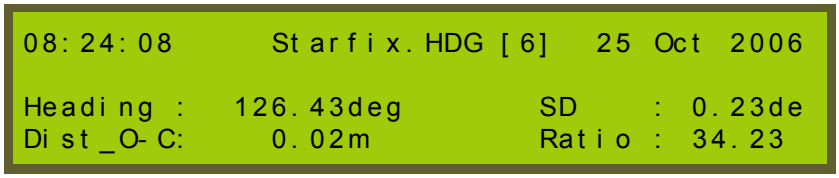
- "L1" indicates that for L1 frequency only station 1 is used,
- "D1, 2" indicates that for L2 (Dual) corrections station 1 and 2 are used.

Resets and Lock time are not shown.



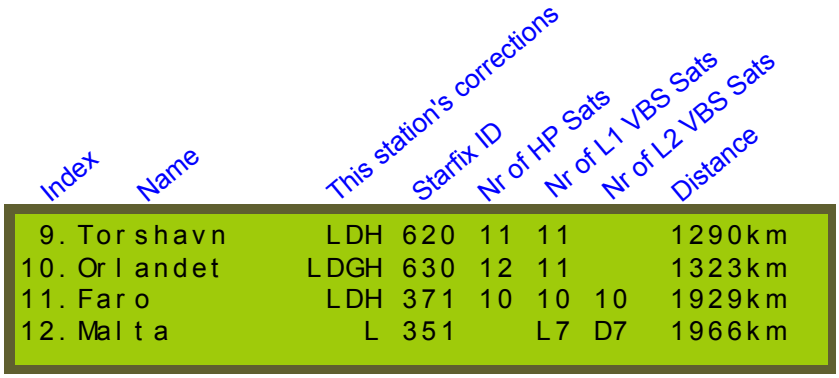
Because the Skyfix.XP Solution uses Satellite based corrections and not Station based corrections, no stations are shown.

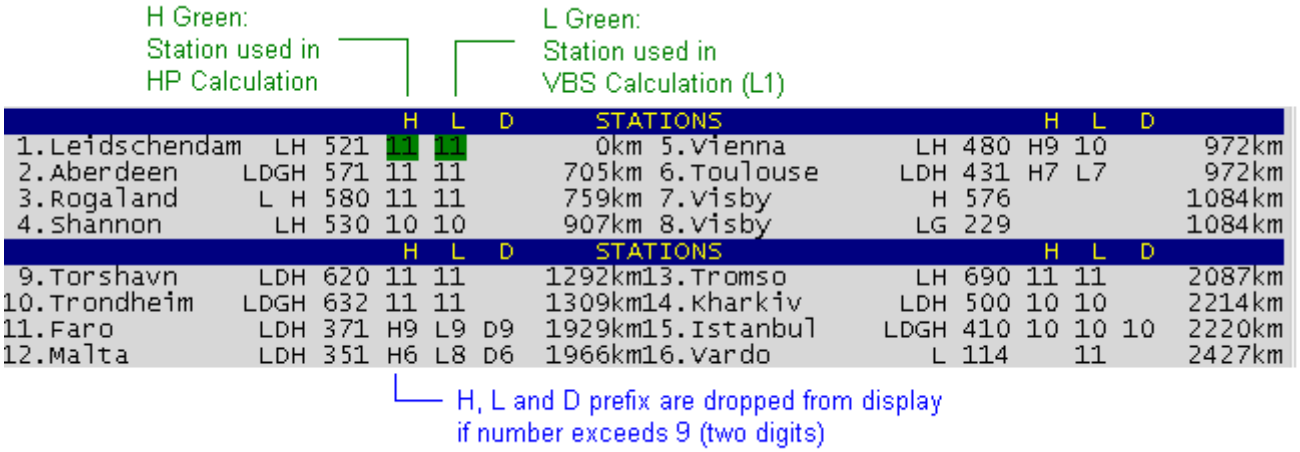
8.1.1.3 Display for Starfix.HDG (Heading)



Heading	Heading solution; the solution is corrected for the Heading C-O as set in the SPM Menu: SPM Menu → Positioning → Starfix.HDG (Heading) (9.6.8).
Dist_O-C	Distance error. Note that the distance Calculated (C) is set in the SPM Menu.
SD	Standard Deviation of the Heading. This number is calculated as Positional Error / Baseline length. So it is more a theoretical (a priori) standard deviation, than an observed standard deviation.
Ratio	Quality indication of the solution. Should be above 10. It is the ratio between this solution and the next best solution.

8.1.2 F1 - Stations Display





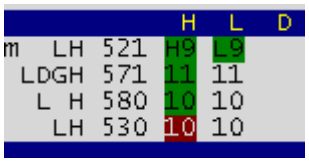
The Stations Display shows

- the Station List
- per station what corrections are received from the Starfix network.
- whether that correction is used in HP or VBS position solution.

The Station List is built by the user in the SPM Menu, read how to do this in 9.5 SPM Menu → Stations. In the demodulator Display (F1 – Demodulator, section 8.1.6) you can see the full list of stations received, not only the stations in the Station list.

Note that the XP corrections are global corrections and thus do not show up in the Stations Display. They can be viewed with F6-3 (not available on front panel).

L DGH LGH	The Starfix Network supports broadcast of different types of corrections: • H refers to Corrections for HP. • L refers to L1 RTCM Type 1 corrections in Super Compressed format for VBS Calculation. • D refers to Dual frequency (L2) RTCM Type 15 (Ionosphere) corrections for VBS Calculation.

	• G refers to Glonass corrections.
10 10 10 L7 D7	The number indicates the number of satellites that are available in the Starfix Corrections. If the number of satellites exceeds 9, the prefix L, D, G or H is omitted. H: first column — Refers to the HP corrections L: the second column — Refers to the L1 corrections for VBS D: the third column — Refers to the L2 (Dual frequency) corrections for VBS. The VBS calculation can optionally use the L1 and / or Dual frequency corrections. This is controlled in the SPM Menu, see section 9.6 SPM Menu → Positioning. A blank means that there are no corrections for HP or VBS available.
	In the screen monitor • A grey background indicates the station is not selected by the user for use in the HP or VBS calculation. • Green indicates the station is selected by the user and the station is used in the HP or VBS calculation. • Red indicates that the station is selected by the user for the HP or VBS calculation, but the station is not used in the Position Calculation, for example because the distance exceeds the maximum distance or the age is too large. The number indicates the amount of satellites available in the corrections. If the number of satellites exceeds 9, the prefix L, D, G or H is omitted.
Index, Name	Index in the Station List, set by the user in 9.5 SPM Menu → Stations.
Distance	Distance to the reference station, calculated from the Initial Position and Station Coordinates. This is continuously updated from the Initial Position.

8.1.3 F1 - Satellite Display

The Satellite displays shows the GPS satellites being tracked by the internal GPS card.

PRN: Satellite number
Azm: Azimuth to satellite (degrees)
LK1: Lock time for L1
LK2: Lock time for L2

```
PRN:  8  10  15  17  23  26  27  28  29  31
Azm:  6  19  32  30  28  29   6  12  29   3
LK1: 03h03h19m02m01h59m04h01h01h23m
LK2: 03h03h19m02m01h59m04h01h01h23m
```

```
PRN:  8  10  15  17  23  26  27  28  29  31
Elv: 49  47  13  19  55  52  23  50  66   9
SN1: 57  47  42  40  48  49  53  55  52  49
SN2: 52  44  37  38  43  45  49  49  47  44
```

PRN: Satellite number
Elv: Elevation to satellite (degrees)
SN1: Signal to Noise Ratio for L1 (dB)
SN2: Signal to Noise Ratio for L2 (dB)

```
                              SATELLITES
PRN: 3 15 16 18 19 21 22 26 27 29     PRN: 3 15 16 18 19 21 22 26 27 29
Elv:73 57 42 45 33 29 40  9 14  8     Azm:28  6 18  8 28  6 14  3 31  2
SN1:53 51 48 47 46 45 50 35 35 31     LK1:02h03h04h02h64m04h79m12m26m18m
SN2:42 41 35 36 34 31 36 19  8  8     LK2:02h03h04h02h57m04h79m10m14m14m
```

One can count here the number of satellites received by the GPS.

They should be around 50 for L1 signal if the satellite is high above the horizon (elevation) and higher than 10 for L2 (SN2).

8.1.4 SN Levels for GPS Satellites

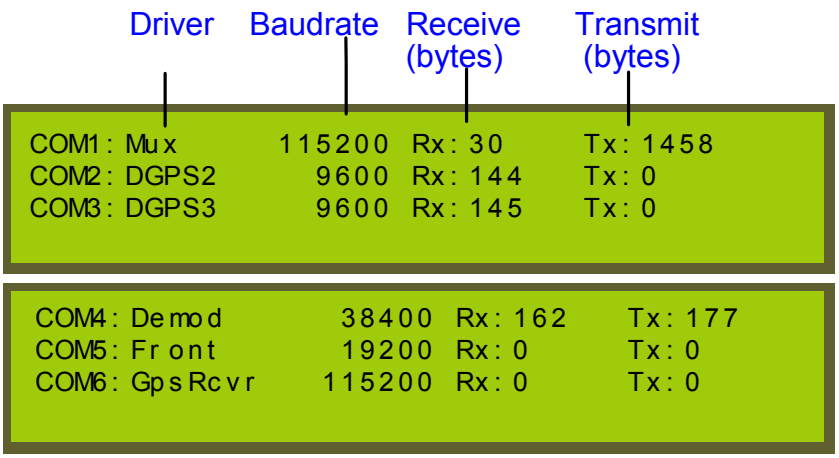
The signal to Noise Ratios (SNR's) show the signal strength for the GPS data coming into the Gps receiver.

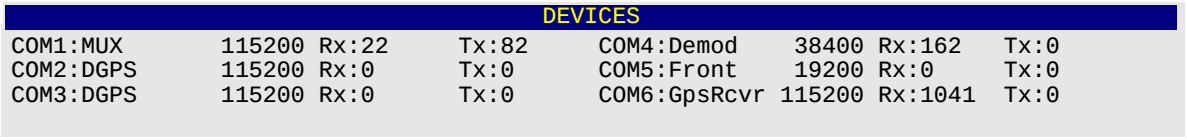
SN1 must be at least 50 dB for satellites with a high elevation. If the elevation is not so high, a lower SN1 can be accepted.

SN2 must SN1-10 dB. So, if SN1 is 52 dB then SN2 must be at least 42 dB.

Both SN's must show a stable value and not vary too much. If they vary from second to second a lot, then multipath should be considered as a cause of this problem. See also 12.1.1 Check reception of GPS.

8.1.5 F1 – Devices (Com Port) display





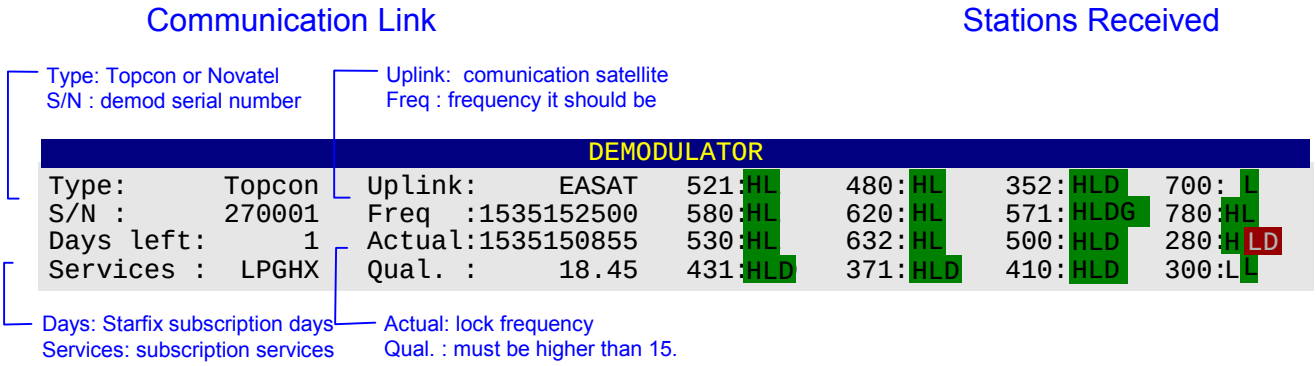
If the Devices Display is not visible on the monitor, then use the Right arrow key on the keyboard to get to this section of the F1 Display.

The list here refers to the six Com ports on the internal Processor Board, not to the Com ports at the back of the HP Mobile.

The Com Port 1 to 4 setup (Driver, baudrate) can be altered in menu SPM Menu → Devices → Port Configuration (section 9.4.1). The use of Ports 5 and 6 cannot be altered by the user (is done through the Advanced SPM menus).

Note that Com 4 will be assigned to an internal demodulator if one is present in the HP Mobile. In that case the user will only be able to use Com Port 1 to 3.

8.1.6 F1 – Demodulator



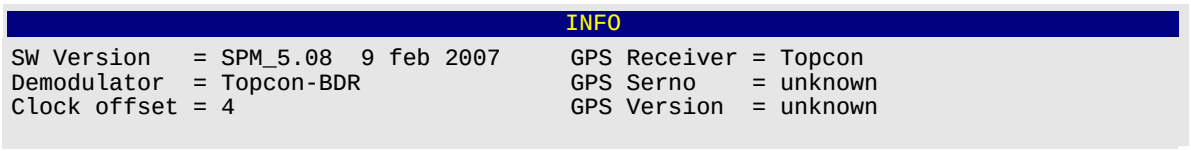
The Demodulator Display shows the status of the uplink and corrections received.

For an explanation on the meaning of the H, L D characters, see section 8.1.2 F1 - Stations Display.

Use the Right arrow key on the keyboard to get to the Demodulator Display of the F1 Display.

Type	Demodulator type, either Topcon or Novatel.
S/N	Serial number of demodulator, the serial number is related to the RSOC subscription.
Days left	Remainder of days that the Demodulator License is valid (RSOC subscription).
Services	Services that are enabled on the RSOC subscription.
Uplink	Communication Satellite used for receiving the Corrections from the Starfix Network.
Frequency	This is the nominal frequency for the selected Satellite service. This information is coming from the SPM list of frequencies.
Actual	Actual Frequency that the demodulator locks onto the signal. This is usually within +/- 1500 Hz of the nominal frequency of the selected Service.
Qual	This indicates the signal strength of the uplink signal. For proper correction decoding this value should be higher than 15. Anything below 12 indicates no link at all.
280:HLD 300:HLD	The HP, L1 and L2 corrections for Station 280 and 300 are being received. The age of corrections is shown in the colors: **H** Green indicates are being received ok. **H** Blue indicates that correction age has dangerously increased, more than 5 seconds for L1, L2 and more than 30 seconds for HP. **L** Red indicates that correction age has increased to unacceptable level, more than 10 seconds for L1, L2 and more than 60 seconds for HP.

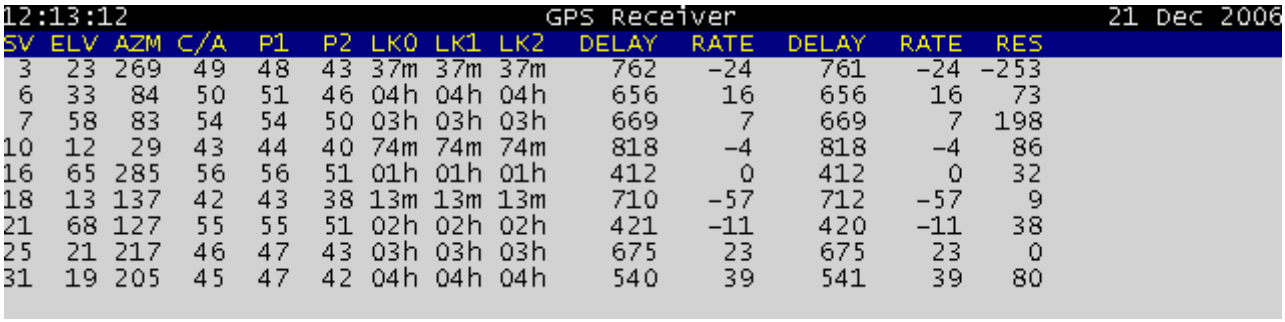
8.1.7 F1 – Info Display



SW Version	Shows SPM softrware version and date of issue.
GPS Receiver	Displays GPS receiver type as was set in 9.4.2 SPM Menu → Devices → GPS Receiver.
Demodulator	Displays Demodulator type as was set in 9.4.3 SPM Menu → Devices → Demodulator.
Clock Offset	Difference in time between GPS Time and Processor board time in seconds. This can vary without any problem between -5 and +5 seconds. If it exceeds this range, then the SPM software should be re-started. Note: information available from 5.07 onwards.

Use the Right arrow key on the keyboard to get to Info Display of the F1 Display.

8.2 F2 - GPS Satellite information displays



12:13:12 GPS Receiver 21 Dec 2006

SV	ELV	AZM	C/A	P1	P2	LK0	LK1	LK2	DELAY	RATE	DELAY	RATE	RES
3	23	269	49	48	43	37m	37m	37m	762	-24	761	-24	-253
6	33	84	50	51	46	04h	04h	04h	656	16	656	16	73
7	58	83	54	54	50	03h	03h	03h	669	7	669	7	198
10	12	29	43	44	40	74m	74m	74m	818	-4	818	-4	86
16	65	285	56	56	51	01h	01h	01h	412	0	412	0	32
18	13	137	42	43	38	13m	13m	13m	710	-57	712	-57	9
21	68	127	55	55	51	02h	02h	02h	421	-11	420	-11	38
25	21	217	46	47	43	03h	03h	03h	675	23	675	23	0
31	19	205	45	47	42	04h	04h	04h	540	39	541	39	80

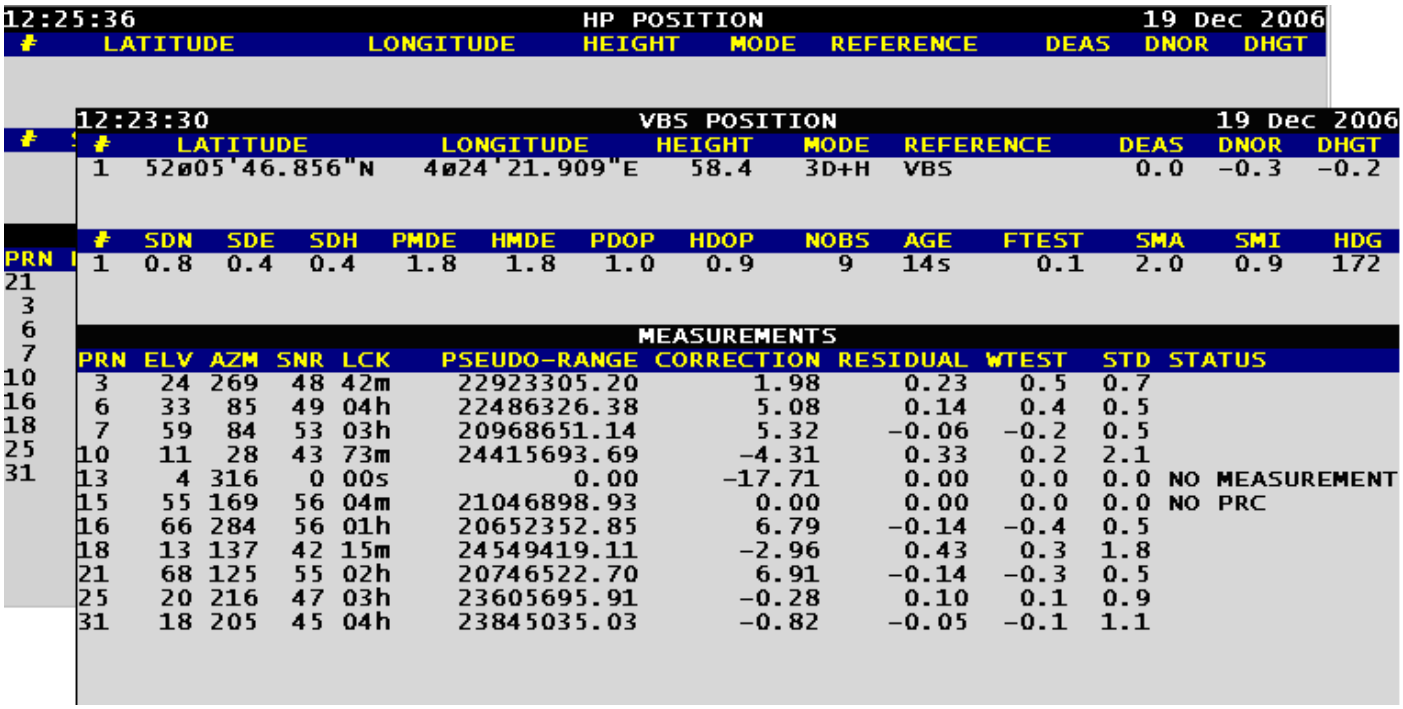
These displays shows the GPS satellites being tracked. This information comes from the internal GPS Card.

SV	Satellite ID number
ELV	Elevation to the satellite (degrees)
AZM	Azimuth to the satellite (degrees)
C/A	Signal to Noise Ratio for L1 Code measurement (dB).
P1	Signal to Noise Ratio for L1 Phase measurement (dB). SN for L1 should be around 50 or better for satellites with high elevation (50 °+)
P2	Signal to Noise Ratio for L2 Phase measurement (dB) SN2 should be higher than SN1 minus 10 dB, e.g. if SN1 is 50 dB, then SN2 should be at least 40 or better.
LK0	Lock Time C/A signal
LK1	Lock Time L1 Phase signal
LK2	Lock Time L2 Phase signal
DELAY	Smoothed Ionospheric delay (cm at fixed minute intervals). The DELAY is an estimate from the P1 / P2 data.
RATE	The smoothed Ionospheric rate of change (milli meters / minute). The RATE is an estimate from the P1 / P2 data.
DELAY	Raw Ionospheric delay (cm at seconds interval)
RATE	The raw Ionospheric rate of change (milli meters / minute)
RES	The residuals of the raw Ionospheric delay (cm).

Shown is the status of the GPS satellites that are currently being tracked by the GPS.

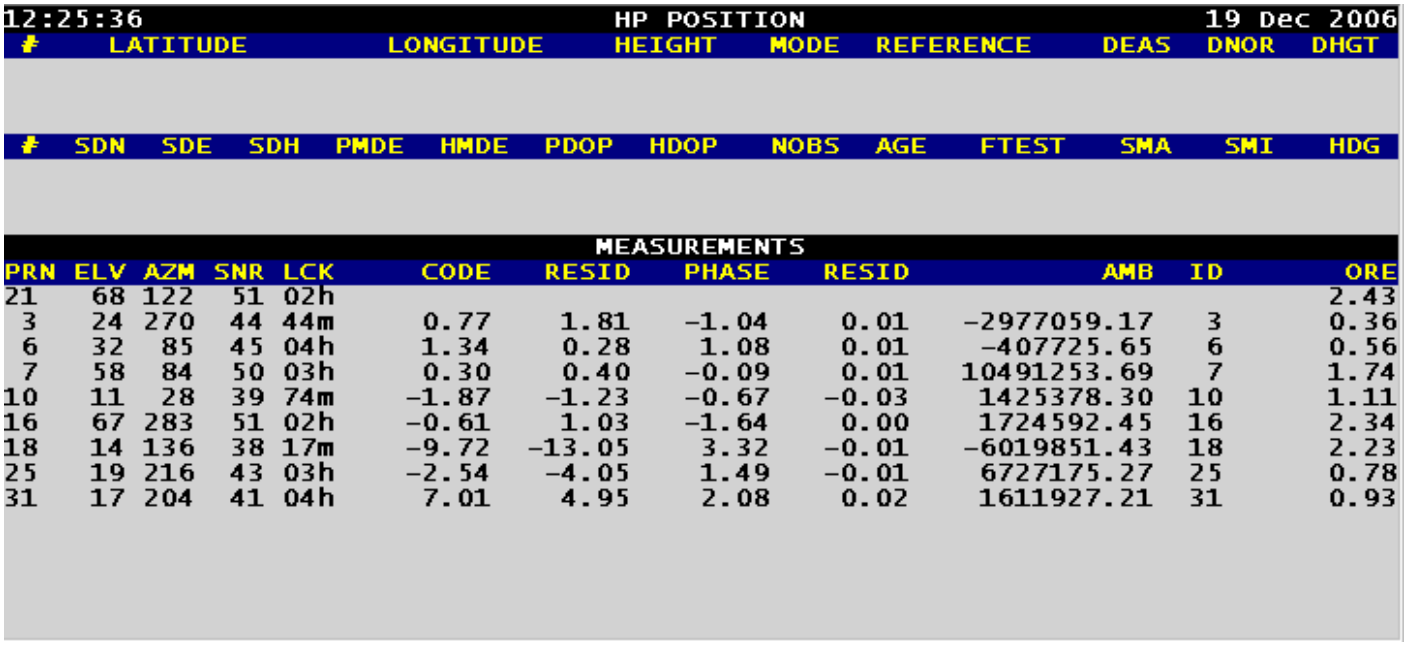
The signal to Noise Ratios (SNR's) are not shown here, but only on the F1 - Satellite Display, section 8.1.3. See there also for acceptable levels.

8.3 F3 - Position Display: HP or VBS Position



Toggle between the two displays with F3.

8.3.1 F3 HP Position



See for explanation next section.

8.3.2 F3 VBS Position

12:23:30 VBS POSITION 19 Dec 2006

#	LATITUDE	LONGITUDE	HEIGHT	MODE	REFERENCE	DEAS	DNOR	DHGT
1	52ø05'46.856"N	4ø24'21.909"E	58.4	3D+H	VBS	0.0	-0.3	-0.2

#	SDN	SDE	SDH	PMDE	HMDE	PDOP	HDOP	NOBS	AGE	FTEST	SMA	SMI	HDG
1	0.8	0.4	0.4	1.8	1.8	1.0	0.9	9	14s	0.1	2.0	0.9	172

MEASUREMENTS

PRN	ELV	AZM	SNR	LCK	PSEUDO-RANGE	CORRECTION	RESIDUAL	WTEST	STD	STATUS
3	24	269	48	42m	22923305.20	1.98	0.23	0.5	0.7	
6	33	85	49	04h	22486326.38	5.08	0.14	0.4	0.5	
7	59	84	53	03h	20968651.14	5.32	-0.06	-0.2	0.5	
10	11	28	43	73m	24415693.69	-4.31	0.33	0.2	2.1	
13	4	316	0	00s	0.00	-17.71	0.00	0.0	0.0	NO MEASUREMENT
15	55	169	56	04m	21046898.93	0.00	0.00	0.0	0.0	NO PRC
16	66	284	56	01h	20652352.85	6.79	-0.14	-0.4	0.5	
18	13	137	42	15m	24549419.11	-2.96	0.43	0.3	1.8	
21	68	125	55	02h	20746522.70	6.91	-0.14	-0.3	0.5	
25	20	216	47	03h	23605695.91	-0.28	0.10	0.1	0.9	
31	18	205	45	04h	23845035.03	-0.82	-0.05	-0.1	1.1	

LATITUDE	Calculated Latitude (WGS84)
LONGITUDE	Calculated Longitude (WGS84)
HEIGHT	Calculated Height (WGS84, meter)
MODE	Positioning mode. This can be either 3D or 3D+H. See comment below.
REFERENCE	VBS or NO VBS. When NO VBS is shown in the “Reference”, no differential corrections are available.
DEAS, DNOR, DHGT	Delta Easting, Northing, Height (meter) (VBS minus HP)
SDN, SDE, SDH	Standard Deviation Northing, Easting or Height (meter)
PMDE, HMDE	Position or Horizontal Marginal Detectable Error in metres
PDOP, HDOP	Position or Horizontal Dilution Of Position
NOBS	Number of Observables used for the position calculation
AGE	Age of the differential corrections in seconds
FTEST	Test on residuals with an expected value of =<1
SMA, SMI, HDG	Semi Major Axis, Semi Minor Axis and Heading of the error ellips (meter)

The list shows all satellites that should be available according to the almanac, with a maximum of 16 satellites.

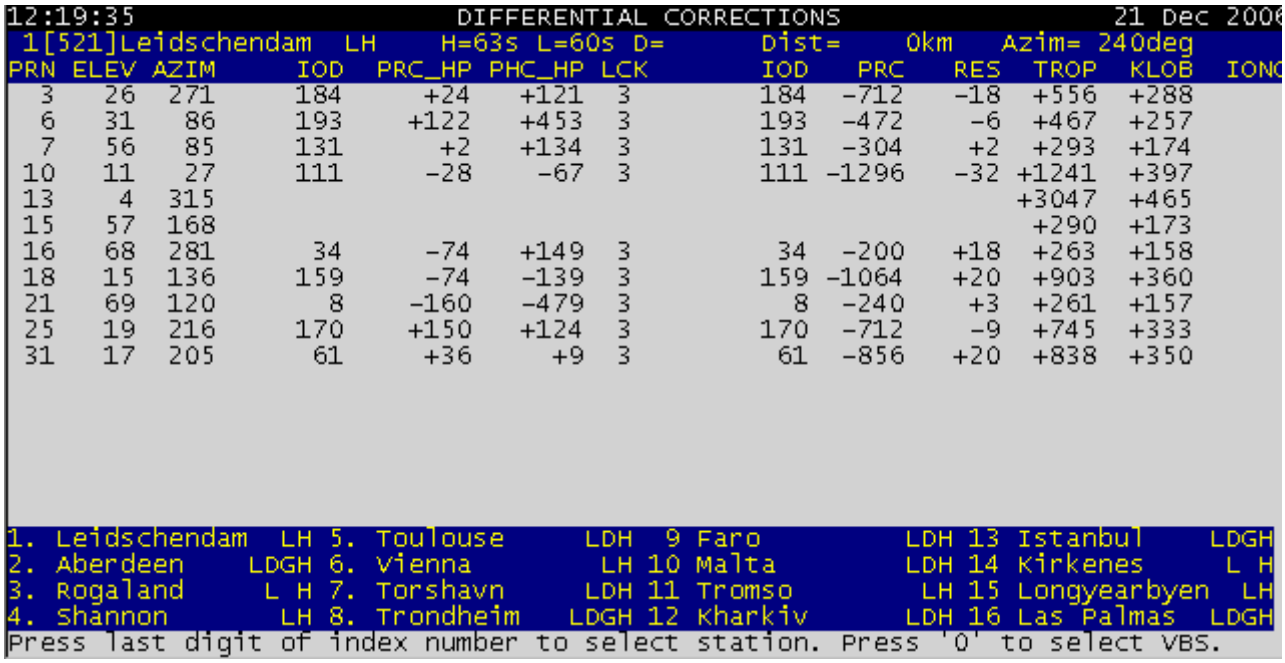
If a satellite is not used for the position calculation, a message with the cause of the rejection is shown in the Status column (e.g. No Measurement, indicating that the satellite is not being tracked because of low elevation).

HEIGHT	MODE
58.4	3D+H

The fields Height and Mode indicate which mode VBS is using, 3D or 3D+H, and the if Height aiding is used, then the Height is shown. Read more on Height Aiding and how to use it properly in 5.4 Theory of the VBS Position Calculation.

Height aiding can be switched on and off in SPM Menu → Positioning → Starfix.VBS Settings, see section 9.6.6.

8.4 F4 - Corrections Display

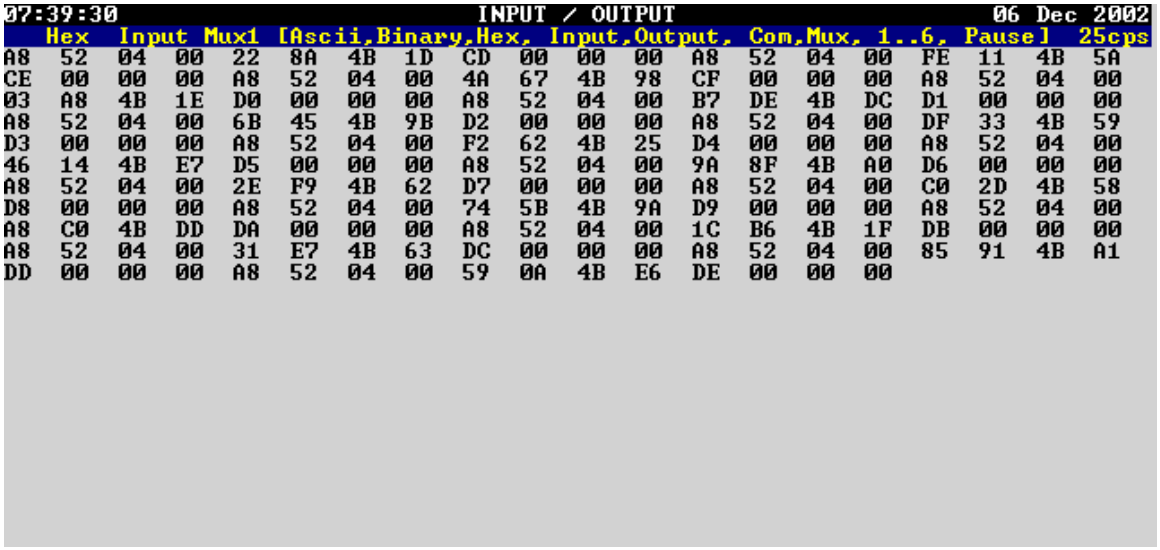


The differential corrections received for the selected stations are shown in this display. Use the number keys (1, 2, etc.) to see corrections for each station. Use 0 for the VBS corrections.

The header shows the following information:				
#[ ]	Station index number (#) followed by Station ID number in [ ]			
Name	Reference Station Name and type of messages (LDGH)			
H=	Age in seconds of HP message			
L=	Age in seconds of standard L1 C/A (type 1) corrections			
D=	Age of the Dual frequency (type 15) messages			
Dist=	Calculated Distance in kilometres to the shown reference station			
Azim=	Calculated Azimuth in degrees to the shown reference station			
The data shown for each visible satellite of the selected reference station is:				
PRN	Satellite ID number			
ELEV	Elevation in degrees			
AZIM	Azimuth in degrees			
The information displayed for HP differential corrections are:				
IOD	Issue Of Data			
PRC_HP	Pseudo Range Correction in centimetres			
PHC_HP	Phase Correction in centimetres			
LCK	Amount of time the satellite signal has been locked at the reference station.			
	0=0-9 seconds	1=10-19 seconds	2=20-29 seconds	3=30 seconds or more
The information displayed for standard differential corrections are:				
IOD	Issue Of Data			
PRC	Pseudo Range Correction in centimetres			
RES	Difference between Pseudo range correction of current station and the Pseudo range correction of the VBS corrections in cm			
TROP	Tropospheric delay in centimetres			
KLOB	Ionospheric delay in centimetres derived from Klobuchar model			
IONO	Derived delay in centimetres from dual frequency observations (type 15)			

8.5 F5 - I/O Display

The I/O display can be used to monitor all incoming and outgoing data streams of Com Ports 1-6 and multiplexed channels 1-6 of the multiplexer driver.



In the seconds line one can see

On the left	Currently active commands
On the right, cps	Cps stands for characters per second.
In the middle, between [ ]	Commands available, see table below.

The following commands are available using a keyboard:

A	Data will be displayed in ASCII format. Only “carriage return” and “line feed” are interpreted, any other non-printable character is represented as a dot ‘.’.
B	Data will be displayed in Binary format. Any non-printable character is represented as a dot ‘.’.
H	Data will be displayed in Hexadecimal bytes.
I	Show Input of selected Com port / Multiplexer channel.
O	Show Output of selected Com port / Multiplexer channel.
C	Select Com port as data stream.
M	Select Multiplexer channel as data stream.
1..6	Select Com port or Multiplexer Channel number.
P	Pauses the data flow on the screen, by Pressing 'P' again, the data flow continues.

8.6 F6 - Messages Displays

8.6.1 Overview

Overview under construction.

8.6.2 F6 – page 1: Message Display – System

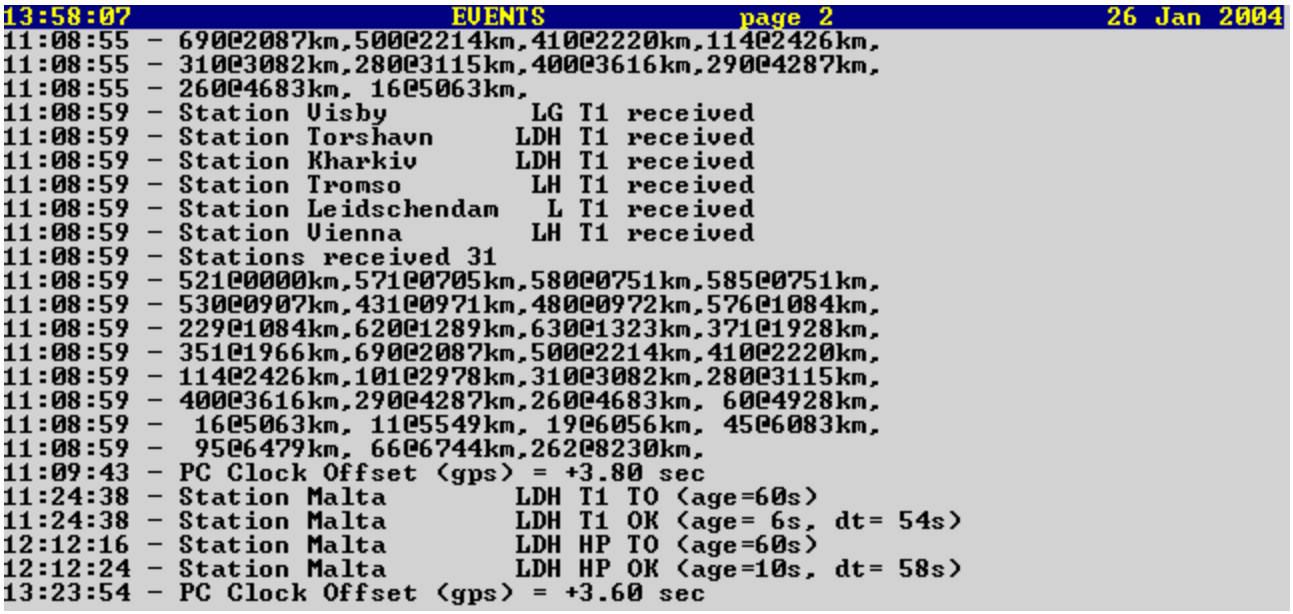
The message display will show the program-generated messages, and will give an aid to advanced users in faultfinding. The individual pages can be selected using the Left and Right arrow keys or by typing the corresponding page number.

```
13:55:46                    SYSTEM              page 1                  26 Jan 2004
11:08:44 - DIR_PRG=*c:/prog*
11:08:44 - Userid=0,code=7,ok=0
11:08:44 - 26 Jan 2004
11:08:44 - Release: SPM_0.27 22 Dec 2003
11:08:44 - Weekno=1255
11:08:44 - Topcon driver selected
11:08:44 - Loaded SCFMAP2,31,229,410,101,95,45,262,11,19,66,620,0,571,16,290,31
           0,340,280,630,580,114,530,371,400,351,431,500,260,690,60,521,480
11:08:44 - Loaded HPSMAP2,0,19,16,290,371,521,571,630,585,530,620,351,431,480,3
           10,400,576,410,690,500,260
11:08:44 - Loaded SCFMAP3,31,229,410,101,95,45,0,11,19,0,620,0,571,16,290,310,3
           40,280,630,580,114,530,371,400,351,431,500,260,690,60,521,480
11:08:44 - Loaded HPSMAP3,0,19,16,290,371,525,571,630,585,530,620,351,431,480,3
           10,400,576,410,690,500,260
11:08:44 - Number of SCF/CBMF drivers is 4 of 4
11:08:44 - Number of COM-ports is 6
11:08:44 - almanacLoad: 1-11,13-18,20-31
11:08:44 - NMEA sequence = gga,gsa,vtg [3]
11:08:44 - HP/GSS positioning seed is on
11:08:44 - Number of stations in spm.stn is 140
11:08:44 - HP Engine 100803
11:08:44 - Number of stations HP engine is 16
11:08:44 - GSS Engine SSE090503
```

This page can be reached by pressing F6 and then 1.

The system message display shows program relevant information upon start-up of the program, such as program version information, Memory allocation, etc.

8.6.3 F6 – page 2: Message Display – Events



This page can be reached by pressing F6 and then 2.

The events message display shows program events during operation. Such as GPS satellite information (new almanac received, satellite health), but also changes in configuration (assigning new device drivers, error messages after configuration) and position calculation messages (VBS calculation failed, etc).

8.6.4 F6 – page 3: Message Display – DGPS Receiver / Demodulator

```
08:12:10                        3:DGPS receivers    3                   17 Oct 2006
          2,352,670,
08:11:49 - HPSDCS4:566:19=290,371,521,632,580,530,620,431,480,300,400,410,690,50
          0,462,280,352,780,670,
08:11:49 - GSSCLK4:048,nsat=29,src=0,map=0
08:11:49 - GSSCLK4:age=10s
08:11:51 - GSSORB4:245,nsat=29,src=0,map=0
08:11:51 - GSSORB4:age=12s
08:11:54 - SCFDCS4:436:12:1183:00000FFF=580,410,780,95,690,11,19,500,620,521,530
          ,371,
08:11:58 - HPSDCS4:566:19=290,371,521,632,580,530,620,431,480,300,400,410,690,50
          0,462,280,352,780,670,
08:11:59 - GSSCLK4:048,nsat=29,src=0,map=0
08:11:59 - GSSCLK4:age=10s
08:12:02 - SCFDCS4:417:13:1194:03DFF000=300,280,45,700,290,60,400,431,632,480,46
          2,352,670,
08:12:02 - SCFPKT4=5,81,15,11
08:12:03 - SCFPKT4=2,21,31,45
08:12:03 - SCFSTA4 MA=430 BA=69538 MR=167 BR=75596 [1.08.00] 30 Aug 2006
08:12:03 - STNMAP41=50,20,290,371,521,571,632,580,530,620,431,480,300,400,410,69
          0,500,462,280,352,780,670,
08:12:07 - HPSDCS4:567:19=290,371,521,632,580,530,620,431,480,300,400,410,690,50
          0,462,280,352,780,670,
08:12:07 - GSSCLK4:048,nsat=29,src=0,map=0
08:12:07 - GSSCLK4:age=8s
```

This page can be reached by pressing F6 and then 3.

This shows the incoming corrections, whether they are received from the internal Demodulator.

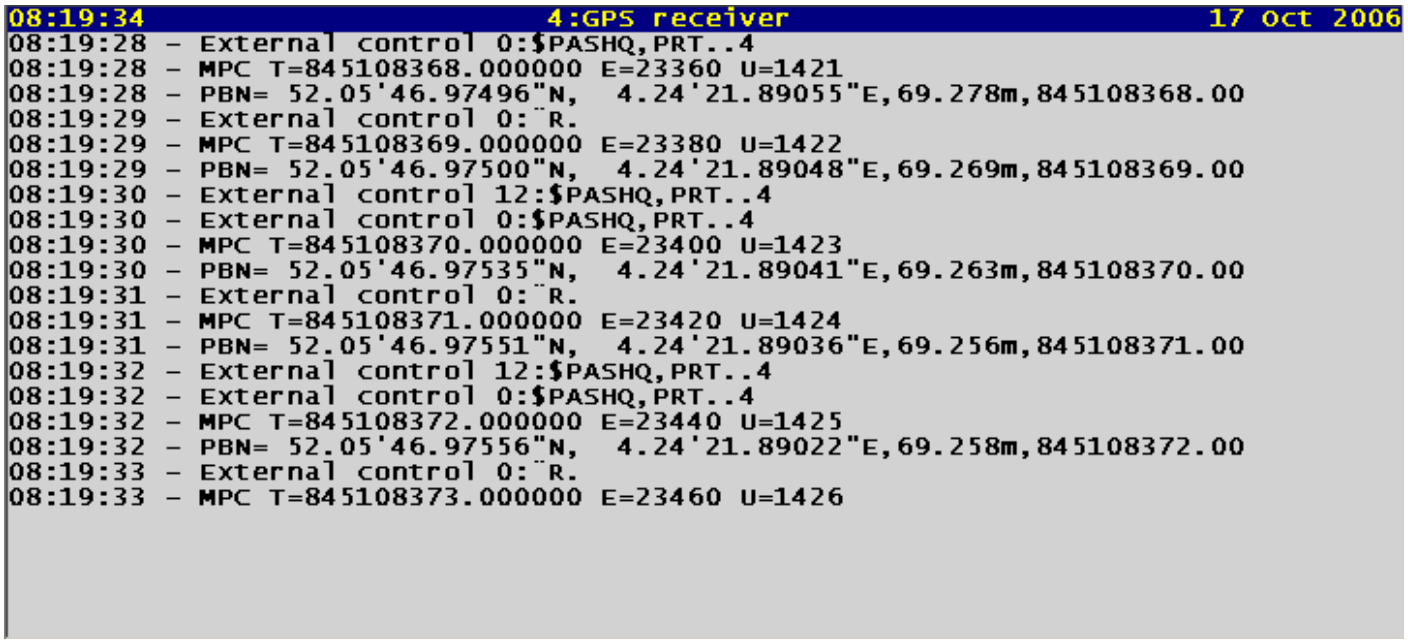
If this menu shows messages such as BAD CHECKSUM, this indicates problems decoding the information. Possibly the incorrect Driver is chosen, should be Demodulator.

Message decode is shown in table below.

SCFDCS	Standard differential corrections.
SCFSAT	Broadcast service the corrections originate from.
SCFMAP	Reference stations are available on the service
SCFSTA	Station
HPSDCS	Starfix HP corrections.
GSS	Refers to XP or GSS corrections.
GSSCLK	Should show nsat = xx with reasonable number
GSSORB	XP corrections.
Number behind the corrections name, e.g. GSSORB4	The 4 indicates the Demodulator instance 4. This is not the Com port number!!
BER	`BER=60m;snr=18.8,ebn=7.0,ber=1.00E-08,bfr=0.00E+00,F=206504,E=42` Bit Error Rate of the Topcon or Novatel Demodulator, in the SPM menu this can be switched on and off and the period of measurement can be selected, see 9.4.2 SPM Menu → Devices → Demodulator. The BER indicates how many bits arrive with errors.

	BER =	Period of measurement, selectable in SPM Menu → Devices → Demodulator.
	snr	Signal to Noise ratio. Should be 19 for Topcon demodulator and 38 for Novatel demodulator (19 is poor for a Novatel).
	ebn	
	ber	Bit error rate Before, There is a recovery procedure for lost bits. This is why we have a BER Before and a BER after, this means before recovery and after recovery. The BER After shows the rate of loss not recoverable and should be low. If the BER After is increasing, that means that at this very moment bits are being lost.
	bfr	Bit error rate After

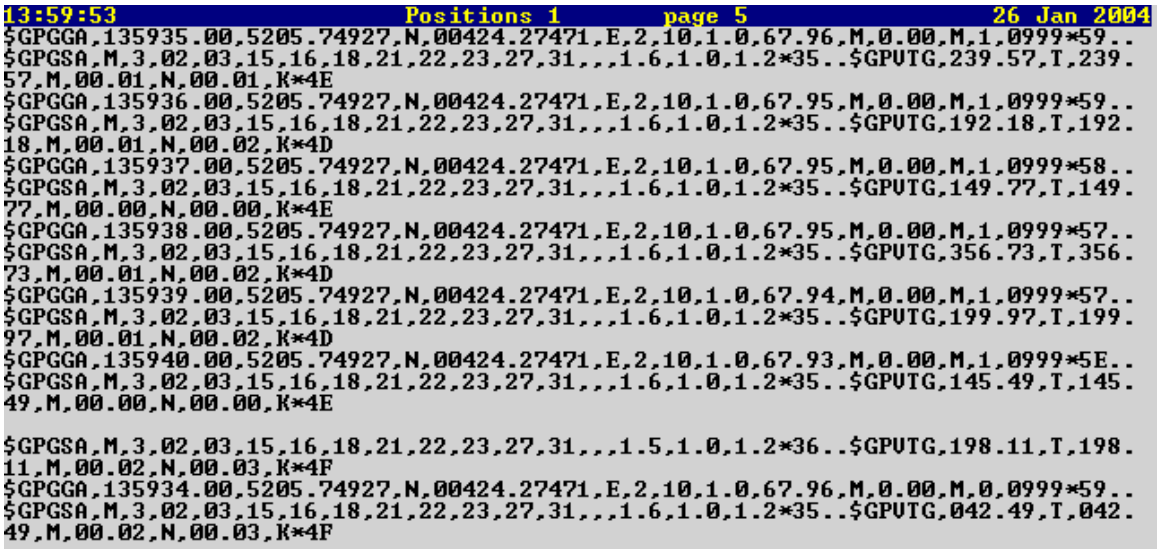
8.6.5 F6 – page 4: Message Display – GPS Receiver



This page can be reached by pressing F6 and then 4.

The GPS receiver message display shows the information flow between the Starfix-SPM program and the internal GPS receiver. Any command issued to and the reply from the GPS card can be viewed here (commands can be sent in SPM Menu → Devices → GPS Receiver).

8.6.6 F6 – page 5, 6, 7, 8: Message Display – Positions 1, 2, 3, 4



These pages can be reached by pressing F6 and then 5, 6 7 or 8.

Page 5, 6 7 and 8 show the generated position string for each of the three selectable position outputs in the menu 9.6.3 SPM Menu → Positioning → Position Outputs.

If nothing is showing here, but you have tried to set up a position output, then the calculation of the selected position type has failed.

8.6.7 F6 – page 9: Message Display – Starfix HP

```
13:53:51                        9:Starfix-HP                          21 Dec 2006
13:53:38 - << HPC1:521,6426,2,11,395613
13:53:38 - << HPC1:571,6426,2,11,395613
13:53:38 - << HPC1:580,6426,2,11,395613
13:53:38 - << HPC1:530,6422,2,9,395611
13:53:38 - << tow=395618 stations 5 1000F age= 5
13:53:38 - << XPC1 src=0 map=0 nsv=30,30 ageOrb=48s
13:53:39 - << tow=395619 stations 5 1000F age= 6
13:53:40 - << tow=395620 stations 5 1000F age= 7
13:53:41 - << tow=395621 stations 5 1000F age= 8
13:53:42 - << tow=395622 stations 5 1000F age= 9
13:53:43 - << tow=395623 stations 5 1000F age=10
13:53:44 - << tow=395624 stations 5 1000F age=11
13:53:45 - << tow=395625 stations 5 1000F age=12
13:53:45 - << HPC1:521,6440,2,11,395620
13:53:45 - << HPC1:571,6440,2,11,395620
13:53:45 - << HPC1:580,6438,2,11,395619
13:53:45 - << HPC1:530,6440,2,9,395620
13:53:46 - << tow=395626 stations 5 1000F age= 6
13:53:47 - << tow=395627 stations 5 1000F age= 7
13:53:48 - << tow=395628 stations 5 1000F age= 8
13:53:49 - << tow=395629 stations 5 1000F age= 9
13:53:49 - << XPC1 src=0 map=0 nsv=30,30 ageOrb=59s
13:53:50 - << tow=395630 stations 5 1000F age=10
```

This page can be reached by pressing F6 and then 9.

8.6.8 F6 - page 10: Message Display - Skyfix.XP

```
13:55:02                        10:Starfix-XP                         21 Dec 2006
13:54:55 - << ppeExec(0) = 0
13:54:55 - << ppeExec(1) = 0
13:54:56 - << PPE_OBS:A=1 I=0 N= 9 T= 850744496
13:54:56 - << ppeExec(0) = 0
13:54:56 - << ppeExec(1) = 0
13:54:57 - << PPE_OBS:A=1 I=0 N= 9 T= 850744497
13:54:57 - << ppeExec(0) = 0
13:54:57 - << ppeExec(1) = 0
13:54:58 - << PPE_OBS:A=1 I=0 N= 9 T= 850744498
13:54:58 - << ppeExec(0) = 0
13:54:58 - << ppeExec(1) = 0
13:54:59 - << PPE_OBS:A=1 I=0 N= 8 T= 850744499
13:54:59 - << ppeExec(0) = 0
13:54:59 - << ppeExec(1) = 0
13:55:00 - << PPE_OBS:A=1 I=0 N= 8 T= 850744500
13:55:00 - << ppeExec(0) = 0
13:55:00 - << ppeExec(1) = 0
13:55:01 - << XPC1 src=0 map=0 nsv=30,30 ageOrb=11s ageClk=11s
13:55:01 - << PPE_OBS:A=1 I=0 N= 8 T= 850744501
13:55:01 - << ppeExec(0) = 0
13:55:01 - << ppeExec(1) = 0
13:55:02 - << PPE_OBS:A=1 I=0 N= 8 T= 850744502
13:55:02 - << ppeExec(0) = 0
13:55:02 - << ppeExec(1) = 0
```

This page can be reached by pressing F6 and then 10.

8.6.9 F6 - page 11: Message Display - Starfix.VBS

```
13:55:55                        11:Starfix-VBS                          21 Dec 2006
13:55:32 - v[0]=-2.121286 a[0]=1.000000 x[0]=-2.020937
13:55:33 - v[0]=-2.080880 a[0]=1.000000 x[0]=-1.980456
13:55:34 - v[0]=-2.012784 a[0]=1.000000 x[0]=-1.914494
13:55:35 - v[0]=-1.920775 a[0]=1.000000 x[0]=-1.824973
13:55:36 - v[0]=-1.868143 a[0]=1.000000 x[0]=-1.770951
13:55:37 - v[0]=-1.817741 a[0]=1.000000 x[0]=-1.722200
13:55:38 - v[0]=-1.791512 a[0]=1.000000 x[0]=-1.699246
13:55:39 - v[0]=-1.805469 a[0]=1.000000 x[0]=-1.715254
13:55:40 - v[0]=-1.794149 a[0]=1.000000 x[0]=-1.706181
13:55:41 - v[0]=-1.776734 a[0]=1.000000 x[0]=-1.689689
13:55:42 - v[0]=-1.791608 a[0]=1.000000 x[0]=-1.704498
13:55:43 - v[0]=-1.827705 a[0]=1.000000 x[0]=-1.744199
13:55:44 - v[0]=-1.814836 a[0]=1.000000 x[0]=-1.730190
13:55:45 - v[0]=-1.789923 a[0]=1.000000 x[0]=-1.703743
13:55:46 - v[0]=-1.745128 a[0]=1.000000 x[0]=-1.658862
13:55:47 - v[0]=-1.697816 a[0]=1.000000 x[0]=-1.612495
13:55:48 - v[0]=-1.673401 a[0]=1.000000 x[0]=-1.589908
13:55:49 - v[0]=-1.686210 a[0]=1.000000 x[0]=-1.600734
13:55:50 - v[0]=-1.698130 a[0]=1.000000 x[0]=-1.612612
13:55:51 - v[0]=-1.728009 a[0]=1.000000 x[0]=-1.644975
13:55:52 - v[0]=-1.797859 a[0]=1.000000 x[0]=-1.715793
13:55:53 - v[0]=-1.883167 a[0]=1.000000 x[0]=-1.803673
13:55:54 - v[0]=-1.917218 a[0]=1.000000 x[0]=-1.838146
```

This page can be reached by pressing F6 and then 11.

8.6.10 F6 - page 14: Message Display – Processing Card Clock

```
13:57:55                        14:PC Clock                             21 Dec 2006
13:57:32 - gpsTim=850744652sec
13:57:33 - gpsTim=850744653sec
13:57:34 - gpsTim=850744654sec
13:57:35 - gpsTim=850744655sec
13:57:36 - gpsTim=850744656sec
13:57:37 - gpsTim=850744657sec
13:57:38 - gpsTim=850744658sec
13:57:39 - gpsTim=850744659sec
13:57:40 - gpsTim=850744660sec
13:57:41 - gpsTim=850744661sec
13:57:42 - gpsTim=850744662sec
13:57:43 - gpsTim=850744663sec
13:57:44 - gpsTim=850744664sec
```

This page can be reached by pressing F6 and then 14.

8.6.11 F6 - page 15: Message Display - Almanac

```
14:00:48                        15:Almanac                          21 Dec 2006
13:49:50 - $ALMA,12,90,20,00,  382,503808,0.000E+00,-2.193E-05,3.201E-01,2.885E-0
           3,5.154E+03,-2.295E+00,-7.840E-09,1.280E+00,9.550E-01,Z
13:49:50 - $ALMA,12,90,21,00,  382,503808,0.000E+00,6.580E-05,1.655E+00,1.183E-02
           ,5.154E+03,2.987E+00,-7.909E-09,-2.900E+00,9.413E-01,Z
13:49:50 - $ALMA,12,90,22,00,  382,503808,3.638E-12,1.574E-04,-1.179E+00,4.978E-0
           3,5.154E+03,-2.234E+00,-7.863E-09,-1.648E+00,9.530E-01,Z
13:49:50 - $ALMA,12,90,23,00,  382,503808,0.000E+00,1.440E-04,-2.068E+00,4.696E-0
           3,5.154E+03,-1.237E+00,-8.195E-09,2.587E+00,9.696E-01,Z
13:49:50 - $ALMA,12,90,24,00,  382,503808,3.638E-12,6.199E-05,1.030E+00,8.752E-03
           ,5.155E+03,3.004E+00,-7.657E-09,-7.722E-01,9.579E-01,Z
13:49:50 - $ALMA,12,90,25,00,  382,503808,-7.276E-12,3.996E-04,2.235E+00,1.289E-0
           2,5.154E+03,-2.832E-01,-8.012E-09,-1.309E+00,9.573E-01,Z
13:49:50 - $ALMA,12,90,26,00,  382,503808,-1.819E-11,-5.913E-05,-2.861E+00,1.763E
           -02,5.154E+03,-1.205E+00,-8.000E-09,8.255E-01,9.914E-01,Z
```

This page can be reached by pressing F6 and then 15.

8.6.12 F6 - page 16: Message Display - Ephemeris

```
14:03:53                        16:Ephemeris                        21 Dec 2006
           2,6.5825E-05,    9,403200,X
14:01:13 - $EPHA,21,4.704E-09,-4.535E-01,1.182E-02,5.154E+03,2.533E-07,1.099E-07
           ,1.767E+02,3.641E+01,1.749E-06,1.002E-05,Y
14:01:13 - $EPHA,21,2.987E+00,-8.061E-09,9.413E-01,-6.897E-10,21.0,0,0,Z
14:01:13 - $EPHA,22,  2,204,  1406,396030,-5.444,   362,403200,0.0000E+00,2.3874E-1
           2,1.5723E-04,  106,403200,X
14:01:13 - $EPHA,22,4.358E-09,2.996E+00,4.979E-03,5.154E+03,-1.118E-08,3.539E-08
           ,2.793E+02,1.526E+02,7.885E-06,5.031E-06,Y
14:01:13 - $EPHA,22,-2.233E+00,-7.920E-09,9.530E-01,1.757E-10,22.0,0,2,Z
14:01:13 - $EPHA,26,  2,204,  1406,396030,-1.954,   398,403200,0.0000E+00,-1.7167E-
           11,-5.7647E-05,  142,403200,X
14:01:13 - $EPHA,26,4.100E-09,1.313E+00,1.763E-02,5.154E+03,-2.012E-07,1.565E-07
           ,4.006E+02,-1.553E+01,-9.630E-07,-1.080E-07,Y
14:01:13 - $EPHA,26,-1.204E+00,-8.350E-09,9.914E-01,-1.321E-10,26.0,0,1,Z
```

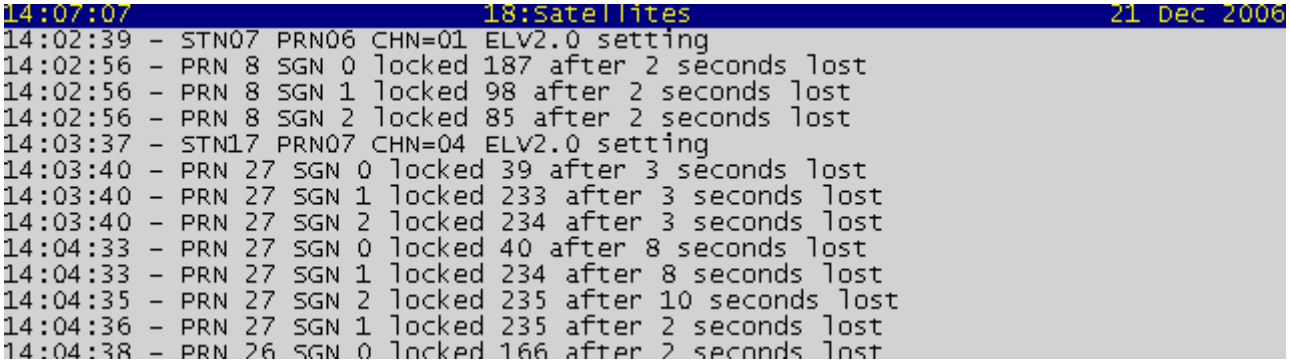
This page can be reached by pressing F6 and then 16.

8.6.13 F6 - page 17: Message Display - Stations

```
14:04:45                        17:Stations                         21 Dec 2006
12:19:52 - Station Faro          LDH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Leidschendam   LH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Aberdeen     LDGH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Trondheim    LDGH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Rogaland      L H HP OK (age= 6s, dt= 75s)
12:19:52 - Station Shannon        LH HP OK (age= 6s, dt= 76s)
12:19:52 - Station Torshavn      LDH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Toulouse      LDH HP OK (age= 6s, dt= 76s)
12:19:52 - Station Vienna         LH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Istanbul     LDGH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Tromso         LH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Kharkiv       LDH HP OK (age= 6s, dt= 75s)
12:19:52 - Station Las Palmas    LDGH HP OK (age= 6s, dt= 75s)
```

This page can be reached by pressing F6 and then 17.

8.6.14 F6 - page 18: Message Display - Satellites



This page can be reached by pressing F6 and then 18.

8.6.15 F6 - page 19 to 25

Several more pages are available, manual under construction.

9 SPM Menu Structure

9.1 SPM Menu Structure - Overview

See next page.

9.1.1 SPM Menu: To get into the SPM Menu

The menus of the Starfix HP mobile can be selected by pressing [Ent] on the keypad or the Enter key on the keyboard.

The menu structure when using the front panel or a monitor is identical. However certain options cannot be changed through the front, such as Port settings and Station numbers.

Displays

```
Title system display ................. : SPM
Number of rows for positions [1-4] ... : 1
Number of rows for stations  [0-4] ... : 1
```

Devices

Port configuration

```
COM#  Device          Baudrate     Protocol     option(s)

1     Multiplexer     <115200>
2     DGPS            <115200>
3     DGPS            <115200>

Relay inputs on ports (2-6) to MUX : on
```

GPS Receiver

```
Select command group.................. :  None
Select and execute command............ :

GPS receiver ......................... : Ashtech
Automatic Connection (default is off). : Off
```

Demodulator

```
Demodulator type (internal)........... :  Topcon-BDR
Starfix decoder instance (1-4) ....... :  1
Raw correction output to port(2) ..... : 14
Free output ports(s) ................. : 2-3,12-13,15-16


Satellite uplink ..................... :  EASAT
Frequency ............................ : 1535152500
Data Rate (bps) ...................... :  1200
Symbol Rate (bps) .................... :  2438

Select and execute command (TopconBDR) :  None
BER Period ........................... :  Frame
BER Messages ......................... :  Off
```

Stations

Stations Advanced

```
Edit cluster (Name, ID1, ID2, ....)
RXD, 521, 571, 580, 530, 431, 480, 56, 229, 620, 632, 371, 352

Load stations of cluster and restart  <<

Select Cluster .....................  : RXD
Reset cluster to stations received .. <<
Reset cluster to stations listed .... <<

Station list mode ..................  : Static
```

#	Station Name	ID	ID+	Latitude	Longitude	Height
1	Leidschendam LH	521	0	52°05'44.9042"N	4°24'16.5454Ë	+69.935
2	Aberdeen LDGH	571	957	57°11'56.2998"N	2°05'32.3094"W	+101.879

Positioning

Initial positioning

```
Initial position mode ............... : <Dynamic>
Initial latitude .................... :  52°05'46.8660"N
Initial longitude ................... :   4°24'21.0938"E
Antenna height (MSL;m) .............. :  58.540
Geoid height (m) .................... :  0.000
Elevation mask (deg) ................ :  5
Satellites disabled ................. :

Leap seconds ........................ :  14
Leap seconds next ................... :  14
Date next leap seconds .............. :  01-Jan-2006
```

Position views

```
Position display mode ............... : Absolute
Position reference for difference .... : HP/XP

# Position
1 HP/XP
2 XP
3 VBS
4 GPS
```

Position outputs

```
#  Position    Format       Ports    Backup(s)

1  HP/XP     HP_MONITOR     2,12
2  XP        HP_MONITOR     3,13     HP/XP,VBS

Free output ports ................... : 14-16
NMEA messages [gga,gll,gsa,vtg,zda,gst]: gga
Disable output while converging .....: No
```

Starfix.HP/XP

```
Starfix.HP/XP ....................... : On
Navigation ID ....................... :  1

Maximum distance to stations (km)..... : 1500
HP uses stations .................... :  1-4
HP preferred channel per station..... : First
HP channels disabled................. :

XP Corrections ...................... : On
XP Service ID ....................... : 0
XP preferred channel ................ : Auto
XP channels disabled ................ :
```

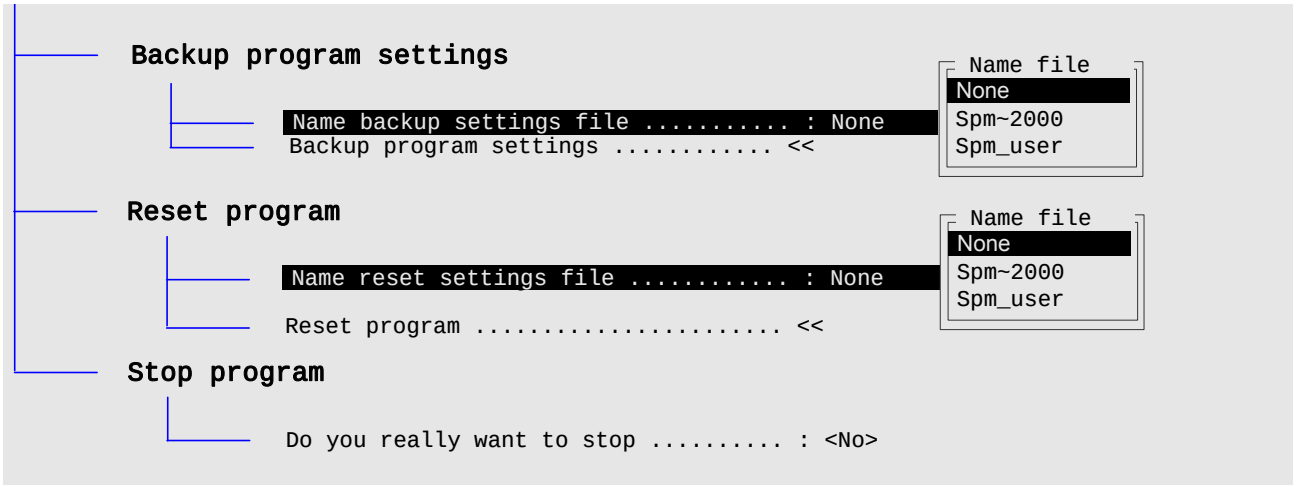
Skyfix.XP

```
Skyfix.XP ........................... :  On
Navigation ID ....................... :  2

XP Service ID ....................... : 0
XP preferred channel ................ : Auto
XP channels disabled ................ :
XP convergence period (<=30 minutes).. : 30
```

```
Positioning (continued)
    Starfix.VBS
        Starfix.VBS ........................... : On
        Navigation ID ......................... : 3

        VBS uses Starfix stations  ............ : 1-4
        VBS uses Starfix-Plus stations ........ :
        VBS identifier ........................ :  999

        100% weight range Starfix (km) ........ : 500
          0% weight range Starfix (km) ........ : 1500
        100% weight range Starfix-Plus (km) ... : 1000
          0% weight range Starfix-Plus (km) ... : 3000


        Height aiding ......................... : Off
        Standard deviation height (m) ......... : 0.5
        Standard deviation pseudo ranges (m) .. : 0.5
        Maximum age corrections (s) ........... : 60
    Starfix.GPS
        Starfix.GPS ........................... : On
        Navigation ID ......................... : 4
    Starfix.HDG
        Starfix.(HDG) Heading.................. : Off
        External GPS receiver type ............ : None

        Derive dist&hdg corr. from offsets.... : No
        Heading correction (deg) .............  :  +0.000
        Computed distance (m).................. :  +0.000
        offsets internal GPS receiver (x,y,z). : +00.000,+00.000,+0.000
        offsets external GPS receiver (x,y,z). : +00.000,+00.000,+0.000
    RTCM Messages
        RTCM Message output ................... : Off
        RTCM Messages to port(s)  ............. :
        RTCM Message types [1/3/15]............ :

        Vitual Base Station identifier ...... :  No
        Starfix Stations selected.............. :
        Starfix-Plus Stations selected ...... :

        Client Software iono corrector is ... : Off
        Client Software tropo corrector is .. : Off
        Type 15 valid for (minutes)  ........ : 10
        Type  3 interval (sec) ............... : 300
Backup program settings
        Name backup settings file ............. : None
        Backup program settings ............. <<
Reset program
        Name reset settings file  ............. : None

        Reset program ........................ <<
Stop program
        Do you really want to stop .......... : <No>
```

Figure 8: SPM Menu

9.2 SPM Menu → Backup and Reset Program



Backup

This menu allows you to save the current settings to a file. For normal users the spm_user file is available.

Advanced menu options (10.1.1 Advanced SPM Menu → Backup program settings.) allow the advanced user to save to new settings files.

Reset

Reset is a reset of the SPM program inclusive I/O and Calculations reset.

Spm~2000	Resets to the default settings of the SPM.
Spm_user	Contains the settings as were saved the last time in the Backup.
Spm~opco	Contains Opco specific settings (Opco = Fugro Operating Company). These settings are maintained by workshop engineers. Contact your Opco support center to see if these settings should be used.
others	Other settings files are made by an advanced users. Settings unknown.

Stop

Stops the Starfix-SPM application and returns to the Loader program, see 3.4 Software on the processing board.

9.3 SPM Menu → Displays

```
Displays
    ├──── Title system display ................. : SPM
    ├──── Number of rows for positions [1-4] ... : 1
    └──── Number of rows for stations  [0-4] ... : 1
```

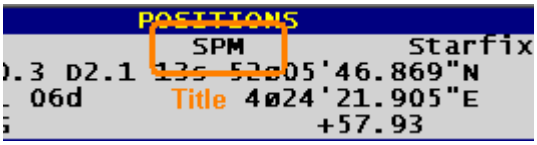
The settings in this menu apply to the F1 - Positions Display (8.1.1).

```
                                    POSITIONS
12:48:56   Starfix.HP/XP [1]            SPM         Skyfix.XP [2]     25 Nov 2006
 52°05'46.868"N   0.03 N5  F0.0 D2.6 09s  52°05'46.8675N   0.03 N5  F0.1 D2.6 13s
  4°24'21.904"E   0.05 R  4 L 11d          4°24'21.906"E   0.05 R  7 L 11d
      +57.69      0.08 H1                     +57.66      0.08 X
                                    POSITIONS
12:48:56   Starfix.VBS [3]              SPM         Starfix.GPS[4]     25 Nov 2006
 52°05'46.863"N   0.75 N6  F0.3 D1.8 05s  52°05'46.904"N   0.00 N5  F0.0 D2.6  00s
  4°24'21.923"E   0.51 D                    4°24'21.919"E   0.00
      +57.68      1.52 L1                     +57.30      0.00
```

Title system display

The title entered here shows up on the F1 - Positions Display. By default the word SPM will be displayed.

Here you can change the text manually.



Number of rows for positions

1 row shows 2 positions, 2 rows shows 4 positions, etc. Changing this settings, affects both the F1 System Display as the amount of position shown on the front panel.

Number of rows for stations

Same as above

Note: in previous SPM software versions one was able to select Delta or Error QC displays here. This option has been moved to SPM Menu → Positioning → Position Views (9.6.2).

9.4 SPM Menu → Devices

9.4.1 SPM Menu → Devices → Port Configuration

```
Devices
    Port configuration
                COM#  Device          Baudrate    Protocol     option(s)

                1     Multiplexer     <115200>
                2     DGPS            <115200>
                3     DGPS            <115200>

                Relay inputs on ports (2-6) to MUX : on
```

This menu shows the ports available for input and output.

The user is able to set in this menu the baud rate and the driver of the Com ports. The driver determines what type of data or messages can be put through the port, see table below.

Shown here are those ports that are not claimed by demodulator, front panel or Gps receiver, i.e. those ports that the user can use freely.

Virtual ports from the Multiplexer or the GPS ports (e.g. port B) are not shown. Virtual ports can be used without the user having to set baud rate or driver. The GPS Ports are configured in the GPS Receiver menu (9.4.2 SPM Menu → Devices → GPS Receiver).

In the SPM advanced menus one is able to set the drivers for all six Com ports (on the internal processing board), including for the internal Demodulator and GPS receiver, see Advanced SPM Menu → Devices → Port Settings (10.1.4). Ports that are assigned to GPS Receiver or Demodulator in the advanced menu are not shown here in the non-advanced menu.

List of Output Drivers

```
 Device
None
Multiplexer
DGPS
GPS External
```

Multiplexer — The multiplexer driver is an output driver.

6 data streams are combined and multiplexed into one data stream.

Elsewhere in the SPM menu the user can refer to the MUX output channels as COM ports 12 to 16, e.g. 13 means Channel 3 on the Multiplexer

MUX channels	Port Reference

MUX 1	Reserved for remotely controlling the Starfix HP mobile through the monitor and keyboard. Do no use channel 11!	Not to be referenced
MUX 2		12
MUX 3		13
MUX 4		14
MUX 5		15
MUX 6	Reserved per default for raw GPS data of the internal GPS receiver. This can be changed through the Advanced menus Advanced SPM Menu → Devices → Port Settings (10.1.4)	16

The MUX protocol is proprietary and only compatible with Starlink-DOS and the SPM remote control driver in Fugro's Starfix.IOWIN. For information on how to use the Starfix Suite IOWIN SPM remote control driver, see Appendix C MUX channels and Starfix.IOWIN (SPM Remote Control driver)

DGPS

The DGPS driver is an input/output driver

Input

As Input DGPS handles differential corrections. The driver handles corrections from

- an external Starfix demodulator (SCF super-compressed corrections), or
- other sources in CBMF or
- RTCM format.

The program automatically recognizes which format is received.

For the use of an external demodulator one is referred to section 11.1.

Output

A DGPS driver can also be used to output data. The output is configured in

- menu SPM Menu → Positioning
- menu: SPM Menu → RTCM Messages
- menu: SPM Menu → Devices → Demodulator

GPS External

This driver has been created for the use in Starfix.HDG (Heading), as this solution requires two GPS receivers. The GPS Receiver can further be configured in the menu SPM Menu → Positioning → Starfix.HDG (Heading) (9.6.8)

NOVEM

The Novatel GPS Card emulator driver of earlier SPM versions has been removed. The Novatel emulator is now only accessible through the Advanced Menus:Advanced SPM Menu → Devices → Options, see 10.1.5.

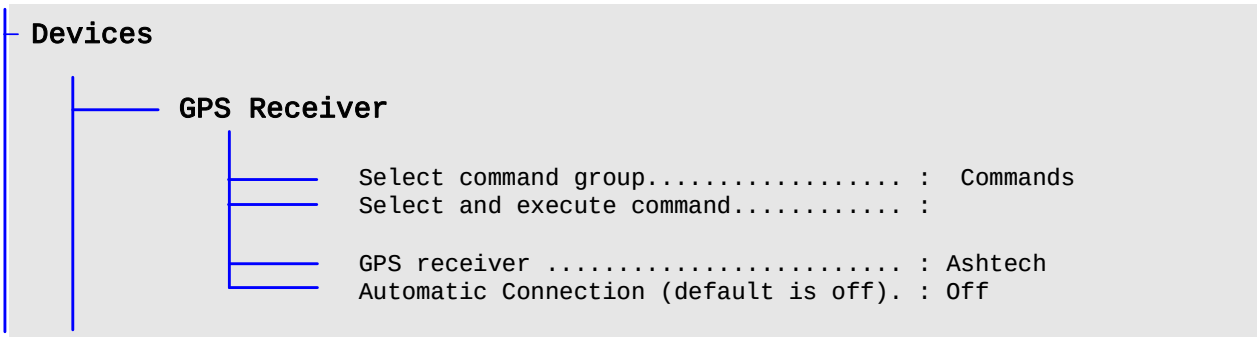
Relay inputs

With this option the user can forward data coming into one port to another port for output. E.g. the GPS coming in on Com 6 can be output on MUX channel 16.

Choose between Off, On and Manual:

Off	Switching to off means no relay.
On	Switching this menu option on, will put the input data of Com2 as output of Mux channel 2 (12), of Com 3 to Mux channel 3 (13), etc. The normal user has no access to Com ports 5 and 6 (and sometimes Com Port 4, if there is an internal demodulator). Hence the user just has to take what comes in on Com 5 on MUX channel 5 (15). These are configured in the advanced menu Advanced SPM Menu → Devices → Port Settings (10.1.4). Usually Mux channel 6 (16) will be pre-configured to have the Raw GPS data on it, which can be interfaced in Starfix with the AshtechZ12 or TopconGPS Iowin Dll.
Manual	Switching this menu option to “Manual”, means that no data is automatically forwarded. The user can do this manually by setting d=2 (forwarded to output on Com 2) or d=13 (forwarded to output on MUX channel 3). `COM#  Device  Baudrate  Protocol  option(s)` `1  Multiplexer  <115200>` `2  DGPS  <115200>` `3  DGPS  <115200>  d=13` `Relay inputs on ports (2-6) to MUX : Manual`

9.4.2 SPM Menu → Devices → GPS Receiver



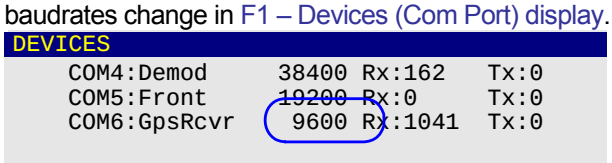
In this menu one is able to configure the internal GPS card directly. This is done by sending commands. It should be done with caution as one can alter the GPS in such a way that the SPM software is not able to use the data anymore. Or worse: is not able to communicate with the GPS anymore.

Special care should be taken when configuring Port A of the GPS, as this is the port through which SPM communicates with the GPS. Port B and Port C (if present) are available to users to freely configure. GPS Port B is connected to the back panel of the Starfix HP mobile (GPS B).

The messages of the executed commands are displayed on the GPS Receiver message display (F6 – page 4: Message Display – GPS Receiver (8.6.5)

If one has reconfigured GPS Port A such, that the SPM cannot use the data anymore, then you can follow the step by step plan in Check reception of GPS (12.1.1).

Command Group	The available pre-defined commands are subdivided in groups to make selection easier. See also section 10.1.3 About the various GPS commands.
Select and execute command	Select and execute command is used to select and execute the GPS receiver command from the commands list to the GPS card, such as 'Date and Time' and 'Request Ephemeris'. Advanced users can add extra commands through the Advanced SPM menu, see (10.1.2)
GPS Receiver	This menu item should only be touched once when the HP leaves the factory. The first engineer selects here which receiver type is inside the HP Mobile. If for some reason the type needs to be changed later (e.g. the GPS card is replaced), then re-start the SPM program to let this change take effect.
Automatic Connection	This option was made particularly for the Ashtech receiver, as it was observed that sometimes the Ashtech receiver automatically resets and then would have baud rate 9600, due to which the SPM software lost connnection with the GPS Receiver. If one observes loss of connection with the GPS Receiver (see 12.1.1 Check reception of GPS) then one can switch this option on to re-gain connection. The Automatic Connection is attempted at start up of the SPM software only. After switching on, the user must restart the SPM software to allow the function to work. The user can see the baudrates change in F1 – Devices (Com Port) display.



Once connections has been re-established, the Automatic Connection option should be switched off again.

On	On start-up the SPM software cycles through the baud rates on Com 6 in an attempt to make connection with the internal GPS receiver.
Off	The SPM software uses the pre-set baud rate on Com 6 to connect to the GPS Receiver.

COM 6 of the built-in processing board is hardwired internally to port A of the GPS card. This means that the baud rate of Com6 must match the baud rate of Port A of the GPS. The SPM software has a preference for a baud rate of 115200, the Ashtech has a factory default of 9600, the Topcon has a default of 115200.

9.4.3 SPM Menu → Devices → Demodulator

```
Devices
    Demodulator

        Demodulator type (internal)..... :  Topcon-BDR
        Starfix decoder instance (1-4) ..... :  1
        Raw correction output to port(2) ..... : 14
        Free output ports(s) ................ : 2-3,12-13,15-16


        Satellite uplink ..................... :  EASAT
        Frequency ............................ : 1535152500
        Data Rate (bps) ...................... :  1200
        Symbol Rate (bps) .................... :  2438

        Select and execute command (TopconBDR) :  None
        BER Period ........................... :  Frame
        BER Messages ......................... :  Off
```

The Demodulator menu serves two purposes:

1. Allows the user to select Satellite Service to receive Starfix corrections from
2. Optionally forward these corrections to an output port.

This menu (Devices -> Demodulator) refers ONLY to the demodulator which is interfaced through the driver Demodulator, usually the internal Demodulator on Com 4. This can be checked in the F1 System Display (F1 – Devices (Com Port) display 8.1.5).

```
   DEVICES
1938   COM4:Demod    38400 Rx:162   Tx:0
0      COM5:Front    19200 Rx:0     Tx:0
0      COM6:Demod   115200 Rx:1041   Tx:0
```

Check the back of the HP Mobile: if no Com 4 port is seen, then most likely you will have an internal demodulator.

The SPM menu Demodulator was introduced in SPM version 4.17 when the operation of the demodulator was integrated in the SPM software. It only is relevant if there is an internal demodulator of the type Topcon or Novatel. If the HP Mobile does not have an internal demodulator or has a demodulator of the type 3000LCE demodulator, then one will see mostly zero's.

Notice that in the display F1 – Demodulator (8.1.6) one can see the actual frequency that the communication satellite is locked on (not the nominal frequency shown in this menu), the serial number and expiry date of the Demodulator for RSOC subscription, etc. More information on the demodulator is also available on the status display F6 – page 3: Message Display – DGPS Receiver / Demodulator (8.6.4).

Demodulator	Select Topcon, Novatel or None. If Topcon or Novatel is selected, the SPM software will send configuration commands to the demodulator. If None is selected whilst a demodulator is present, then the demodulator won't be configured, won't output anything and appears to be not working.
Decoder instance	The instance has been introduced in the SPM version 5 to allow for multiple broadcast streams, and thus multiple demodulators. The internal demodulator is per default instance 1, but the user can change this here. See for more information on the use of multiple demodulators section 11.1.

Raw correction output	For available ports, use one or more of the ports listed below in free ports.
Free output ports	List available ports for menu item above. Should not be changed, unless you are an experienced user.
Satellite uplink	This is user selectable to select the satellite for the Starfix Network Service.
Frequency	The frequency of the Service selected. The Frequency is not editable, however there is a “User Defined” Service, whereby the user can manually edit the frequency. Advanced users only: there is a Text file on the disk where the SPM software runs. In the text file are the frequencies stored.
Data Rate, symbol rate	The user should enter here the Data Rate and Symbol Rate of the selected Service. Listed in Appendix I Fugro Broadcast Information. Note: this information can change, so please verify the latest settings with the NCC in case of troubles with the uplink.
BER Period	The Period over which the Bit Error Rate is to reported. The BER indicates how many bits arrive with errors. These BER’s are shown in 8.6.4 F6 – page 3: Message Display – DGPS Receiver / Demodulator. Choose: Frame (approx 3 seconds), Minute, Hour or Day.
BER Messages	If On, then the BER messages are displayed on Status display F6, page 3, see 8.6.4 F6 – page 3: Message Display – DGPS Receiver

9.5 SPM Menu → Stations

```
============================ SPM MAIN MENU ================================
============================ STATIONS MENU ================================


Stations advanced ........ [Ent]

 #   Station Name        ID   ID+  Latitude         Longitude        Height

 1   Leidschendam    LH  521  0    52°05'44.9042"N   4°24'16.5454"E   +69.935
 2   Aberdeen      LDGH  571  957  57°11'56.2998"N   2°05'32.3094"W  +101.879
 3   Rogaland       L H  580  0    58°52'47.4782"N   5°43'26.5175"E   +75.486
 4   Shannon         LH  530  0    52°41'30.2706"N   8°55'04.7435"W   +78.068
 5   Toulouse        LDH 431  943  43°34'01.0113"N   1°29'15.0138"E  +203.531
 6   Torshavn        LDH 620  962  62°02'09.2612"N   6°46'04.8244"W  +164.376
 7   Trondheim     LDGH  632  963  63°26'29.5768"N   6°46'04.8244"E   +68.628
```

9.5.1 The Station List

The Station List is used by the HP and VBS calculations as they use station corrections. GPS and XP do not use station corrections. In the SPM Menu → Stations → Advanced Menu one builds the full Station List. Then in the menu SPM Menu → Positioning → Starfix.HP/XP Settings (section 9.6.4) or SPM Menu → Positioning → Starfix.VBS Settings one can make a sub-selection that is actually used by HP or VBS. Only stations in the Station List can be selected for use in HP or VBS.

The display above shows the current Station List. This is the same list as shown in the F1 - Stations Display. One can create and change the Station List in the Stations advanced menu (see top of picrure).

By default, if the automatic procedure, explained in section 9.5.2.1, is followed to create the Station List, then the stations are sorted on distance. This is the distance between the station and the Initial Position at the time of creation, see menu 9.6.1. In the same Stations Advanced Menu one can manually re-order the stations.

This is the only moment when the order of the stations is changed: at no point will the SPM software re-order the list of stations. It is therefore adviseable to request the station list whenever the HP Mobile is started for the first time in a new area of the world, so as to allow the station list to be re-sorted on distance.

9.5.1.1 The Station names and Latitude/Longitude information

The information in the list above has been compiled from different sources.

The Starfix Network broadcasts the corrections based on station ID's only. The station ID's are retrieved from the Starfix Network.

The names of the stations are never broadcast but are retrieved from a database that is part of the SPM software. The locations of the stations are in the database as well, but will also be broadcast. Every 15 minutes to 1 hour the coordinates of the stations are broadcast, Latitude, Longitude and Height.

At the time of release, the SPM software includes the latest database of stations. If new stations are added later, then you may see that a station ID appears, but the SPM software is not able to affix a name to this ID. The station appears as None. The user can use this station without problems.

As well, it is possible that the user is able to select a Station, but does not see a Latitude or Longitude for this station. After a while, the Latitude and Longitude should appear. Alternatively enter the Lat, Lon yourself.

9.5.1.2 The Station List and Communication Link

The Starfix Corrections are broadcast via various communication satellites (EASAT, AFSAT, etc.). These communication satellites cover specific areas of the Earth, e.g. Europe or Africa. For each communication satellite, only a sub-selection of station correction is sent, applicable to the working area of these satellites.

Since SPM version 5 the user is able to simultaneously interface to different communication satellites. These stations from these different satellites can be mixed and matched in the Station list. However, we advise users not to use more than one communication satellite at a time in the HP calculation (SPM Menu → Positioning → Starfix.HP/XP Settings). A good solution is to create a cluster with all stations in it, and accept that some stations may not be received, if they happen to be on a communication satellite that is currently not used. Alternatively the user can create multiple clusters of stations, based on the satellite in use and re-load them when switching over.

9.5.1.3 Expanding and reducing the length of the Station List

```
============================= SPM MAIN MENU ================================
============================= STATIONS MENU ================================


Stations advanced ........ [Ent]

 #    Station Name        ID   ID+  Latitude         Longitude        Height

 1    Leidschendam    LH  521  0    52°05'44.9042"N   4°24'16.5454"   +69.935
 2    Aberdeen      LDGH  571  957  57°11'56.2998"N   2°05'32.3094"W +101.879
 3    Rogaland       L H  580  0    58°52'47.4782"N   5°43'26.5175"E  +75.486
 4    Shannon         LH  530  0    52°41'30.2706"N   8°55'04.7435"E  +78.068
```

The length of the Station list can be expanded and reduced. This is explained in section 7.5 Expanding the list of Stations or Position Outputs. The maximum length of the list is 16 stations.

9.5.2 SPM Menu → Stations → Advanced Menu

```
Stations
    Stations Advanced
        Edit cluster (Name, ID1, ID2, ....)
        RXD, 521, 571, 580, 530, 431, 480, 56, 229, 620, 632, 371, 352

        Load stations of cluster and restart  <<

        Select Cluster ......................  : RXD
        Reset cluster to stations received .. <<
        Reset cluster to stations listed .... <<

        Station list mode ..................  : Static

      #   Station Name        ID   ID+  Latitude         Longitude        Height
      1   Leidschendam    LH  521  0    52°05'44.9042"N   4°24'16.5454Ë   +69.935
      2   Aberdeen      LDGH  571  957  57°11'56.2998"N   2°05'32.3094"W  +101.879
```

9.5.2.1 Automatic Station List procedure

To use this menu follow this step by step plan.

1. Check Initial position in the menu 9.6 SPM Menu → Positioning. Make sure that the current position is shown.
2. Activate ‘Reset cluster to stations received’ by pressing Enter
3. Activate ‘Load stations and restart’ by pressing Enter

Optionally one can perform the following actions between step 1 and 2:

4. Optional: ‘Edit the cluster’: e.g. remove stations, or change the order of the stations.
5. Optional: ‘Edit the cluster’ and give the cluster a new name.

Cluster	This menu introduces the concept of a cluster. A cluster is a sequence of Station ID numbers. A cluster has a name, for example in the picture above the name is RXD. The program has no built in clusters, however after having used the option “Reset cluster to received” you will have a cluster called RXD.
Edit cluster	This menu allows one to 1. Change the stations and the order of stations in the cluster. By typing and deleting the station ID’s one can change the cluster. 2. Change the name of the cluster. Instead of the name RXD one can type any name. When pressing Enter a new cluster is created with the new name. The new cluster can be selected in the ‘Select cluster’ menu opton.
Load stations of cluster	This will reset the active Station List and reset the SPM program. This means the HP needs to re-converge!!!

Select cluster	A cluster from the list of clusters can be loaded. It will be seen under the Edit cluster list.
Reset cluster to received	This will create a cluster called RXD. The cluster will have all stations received since start-up. The stations are ordered on distance from your current location., using the position currently listed in the SPM Menu Initial Position. Check that this is set to automatic, so that your current position is used. In the displays 'F1 – Demodulator' or 'F6 – page 3: Message Display – DGPS Receiver / Demodulator' one can see which stations are being received.
Reset cluster to listed	This will create a cluster called LST with the stations which are currently in the Station List.
Station list mode	Dynamic is not implemented yet. If implemented it is the mode in which the Station List is automatically modified so that stations are sorted on distance. This new Station List would also be sent to the HP engine without requiring HP to reset. The fact that the Station List would be modified without a reset is the main benefit.
Delete a cluster	To delete a cluster type after Edit cluster: [cluster name], delete, e.g. if the cluster name is MyArea, then type MyArea,delete.

9.6 SPM Menu → Positioning

9.6.1 SPM Menu → Positioning → Initial Position

```
Positioning
    Initial positioning
        Initial position mode ..... : <Dynamic>
        Initial latitude ..... :  52°05'46.8660"N
        Initial longitude ..... :   4°24'21.0938"E
        Antenna height (MSL;m) ..... :  58.540
        Geoid height (m) ..... :  0.000
        Elevation mask (deg) ..... :  5
        Satellites disabled ..... :

        Leap seconds ..... :  14
        Leap seconds next ..... :  14
        Date next leap seconds ..... :  01-Jan-2006
```

The initial position is used:

- at startup or reset to seed the HP, XP and VBS position calculation.
- to update the distances as shown in F1 - Stations Display, this is done on a continuous basis.
- when the order of stations on distance in the Station List is set. This is discussed in more details in 9.5.1 The Station List.
- for displaying the Difference View in the System Position Display (F1), see section 8.1.1 F1 - Positions Display.
- in the VBS calculation to calculate the virtual RTCM corrections, see 9.6.6 SPM Menu → Positioning → Starfix.VBS Settings.

Initial Position Mode

The update of the initial position knows two modes:

Static	For monitoring purposes, whereby antenna co-ordinates are known precisely. Should not be used for normal operation as it can negatively affect the VBS position, see HP Monitoring: example (section 6.5.8). If static mode is used for HP or XP convergence purposes, then the initial position (latitude, longitude) should be within 1° or better, for HP or XP to be able to convergerge. However, in general there should be no need to enter a manual position here, as Dynamic mode will use the GPS position to seed the Initial Position.
Dynamic	For normal operation purposes, whereby the antenna co-ordinates are continuously updated by the GPS receiver. When the position is not updated by the GPS receiver in Dynamic mode, select the Upload Configuration in the GPS receiver menu to reset the receiver to default settings, and reset the program.

After the changing the new initial position coordinates, the program needs to be reset in order to accept the new initial position.

Initial latitude, longitude	Enter start Latitude for Static mode. In Dynamic mode the Initial position will come from the best available position,. In the worst case this is stand alone GPS, which is still good enough.
Antenna height (MSL; m), Geoid height (m)	The sum of the Antenna height and the Geoid height is used for height aiding in the VBS position calculation, see section 9.6.6, SPM Menu → Positioning → Starfix.VBS Settings.
Elevation mask (deg)	Satellites below the Elevation mask are excluded from all the three position calculations, VBS, XP, and HP. Note that each GPS card also handles Elevation Masks. The Elevation Mask used is therefore the highest of the two settings. The User can set the Elevation Mask for the GPS card in SPM Menu → Devices → GPS Receiver (9.4.2).
Satellites disabled	Satellites specified (Satellite SV numbers) are excluded from the position calculations
Leap seconds	GPS minus UTC time; at present +14 seconds
Leap seconds next	At the next leap seconds change over, then this value will be used
Date next leap seconds	Date that the above Next Leap seconds will be used.

9.6.2 SPM Menu → Positioning → Position Views

```
Positioning
    Position views
        Position display mode ................ : Absolute
        Position reference for difference .... : HP/XP

        # Position

        1 HP/XP
        2 XP
        3 VBS
        4 GPS
```

The Position view refers to the Positions in the F1 display in F1 - Positions Display.

Display mode

```
Position mode
Absolute
Difference
```

Choose Absolute or Difference, default is Absolute.

Absolute:

```
                                          POSITIONS
12:48:56   Skyfix.XP [2]                      SPM
 53°05'46.876"N   0.04 N8   F03 D2.3  08s
  4°24'21.908"E   0.03 R  1 L 05d
      +57.80      0.09 H1-4:X
```

Difference View: difference with reference position:

```
                                          POSITIONS
12:48:56   Starfix-XP [2]                    SPM
       +0.00      0.04 N8   F03 D2.3  08s
       +0.00      0.02 R  1 L 05d
HP     +0.00      0.08 H1-4:G
```

This setting can also be controlled from the F1 page with the keyboard, see 8.1.1F1 - Positions Display

Position reference

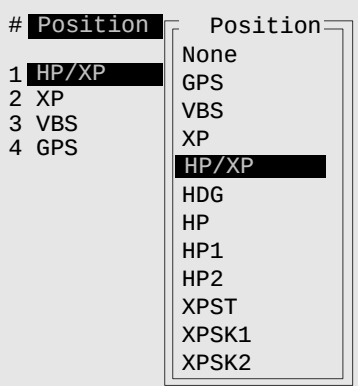
```
Position
Static
GPS
VBS
XP
HP/XP
HDG
HP
HP1
HP2
XPST
XP1
XP2
```

This menu is used if the display mode is Difference.

Static refers to the Initial Position in SPM Menu → Positioning → Initial Position.

This setting can also be controlled from the F1 page with the keyboard, see 8.1.1F1 - Positions Display

Position



This determines which positions are shown on positions 1 to 4 in F1 - Positions Display.

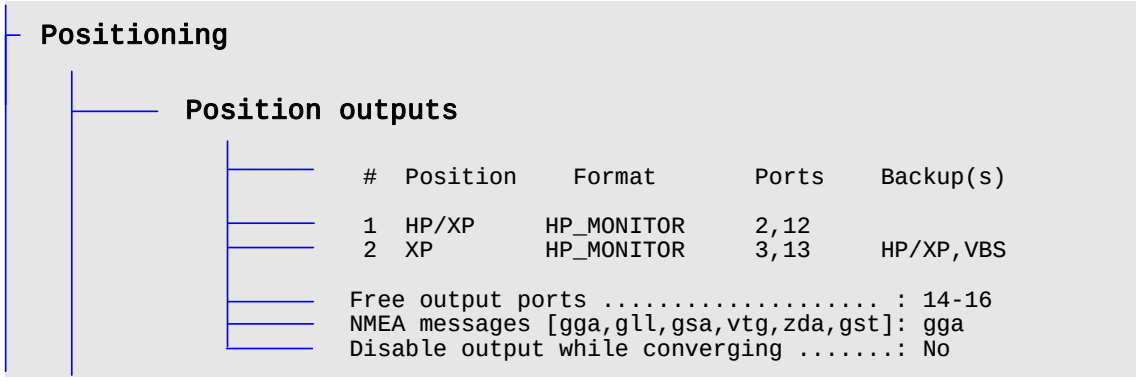
The list can be expanded to have more than 4 outputs using the Insert key and reduced using the Delete key, see instructions in section 7.5 Expanding the list of Stations or Position Outputs.

9.6.2.1 List of Positions

GPS	GPS standalone using position received from the GPS receiver
VBS	VBS (L1 and optional Type15)
XP	Skyfix.XP
HP/XP	Starfix.HP/XP (but can also be configured as HP only or XP only)
HDG	Starfix.HDG (ProTrack engine for a single baseline)
HP	Starfix.HP using only HP corrections
XPST	Starfix.XP using only XP corrections
XPSK1	Skyfix.XP using L1/L2 phase and code
XPSK2	Skyfix.XP using L1/L2 code only

HP and XPST (previously HP1 and HP2) are yet to be implemented (that's why NO POSITION is shown)

9.6.3 SPM Menu → Positioning → Position Outputs



The positions can be output through the COM Ports 1 to 4 at the rear panel of the HP Mobile or via the multiplexer channels 12 to 15.

The Driver for that port must be set to DGPS in SPM Menu → Devices → Port Configuration (9.4.1).

Up to 8 different Positon Outputs can be configured, extend the list using the instructions in section 7.5 Expanding the list of Stations or Position Outputs.

Each Position Output can be directed to multiple Com Ports and / or MUX Channels. The same Com Ports and MUX channels can be configured to receive RTCM data from external sources. (in SPM Menu → RTCM Messages) at the same time.

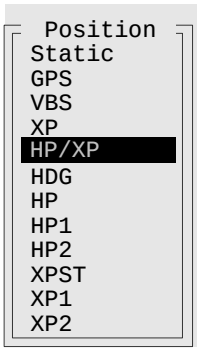
Use backup positions with care. The problem with using backup positions is that the user may not notice that the HP Mobile is outputting the backup position instead of the original position, and thus may use a reduced accuracy or different solution than required. The NMEA and HP_MONITOR formats contain a digit indicating which position is output, see D Starfix SPM Output formats.

The list of available ports is shown at the bottom. These ports have not been used elsewhere in the SPM menu.

Insert and Delete keys

The list can be expanded to have more than 4 outputs using the Insert key and reduced using the Delete key, see instructions in section 7.5 Expanding the list of Stations or Position Outputs.

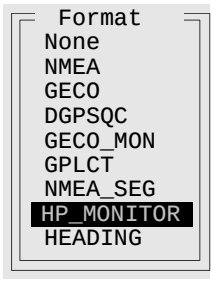
Position



Select the Position calculation for output.

Note that both Starfix..HP/XP and HP only can be selected here.

Position format



See Appendix G for more information on the available position output formats.

For NMEA, select the message types below (GGA, GLL, etc.).

MONITOR_PVT, MONITOR_HPQ, MON_PVT_HPQ have all been replaced with HP_MONITOR

Ports

The port(s) to where the selected Position calculation is sent to.

Use standard definitions as described in paragraph 7.4 Entering Station Numbers or Output Ports.

Do not use Com 5, Com 6, MUX 1(11) or MUX 6 (16), as these ports are already claimed.

Backup(s)

The backup Position works as a fall back in case the primary is not giving a solution.

NMEA messages

Is used to specify the preferred NMEA messages for the selected NMEA output format.

A combination can be entered: e.g. gga, zda (it is free text entry).

Disable output while converging

Yes	While Starfix HP or Skyfix.XP is converging, the Position Output to a (Com) port will be disabled: no Position will come out, or the backup position will come out.
No	While HP/XP is converging the HP Position will come out, even though the accuracy

	may not be to low yet.. The user may inadvertently use a degraded Position Output.

9.6.4 SPM Menu → Positioning → Starfix.HP/XP Settings

```
Positioning
    Starfix.HP
        Starfix.HP/XP ..................... : On
        Navigation ID ..................... :  1

        Maximum distance to stations (km)..... : 1500
        HP uses stations ..................... :  1-4
        HP preferred channel per station...... : First
        HP channels disabled.................. :

        XP Corrections ....................... : On
        XP Service ID ........................ : 0
        XP preferred channel ................. : Auto
        XP channels disabled ................. :
```

This menu contains the settings for the Starfix.HP/XP position calculation. The HP/XP position calculation can be configured such that it is Starfix.HP only, Starfix.XP only or a combined Starfix.HP/XPsolution. Manipulate the menu items 'HP uses stations' and 'XP Corrections'.

Even if a HP/XP combined solution has been chosen here, one can still output the combined position and the HP only solution separately in SPM Menu → Positioning → Position Outputs (9.6.3).

Starfix.HP/XP can be configured to compute either solution:

- Set "XP Corrections" to "Off" to get effectively Starfix.HP
- Set "HP uses stations" to none to get effectively Starfix.XP

Starfix.HP/XP

Switches the computation of the HP corrections On or Off.

If Off, then the HP/XP position will not be calculated and can not be output. You get to see this in F1 display:

```
                                        POSI
12:48:56  Starfix.HP/XP                   SP
              NO POSITION
SWITCHED OFF
```

Navigation ID

This ID is used in some position outputs (NMEA, Geco Monitor) to identify the position calculation type. See Appendix D-1 Format: NMEA GPGGA or D-5 Format: HP_MONITOR.

Maximum distance to stations (km)

If a selected station exceeds the distance specified, it will not be used for the HP position calculation. Entry between 0 and 9999.

The recommended and default distance to a reference station is Maximum 1500 Km, see also 6.5.6 HP Monitoring: example .

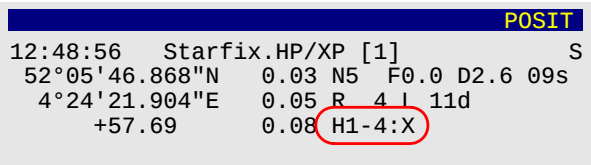
HP uses stations

Selects the Starfix.HP reference stations, which are used in the HP positioning calculation. The numbers refer to the station list as set in SPM Menu → Stations.

Changes in the selection may take up to a minute to take effect.

Default should be set to station 1-16. Entry here is free text, e.g. 1,2, 3 or 1-16, 18, see also section 7.4.

Whatever is chosen here, is shown in the F1 Position Display:



HP preferred channel

This channel refers to the Starfix uplink channel. If an internal demodulator is used then choose here 1. If more than one Starfix link (or demodulators) is interfaced, then refer to section 11.1 for more information.

Note: it has been observed that if one uses more than one Starfix link, that this may cause the HP calculation to reset at unpredictable moments. Untill this has fully been investigated one is advised to use only one satellite at a time. Using two channels, both on the same satellite, is not a problem.

HP channels disabled

Refers to same as above. Channels can be disabled for use with HP.

XP Corrections

On or Off. The State Space corrections for XP can also be used in HP. If the use of XP corrections has been switched off, the HP/XP solution has become a HP only solution.

XP Service ID

Height aiding

This feature was implemented in SPM version 4 and is not applicable to the updated HP engine in version 5.

9.6.5 SPM Menu → Positioning → Skyfix.XP Settings

```
Positioning
    Skyfix.XP
        Skyfix.XP ............................ :  On
        Navigation ID ........................ :  2

        XP Service ID ........................ : 0
        XP preferred channel ................. : Auto
        XP channels disabled ................. :
        XP convergence period (<=30 minutes).. : 30
```

Skyfix.XP

Switches the computation of the XP calculation On or Off.

If Off is selected, then the XP position cannot be calculated and any output or displaysof the XP position become void. You'll see this in the F1 display.

It takes approximately 15 seconds after switching on, before calculation starts.

Navigation ID

This ID is used in some position outputs (NMEA, Geco Monitor) to identify the position calculation type. See Appendix D-1 Format: NMEA GPGGA and D-5 Format: HP_MONITOR.

XP Service ID

XP channel s

See for an explanation on channels similar item in HP menu: 9.6.4 SPM Menu → Positioning → Starfix.HP/XP Settings.

XP convergence period

9.6.6 SPM Menu → Positioning → Starfix.VBS Settings

```
Positioning
    Starfix.VBS
        Starfix.VBS ........................... : On
        Navigation ID ......................... : 3

        VBS uses Starfix stations  ............ : 1-4
        VBS uses Starfix-Plus stations ........ : 1-4
        VBS identifier ........................ :  999

        100% weight range Starfix (km) ........ : 500
          0% weight range Starfix (km) ........ : 1500
        100% weight range Starfix-Plus (km) ... : 1000
          0% weight range Starfix-Plus (km) ... : 3000


        Height aiding ......................... : Off
        Standard deviation height (m) ......... : 0.5
        Standard deviation pseudo ranges (m) .. : 0.5
        Maximum age corrections (s) ........... : 60
```

Starfix VBS is Fugro's Virtual Base Station solution. The solution uses the L1 (L) and/ or L2 (D). Read for more information section 5.4 Theory of the VBS Position Calculation.

The VBS calculation is dependent on the Initial Position to calculate the virtual RTCM corrections. Ensure that Initial Position is set to Dynamic mode to ensure that a correct Initial Position is always in use, see section 9.6.1 SPM Menu → Positioning → Initial Position.

Starfix.VBS On, Off

Switches the computation of the VBS position On, Off or XP.

If switched off, then RTCM Output of VBS is not possible, see SPM Menu → RTCM Messages (section 9.7).

The XP mode is a special feature, that is normally not used. It allows for outputting Ionosphere free RTCM corrections. By selecting XP the VBS calculation uses the XP position to back- calculate RTCM corrections. Since the XP solution is ionosphere corrected, the RTCM corrections will be ionosphere free, too. Use the RTCM menu to configure the output.

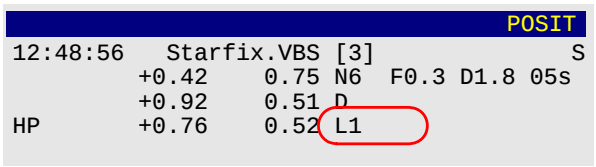
Navigation ID

This ID is used in some position outputs (NMEA, Geco Monitor) to identify the position calculation type. See Appendix D-1 Format: NMEA GPGGA or D-5 Format: HP_MONITOR.

VBS uses Starfix Stations

Index numbers of Starfix L1 stations (L), to be used in the VBS correction calculation. Multiple stations can be used. Use the composed string as explained in section.

Changes may take up to a minute to take effect.



VBS uses Starfix-Plus Stations

Index numbers of Starfix-Plus (L2) stations (D), to be used in the VBS correction calculation.

VBS identifier

A VBS station ID number could be entered here, and is used to identify the station number for VBS corrections when using the NMEA_SEG output format in the 'position output menu' (a figure between 0 and 1023), or when selecting the VBS corrections for output in the 'RTCM Messages menu'.

Weight ranges

The weight ranges is a distance to the reference station in kilometres.

If the distance of a station is inside the 100% weight range, then the full weight is used for this station. If a station is further away than the distance specified for 0% weight, then the station is not used. Inside the 100% and 0% distances, the weight is interpolated.

The default values are the one shown in the figure above.

Height aiding, Standard Deviation

If enabled, this entry switches the VBS position calculation to 3D+H mode, see section 5.4 Theory of the VBS Position Calculation.

VBS Height = Antenna Height + Geoid Height

If selected, make sure that

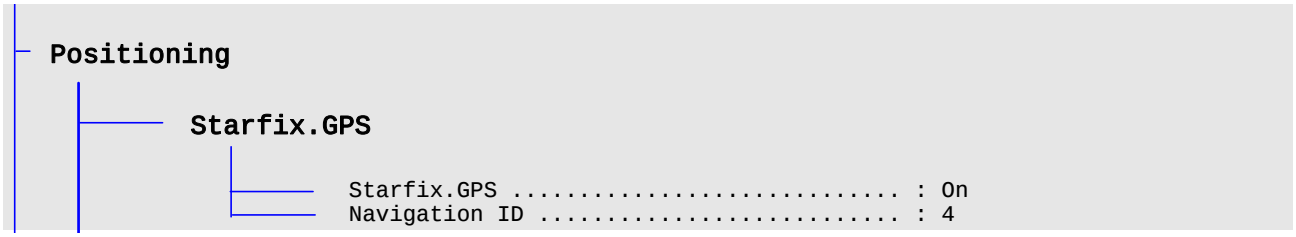
- the heights entered for the Antenna and the Geoid height are entered correctly in SPM Menu → Positioning → Initial Position.
- the standard deviations are entered.

Standard deviation height (m	Is a measure for the weight of the given height in the VBS calculation. This number should include the Antenna Height variations due to Vessel movement (roll, heave) and Tides, i.e. should be larger if if vessel moves more. If an SD of 0.01 is entered, then a 2D mode is emulated. This should be used with caution. Default value is 0.5
Standard deviation pseudo ranges (m)	Is a measure for the weight of the pseudo range measurements in the VBS position calculation. Default value is 0.5.

Maximum age corrections (sec)

Recommended value is 60 seconds. Do not use a value less than 15 seconds

9.6.7 SPM Menu → Positioning → Starfix.GPS Settings



Starfix.GPS	Switches the use of the GPS position in SPM On or Off.
Navigation ID	This ID is used in some position outputs (NMEA, Geco Monitor) to identify the position calculation type. See Appendix D-1 Format: NMEA GPGGA or D-5 Format: HP_MONITOR.

9.6.8 SPM Menu → Positioning → Starfix.HDG (Heading)

```
Positioning
    Starfix.HDG
        Starfix.(HDG) Heading ................ : Off
        External GPS receiver type ........... : None

        Derive dist & hdg corr. from offsets.. : No
        Heading correction (deg) ............. :  +0.000
        Computed distance (m)................. :  +0.000
        offsets internal GPS receiver (x,y,z). : +00.000,+00.000,+0.000
        offsets external GPS receiver (x,y,z). : +00.000,+00.000,+0.000
```

This Heading solution requires an External GPS receiver to be connected. In SPM Menu → Devices → Port Configuration (9.4.1) one should have the driver for External GPS Receiver selected and interface the GPS Receiver. Three types of GPS Receivers are supported: AshtechZ12, Topcon and Novatel. The HDG solution requires L1 and L2 for optimum performance. The GPS Receivers must be configured to output raw data.

Typically one uses another HP Mobile to interface to. The other HP Mobile can then configure GPS Port B in the menu: SPM Menu → Devices → GPS Receiver (see image below). Choose Command group Configurations and then choose command “Config port B default”. Then connect Port B to a Com port of this HP Mobile:

```
============================ SPM MAIN MENU ================================
=========================== DEVICES ===================================
=========================GPS RECEIVER MENU ================================

                                                  Select command
Select command group.....: Configurations         None
Select and execute command : Ready                Config port A default
                                                  Config port B default
```

External GPS type

Choose Ashtech, Topcon or Novatel.

Derive dist & hdg corr. from offsets

This relates to how the Dist O-C field is taking the Calculated Distance.

```
Derive dist & hdg corr. from offsets
Heading correction (deg)
Computed distance (m)
offsets internal GPS receiver (x,y,z)
offsets external GPS receiver (x,y,z)
```

No	Distance is taken from Computer Distance field.
Yes	Distance is calculated from the Offsets.

This also relates to the Heading shown. The Heading shown is corrected for a C-O.

No	Heading C-O is taken from the Heading correction field.
Yes	Heading C-O is calculated from the Offsets.

9.7 SPM Menu → RTCM Messages

```
============================ SPM MAIN MENU ==============================
========================== RTCM MESSAGES MENU ==========================


RTCM Message output ................. : On
RTCM Messages to port(s)  ........... : 2,12
RTCM Message types [1/3/15].......... : 1,3,15

Vitual Base Station identifier ...... : Yes
Starfix Stations selected............ : 1-4
Starfix-Plus Stations selected ...... : 1-4

Client Software iono corrector is ... : On
Client Software tropo corrector is .. : On
Type 15 valid for (minutes)  ........ : 10
Type  3 interval (sec) .............. : 300
```

This menu allows the user to forward the corrections as RTCM corrections to a Com port. RTCM types 1, 3 and 15 are supported.

The user can forward L1 and or L2 corrections for the Starfix Reference Stations and / or for the current VBS position.

Output

Switches the output of RTCM messages on or off. This will automatically forward RTCM data for

- the stations selected in “Starfix Stations selected”
- the stations selected in “Starfix-Plus Stations selected”
- and / or VBS RTCM data.

Port(s)

Specifies the Com port(s) for RTCM output, entries as described in section 7.4 Entering Station Numbers or Output Ports.

The Com port needs to be configured for a driver DGPS or None.

Message types [1/3/15]

Enter 1, 3 or 15 or a combination.

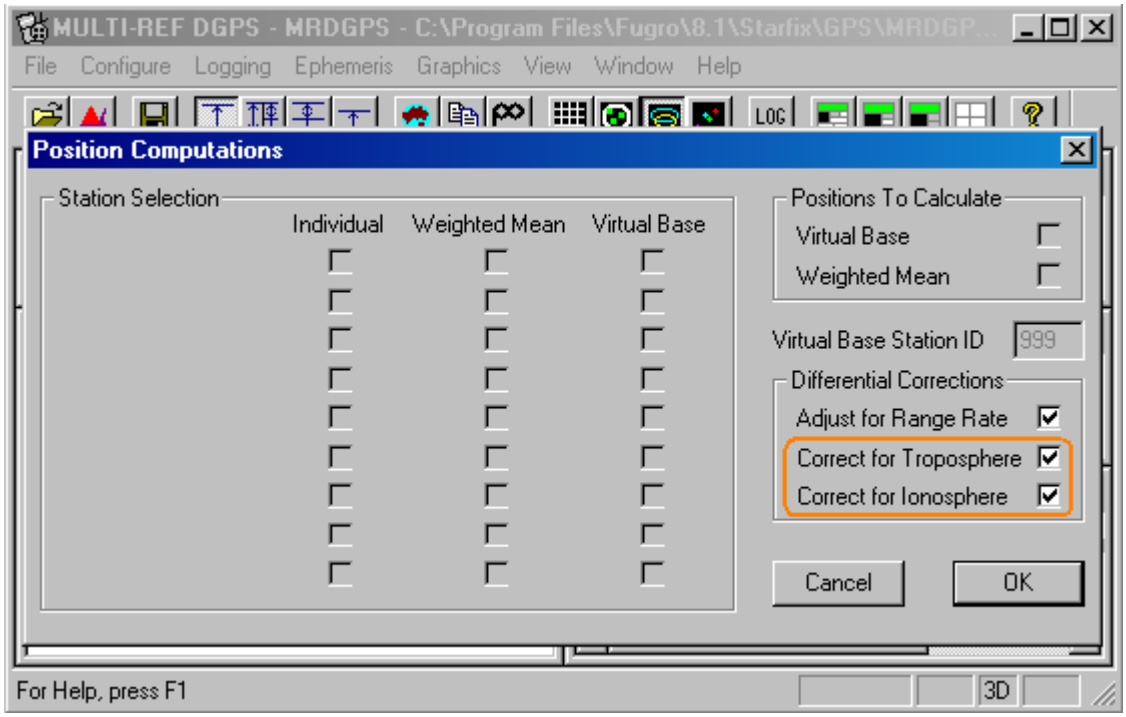
- Type 1 – Differential GPS Corrections.
- Type 3 – Station information (a.o. coordinates).
- Type 15 – Ionospheric Delay, L2 corrections.

Virtual Base Station

Switches the RTCM output for the current VBS position on or off. This forwards the RTCM data as used for calculating the VBS position. This is additional to the RTCM data for the stations mentioned below.

This output will only work if VBS is switched on in SPM Menu → Positioning → Starfix.VBS Settings.

Station ID is as per menu setting in SPM Menu → Positioning → Starfix.VBS Settings.

Starfix Stations	Starfix Reference Stations (L) for which RTCM data is forwarded. This is additional RTCM data to the VBS or Dual frequency RTCM data.
Starfix-Plus Stations	Starfix Reference Stations (L) for which RTCM data is forwarded. This is additional RTCM data to the VBS or Single frequency RTCM data.
Client Software Iono corr., Client Software Tropo corr.	This setting is introduced to achieve compatibility with other software, which software is on the receiving end of the RTCM data. So, if you forward the RTCM data to GPS software, such as Starfix.MRDGPS, or a GPS receiver, then this setting may apply. The other software ('Client Software') may have settings to correct for Ionosphere and / or Troposphere. Starfix.MRDGPS has such settings in Position Computations:  It is important that you select here the same settings as in the Client software. If you swith Ionosphere correction on in the Client software, then you switch the correction to on here in the SPM software. This will ensure that you are using the Starfix measured Ionosphere correction in the client software. If you don't match these settings you could potentially use double corrections. This table is based on assumptions of client software calcualtions. If the Client software does not apply corrections as defined, this can lead to large positioning errors. See Appendix H Ionospheric and Tropospheric Corrector Settings for preferred settings.
Type 15 valid for (minutes)	The maximum age of type 15 corrections. Recommended value is 10 minutes, choose between 0 and 9999.
Type 3 interval (sec)	Output interval between type 3 messages. Recommended value is 300 seconds, choose between 0 and 9999.

10 SPM Menu Structure – Hidden or Advanced

The SPM Menu is divided in two parts. One part is available to everyone, the other part, so-called hidden, part is only available to those users who are confident that they can alter settings, without causing undesired side effects, such as disabling the HP calculation.

The user can get access to the hidden part of the SPM Menu on the Front Panel or the keyboard.

Front Panel	Three times 
Keyboard	Press F8 – H

To get out of the advanced menus

Keyboard	Press F1

On the next pages the full SPM Menu Structure is shown, whereby the hidden items are shown in Brown.

Displays

```
Title system display ................. : SPM
Number of rows for positions [1-4] ... : 1
Number of rows for stations  [0-4] ... : 1

System display          [F1] [Ent]
GPS Receiver display    [F2] [Ent]
Position display        [F3] [Ent]
Correction display      [F4] [Ent]
I/O display             [F5] [Ent]
Messages display        [F6] [Ent]
```

Devices

Port configuration

```
        COM#  Device          Baudrate

        1     Multiplexer      <115200>
        2     DGPS             <115200>
        3     DGPS             <115200>

        Relay inputs on ports (2-6) to MUX : off
```

GPS Receiver

```
Select command group.................. :  None
Select and execute command............ :

GPS receiver ......................... : Ashtech
Automatic Connection (default is off). : Off

Select command ....................... :
Execute command ..................... <<
Edit command ......................... :
Save command ......................... <<
```

Demodulator

```
Demodulator type (internal)........... :  Topcon-BDR
Starfix decoder instance (1-4) ....... :  1
Raw correction output to port(2) ..... : 14
Free output ports(s) ................. : 2-3,12-13,15-16


Satellite uplink ..................... :  EASAT
Frequency ............................ : 1535152500
Data Rate (bps) ...................... :  1200
Symbol Rate (bps) .................... :  2438

Select and execute command (TopconBDR) :  None
BER Period ........................... :  Minute
BER Messages ......................... :  Off
```

DGPS Receiver

```
DGPS Receiver 1 format ............... :  <SCF|CBMF>
DGPS Receiver 2 format ............... :  <SCF|CBMF>
DGPS Receiver 3 format ............... :  <SCF|CBMF>
DGPS Receiver 4 format ............... :  <SCF|CBMF>
```

Port Settings

COM#	Device	Baudrate	Protocol	Option(s)
1	Multiplexer	115200	None	
2	DGPS2	115200	None	d=15;t=8,0.2
3	DGPS3	115200	None	
4	Demod	38400	None	
5	Frontpanel	19200	None	
6	GPS Receiver	115200	RTS/CTS	

Logging

```
Logging raw-data .............[off/on] :  off
File ID (3 characters) ..... :  FGR
Directory ..... :  .
Ports disabled ..... :
Logging objects ..... :  off
Object groups enabled ..... :

Logging messages .............[off/on] :  off
Directory ..... :  .
Pages enabled ..... :
```

Replay

```
Replay raw-data ........[off/on/batch] :  Off
Filename ..... : FGRmddhh
Directory ..... :  .
Ports disabled ..... :
```

Options

```
Options command ..... :
Load options command ..... :

Novatel emulator output to port ..... : 0
```

Stations

Stations Advanced

```
Edit cluster (Name, ID1, ID2, ....)
RXD, 521, 571, 580, 530, 431, 480, 56, 229, 620, 632, 371, 352

Load stations of cluster and restart  <<

Select Cluster .....  : RXD
Reset cluster to stations received .. <<
Reset cluster to stations listed .... <<

Station list mode .....  : Static
```

#	Station Name	ID	ID+	Latitude	Longitude	Height
1	Leidschendam LH	521	0	52°05'44.9042"N	4°24'16.5454Ë	+69.935
2	Aberdeen LDGH	571	957	57°11'56.2998"N	2°05'32.3094"W	+101.879

Positioning

Initial positioning

```
Initial position mode ............... : <Dynamic>
Initial latitude .................... :  52°05'46.8660"N
Initial longitude ................... :   4°24'21.0938"E
Antenna height (MSL;m) .............. :  58.540
Geoid height (m) .................... :  0.000
Elevation mask (deg) ................ :  5
Satellites disabled ................. :

Leap seconds ........................ :  14
Leap seconds next ................... :  14
Date next leap seconds .............. :  01-Jan-2006
```

Position views

```
Position display mode ............... : Absolute
Position reference for difference .... : HP/XP

# Position
1 HP/XP
2 XP
3 VBS
4 GPS
```

Position outputs

```
 #  Position    Format       Ports    Backup(s)

 1  HP/XP     HP_MONITOR    2
 2  HP/XP     HP_MONITOR    13

Free output ports ................... : 3,12,14-16
NMEA messages [gga,gll,gsa,vtg,zda,gst]: gga
Disable output while converging .....: No
```

Starfix.HP/XP

```
Starfix-HP/XP ....................... : On
Navigation ID ....................... :  1

Maximum distance to stations (km)..... : 1500
HP uses stations .................... :  1-4
HP preferred channel per station..... : First
HP channels disabled................. :

XP Corrections ...................... : On
XP Service ID ....................... : 0
XP preferred channel ................ : Auto
XP channels disabled ................ :
```

Skyfix.XP

```
Skyfix-XP ........................... :  On
Navigation ID ....................... :  2

XP Service ID ....................... : 0
XP preferred channel ................ : Auto
XP channels disabled ................ :
XP convergence period (<=30 minutes).. : 30
```

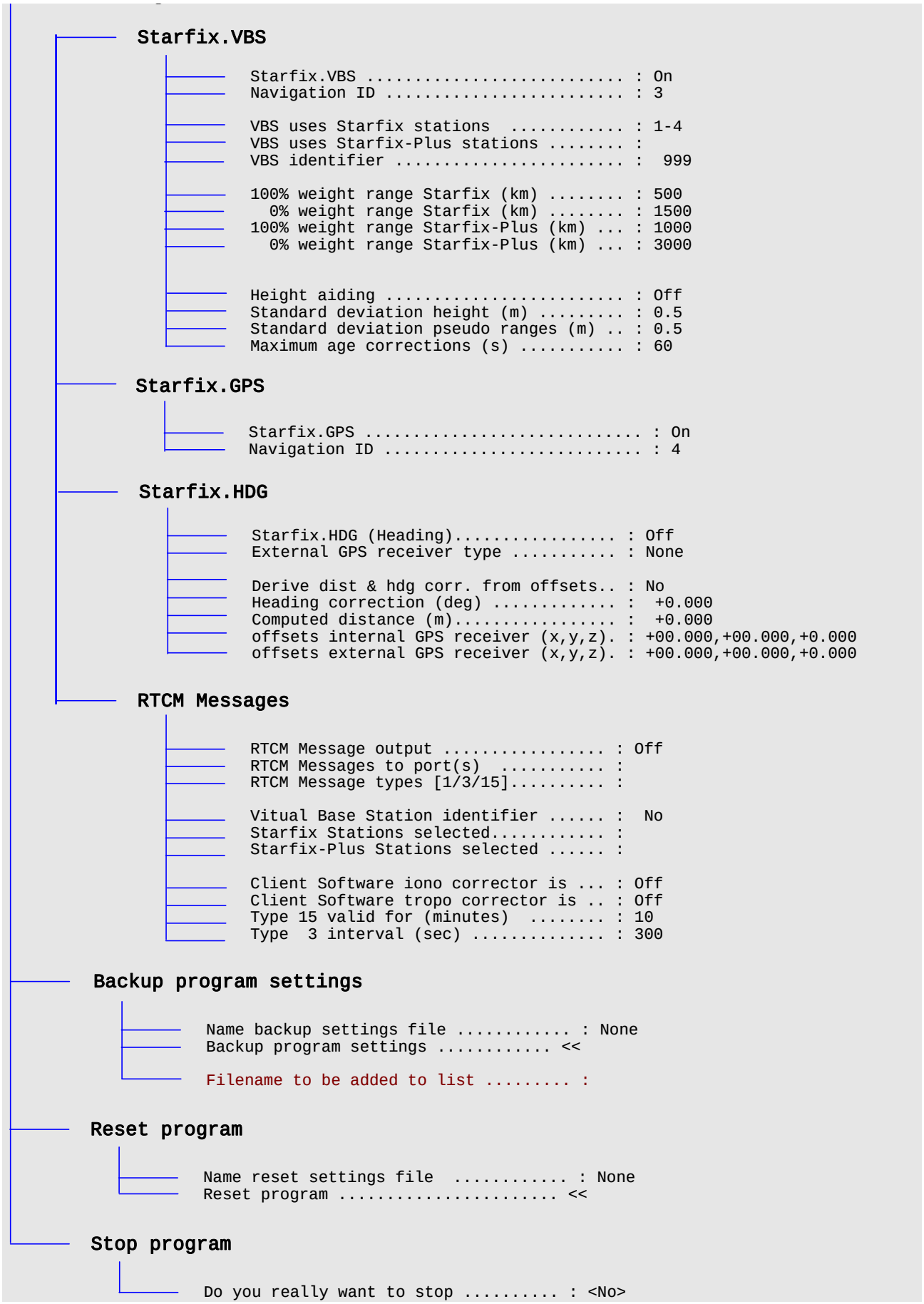
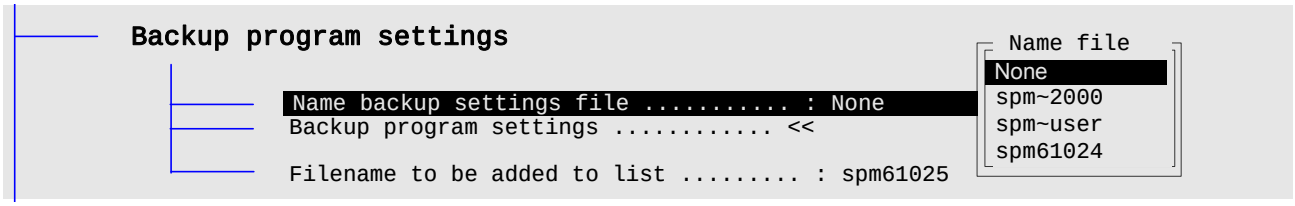


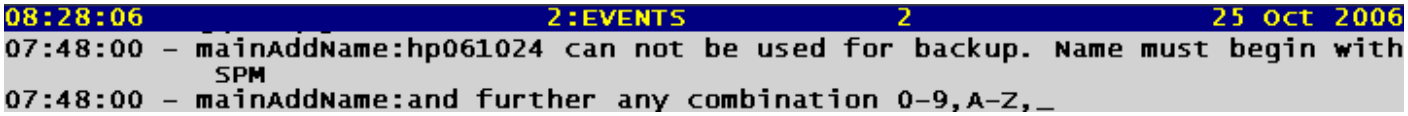
Figure 9: SPM Menu (hidden)

10.1.1 Advanced SPM Menu → Backup program settings.



The Advanced user is allowed to create new file names for backing up. The backup files can be used to load from in the Reset menu.

Type the name in “Filename to be added to list”. The name must start with SPM and can have maximum of eight characters, being 0 to 9 or a to z or underscore. (_). If other characters are entered, then the file is not created. Under page F6, 2 (Events) one can see the error message.



After a file name is successfully added, the name will appear in the list AFTER one has exited the menu to the status displays (use any F key) and entered again .

The settings files with the symbol ~ cannot be overwritten (are write protected). They will always be available as factor delivered to users.

If an advanced user adds a file, then this file is also available for not-advanced users.

Note: this settings file is not a separate file on the internal hard disk, but a section in the SPM.set file.

10.1.2 Advanced SPM Menu → Devices → GPS Receiver

```
Devices
    GPS Receiver
        Select command group.................. :  Commands
        Select and execute command............ :

        GPS receiver ......................... : Ashtech
        Automatic Connection (default is off). : Off

        Select command ....................... :  Request Ephemeris
        Execute command ...................... <<
        Edit command ......... :  Request Ephemeris,$PASHS,SNV
        Save command ......................... <<
```

The Advanced GPS Receiver menu allows the advanced user to add or modify commands of the list. This requires knowledge of the factory commands (Ashtech, Topcon or Novatel). Download the manuals from the internet if you don't have them.

Take care not to add too many commands, as this may confuse inexperienced users.

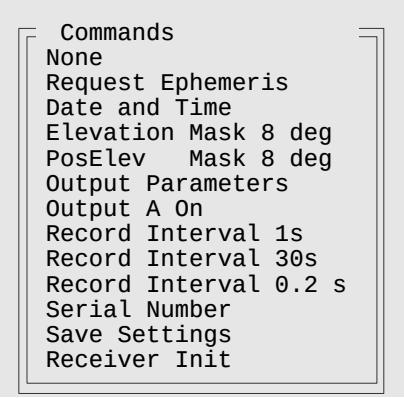
Select command	Select a command, note that a sub-selection is presented, based on the group selected (top line in the menu).
Edit command, Save command	You can now alter the command and then save into the GPS command list under a new name (or the same name, but this is not advised). One is also able to alter the command and execute it, without saving the command. See the example below where the command Port B 38400 is changed into Port B 19200.

```
Select command ....................... :  Port B 38400
Execute command ...................... <<
Edit command ......... :  Port B 19200,$PASHS,SPD,B,6
Save command ......................... <<
```

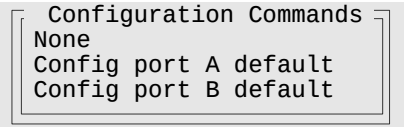
Make sure you don't alter the command Default Port A configuration, as this is the command that allows you to keep the HP Mobile operation, in case you have messed up the GPS Receiver configuration.

Typing the command name followed by delete (e.g. "Receiver Init, delete") will remove the command. This should be done with caution as any removal is un-recoverable.

10.1.3 About the various GPS commands



Record interval to 0.2 s	This equates to 5 updates per second. Not all GPS cards have this option enabled. So, sending this command only has the desired effect is the option is available. The SPM software is capable of handling this update rate, however baudrates must be high enough to be able to handle the data streams, both from the GPS to Com 6 and from the SPM software to any position output port.
Elevation Mask 8 deg	This will block information from satellites with elevations lower than 8 degrees. Note that in the menu SPM Menu → Positioning → Starfix.HP/XP Settings (section 9.6.4) also an elevation mask can be set. The higher of the two elevation masks is effective on the HP calculation.
Date and Time	This command can be sent to synchronise SPM software with UTC time (GPS time plus leap seconds).



Port A default	Default configuration for GPS Port A to work with SPM software. This includes setting • an update interval of 1 second, • Port A On with baud rate 115200, • Raw GPS output on, • RTCM usage off, and • Elevation mask of 8 degrees.
Port B default	Default configuration for GPS Port B to output raw GPS data. This includes • Port B on with baud rate 115200, • Disable RTS/CTS (for AshtechZ12) • Raw GPS output on. • Elevation mask 8 degrees.

```
 More Commands
None
Request Ephemeris
Date and Time
Elevation Mask 5 deg
PosElev   Mask 5 deg
Elevation Mask 8 deg
PosElev   Mask 8 deg
Tracking Parameters
Tracking -> Normal
Tracking -> High
Request-Eph EPB
Request-Eph SNV
Output Parameters
Output A On
Output A Off
Port A   9600
Port A  38400
Port A 115200
Output B On
Output B Off
Port B   9600
Port B  38400
Port B 115200
Disable RTS/CTS B
Record Interval 1s
Record Interval 30s
Record Interval 0.2 s
Serial Number
Receiver Options
Receiver Parameters
RTCM Off
RTCM Status
Satellite Status
Warnings
Save Settings
Receiver Init
```

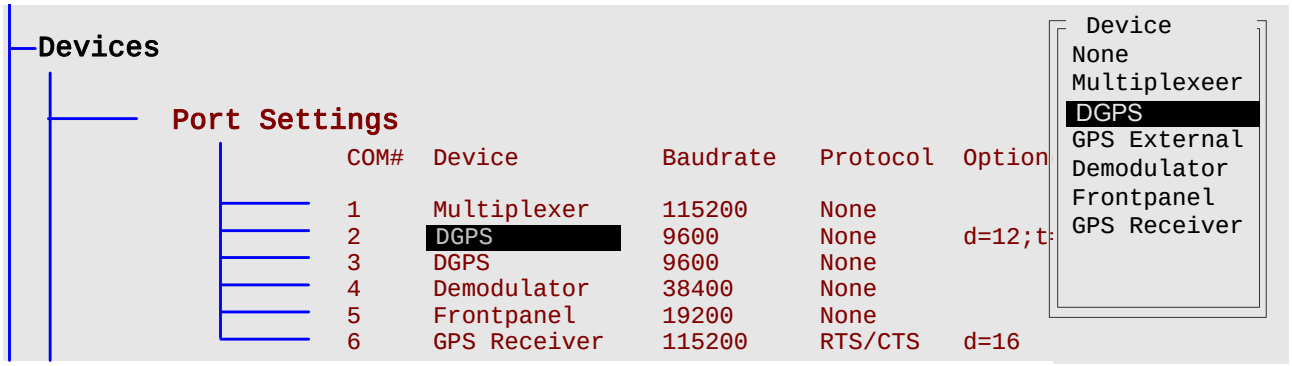
Port A settings	Should usually not be used as Port A is configured by the SPM software.
RTS/CTS	Using the Ashtech from Starfix.Iowin with the Ashtech Z12 driver, requires that handshaking (RTS/CTS) is switched off, or that the cable is such that RTS and CTS are connected.

```
 Initialisation Commands
None
SNV
EPB
ALM
ION
ZDA
SID
```

Initialisation	Switches the Ephemeris, Almanac, ionospheric info, time broadcast on.

Note: commands are saved in an ascii file on the internal processor board. The file is called SPM.dev.

10.1.4 Advanced SPM Menu → Devices → Port Settings



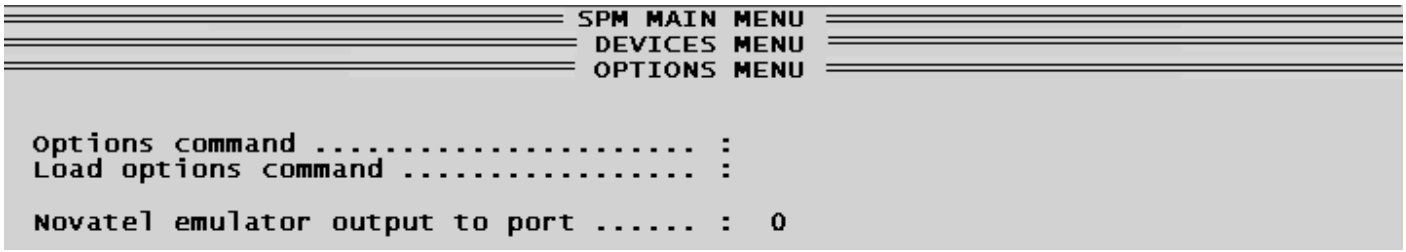
This menu is the extended menu from the menu Devices -> Port Configuration. The extension is protected by the Advanced menu and they can severely disable the HP Mobile from functioning. For example by removing the GPS Receiver driver one would break make the GPS Receiver non-detectable for the SPM software and hence no positions can be calculated.

The drivers GPS Receiver, Frontpanel and Demodulator are only available to Advanced users in this Advanced menu.

The drivers Demod and GPS Receiver should only be used once in this list. The SPM software does not allow for multiple GPS receivers or demodulators to be interfaced (apart from the External GPS receiver for Starfix.HDG).

Frontpanel	Connects to the front panel of the HP mobile.
Demodulator	Driver for the (internal) demodulator. The demodulator is further configured in SPM Menu → Devices → Demodulator, section 9.4.3).
GPS Receiver	Driver for the (internal) GPS Receiver. The GPS Receiver is further configured in SPM Menu → Devices → GPS Receiver, section 9.4.2).
DGPS	General input and output driver. Further described in section 9.4.1 for SPM Menu → Devices → Port Configuration.
Multiplexer.	Further described in section 9.4.1 for SPM Menu → Devices → Port Configuration.
GPS External	For use with Starfix HDG (Heading) only. Further described in section 9.4.1 for SPM Menu → Devices → Port Configuration.
d=16	With the command d= one can forward the incoming data to another port. In this case the GPS raw data is forwarded to MUX channel 6.
d=12;t=8,0.2	For serial ports amend the t=8,0.2 statement (no spaces in the statement). This forwarding can be blocked by the setting in SPM Menu → Devices → Port Configuration (9.4.1), if “Relay inputs” is set to off.

10.1.5 Advanced SPM Menu → Devices → Options



Options

The Options menu allows for creating menu's that are only available to users which have those options enabled. This is for example a new logging program, or the certain password enabled utilities.

Those users who have certain options, will be informed on the use of this menu separately.

Novatel emulator

The Novatel driver from the SPM 4.xx program has been removed. However one is still able to export Novatel emulator to a port.

This driver can emulate the Novatel 3151R L1 C/A GPS receivers for use by DGPS programs such as Fugro's Starfix.MRDGPS.

The driver outputs raw measurement data and position data at 1 Hz and almanac and ephemeris data on change.

Any command received on this port is interpreted as a request for Ephemeris and Almanac data.

Alternatively, the user can use the data from the internal GPS card. Interface directly to COM Port labelled GPS PORT B on the back panel. This connector is connected to the internal GPS receiver's second serial port B, and requires hardware handshaking (RTS/CTS).

11 Special Hardware Configurations

11.1 Using an external demodulator or multiple demodulators.

To allow for the use of multiple demodulators the SPM software uses the concept of instances or channels. Each demodulator streams its data on an instance.

The internal demodulator on Com 4 is per default set to instance 1. The other (external) demodulators are streaming through instances 2 to 4, whereby the instance is the number of the Com port. For example, an external demodulator interfaced on Com 2 becomes instance 2.

An external demodulator should not be interfaced through Com 1 if there is also an internal demodulator. The consequence of this would be that two demodulators would be streaming data through instance 1 (or channel 1). There is a way around this, by assigning the internal demodulator to another instance in SPM Menu → Devices → Demodulator.

One demodulator, the internal demodulator, will be interfaced through a Com port with the driver Demodulator. This demodulator can then be automatically configured through the SPM software. All other demodulators, external demodulators, will be interfaced through DGPS drivers. This can be done by normal users in SPM Menu → Devices → Port Configuration. The driver Demodulator can only be assigned by an Advanced user in Advanced SPM Menu → Devices → Port Settings.

Type of demodulator	Com port	Driver	Set by	In SPM menu
Internal demodulator (preconfigured by workshop engineer)	Com 4	Demodulator	Advanced user	Advanced SPM Menu → Devices → Port Settings
External demodulator 1, 2 or 3	Com 2 or Com 3 (Com 1, see above)	DGPS	Normal user	SPM Menu → Devices → Port Configuration

The following SPM Menu options refer to the use of external demodulators:

1. 9.4.1 SPM Menu → Devices → Port Configuration. Assign the DGPS driver to the Com port which has the external demodulator
2. 9.6.4 SPM Menu → Positioning → Starfix.HP/XP Settings and 9.6.5

SPM Menu → Positioning → Skyfix.XP Settings. One is able to choose the channels (i.e. demodulator instances) to use in the HP or XP calculation.

11.2 Using a Novatel combined demodulator and GPS card

If one has a HP Mobile unit with a Novatel demodulator card, then

1. The Novatel card will be interfaced on Com 6 of the internal processor board.
2. Com 4 wil be free and available on the back panel.
3. You will need SPM 5.02 onwards to allow selecting a combined Demodulator and Gps Receiver driver in Advanced SPM Menu → Devices → Port Settings.

11.3 Using a 3000LCE demodulator

Under construction.

See also Appendix G Configuring the integrated demodulator 3000LCE.

12 Trouble shooting Starfix-SPM

12.1 Check reception of GPS and Correction signals.

In this section we discuss how you can check that GPS signals and Starfix Corrections are being received by the SPM software. If both are being received, then the HP calculation will work.

12.1.1 Check reception of GPS

GPS signals will travel the following path through our HP Mobile:

1. GPS Antenna
2. Antenna cable
3. Connectors
4. Internal GPS card
5. HP Mobile Internal cable from GPS Port A to processor board Com 6
6. SPM F1 display
7. SPM HP calculation

If the GPS signal arrives succesfully at anyone of these, it means it has succesfully travelled throught he previous pathes. If it fails to arrive in any spot, this can indicate a problem in any of the previous steps.

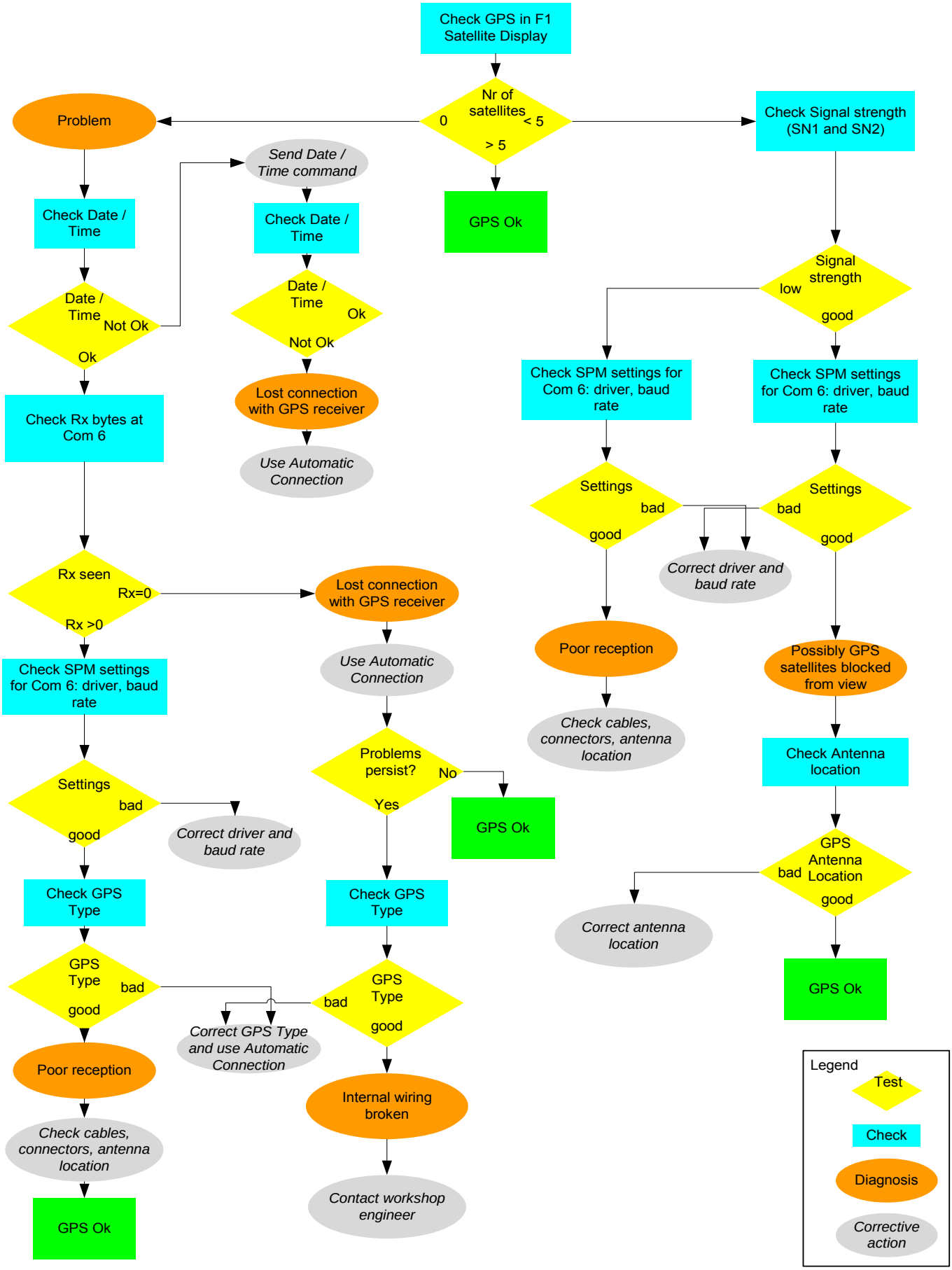
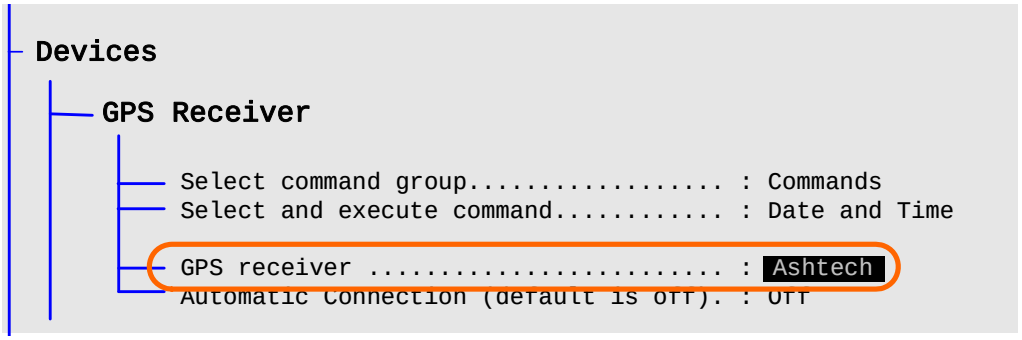
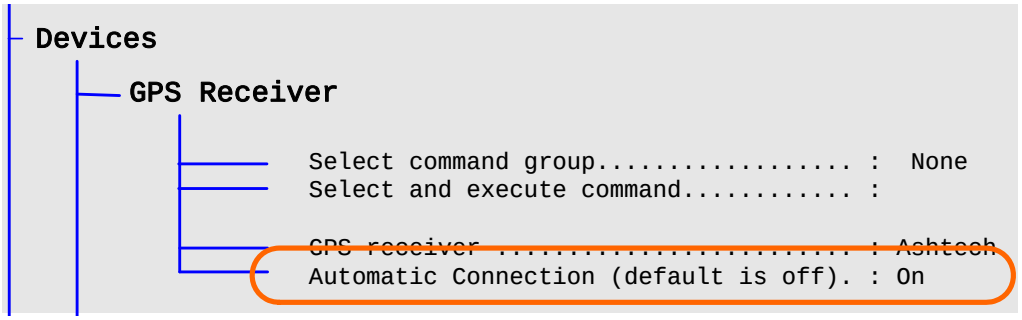
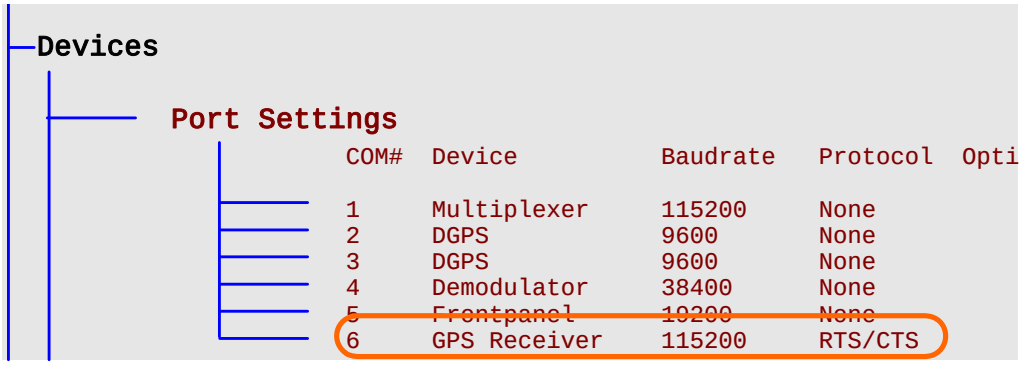


Figure 10 Trouble shooting GPS failure

Check GPS in F1 Satellite Display Check Signal Strength	See F1 - Satellite Display, section 8.1.3 SATELLITES PRN: 3 15 16 18 19 21 22 26 27 29 Elv:73 57 42 45 33 29 40 9 14 8 SN1:53 51 48 47 46 45 50 35 35 31 SN2:42 41 35 36 34 31 36 19 8 8 Number of satellites 5 or more. Check SN levels, for criteria see 8.1.4 SN Levels for GPS Satellites.
Check Date / Time	See F1 - Positions Display, section 8.1.1. POSITION 12:48:56 Starfix.VBS [5] 52°05'46.862"N 0.52 N8 F0.1 D2.3 1 4°24'21.911"E 0.39 D +57.91 1.21 L1-4 Date and Time must be updating every second and show a correct value.
Check Rx at Com 6	See F1 – Devices (Com Port) display, section 8.1.5 DEVICES COM4:Demod 38400 Rx:162 Tx:0 COM5:Front 19200 Rx:0 Tx:0 COM6:GpsRcvr 115200 Rx:1041 Tx:0
Check SPM Settings for Com 6	See Advanced SPM Menu → Devices → Port Settings, section 10.1.4. Devices Port Settings COM# Device Baudrate Protocol Opti 1 Multiplexer 115200 None 2 DGPS 9600 None 3 DGPS 9600 None 4 Demodulator 38400 None 5 Frontpanel 19200 None 6 GPS Receiver 115200 RTS/CTS
Send Date / Time command	See SPM Menu → Devices → GPS Receiver, section 9.4.2 Devices GPS Receiver Select command group..... : Commands Select and execute command..... : Date and Time GPS receiver ..... : Ashtech Automatic Connection (default is off). : Off

Correct GPS Type	See SPM Menu → Devices → GPS Receiver, section 9.4.2  If you correct the GPS Type, because the setting was wrong, then you also need to set Automatic Connection On and Stop and Start the SPM program.
Use Automatic Connection	See SPM Menu → Devices → GPS Receiver, section 9.4.2  After switching this on, you need to Stop and Start the SPM program.
Correct driver baudrate	The driver must be GpsReceiver, baud rate must be 115200. See Advanced SPM Menu → Devices → Port Settings, section 10.1.4.  RTS/CTS must be on for AshtechZ12 cards.

12.1.2 Check reception Starfix Corrections

12.1.2.1 Use the Demodulator display on F1

On the main F1 display one has the Demodulator display.

```
                                DEMODULATOR
Type:       Topcon   Uplink:     EASAT   521:HL    480:HL    352:HLD   700: L
S/N :       270001   Freq  :1535152500   580:HL    620:HL    571:HLDG  780:HL
Days left:       1   Actual:1535150855   530:HL    632:HL    500:HLD   280:H:D
Services :  LPGHX    Qual. :     18.45   431:HLD   371:HLD   410:HLD   300: L
```

The color green in the display indicates good reception of the corections. See for more details 8.1.6F1 – Demodulator.

12.1.2.2 F6-3

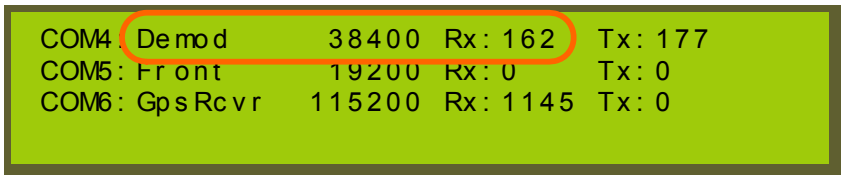
Another method is by pressing F6 and then 3. This shows the decoded Starfix corrections.

The page should show readable text and not the words “rejected”, BAD CHECKSUM, or garbled text. See below an example of correct corrections. See for more details section 8.6.4 F6 – page 3: Message Display – DGPS Receiver / Demodulator.

```
15:58:32                    DGPS Receiver     page 3                    16 Dec 2005
15:58:31 - SCFPKT4=2,21,31,45
15:58:32 - BER=60m;snr=19.0,ebn=7.0,ber=1.00E-08,bfr=0.00E+00,F=380,E=0

15:58:16 - HPSDCS4: n=1, skip=0
15:58:17 - GSSCLK4:046,nsat=28,src=0,map=3,use=1
15:58:17 - GSSCLK4:age=11s, use=1
15:58:19 - BER=60m;snr=18.7,ebn=7.0,ber=1.00E-08,bfr=0.00E+00,F=377,E=0
15:58:20 - SCFDCS4:474:14=580,410,101,95,690,144,11,19,500,620,521,351,530,371,
15:58:21 - SCFPKT4=5,96,15,400
15:58:21 - GSSCLK4:046,nsat=28,src=0,map=3,use=1
15:58:21 - GSSCLK4:age=7s, use=1
15:58:21 - BER=60m;snr=18.6,ebn=7.0,ber=1.00E-08,bfr=0.00E+00,F=377,E=0
15:58:24 - BER=60m;snr=18.7,ebn=7.0,ber=1.00E-08,bfr=0.00E+00,F=378,E=0
```

12.1.2.3 Bytes received on Demodulator

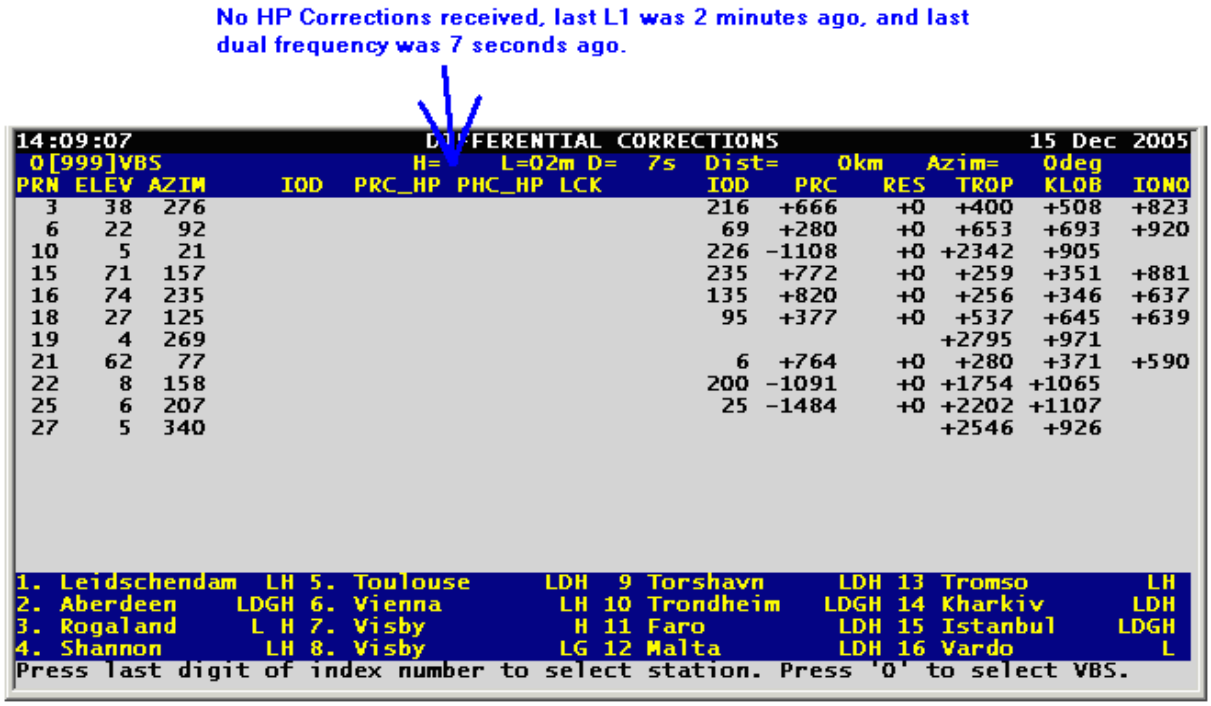
If one has no monitor and keyboard connected, then the above information is not available. In that case one can check the amount of data flow from the demodulator.



Make sure that Com4 with the driver Demod shows Received Bytes (Rx) around 160 bytes. It may take up to two minutes after startup to get to 160 bytes. If the Rx is showing 160 bytes, this means enough data is received. It does not say that it is properly decoded, so one has to assume that it is.

12.1.2.4 F4

Also on F4 - Corrections Display you can check corrections being received:

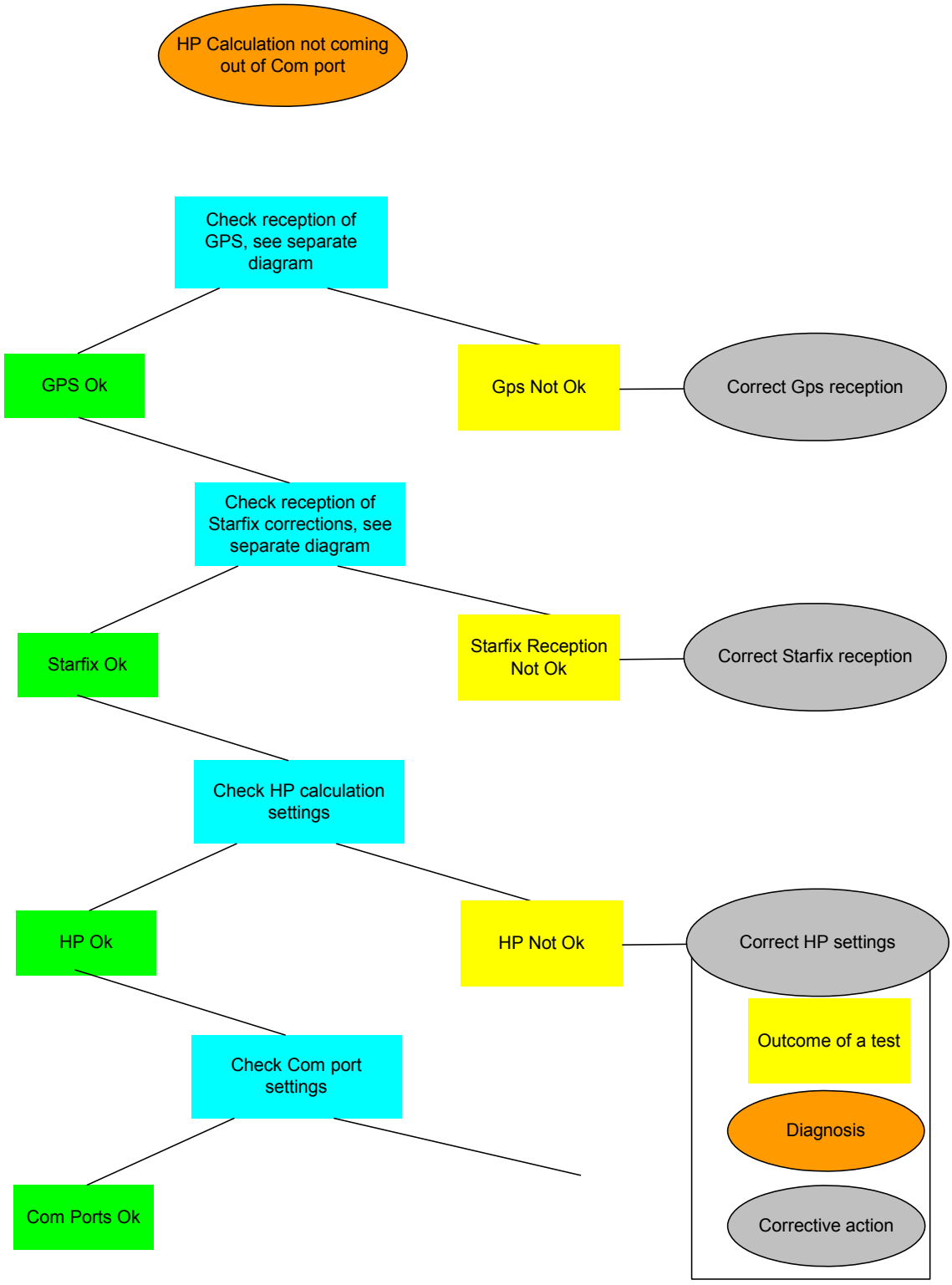


If interruptions in the Correction signal occur, this will have the consequence that the HP solution will not be calculated. Possibly the solution falls back to its' backup position, if so configured in the SPM menu. A possible cause can be grounding problems in the antenna cable.

12.2 Trouble shooting Position Output

What if one is expecting a position output out of one of the serial Com ports or a virtual Mux port, but no position is received?

For HP: check that Initial Position is set to Dynamic and not Static.



12.3 Known Issues

12.3.1 Spm.set failed

```
START SPM 5.06 24 January 2007
Opening menu settings file spm.set failed (1)
Too many open files (EMFILE)
mainBoot.menuInit failed
Press <ENTER> to terminate
```

Upon starting SPM software in rare cases you may get the above message. Please switch the HP Mobile off and on again to restart.

12.3.2 Display changes without user touching keyboard or front panel

In older units it has been observed that the menu's of the SPM in menu mode change without the user pressing a key. For example the User presses Enter to get into the SPM Menu. The SPM goes into menu mode but then shows different menus successively and eventually goes out of menu mode.

In this case, the front panel is confused and starts outputting random commands. Press some or all keys on the front panel, untill random behaviour stops. Stop and Start of SPM software will also solve this.

12.3.3 Topcon demodulator does not start

Some internal Topcon demodulators have been observed to intermittently fail to start. This is seen in the F1 – Devices (Com Port) display (8.1.5). The Rx bytes on COM 4, Demodulator will not increase to 162 bytes after system is booted.

This is a problem with the Topcon demodulator itself. Switch the HP Mobile off and on to try to get the Topcon demodulator to start.

13 Loader program

13.1 Loader program

```
============================ LOADER [9] ==================================


Select and run program ..................: Starfix-Mobile SPM
Select and run utility ..................: None

Install program/ utility ................: None



Advanced
```

The Loader program allows the user to start the different software packages available on the processing board. The Loader software is usually only seen on start-up, where it automatically continues by starting the SPM software.

The Loader program is used to make a selection between any of the installed programs:

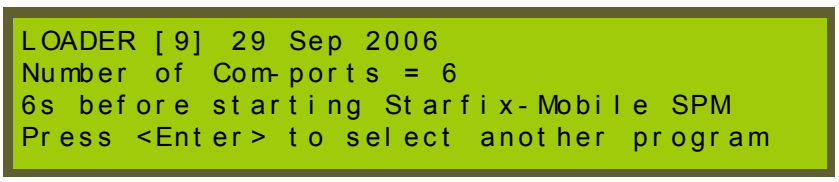
- SPM
- SPM File Transfer
- Upgrade Firmware (dos)
- Upgrade Firmware (win)
- DOS Prompt
- None

Together with SPM Version 5 a new version of the Loader software has been release, Loader 9.

13.2 To get into the Loader program

The user can get access to the Loader program by

1. Interrupting the start-up procedure when the front panel shows:



   Or monitor:

```
LOADER [9] 29 Sep 2006
Number of Com-ports = 6
6s before starting Starfix-Mobile SPM
Press <Enter> to select another program
```

Press Enter.

2. Stopping the SPM software. In the SPM Menu go to Main -> Stop Program. After the SPM software is stopped then the above 6 seconds wait message is shown. Press Enter to get into the Loader program itself..

13.3 The Loader Menu

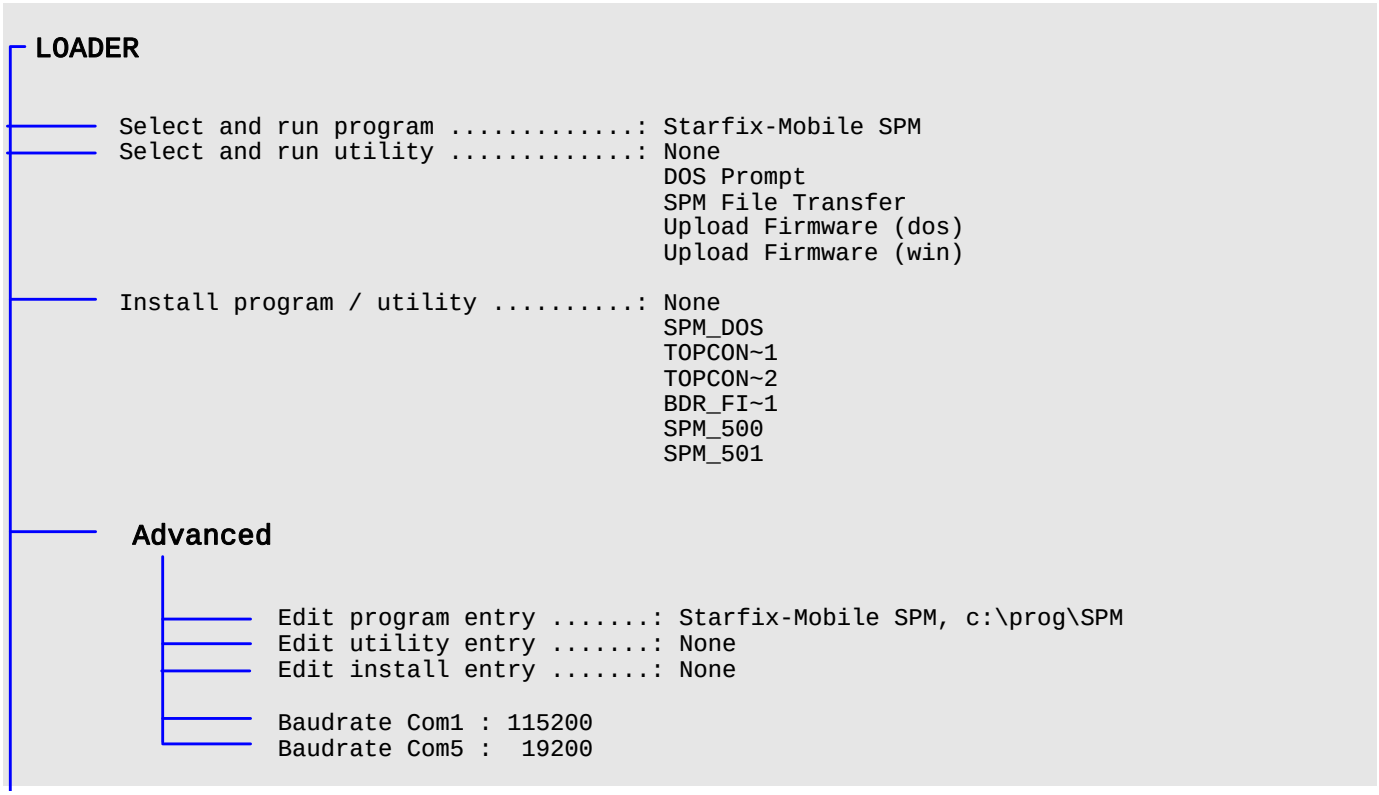


Figure 11: Loader Menu Structure

Run program	Currently only one program installed on HP Mobile: SPM
Run utility	
Install program / utility	Lists the executables in …. When you run one of these self-extractable files, they will install software. As can be seen from the example we can keep older versions of the SPM software (SPM_500 is SPM version 5.0, SPM_501 is SPM 5.01). Then install the required software by selecting the file here.

13.4 Uploading new Loader software

See Appendix E-1 Uploading new Loader software, Loader 9 for instructions.

14 Uploading a new version of SPM Software

New versions of the SPM software are distributed to Fugro's SPM Users email list. On this list are the workshop managers of Fugro Opco's.

To upload a new SPM version one uses the SPM File Transfer utility in the Loader program.

When new SPM software is uploaded from 4.xx to 5.xx the software is back to default and all settings must be entered manually: GPS, Demodulator, Drivers for Com ports.

When new software is uploaded from 5.xx to another 5.xx version, the SPM program settings are maintained. This is done by reading the SPM.CFG file and the SPM.SET file.

The upload procedure is described in Appendix E Uploading new SPM Firmware, SPM Version 5.

Uploading new Loader software, see Appendix E-1 Uploading new Loader software, Loader 9 .

15 Release History of HP Mobile

15.1 Release History of SPM Software

09 Sep 2005	SPM 4.16	Added support for Subscription Control over the air (RSOC). This requires Topcon demodulator with firmware 3.0a9 New Device Demod introduced to service Internal Topcon Demodulator HP correction input option AUTO changed to ALL and FIRST Automatic Leap Second
27 Sep 2005	SPM 4.17	Added VBS XP option as alternative to Starfix-Plus
	SPM 4.18	Special version for Fugro India
	SPM 4.19	Testing only
22 Nov 2005	SPM 4.20	SPM could crash if GSS was switched off. Disabled all calls to HP and GSS engine functions when switched off.
15 Dec 2005	SPM 4.21	Release for correct handling of GPS leap second 31 Dec 2005.
October 2006	SPM 5.01	Totally revised SPM version with upgraded HP and XP engines.
January 2007	SPM 5.06	Naming conventions for calculations applied in the software.
February 2007	SPM 5.07	Almanac from Novatel was not downloaded.
12 February 2007	SPM 5.08	Changed HP_MONITOR output format to say GPS, VBS, HP or XP instead of SPM_5.06. Introduced setting in Position Output menu: Disable output while converging. Clock offset displayed in F1 menu.

15.2 Release History of HP Mobile

This information is compiled from the delivery sheets. Post delivery changes to the hardware are not taken into account.

Serial Number	GPS Card
001 - 480	Ashtech Z12
481 - 700	Topcon
700 - 900	Ashtech Z12
700 - 900	Ashtech Z12
900 onwards	Novatel

Current version of Topcon firmware is 3.0A9, older versions are still running 3.0 A3, there is no need to upgrade these.

If one uses a combined antenna, then the HP corrections are received on the internal COM 4.

APPENDICES

A Starfix HP Specifications

Accuracy:

Starfix.HP position:

0.2m, 95% Horizontal

0.3m, 95% Vertical

Skyfix.XP position:

0.2m, 95% Horizontal

0.3m, 95% Vertical

Starfix.VBS position:

3m, 95%

Physical, Environmental, Power:

Size	:	19” x 10” x 3.5” (48.26 x 25.40 x 8.89 cm)
Weight	:	5.5 kg
Power	:	88–264 Vac, 40–60 Hz, 35W
Operating temp	:	0 – 40° C
Storage temp	:	-25 to +70° C (non condensing)

Input / Output ports:

RS232	:	4 x user configurable I/O ports (DB9)
LCD/Keypad	:	Internally connected to Com Port 5
GPS	:	Internally connected to Com Port 6
Screen/keyboard	:	External VGA and keyboard connector
Antenna	:	50Ω N-Type female.

GPS receivers:

Ashtech:

GPS receiver : Ashtech Z-Eurocard OEM, L1/L2

GPS antenna : Ashtech Kinematic (Marine IV), or Geodetic

Topcon:

GPS receiver : Topcon GD80 OEM, L1/L2

GPS antenna : Alison, L1/L2/L-Band antenna

Input formats:

Fugro SCF/CBMF

Output formats (max. 15 dual frequency reference stations):

Starfix HP/XP, Starfix.HP, Starfix.XP, Skyfix.XP, Starfix VBS position message, see Appendix D Starfix SPM Output formats.

Uncorrected and corrected RTCM 104, Type 1, 3 and 15, see section 9.7 SPM Menu → RTCM Messages.

For additional information on Starfix.HP send an @mail to: intersite.sales@fugro.nl

For technical information or support on Starfix.HP send an @mail to: SPM2000support@fugro.nl

B Back panel Pin Layout

B-1 Com Port 1 to 4

(RS232 9 Pin Sub-D connectors)

Pin Number	Description (9 Pin Sub-D RS232)	
1	DCD	Data Carrier Detect
2	RX	Receive Data
3	TX	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal GND
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

B-2 GPS B

Pin Number	**Description (9 Pin Sub-D Male RS232)**	
2	RX	Receive Data
3	TX	Transmit Data
5	GND	Signal GND
7	RTS	Request to Send
8	CTS	Clear to Send
9	PPS	1PPS signal from GPS receiver

Pin 9 on this connector is used take make the 1PPS signal from the internal GPS receiver available. In older models of the HP mobile this 1PPS was not capable of driving high power inputs such as Com ports, they could therefore not be used in combination with 1pps drivers that work through Com ports (such as in Starfix.Iowin), they should be buffered before being used. Newer models of HP Mobile have internal buffering and do not have this problem.

B-3 VGA and Keyboard Connectors

VGA Connector (15 Pin HD Sub-D)		Keyboard Connector (6 Pin PS/2)	
Pin Number	15 Pin High Density D-Conn.	Pin Number	PS/2 Keyboard
1	RED Out	1	Keyboard Data
2	GREEN Out	2	N/C
3	BLUE Out	3	Keyboard GND
4	N/C	4	Keyboard +5V
5	CRT GND	5	Keyboard Clock
6	RED Return	6	N/C
7	GREEN Return		
8	BLUE Return		
9	N/C		
10	SYNC Return		
11	N/C		
12	N/C		
13	H_SYNC		
14	V_SYNC		
15	N/C		

C MUX channels and Starfix.IOWIN (SPM Remote Control driver)

C-1 Wiring

Make an Interface cable between the HP Mobile Com port 1 and the PC (DB9 Female to DB9 Female or DB9 Female to DB25 Female) as shown in the table below.

HP Mobile: Sub-D Connector DB9 Female		Computer: Sub-D Connector DB9 Female		Sub-D Connector DB25 Female	
Pin Nr	**Description**	**Pin Nr**	**Description**	**Pin Nr**	**Description**
2	Rx	3	Rx	2	Tx
3	Tx	2	Tx	3	Rx
5	Gnd	5	Gnd	7	Gnd

Note that the HP side is considered a computer and hence the port is of type DTE (Data Terminal Equipment (female) as opposed to DCE (male).

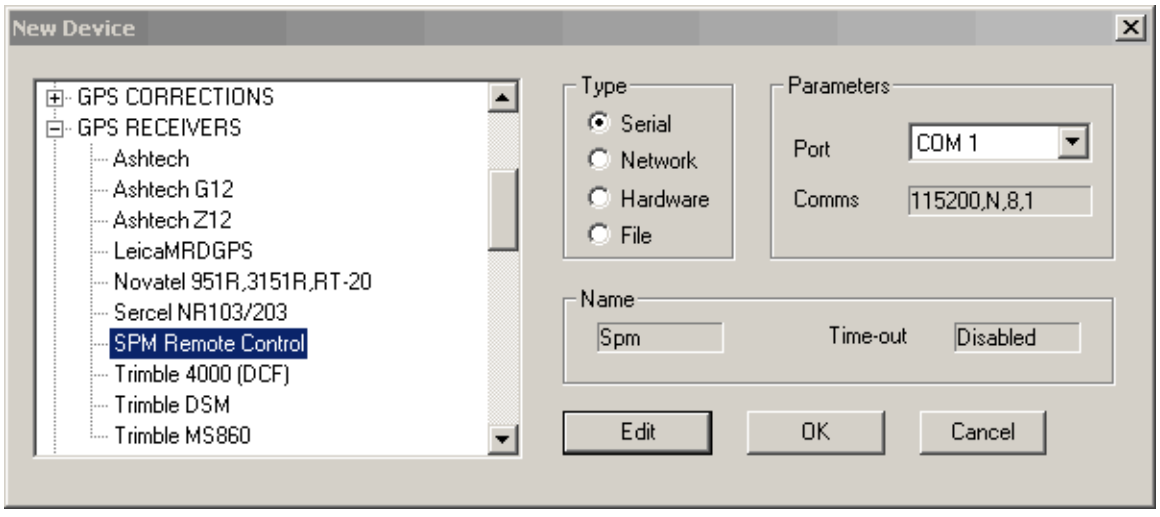
C-2 How to configure the HP Mobile for interfacing with IOWIN:

Com port 1 of the HP Mobile needs to be configured as MUX channel in SPM Menu → Devices → Port Configuration (section 9.4.1.). The baudrate for Com Port 1 needs to set to 115200 in the same menu

```
Devices
    Port configuration
        COM#  Device          Baudrate

        1     Multiplexer      <115200>
        2     DGPS             <115200>
        3     DGPS             <115200>

        Relay inputs on ports (2-6) to MUX : off
```

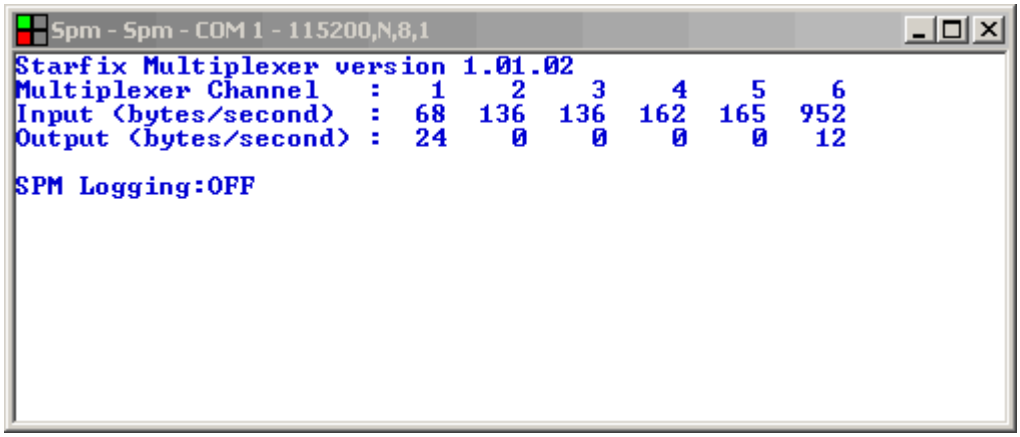
C-3 How to configure IOWIN:

Start IOWIN from Fugro Control. Select “Device => New” and the next GUI will be shown



Choose “SPM Remote Control” from the “GPS RECEIVERS” list.

The baudrate to 115200, 8, N, 1. It is advisable to always use 115200 as baudrate for the MUX, as this is the maximum that the SPM can handle, and the minumum to guarentee faultless flaw of the data.



On occasions you will not see anything in this Dll untill you have start SPMMon, see C-6

C-4 Virtual Mux ports in Iowin

With the SPM Remote Control driver is running, six new virtual Com Ports are available in Iowin: the OIS ports or in later versions of Iowin (Starfix Suite 8.1 onwards) SpmRemote ports. Multiplexer Channels 1 through 6 are corresponding with: SpmRemote1 through SpmRemote6 in Iowin.

If one has multiple HP Mobiles, it is possible to have multiple instances of the SPM Remote Control driver running in Iowin. Each SpmRemote instance has its’ own name and this will be reflected in the virtual port name. For example the second instance is called SpmRemote_2, then the port is SpmRemote_21 to SpmRemote_26.

C-5 Interfacing Raw GPS or NMEA

Provided the correct settings are set in the SPM menu, one can now for example choose AshtechZ12 or TopconGPS driver (under GpsReceiver) and connect to SpmRemote6, to get Raw Gps in the Starfix Suite.

Note that this Raw GPS should NOT be used as a Time Source for Starfix.Time, as it is delayed and not reliable. For Starfix.Time one should interface to GpsPort B directly at the back panel of HP Mobile.

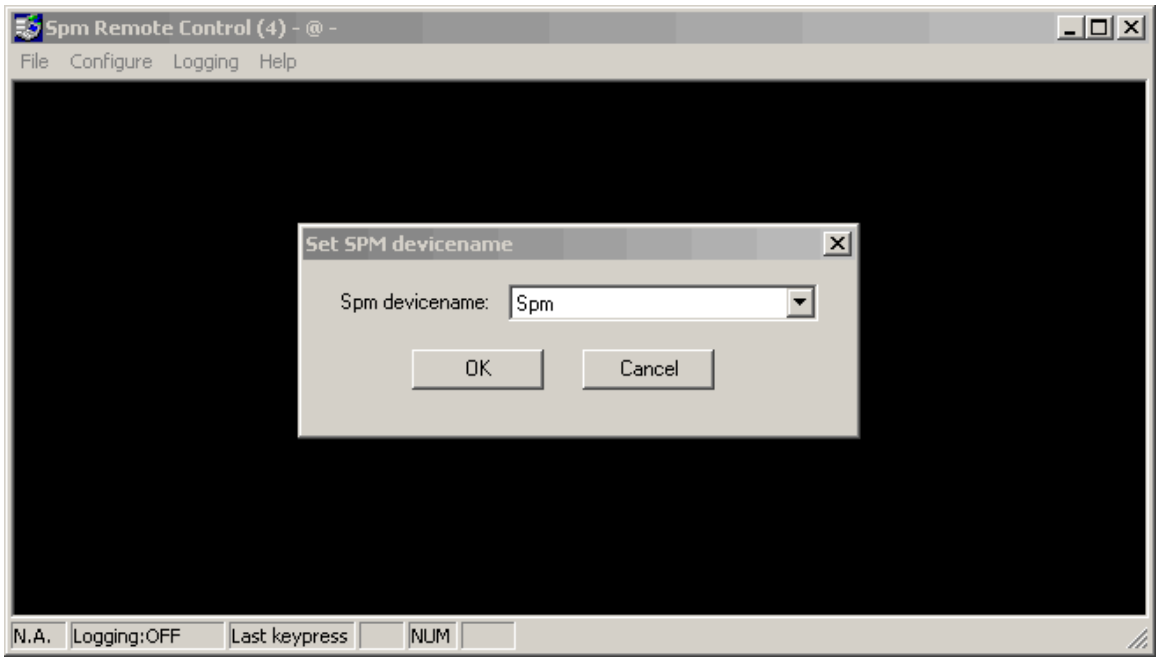
Or one can use the NMEA In driver under Position Inputs to read Nmea positions.

C-6 SpmMon or SpmRemote (Configure)

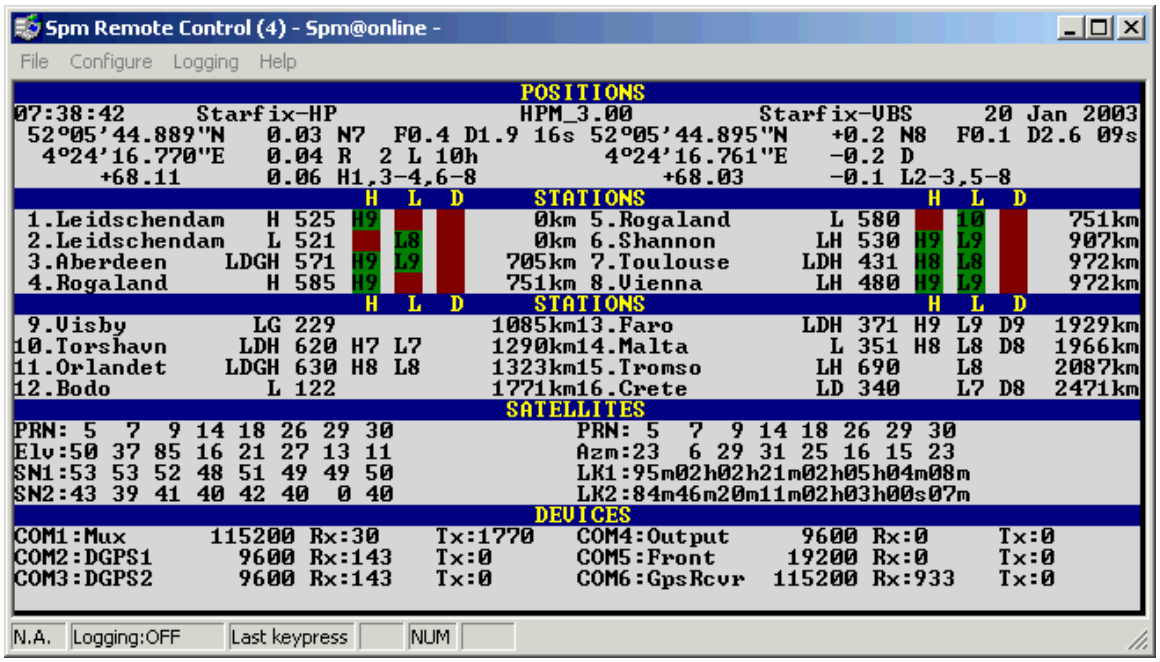
One can get to the SpmRemote program in two ways:

1. From Starfix.Control find SpmMon under GPS programs
2. In Windows go the Start button -> Programs -> Starfix Suite -> Gps Suite -> SpmMon
3. Go to the SPM window in Iowin, click the right mouse button and press Configure.

The next image will be displayed to configure the SpmMon application.



Select the correct Device Name. Press OK and the SpmRemote program is running.

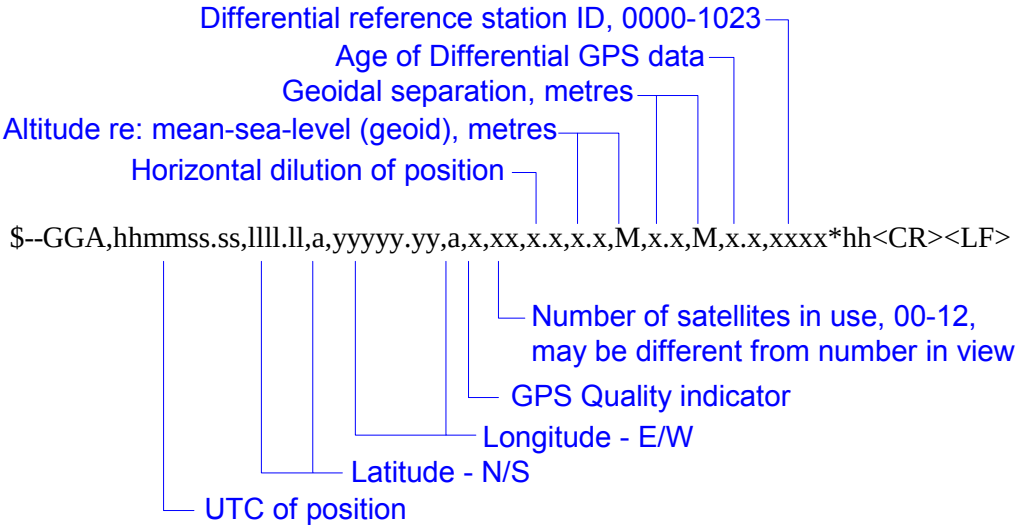


From here, the Starfix SPM unit can be configured, and addition device drivers started.

D Starfix SPM Output formats

D-1 Format: NMEA GPGGA

The GPGGA string outputs Time, position, and fix related data for a GPS receiver.



Example:

$GPGGA, 150653.00,5305.78115,N,00424.36505,E,5,7,1.2,24.44,M,15.25,M,11,0001*66

GPS Quality Indicator

The GPS Quality Indicator field shall not be a null field.

0	Fix not available or invalid
1	GPS, SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS, PPS Mode, fix valid
4	Real Time Kinematic. System used in RTK Mode with fixed integers
5	Float RTK. Satellite system used in RTK Mode, floating integers
6	Estimated (dead reckoning) Mode
7	Manual Input Mode
8	Simulator Mode

Age

Time in seconds since last Type 1 or 9 update.

Geoidal Separation

the difference between the WGS-84 earth ellipsoid surface and mean-sea-level (geoid) surface, "-"= mean-sea-level surface below WGS-84 ellipsoid surface.

This field is populated with the information in SPM Menu → Positioning → Initial Position (9.6.1).

Differential reference station ID

The 'Differential reference station ID' field is the 'Navigation ID' from the SPM program, see SPM Menu → Positioning → Starfix.HP/XP Settings, SPM Menu → Positioning →

Skyfix.XP Settings, SPM Menu → Positioning → Starfix.VBS Settings.

By default the Navigation ID's are (if not differently entered in the SPM software) are:

1	Starfix.HP/XP
2	Skyfix.XP
3	Starfix.VBS
4	Starfix.GPS

D-2 Format: GECO

The Geco format is a DGPS Computed Position Transfer Format

The data string is to be used for transfer of position data (normally vessel positions) from a 3rd party DGPS system to Schlumberger RES's Integrated Navigation System (TRINAV). This is an ASCII format terminated by CR/LF and is described in the table below.

Content	Format	Byte	Unit	Comments
Start character	A1	1..1	[-]	[
Record identifier	I2	2..3	[-]	= 01
Format version	I2	4..5	[-]	= 02 for this version
Nav. Point no.	I2	6..7	[-]	See comment (a)
System name/version	A10	8..17	[-]	Name + ver. of DGPS system See comment (b)
GPS Week number	I4	18..21	[-]	Week number since August 21 1999
Fix time tag	F9.1	22..30	[s]	Seconds into GPS week (GPS time)
Age of fix	F4.1	31..34	[s]	See comment (c)
Latitude	A13	35..47	[dm]	^dd^mm.mmmmmN (^=space)
Longitude	A14	48..61	[dm]	^ddd^mm.mmmmmE
Height	F5.1	62..66	[m]	Antenna height above ellipsoid, see comment (d)
HDOP	F5.1	67..71	[-]	
VDOP	F5.1	72..76	[-]	
Unit variance	F6.x	77..82	[-]	
Variance Lat	F6.x	83..88	[m^2]	See comment (e)
Covariance Lat/Lon	F6.x	89..94	[m^2]	See comment (e)
Variance Lon	F6.x	95..100	[m^2]	See comment (e)
Variance Height	F6.x	101..106	[m^2]	See comment (e)
External Reliability	F6.1	107..112	[m]	See comment (f)
Fix status	I2	113..114	[-]	See comment (g)
No of satellites	I3	115..117	[-]	No of Satellites used for this fix
No of ref stations	I3	118..120	[-]	No Ref stns used for this fix See comment (h)
Sats Used PRNs	I3*n	121..	[-]	Satellites used for this fix
Ref Station Idents	I3*n	.. ...	[-]	Ref stns used for this fix
End character	A1		[-]	]
CRLF	A2			

Comments

a) Nav point no — is a unique integer identifying the position, and the 'navigation ID's' entered in the 'Position menu' for each calculation is used to identify them.

Should be manually input to the software according to requests from Positioning Engineers.

Alternatively, this should start from 1 and be incremented if several positions are output from the same system.

b) system name — should identify the system (or contractor) and software version (eg. "SEADIFF 2.1" or "MFIX 1.2.3").

c) Age of fix — is the time of the first character of the data string being output to Schlumberger RES's Positioning system minus the time of position.

d) Antenna height — WGS84 ellipsoid and datum must be used. The Height must be antenna height above the WGS84 ellipsoid.

e) Variance, Covariance — The Variance and Covariance terms are elements from the Variance-Covariance matrix of the position fix computation (un-scaled).

f) External Reliability — The External Reliability is the maximum positional effect of an undetectable error in an observation. This quantity is related to the Power of the test (probability that the MDE would be detected) and the Significance level used.

- The values recommended by UKOOA should be used (see UKOOA Guidelines for The use of Differential GPS in offshore surveying, Issue number 1, Sept 1994) ie. a Significance level of test 1% and the Power of the test 80%.
- If values other than those given above are used, the contractor must explicitly state them.

If no statistical testing takes place in the software, or the value is not computed, the external reliability must be set to -1.

g) Fix status — Single Frequency

Status Code	Meaning
0	No or Bad fix
1	Altitude aiding (Weighted height used in fix)
2	Altitude hold (2D fix)
3	3D fix

Dual Frequency (4 is added to the above values when positioning is set-up for dual frequency measurements)

Status Code	Meaning
4	No or Bad fix
5	Altitude aiding (Weighted height used in fix)
6	Altitude hold (2D fix)
7	3D fix

h) No of ref stations — gives the number of reference stations in use for this fix, not the number of stations available. This field must be set to 0 if the fix is not differential. If numerical data is missing or can not be computed, the value must be set to -1

Field formats:

x total field length

Ax Alphanumeric text

Ix Integer field

Fx.y Floating point field, where

x gives total length including the decimal point and decimals

y the no of decimals

If a sign (+ or -) is included in the field, the sign must be immediately adjacent to the number it relates to with no spaces in between, for example –3.12

The number of decimals for the Variance fields is free to be selected, depending on the size of the values (indicated as F6.x). This will extend the dynamic range. It is recommended to decide the number of decimals dynamically after each computation, to avoid losing significant digits. The decimal point must always be included.

Alphanumeric text fields must be left justified, and numeric fields right justified.

The field sizes are selected so that there normally will be a space between each item (except possibly for reference station IDs). This aids manual readability and protects against field overflow.

D-3 Format: DGPSQC

Content	Format	Byte	Unit	Comments
Start character	A1	1..1		[
System name/version	A24	2..25		Fugro MRDGPS V 3.01.01
Week number	I4	26..29		Week number since GPS week number roll over
Fix timetag (GPS time)	F9.1	30..38	[s]	Seconds into week
Age of fix	F4.2	39..42	[s]	Time of the first character of the data string being output to nav. System minus time of position
Latitude	A14	43..56	[deg min]	^dd^mm.mmmmmmN (^ = space)
Longitude	A15	57..71	[deg min]	^ddd^mm.mmmmmmE (^ = space)
Height	F6.2	72..77	[m]	Ant. Height above ellipsoid
HDOP	F5.1	78..82		
VDOP	F5.1	83..87		
Unit Variance fix	F7.3	88..94		
Variance Lat	F7.1	95..101	[m2]	
Covariance Lat/Lon	F7.1	102..108	[m2]	
Variance Lon	F7.1	109..115	[m2]	
Variance Height	F7.1	116..122	[m2]	
External Reliability	F6.1	123..128	[m]	The External Reliability is the max potential effect of an undetectable error in an observation. Computed from the MDEs with the power of the test set to 80% (UKOOA guidelines).
Fix status	I2	129..130		0 = No/bad fix 1 = Height aiding 2 = Fixed height 3 = 3D fix
No of satellites used	I3	131..133		No of satellites used for this fix
PRNs used	I3*n	134..		PRNs used for this fix
No of reference stations used	I3			No of ref station used for this fix

Repeated for all stations

Content	Format	Byte	Unit	Comments
ID for ref stn No 1	I4			
Age of fix for ref sta No 1	F4.1			
Unit Variance fix for ref sta No 1	F7.3			
Weight in solution ref sta No 1	F5.2			
No of common SVs ref sta No 1	I3			
..				
..				
ID for ref stn No n	I4			
Age of fix for ref sta No n	F4.1			
Unit Variance fix for ref sta No n	F7.3			
Weight in solution ref sta No n	F5.2			
No of common SVs ref sta No n	I3			
End character	A1			]
CrLf	A2			

12/06/2001 Format and Byte columns corrected for error in Latitude and Longitude format length.

D-4 Format: GPLCT

Example:

$GPLCT,2001365,170002.00,2859.836227,N,09304.171413,W,5, -025.13, 090.00,05.55,02.01*64

Data Item	Units	Sample - comment
Identifier	N/A	$GPLCT – fixed string that identifies the string
Date	yyyyjjj	Identifies year and day. Day can be either month and day or Julian day. Use of 4 digit year to avoid any remote chance of ambiguity.
UTC	hhmmss.ss	
Latitude	ddmm.mmmmmm	Degrees and decimal minutes, **6** digits on the decimal minutes
Latitude Hemisphere	c	N or S
Longitude	dddmm.mmmmmm	Degrees and decimal minutes, **6** digits on the decimal minutes
Longitude Hemisphere	c	E or W
GPS Quality indicator	n	0 = fix not valid 1 = GPS fix 2 = DGPS 5 = Float RTK/Starfix-HP
Antenna Height	±mmm.mm	Relative to **ellipsoid**, metres; Range: -999.99 to +999.99
Course	ddd.dd	Vessel course over ground, degrees from North
Velocity	ss.ss	Vessel speed over ground, knots; Range: 0.00 to +999.99
PDOP	pp.pp	PDOP, HDOP is also acceptable, we just need to know which is provided.
*		Fixed end delimiter
		Checksum
		<CR><LF>

Notes:

- The string should be comma separated, but fixed width on the fields. This will emulate the NMEA format but does not need to strictly follow it.
- The sample shows year and Julian rather than year, month day. Year Julian day is preferred but year month day is acceptable.
- As laid out, the string is 87 characters, including the "*" character and the checksum.
- Fonts are set to bold for key points in the table above.
- Course and Velocity are useful for field QC with UNISON.

D-5 Format: HP_MONITOR

The HP_Monitor format was formerly know as Mon_PVT, Mon_HPQ or Mon_PVT_HPQ. The separate output messages have been removed.

D-6 Format: HP MONITOR: MON_PVT

This format is based on a NMEA GGA string, see Appendix D-1 Format: NMEA GPGGA.. Information in addition to a GGA string includes full date, speed, VDOP, and no of ref stns.

Example:

$PFGRPVT,01,SPM_5.06,223010.00,11,07,2006,,,,,,…….,,,*<CS><CR><LF>

Content	Example	Format	Unit	Comments
Start character	$		[-]	$ (HEX 24), Start of sentence
Sentence ID	P		[-]	P (HEX 50), Proprietary sentence ID
Talker	FGR		[-]	FGR, Manufactures Mnemonic code
Message info	PVT		[-]	PVT, Monitor string position/velocity
Nav point no	01	xx		See comment (a) in D-7
System name/version	SPM_5.06	aaaaaaaaaa	[-]	
Time	223010.00	Hhmmss.ss	[s]	Time UTC
Day	11	xx	[-]	
Month	07	xx	[-]	
Year	2006	xxxx	[-]	
Latitude	5205.781083	ddmm.mmmmm	[dm]	WGS84
North or South	N	a		N/S
Longitude	00424.365168	dddmm.mmmmm	[dm]	WGS84
East or West	E	a		E/W
Ellipsoid Height	+57.265	xxxx.xxx	[m]	WGS84
Speed North	-0.0195	xxx.xxxx	[m/s]	
Speed East	-0.0006	xxx.xxxx	[m/s]	
Speed Up	+0.0717	xxx.xxxx	[m/s]	
Fix status	05	xx	[-]	See comment (b)) in D-7
No of satellites	07	xx	[-]	Number of Satellites used for this fix
HDOP	01.60	xx.xx	[-]	
VDOP	01.84	xx.xx	[-]	
Age of corrections	11.0	xx.x	[s]	See comment (c)) in D-7
No of ref Stations	07	xx	[-]	No Ref stns used for this fix See 2.2(i)
Checksum field	*58			*<CS>
CRLF				<CR><LF>

D-7 Format: HP MONITOR: MON_HPQ

Example:

$PFGRHPQ,01,SPM2.2,223010.00,11,07,2002,,,,,,…….,,,*<CS><CR><LF>

Content	Example	Format	Unit	Comments
Start character	$		[-]	$ (HEX 24), Start of sentence
Sentence ID	P		[-]	P (HEX 50), Proprietary sentence ID
Talker	FGR		[-]	Manufactures Mnemonic code
Message info	HPQ		[-]	Monitor string quality
Nav point no	01	xx		See comment (a)
System name/version	SPM_5.06	aaaaaaaaaa	[-]	
Time	223010.00	hhmmss.ss	[s]	Time UTC
Day	11	xx	[-]	
Month	07	xx	[-]	
Year	2006	xxxx	[-]	
Reserved		xx.xxx	[m]	
Reserved		xx.xxx	[m]	
Reserved		xx.xxx	[m]	
Reserved		xx.xxx	[m]	
SDUW		xx.xxx	[-]	SDUW, Standard Deviation of Unit Weight, square root of Unit Variance, calculated from the normalized residuals in the overdetermined fix.
Standard Deviation Lat		xx.xxx	[m]	The standard deviation terms are calculated from the Variance-Covariance matrix of the position fix computation.
Standard Deviation Lon		xx.xxx	[m]	See above
Standard Deviation Height		xx.xxx	[m]	See above
Reserved		xx.xxx	[m]	
No of satellites	07	xx	[-]	Sats used for this fix
Reserved		xx	[-]	
No of ref Stations		xx	[-]	No Ref stns used for this fix, see (d)
Sats Used PRNs		xx^xx^xx^xx……..	[-]	Sats used for this fix (^=space)
Reserved		xx^xx^xx^xx……..	[-]	
Ref Station Idents		xx^xx^xx^xx……..	[-]	Ref stns used for this fix.
Checksum field				*<CS>
CRLF				<CR><LF>

a) The "Nav point no." is a unique integer identifying the position (eg what antenna used).

- Can be set in SPM menu: SPM Menu → Positioning → Starfix.HP/XP Settings (9.6.4)
- Should be manually input to the software according to requests from Positioning Engineers.
- Alternatively, this should start from 1 and be incremented if several positions are output from the same system.

b) Fix status :

0	No fix,

1	Standalone
2	DGPS
3	PPS
4	RTK/Fixed Integer
5	Float

c) The "Age of correction" is the time between Fix Time Tag and the time stamp of the youngest correction used.

d) "No of ref stations" gives the number of reference stations in use for this fix, not the number of stations available. This field is empty if the fix is not differential.

E Uploading new SPM Firmware, SPM Version 5

E-1 Uploading new Loader software, Loader 9

1.	SPM_DOSX.ZIP contains files for the C:\DOS directory, including the new loader and file transfer utility. These should be installed first using FastLynx (Windows) or Interlink (DOS). It is assumed that you have a screen and keyboard connected to the SPM unit
2.	Restart the SPM unit and select in the loader the Upload Firmware utility of your choice.
3.	Connect SPM COM1 to PC COM1 using a null-modem cable.
4.	Copy SPM_DOSX.ZIP to any directory on the PC.
5.	Extract the 3 files in SPM_DOSX.ZIP. Password is zip. Lower case.
6.	The three files in SPM_DOSX.ZIP are: • SPM_DOS.ZIP - archive to be installed in C:\DOS of the SPM. • SPM_DOS.BAT - commands to extract files from SPM_DOS.ZIP. • PKUNZIP.EXE - program used to extract files from SPM_DOS.ZIP. All 3 files must be copied to C:\DOS of the SPM unit using FastLynx or Interlink.
7.	Restart the SPM unit and select the DOS Prompt and change directory to C:\DOS.
8.	Type command SPM_DOS.BAT. Now files in SPM_DOS.ZIP are extracted to C:\DOS.
9.	Restart the SPM unit and check that you can start the currently installed SPM program.

The new loader lets you select a default program to be started, although this is at present just the SPM program.

If you want to run a utility then first go to the next item ("Select and run utility") and select.

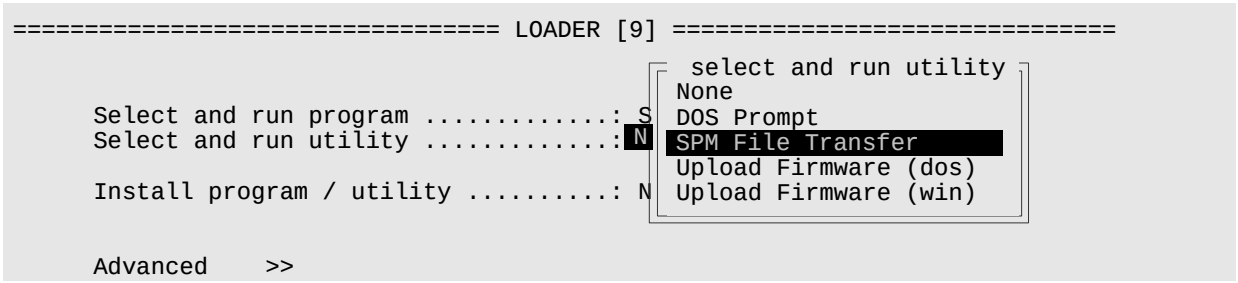
The options are:

- DOS Prompt
- SPM File Transfer
- Upgrade Firmware (dos) (Interlink)
- Upgrade Firmware (win) (FastLynx)

E-2 Installation Procedure SPM, SPM 5.07 from SPM 5.xx or SPM 4.xx

1. Restart the SPM unit and do not re-start SPM.

2. In the Loader select the SPM File Transfer utility.



3. The SPM screen should show:

4. Connect SPM COM1 to PC COM1 using a null-modem cable.

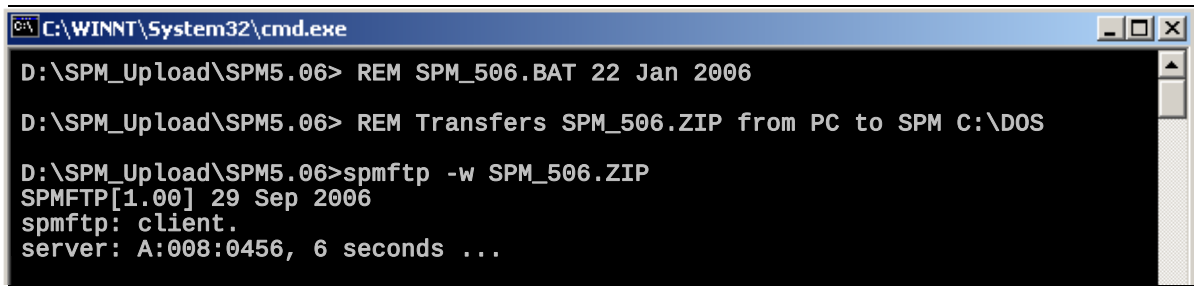
5. Copy SPM_500X.ZIP to any directory of the PC.

6. Extract the 3 files in SPM_500.ZIP. Password is zip. Lower case.

7. The three files in SPM_500X.ZIP are:

   - SPM_500.ZIP - archive to be transferred to C:\PROG of the SPM
   - SPM_500.BAT - command to transfer the above file from PC to SPM
   - SPMFTP.EXE - SPM File transfer utility for use on the PC

8. To transfer the file you can click SPM_500.BAT in Windows Explorer or run SPM_500.BAT in a console window.



   The file transfer takes about 2 minutes (5KB/sec, SPM_500.ZIP=624KB).

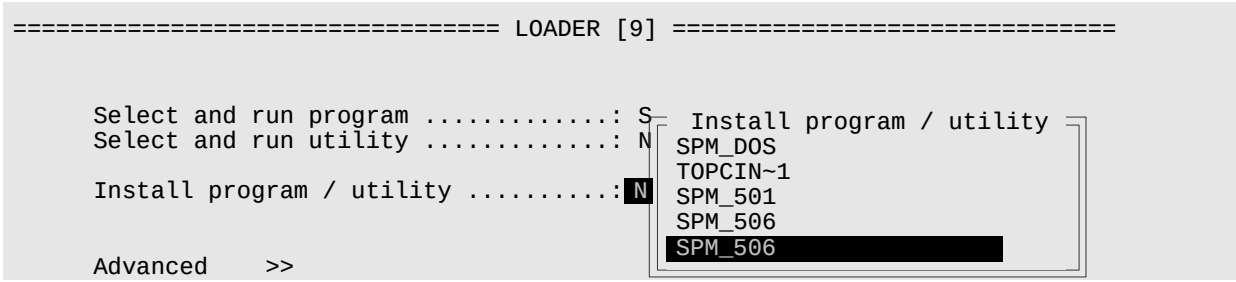
   If you run SPM_500.BAT from Windows Explorer then the console window automatically closes upon completion transfer. If you run the command in a console window you can better read the file transfer completed message: drag and drop the .bat file from Windows Explorer into de Command prompt window.

9. After a successful transfer you see in the SPM:

```
Running SPM File Transfer
SPMFTP [1.00] 29 Sep 2006
spmftp: server; directory = c:\prog
spmftp: transfer c:\prog\SPM506.ZIP complete (WRQ)
```

10. After file-transfer press X on the keyboard connected to the SPM or restart the SPM unit.

11. Select in the loader at item “Install program / utility” option SPM_500. The other option is SPM_DOS. SPM_DOS has already been installed. The install files SPM_500.ZIP and SPM_DOS.ZIP remain on the system to enable you to re-install at a future date.



12. After installation SPM [5.00] 29 Sep 2006 starts automatically as it is the default program.

If you upgrade from SPM 4.xx to 5.xx you must reconfigure the software from scratch. Future (5.XX) updates shall import automatically the latest device and station configuration.

F Mobile Firmware upload procedure

This procedure is applicable to SPM 3.07 untill SPM 4.

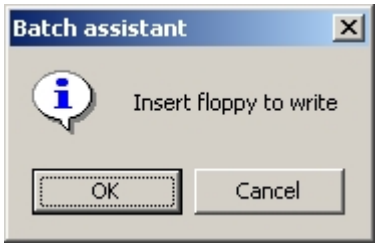
F-1 Step 1: requirements

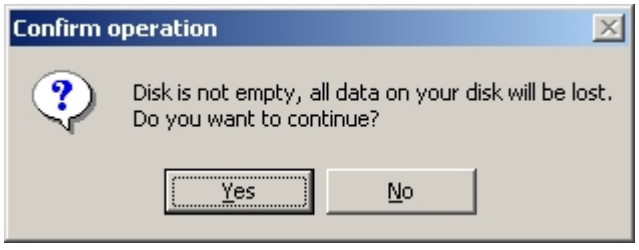
To upgrade software on the HP mobile you need:

- the Starfix HP software release executable.
- computer with floppy disk drive and a Com port.
- null modem cable (at least pins 2, 3 and 5) or interface cable provided with the HP mobile system to connect Pc Com1 to HP port 1.
- empty floppy disk.

F-2 Step 2: create a bootable floppy

The Starfix HP software release is a windows executable, which creates a bootable disk. Start the executable and insert a floppy.





The floppy image will now be restored, and is a MS-Dos 6.22 bootable floppy.

F-3 Step 3: Peer to Peer network connection between PC and HP Mobile

The bootable disk is used to boot your computer with a Dos system and is configured to establish a peer to peer network connection between your computer and the HP mobile.

The peer to peer network is established with:

- the MS-DOS software floppy and computer.
- the Dos utility Dos Interlink Server on the HP mobile, see Step 4.

F-4 Step 4: Setting up the HP Mobile

You must start the program Dos Interlink Server on the HP Mobile. This needs to be done in the sequence below:

1. connect the Null modem cable to Com1 of both your PC and the HP Mobile.
2. power-up the HP Mobile.
3. wait for the following message on the LCD screen:
4. interrupt the countdown by pressing any key on the keypad of the HP Mobile.
5. select the Dos Interlink Server program in the loader program.

```
LOADER [8] 25 Nov 2003
Number of Com-Ports = 6
10s before starting Starfix-Mobile SPM
Press <Enter> to select another program
```

F-5 Step 5 Setting up the PC

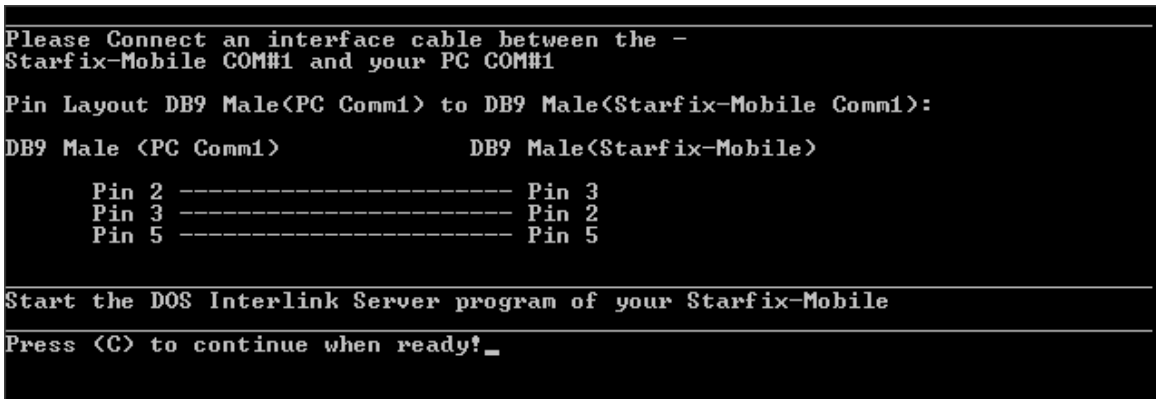
Insert the floppy disk in a computer and boot from this disk.

F-6 Step 6: Running the HP Upload program

The HP Upload program starts with the following message:

```
Starfix-HPM Utility Disk 02-2003

1. Install New HPM Software on Starfix-Mobile
2. Exit to Dos Prompt

Please select an option (1 or 2)
```

Select ‘1’ to install the new software on the Starfix HP Mobile. You get this screen:



When the cable is installed and everything is checked, press <C> to continue.

The connection between the HP mobile and the computer is now tested.

If it fails the previous screen will be visible again. If this happens you can check if the cable is wired correctly and the cable is connected to the Com ports described.

If a previous install is found a screen like below will appear:

1	installs the SPM software for mobiles with internal Ashtech cards. This applies to units with serial numbers between 1 and 480 and higher than 571.
2	installs the SPM software for mobiles with internal Topcon cards. This applies to units with serial numbers between 481 and 570.
3	Installs the Loader software
4	Not necessary from SPM 4.21 onwards as the demodulator configuration is done from SPM software.
5	Option not available anymore as previous installs are not being restored anymore.
6	Close the upload software

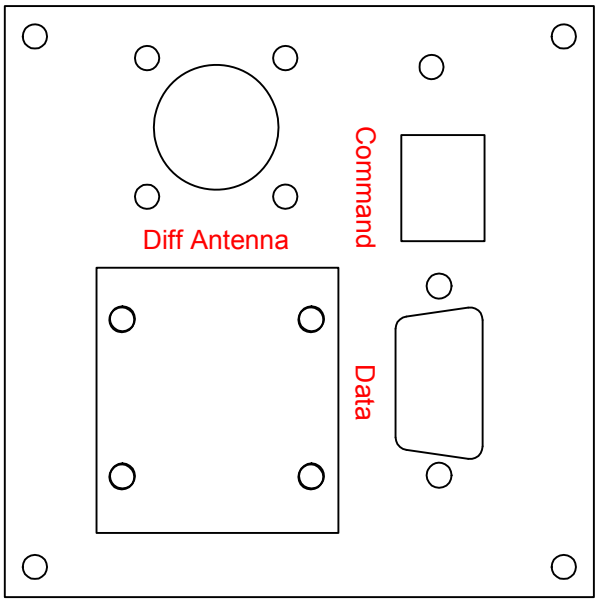
After making a selection the current software is copied to a backup directory, and the new software is installed automatically. After installation it will return to the screen above for further installation if required.

When all the required software has been installed, power cycle the unit for normal operation and select the SPM software to start.

G Configuring the integrated demodulator 3000LCE

The HP Mobile can optionally be fitted with a built-in demodulator, either of the type 3000LCE or of the type Topcon.

In this case on the back of the Starfix HP mobile there are two data connectors and one antenna connector: an additional N-Type bulkhead is visible on the back of the unit



The demodulator can be configured by connecting the **COMMAND** port to **COM#1-4** on the back of the unit using a RJ45 to DB9 female cable delivered with the unit. Differential correction data can be taken from the data Port into the Starfix HP (Com2 or Com3).

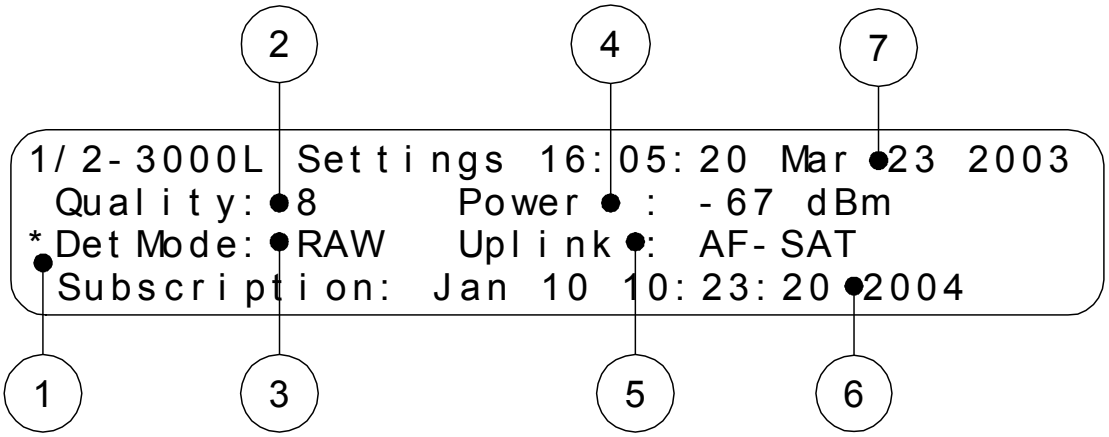
G-1 Configuring the 3000LCE demodulator.

- Connect the **COMMAND** port to **COM#1-4** on the back of the unit using a RJ45 to DB9 female cable delivered with the unit.
- Switch on the HP mobile and wait for the loader to appear. Interrupt the Loader during count-down to enter the menu (See chapter 3.3 Loader).
- Now select the **Configuration 3000L** program.

The program will start searching for a connected 3000 demodulator on all available comports.

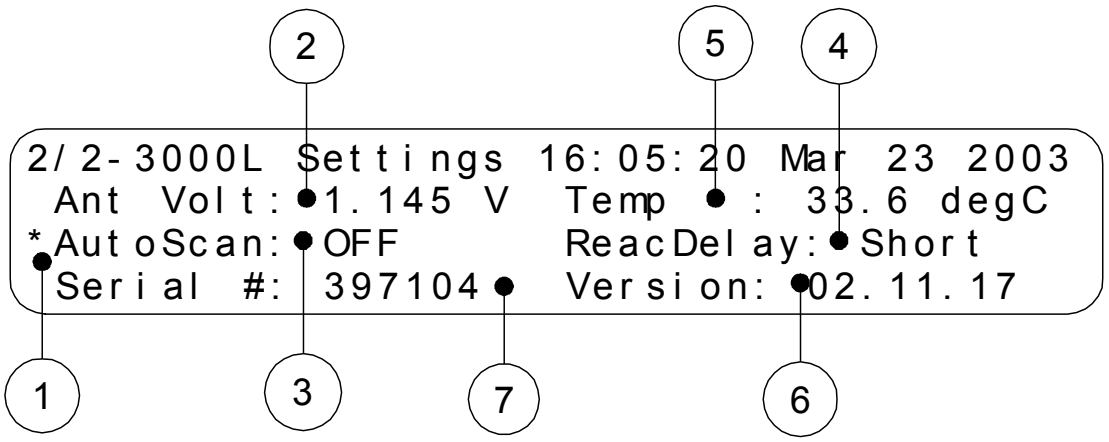
```
Connecting to 3000LCE demodulator
Checking Com# 4 at 9600 Baud
```

When the program has connected to the demodulator the following screen appears on the LCD. There are two displays available:



Demodulator 3000 LCE Display	
1	Selector Cursor (is used to identify the current selected setting to be edited/changed)
2	3000LCE demodulator Data quality figure for the data received via the selected Uplink. **Range = 0 (No Data) to 8 (Good Data)**
3	Detector Mode is the selected output mode. **Selection = RAW or RTCM***
4	Power level of received signal in dBm.
5	Selected Uplink satellite.
6	Subscription expiry date (Valid until)
7	Current Date and time of demodulator.

When the detector mode has been set to RTCM, only RTCM messages type 1 and 3 of single frequency reference stations are available. For use with the HP Mobile in HP mode, XP or VBS-Plus (L2) mode, the detector mode must be set to RAW.



1	Selector Cursor (is used to identify the current selected setting to be edited/changed)
2	Connected Antenna Voltage.
3	Auto-scan is used to scan through all available uplink satellites when the selected Uplink has been lost. **Selection = ON or OFF.**
4	ReacDelay is the time out between losing the signal and the start of auto scanning.
5	Internal temperature of 3000LCE demodulator
6	Firmware version of Demodulator.
7	Serial Number of Demodulator.

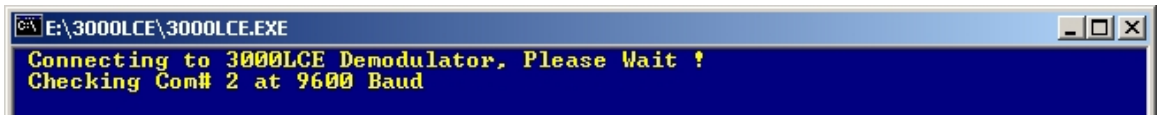
Settings are changed using the front panel keys. Using the front-panel keys there are four settings which can be changed by the user:

- Auto-scan
  - This setting can either switched **on** or **off**. When switched on the demodulator will start cycling through all the available up-link satellite frequencies stored inside the demodulator. When switched off, the demodulator will remain searching the selected up-link frequency when lock has been lost.
- ReacDelay
  - Re-acquisition Delay is the delay between narrow-band and wide-band search within the selected up-link frequency after loss of lock.
- DetMode
  - Detector Mode can be set to **RAW** and **RTCM.** When set to **RAW** mode all differential data being received is sent out via the Data Port without change. This mode must be used if the data is fed directly into the HP mobile (See chapter 6.2.1). If set to **RTCM** the differential data is being converted to RTCM using only the L1 single frequency reference stations (Only Type 1 and Type 3 RTCM messages are available on the data Port).

    DO NOT USE RTCM MODE WHEN FEEDING THE DIFFERENTIAL CORRECTIONS DIRECTLY INTO THE HP MOBILE!
- Uplink

- This is a list of available up-link satellites stored in the demodulator and can be cycled through using the front-panel keys. **If for some reason the desired up-link is not present, you can connect an external screen and keyboard to the HP mobile to set the Frequency and symbol rate yourself using a Command-Line.**

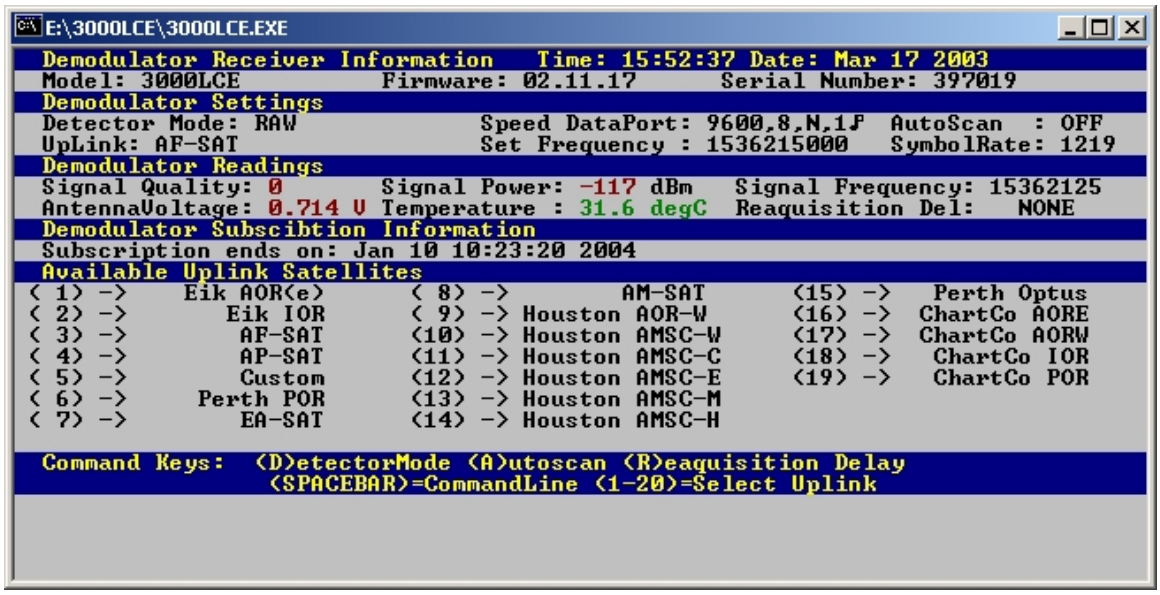
G-2 CRT Displays:



When the Configuration 3000L Program has started the following screen should visible.

The program will start searching for a connected 3000 demodulator on all available comports.

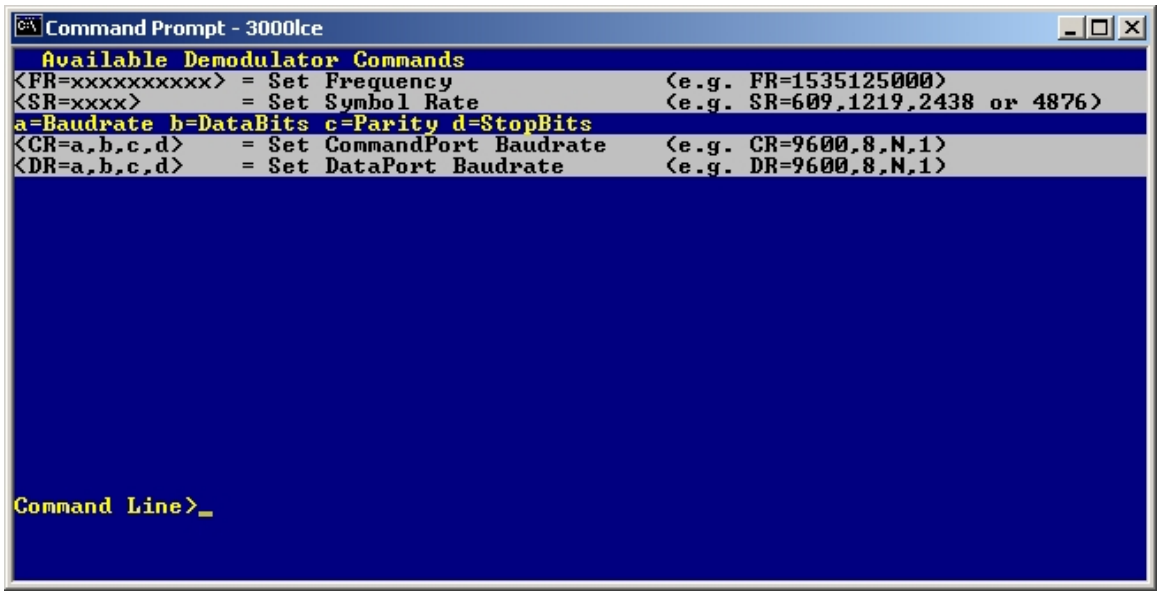
When the program has connected to the demodulator the following screen appears on the screen. There are two displays available:



There are 4 settings and a command line for manual input to change the same settings as previously mentioned:

- Auto-scan (Key ‘A’)
- Reacquisition Delay (Key ‘R’)
- Detector Mode (Key ‘D’)
- Uplink (Keys 1 – 9)

This is a list of available uplink satellites stored in the demodulator and are listed 1 to 19. If for some reason the desired up-link is not present, you can set the Frequency and symbol rate yourself using the Command-Line screen (Key ‘Space-Bar’).


Command Prompt - 3000Ice
Available Demodulator Commands
<FR=xxxxxxxxxx> = Set Frequency (e.g. FR=1535125000)
<SR=xxxx> = Set Symbol Rate (e.g. SR=609,1219,2438 or 4876)
a=Baudrate b=DataBits c=Parity d=StopBits
<CR=a,b,c,d> = Set CommandPort Baudrate (e.g. CR=9600,8,N,1)
<DR=a,b,c,d> = Set DataPort Baudrate (e.g. DR=9600,8,N,1)
Command Line>_

H Ionospheric and Tropospheric Corrector Settings

This information is additional to the settings in SPM software:

9.7 SPM Menu → RTCM Messages.

These settings in the SPM RTCM Menu have been introduced to ensure that you can use the SPM measured Ionospheric corrections in Client Software, such as Starfix.MRDGPS.

Two of the major sources of positional errors are the delays in the GPS signal due to the Ionosphere and Troposphere (layers in the Earth atmosphere). This is especially of influence if working around the Equator. The tropospheric delay we are able to predict accurately using a model. However, the ionospheric delay can vary considerably due to local (atmospheric) circumstances.

With an L1/L2 GPS receiver the ionospheric delay can be measured. A measured ionospheric delay is much more accurate than any model, e.g. the Klobuchar model, but requires a L1/L2 GPS receiver.

We can measure the delay due to ionosphere at a Starfix Reference Station, and also at your current position with the GPS Reciever in the HP Mobile. The ionospheric delay at the reference station is broadcast in the RTCM Type 15 message in the Starfix network. The RTCM message that you output from the SPM software can incorporate the measured ilonospheric delay at your current position.

The table below demonstrates that as long as the settings in SPM match the settings in the Client software, the end result is always that the Client software applies the Troposphere and Ionosphere corrections from Starfix. This is assuming that the Client Software will correct for Ionosphere and Troposphere using the Troposphere and Klobuchar (Ionosphere) model.

SPM software		SPM software		Client Software		Client Software		End Result
Iono is Off	+T15	Tropo is Off	+TROP	Iono is Off		Tropo is Off		+T15 +TROP
Iono is On	+T15-KLOB	Tropo is Off	+TROP	Iono is On	+KLOB	Tropo is Off		+T15 +TROP
Iono is Off	+T15	Tropo is On		Iono is Off		Tropo is On	+TROP	+T15 +TROP
Iono is On	+T15 -KLOB	Tropo is On		Iono is On	+KLOB	Tropo is On	+TROP	+T15 +TROP

T15 = differential ionospheric delay from GPS L1/L2 observable (RTCM Type 15)

KLOB = differential ionospheric delay using the Klobuchar model

TROP = differential tropospheric delay using the ICD-200 troposphere model

A differential delay is the difference between the delay at the reference station and the mobile, so it is a correction on a correction. The ionospheric delay at your current position is part of the Pseudo Range correction of RTCM Type 1. The measured ionospheric delay is output as a correction on top of that, hence the wording differential delay.

If the Client's software allows it, it is best to disable in the Client's software the Klobuchar corrections and to enable the tropospheric corrections (case 3). The reason for this is that it could be that the 8 Klobuchar parameters used by Starfix-Plus

and the Client's software may be different during change over of almanac data. Second best is to disable both the ionospheric and tropospheric corrections in the Client's DGPS software (case 1).

If the Client's software also uses single frequency reference stations then it is best to use case 4 (IONO=ON & TROPO=ON). However, in general it is not recommended to mix single frequency and dual frequency reference stations. If MRDGPS is used, it is recommended to use two instances of this program; one for single frequency corrections and one for dual frequency corrections. Case 2 has been added for completeness only.

I Fugro Broadcast Information

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