Operating Manual

Starfix HP

Starfix Plus

Version 3.07

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1 System Description

The SPM2000 with HPM 3.XX firmware provides single and dual frequency GPS positioning, using corrections generated by the global Fugro Starfix network of reference stations received from geostationary communication satellites.

The standard single frequency service is Starfix and the dual frequency services are Starfix-Plus and Starfix-HP (High Performance).

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

Starfix-HP is the latest 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.

2 Installation

A mobile system consists of:

- A Starfix-HP or Starfix-Plus mobile
- GPS Antenna + antenna cable

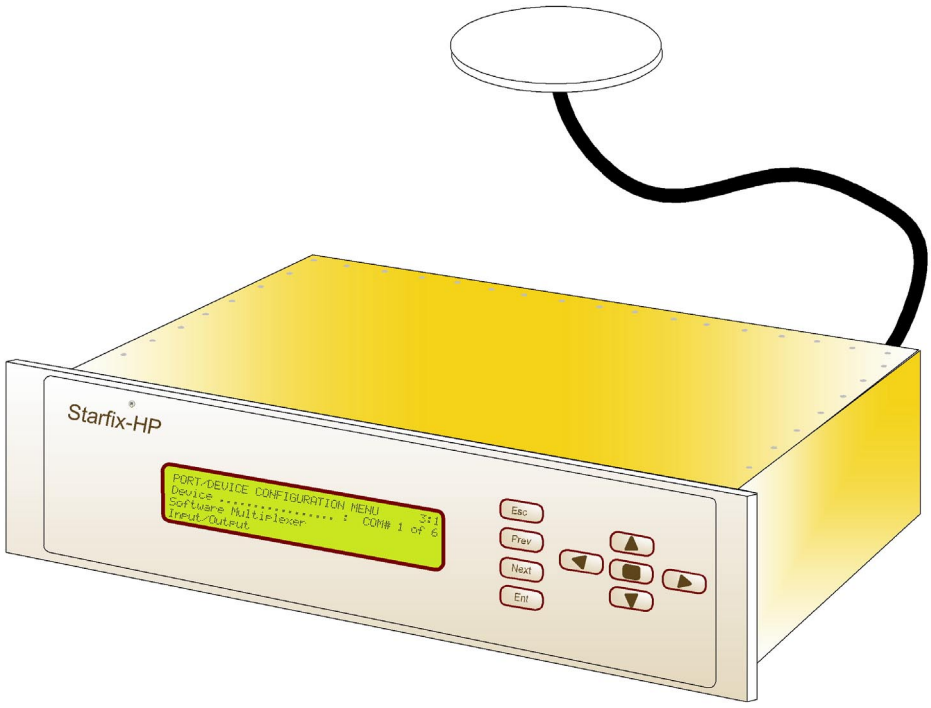


Figure 1: Front Panel of Starfix-HP mobile

The Starfix mobile is a 2-U high, 19-Inch casing that should preferably be installed in a 19-Inch rack with sufficient space on all sides to ensure proper cooling. The unit has a wide-input power range (85 – 240 VAC/50-440Hz). On the back-panel of the unit, 6 filtered 9 Pin sub-D connectors are available for I/O purposes, spare and Port B of the internal GPS receiver.

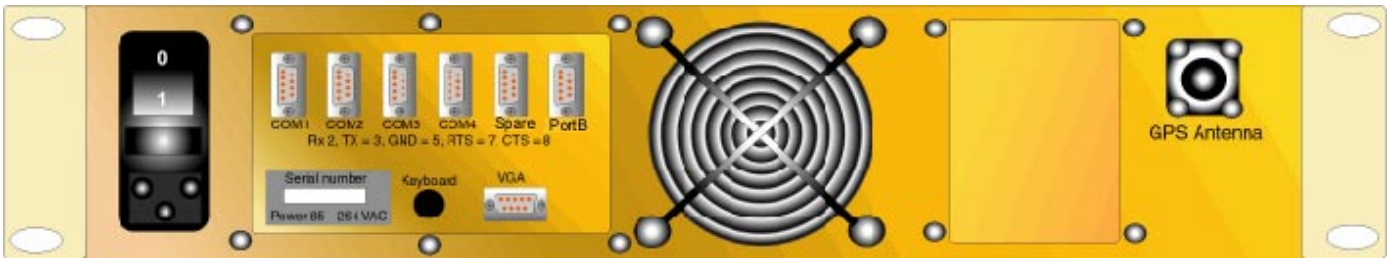


Figure 2: Back Panel Layout

2.1 Antenna location

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

- Do not install the GPS antenna nearby an INMARSAT installation.
- Avoid antenna installation too close to any other transmitting antennas.
- Make sure the antenna has a clear line of sight to all satellites at every possible vessel headings. If the antenna view is blocked by e.g. a mast in between the satellite and the antenna, it is possible that the signal will be lost.

2.2 Cable installation

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

- 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 maximum cable loss for the GPS antenna without inline amplification is specified to be 15dB (1500MHz). If a longer cable is needed as supplied, an in-line amplifier should be used.

2.3 Interfacing

The mobile has 4 Com Ports available for I/O, and has been factory set-up as follows:

COM#1 : Software Multiplexer.
COM#2 : Fugro Starfix differential corrections Input.
COM#3 : Fugro Starfix differential corrections Input.
COM#4 : Output of position data.

For additional information on Pin Layout, see **Appendix B**.

3 Starfix Mobile Start-up

3.1 Front panel description

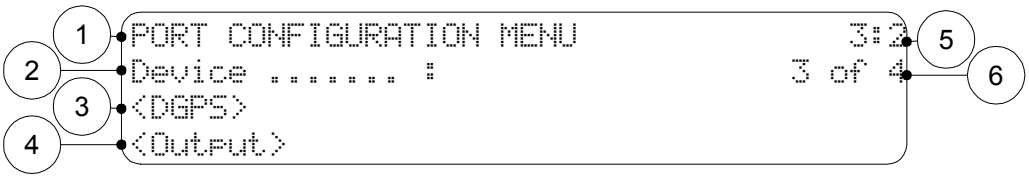


Figure 3: Front panel description

1	Description of current selected menu	
2	Selected menu item	
3	Selected item	
4	Item selector / Editor	
5	Menu level indicator (Level : Item)	
	Level 1	HPM Main Menu
	Level 2	Devices Menu
	Level 3	Port Configuration Menu
	Item 1	Com Port selector (can only be selected from a keyboard)
	Item 2	Device selector
6	Current index number: Com Port # of 4	

Esc	Escape menu
	Back to previous menu
	Cancel entry or selection
Prev	Previous Index number
Next	Next Index number
Ent	Enter 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

3.2 Initialisation

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

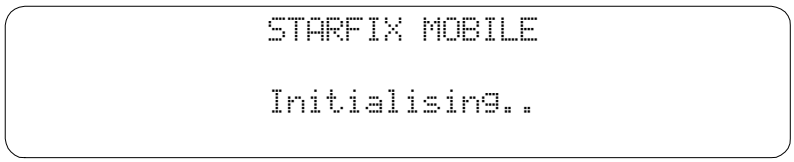


Figure 4: Initialising Display

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

3.3 Loader

After loading the operating system, the Loader program will be activated showing the following message:

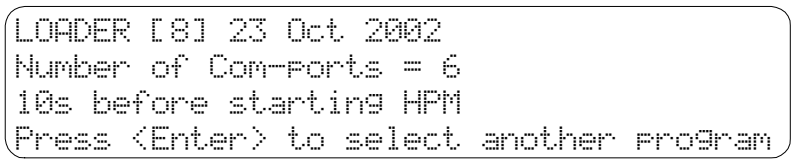


Figure 5: Loader Display

The user can interrupt the Loader program by pressing either the [Ent] Key on the keypad or [Enter] on the external connected keyboard. If the user does not interrupt the Loader within 10 seconds, the **'Starfix-HPM'** program will be started.

3.4 Starting Starfix-HPM for the first time

Upon start-up, the program will show the **Starfix-HPM** information display on the LCD. At this point the Starfix-Mobile starts acquiring satellites. The LCD display shows the Starfix-HP position solution. The Starfix-HP position is computed using Starfix-HP differential corrections and the L1/L2 GPS observables. For the output of the Starfix-HP position, various formats can be selected. Currently there are 10 status display types available. On how to navigate through these Displays; See Figure 7: LCD Status Display Overview.

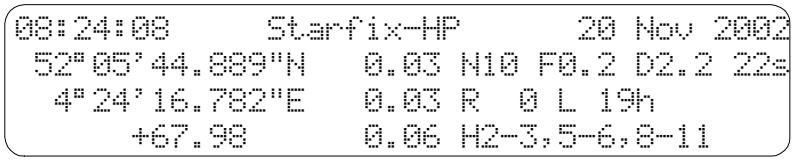


Figure 6: Initial display / Starfix HP information display

Upon start-up, Starfix HPM will start to calculate 2 positions; the VBS position and the HP position. Before the unit starts to work the following could be checked:

- Check the IO config (Baudrate and port combination for each COM-Port) in menu Devices\Port configuration (see menu Devices \ Port Configuration)
- Check diff corrections are being received (see 4.5 COM-Port Information display)
- Check the approximate position and height in positioning menu (see 6.4 Positioning) . The accuracy of the position entered should be 1 degree or better. The accuracy for the height should be as close as possible (within 1m).
- Configure the stations to be used (see 6.3 Stations) and check that corrections are received (see 5.4 Corrections Display [F4]).
- If an accurate height is not known, set-up the VBS position calculation in 3D mode and observe calculated height. When the height is stable for 1 minute, enter this height in the Positioning menu (see 6.4 Positioning). Now the 3D+H mode may be selected.
- Set the position parameters for the VBS and HP position calculation (see 6.4 Positioning) and check the output to the client software.
- Check the position quality parameters (see 4.1 Starfix-HP Position Display and 4.2 Starfix-VBS Position Display) for both calculations.

4 LCD Data Displays

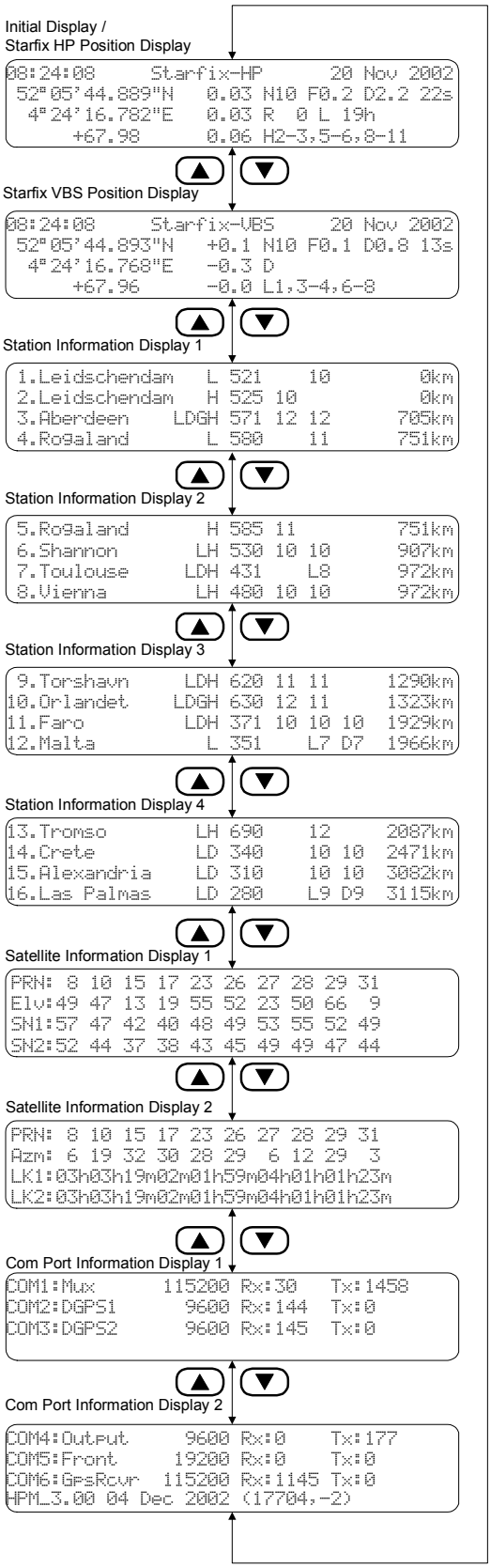


Figure 7: LCD Status Display Overview

4.1 Starfix-HP position Display

This display gives information about the current Starfix-HP position such as:

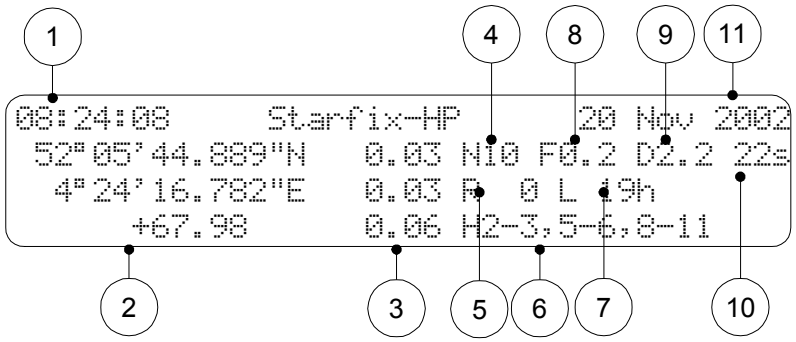


Figure 8: Initial Display / Starfix-HP position display information

1	Current GPS time. If no satellites are tracked, local PC time time shown.
2	Antenna Position and Height in WGS84 geographical coordinates.
3	Standard deviations for Latitude, Longitude and Height in metres.
4	Number of satellites used in Starfix-HP position calculation.
5	Number of resets of the Starfix-HPM program since startup.
6	Sequence of station ID numbers (from the reference station list) currently used for the position calculation. (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.
7	Lock-time in seconds (s), minutes (m) or hours (h), since last position calculation reset. If a 'C' is show, then the HP position calculation is converging.
8	F-test for the Starfix-HP position calculation.
9	HDOP
10	Age of the received Starfix-HP corrections in seconds.
11	Current Date.

4.2 Starfix VBS position display

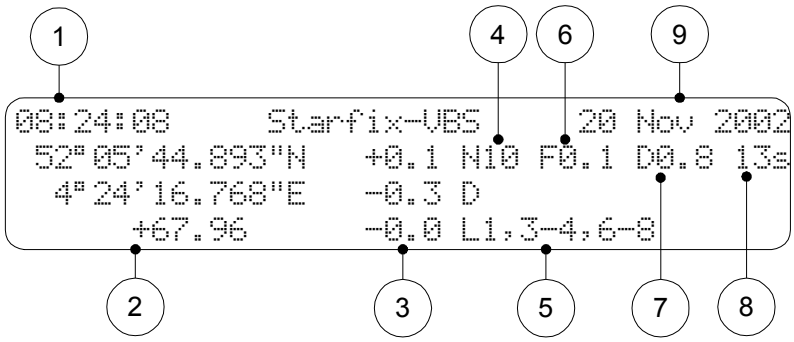


Figure 9: Starfix VBS position display information

1	Current GPS time. If no satellites are tracked, local PC time time shown.
2	Antenna Position and Height in WGS84 geographical coordinates.
3	Position difference between the VBS and the Starfix-HP position in meters (VBS-HP).
4	Number of satellites used in the VBS position calculation.
5	Sequence of station index numbers (from the reference station list) used for the VBS position calculation. (6-8=sequence of stations with index 6 through to 8).
6	F-test for the VBS position calculation.
7	HDOP
8	Age of the received VBS corrections in seconds.
9	Current Date.

4.3 Station information displays

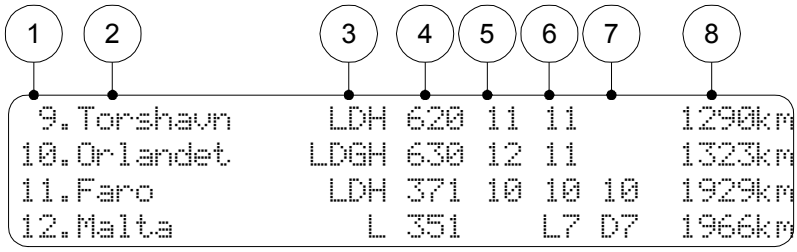


Figure 10: Station information display

Four Station information displays can show a maximum of 16 (user selectable) reference stations. The station information display shows the following information:

1	Station Index Number the of selected reference station (See chapter 6.3 Stations menu)	
2	Reference Station Name	
3	Type of broadcast supported by Reference Station:	
	L	L1 Corrections
	D	Dual Frequency Corrections (IONO Corrections)
	G	Glonass Corrections (not used by this software)
	H	HP Corrections
4	Station ID	
5*	Number of HP corrections	
6*	Number of L1 corrections	
7*	Number of dual frequency corrections	
8	Calculated distance to the selected reference station	

* If the number of corrections exceeds 9, the prefix is omitted.

4.4 Satellite information displays

These displays show the number of satellites being tracked by the Starfix mobile.

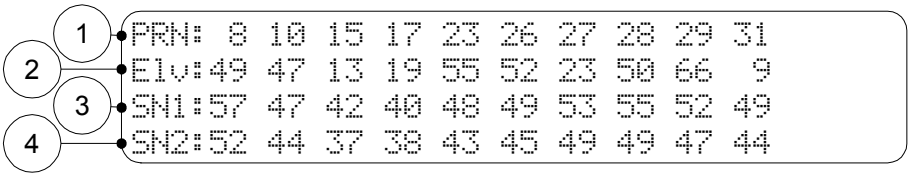


Figure 11: Satellite information, display 1

1	Satellite identification number.
2	Elevation in degrees for each satellite.
3	Signal to Noise ratio for the L1 frequency of each satellite.
4	Signal to Noise ratio for the L2 frequency of each satellite.

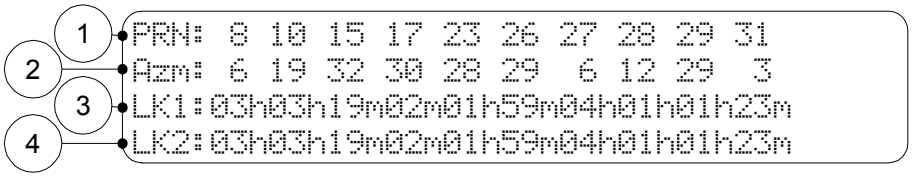


Figure 12: Satellite information, display 2

1	Satellite identification number.
2	Azimuth in degrees (Azimuth /10) to each satellite.
3	Satellite lock-time for frequency L1 in seconds (s), minutes (m) or hours (h).
4	Satellite lock-time for frequency L2 in seconds (s), minutes (m) or hours (h).

4.5 Com Port information displays

The driver type, Baudrate and activity for the 6 COM ports are shown in the Com Port information displays.

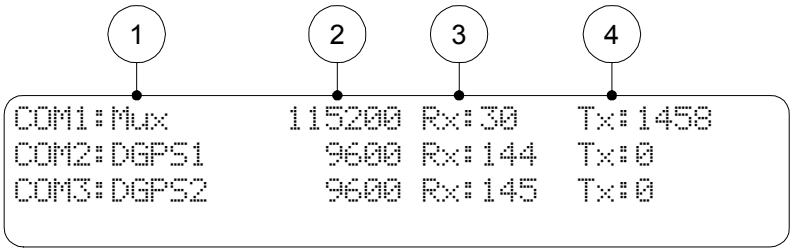


Figure 13: Com Port information, display 1

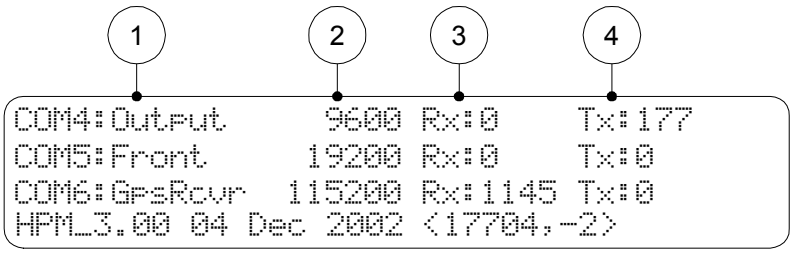


Figure 14: Com Port information, display 2

1	Driver Type for selected COM port. See 6.2.1: Port Configuration for additional information	
	Mux	Software Multiplexer
	DGPS	Starfix differential corrections input
	Output	Output (position, RTCM)
	Front	LCD Front-panel (internally connected to COM Port 5)
	GpsRcvr	GPS (internally connected to COM-Port 6)
2	Baudrate selected	
3	Activity in Characters per second for received data on COM port	
4	Activity in Characters per second for transmitted data on COM port	

5 CRT data displays

5.1 System Display [F1]

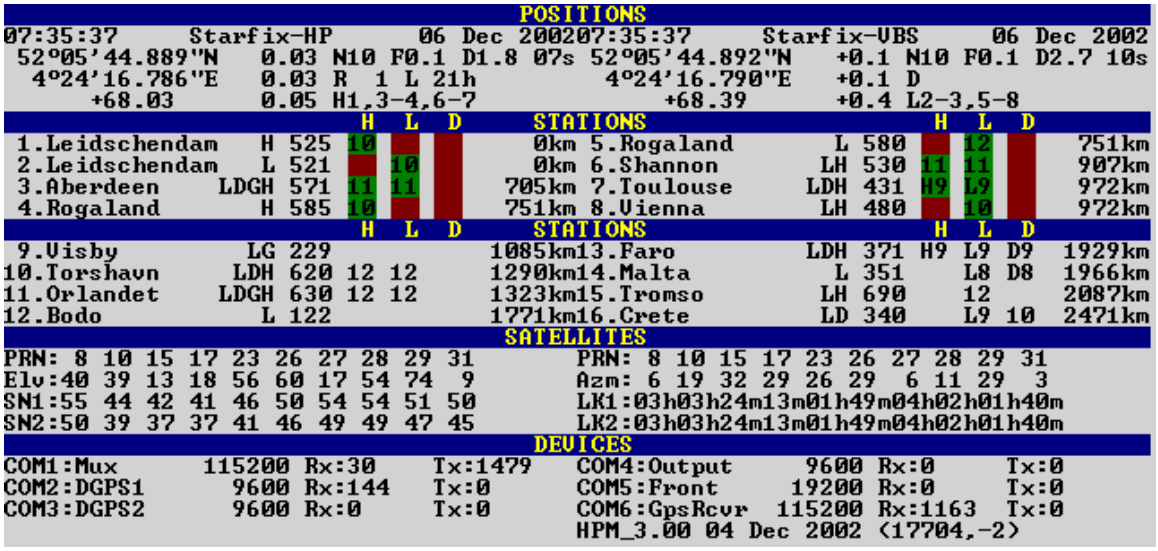


Figure 15: System Display [F1]

This display shows an overview of the current performance of the Starfix mobile. The display is divided into 5 panels:

1	POSITIONS	Information of the HP and VBS position calculation
2	STATIONS	Reference station information
3	STATIONS	Reference station information
4	SATELLITES	Satellite information
5	DEVICES	Com-Port information

For additional information on the system display items see Chapter 4: LCD Data Displays.

5.2 GPS Receiver Display [F2]

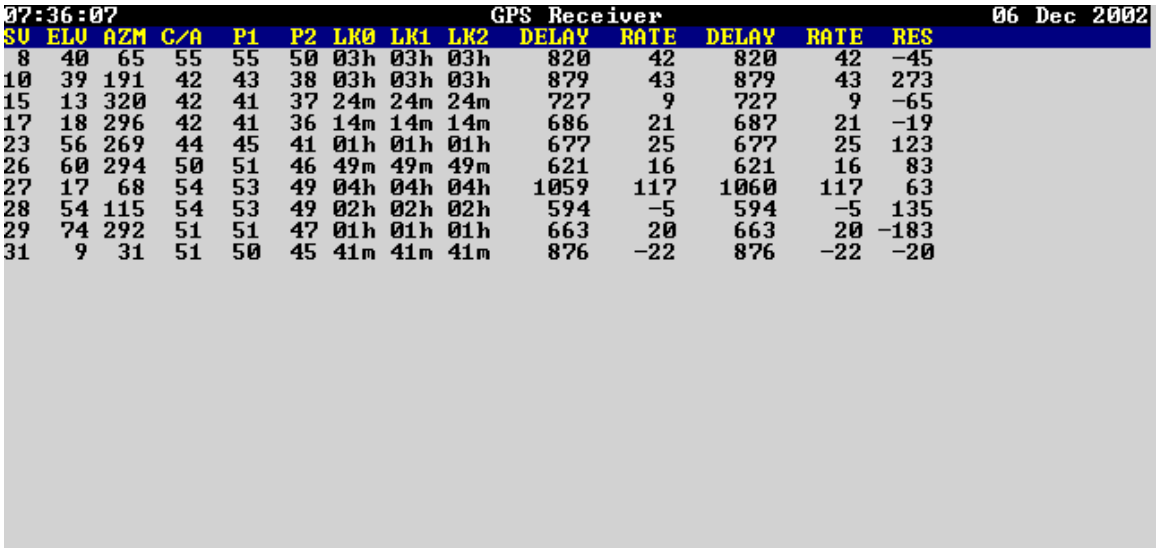
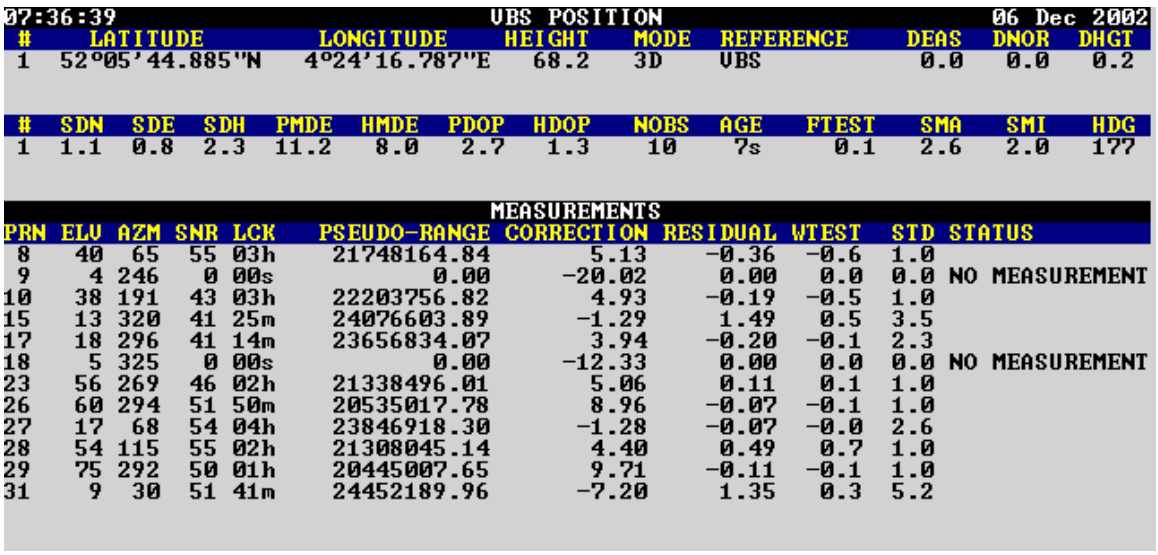


Figure 16: GPS Receiver Display [F2]

Only the status of the visible GPS satellites are shown.

SV	Satellite ID number
ELV	Elevation in degrees
AZM	Azimuth in degrees
C/A	Signal to Noise Ratio (SNR) for the L1 C/A signal in dB/Hz
P1	Signal to Noise Ratio (SNR) for the P1 C/A signal in dB/Hz
P2	Signal to Noise Ratio (SNR) for the P2 C/A signal in dB/Hz
LK0	Lock Time C/A signal in seconds (s), minutes (m) or hours (h)
LK1	Lock Time P1 signal in seconds (s), minutes (m) or hours (h)
LK2	Lock Time P2 signal in seconds (s), minutes (m) or hours (h)
DELAY	Ionospheric delay in cm at fixed minute intervals (estimate from P1 & P2 data)
RATE	Ionospheric rate in mm/minute
DELAY	Ionospheric delay in cm at seconds interval (estimate from P1 & P2 data)
RATE	Ionospheric rate in mm/minute
RES	Difference between raw and smoothed ionospheric delay in cm.

5.3 VBS Positioning Display [F3]



07:36:39 VBS POSITION 06 Dec 2002

#	LATITUDE	LONGITUDE	HEIGHT	MODE	REFERENCE	DEAS	DNOR	DHGT
1	52°05'44.885"N	4°24'16.787"E	68.2	3D	VBS	0.0	0.0	0.2

#	SDN	SDE	SDH	PMDE	HMDE	PDOP	HDOP	NOBS	AGE	FTEST	SMA	SMI	HDG
1	1.1	0.8	2.3	11.2	8.0	2.7	1.3	10	7s	0.1	2.6	2.0	177

MEASUREMENTS

PRN	ELV	AZM	SNR	LCK	PSEUDO-RANGE	CORRECTION	RESIDUAL	WTEST	STD	STATUS
8	40	65	55	03h	21748164.84	5.13	-0.36	-0.6	1.0	
9	4	246	0	00s	0.00	-20.02	0.00	0.0	0.0	NO MEASUREMENT
10	38	191	43	03h	22203756.82	4.93	-0.19	-0.5	1.0	
15	13	320	41	25m	24076603.89	-1.29	1.49	0.5	3.5	
17	18	296	41	14m	23656834.07	3.94	-0.20	-0.1	2.3	
18	5	325	0	00s	0.00	-12.33	0.00	0.0	0.0	NO MEASUREMENT
23	56	269	46	02h	21338496.01	5.06	0.11	0.1	1.0	
26	60	294	51	50m	20535017.78	8.96	-0.07	-0.1	1.0	
27	17	68	54	04h	23846918.30	-1.28	-0.07	-0.0	2.6	
28	54	115	55	02h	21308045.14	4.40	0.49	0.7	1.0	
29	75	292	50	01h	20445007.65	9.71	-0.11	-0.1	1.0	
31	9	30	51	41m	24452189.96	-7.20	1.35	0.3	5.2	

Figure 17: VBS Positioning Display [F3]

The display is divided into 3 panels. In the top and centre panel, the position and position QC data are shown for the calculated VBS position using a 3D or 3D+H solution.

LATITUDE	Calculated Latitude in degrees, minutes and decimal seconds (WGS84)
LONGITUDE	Calculated Longitude in degrees, minutes and decimal seconds (WGS84)
HEIGHT	Calculated Height in metres (WGS84)
MODE	Positioning mode. This can be either 3D or 3D+H. When height aiding is used for the VBS position calculation, the entered height should be: **Height above Sea Level + Geoid Height**
REFERENCE	VBS or NO VBS. Note: When NO VBS is shown in the “Reference”, no differential corrections are available. The position calculation will revert back to a stand alone 3D or 3D+H GPS calculation
DEAS	Delta Easting in metres (VBS minus HP)
DNOR	Delta Northing in metres (VBS minus HP)
DHGT	Delta Height in metres (VBS minus HP)
SDN	Standard Deviation Northing in metres
SDE	Standard Deviation Easting in metres
SDH	Standard Deviation Height in metres
PMDE	Position Marginal Detectable Error in metres
HMDE	Horizontal Marginal Detectable Error in metres
PDOP	Position Dilution Of Position
HDOP	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	Semi Major Axis in metres
SMI	Semi Minor Axis in metres
HDG	Heading in degrees

See **Chapter 6.4 Positioning** for more information on position calculation settings.

In the third panel, the GPS pseudo ranges, corrections and measurement QC results are shown. The measurement QC results shown are those of the current reference mode (3D or 3D+H) selected in the **Positioning Menu**. If a satellite is not used for the position calculation, a message with the cause of the rejection is shown in the STATUS column.

5.4 Corrections Display [F4]

The differential corrections received for the selected stations are shown in this display.

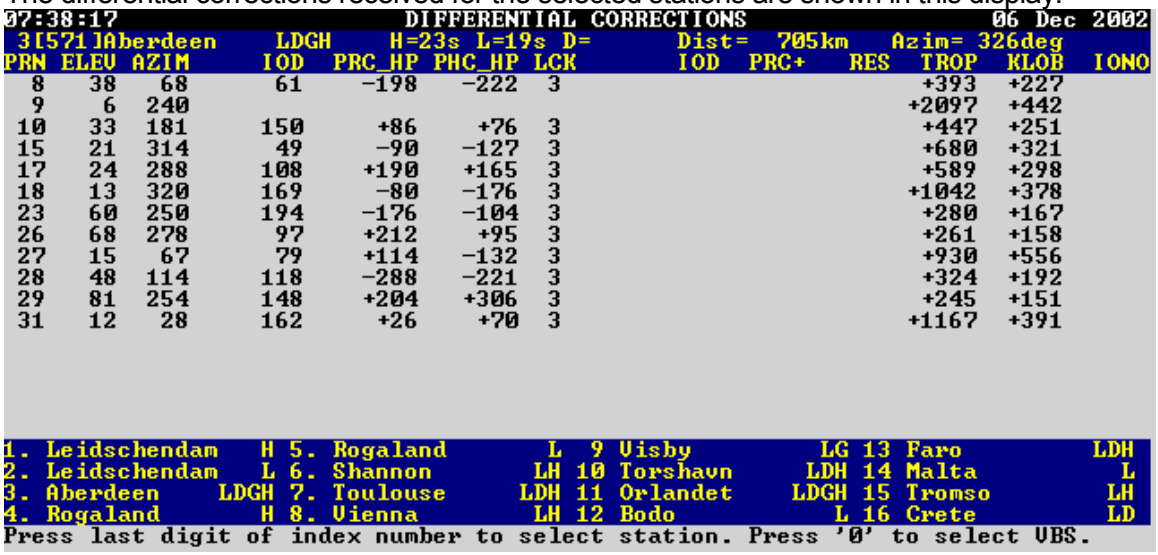


Figure 18: Differential Corrections Display [F4]

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 standard L1 C/A (type 1) corrections			
D=	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 where:			
	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)			

5.5 I/O Display [F5]

The I/O display can be used to monitor all incoming and outgoing data streams from and to Com Ports and from and to multiplexer channels.

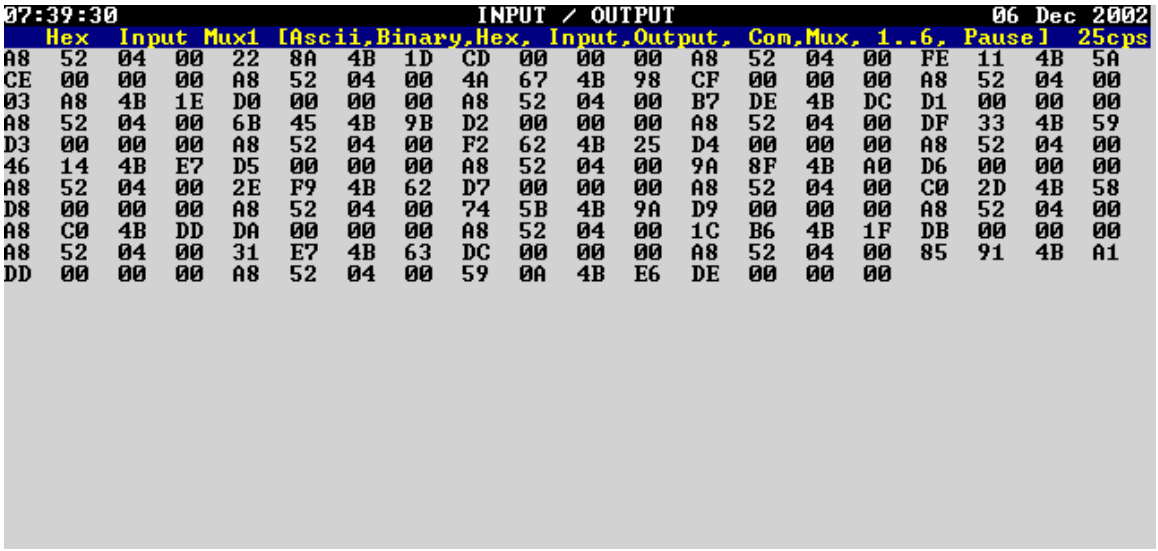


Figure 19: Input / Output Display [F5]

The following short cuts 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 datastream.
M	Select Multiplexer channel as datastream.
1..6	Select Com port or Multiplexer Channel number.
P	Pause the data flow, Press P again to continue the data flow.

5.6 Messages Displays [F6]

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

```
07:40:13                    SYSTEM              page 1              06 Dec 2002
12:38:23 - Coreleft1=20288
12:38:29 - Saved SCFMAP1,31,335,305,235,95,45,15,11,43,50,620,155,571,16,290,31
           0,340,280,630,580,144,530,371,400,351,431,337,462,690,60,521,480
12:39:08 - Saved HPSMAP1,0,13,16,290,371,525,571,630,585,530,620,45,43,11,431
12:39:11 - Source HP corrections DGPS1
12:53:31 - PC-Clock correction:  clock,-0.0
12:55:02 - HPM.MSG in D:
12:55:02 - 04 Dec 2002
12:55:02 - Release: HPM_3.00 04 Dec 2002
12:55:02 - Weekno=1195
12:55:02 - GPS receiver driver is Ashtech.
12:55:02 - Loaded SCFMAP1,31,335,305,235,95,45,15,11,43,50,620,155,571,16,290,3
           10,340,280,630,580,144,530,371,400,351,431,337,462,690,60,521,480
12:55:02 - Loaded HPSMAP1,0,13,16,290,371,525,571,630,585,530,620,45,43,11,431
12:55:02 - Number of SCF/CBMF drivers is 2 of 2
12:55:02 - Number of COM-ports is 6
12:55:02 - almanacLoad: 1-11,13-15,17-18,20-31
12:55:02 - Number of stations in hpm.stn is 132
12:55:02 - HP Engine 081502Ao
12:55:02 - Number of stations HP engine is 16
12:55:02 - Coreleft1=20288
12:55:05 - Source HP corrections DGPS1
00:00:00 - 05 Dec 2002
06:58:05 - 06 Dec 2002
```

Figure 20: CRT System message display [F6]

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

```
07:40:33                    EVENTS              page 2              06 Dec 2002
04:56:28 - almanacPutAlm: prn 21 health 255
04:56:28 - almanacPutAlm: prn 22 health 255
05:11:29 - almanacPutAlm: prn 21 health 255
05:11:29 - almanacPutAlm: prn 22 health 255
05:26:29 - almanacPutAlm: prn 21 health 255
05:26:29 - almanacPutAlm: prn 22 health 255
05:30:03 - PC Clock Offset (gps) = -2.61 sec
05:41:29 - almanacPutAlm: prn 21 health 255
05:41:29 - almanacPutAlm: prn 22 health 255
05:56:29 - almanacPutAlm: prn 21 health 255
05:56:29 - almanacPutAlm: prn 22 health 255
06:11:29 - almanacPutAlm: prn 21 health 255
06:11:29 - almanacPutAlm: prn 22 health 255
06:26:30 - almanacPutAlm: prn 21 health 255
06:26:30 - almanacPutAlm: prn 22 health 255
06:41:30 - almanacPutAlm: prn 21 health 255
06:41:30 - almanacPutAlm: prn 22 health 255
06:56:30 - almanacPutAlm: prn 21 health 255
06:56:30 - almanacPutAlm: prn 22 health 255
06:58:05 - 06 Dec 2002
07:11:30 - almanacPutAlm: prn 21 health 255
07:11:30 - almanacPutAlm: prn 22 health 255
07:26:30 - almanacPutAlm: prn 21 health 255
07:26:30 - almanacPutAlm: prn 22 health 255
```

Figure 21: CRT Events message display [F6]

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).

```
07:41:03                    DGPS Receiver     page 3                  06 Dec 2002
07:40:58 - SCFDCS1:431:12=335,305,235,95,45,15,11,43,50,620,144,337,
07:40:58 - SCFPKT1=5,81
07:41:02 - HPSDCS1:522:13=16,290,371,525,571,630,585,530,620,45,43,11,431, [5]
07:41:02 - SCFPKT1=2,31

07:40:28 - SCFPKT1=5,66
07:40:29 - SCFDCS1:264:04=690,60,521,480,
07:40:32 - SCFDCS1:367:11=335,305,235,95,45,15,11,43,50,144,337,
07:40:36 - HPSDCS1:528:13=16,290,371,525,571,630,585,530,620,45,43,11,431, [5]
07:40:36 - SCFPKT1=5,86
07:40:40 - SCFDCS1:500:14=155,571,16,290,310,340,280,630,580,530,371,400,351,43
           1,
07:40:41 - SCFDCS1:264:04=690,60,521,480,
07:40:42 - SCFPKT1=5,81
07:40:45 - SCFDCS1:370:11=335,305,235,95,45,15,11,43,50,144,337,
07:40:48 - HPSDCS1:528:13=16,290,371,525,571,630,585,530,620,45,43,11,431, [5]
07:40:52 - SCFDCS1:500:14=155,571,16,290,310,340,280,630,580,530,371,400,351,43
           1,
07:40:52 - SCFPKT1=5,86
07:40:52 - SCFTIM1=1
07:40:53 - SCFMAP1=335,305,235,95,45,15,11,43,50,620,155,571,16,290,310,340,280
           ,630,580,144,530,371,400,351,431,337,462,690,60,521,480,
07:40:53 - SCFSAT1=EASAT
07:40:55 - SCFDCS1:264:04=690,60,521,480,
```

Figure 22: CRT DGPS Receiver message display [F6]

Incoming starfix HP differential corrections can be viewed and provides information on the received station ID's (SCFDCS = standard differential corrections, HPSDCS = Starfix-HP corrections), which broadcast service the corrections originate from (SCFSAT), which reference stations are available on the service (SCFMAP).

```
07:41:20                     GPS Receiver     page 4                  06 Dec 2002
07:15:44 - Ephemeris SNV [0] PRN=10 IODE=150 IODC=150 HEALTH=0
07:15:44 - Ephemeris SNV [0] PRN=23 IODE=194 IODC=194 HEALTH=0
07:15:44 - Ephemeris SNV [0] PRN=26 IODE= 97 IODC= 97 HEALTH=0
07:15:44 - Ephemeris SNV [0] PRN=27 IODE= 79 IODC= 79 HEALTH=0
07:15:44 - Ephemeris SNV [0] PRN=28 IODE=118 IODC=118 HEALTH=0
07:15:44 - ashdataPut:SNV format error
07:15:44 - ashtechExec:Error 392
07:18:32 - Ephemeris SNV [0] PRN=17 IODE=108 IODC=108 HEALTH=0
07:20:31 - Ephemeris SNV [0] PRN=15 IODE= 49 IODC= 49 HEALTH=0
07:26:30 - ashdataPut:ALM format error
07:26:30 - ashtechExec:Error 393
07:26:30 - ashdataPut:ALM format error
07:26:30 - ashtechExec:Error 394
07:27:32 - Ephemeris SNV [0] PRN=31 IODE=162 IODC=162 HEALTH=0
07:30:44 - Ephemeris SNV [0] PRN= 8 IODE= 61 IODC= 61 HEALTH=0
07:30:44 - Ephemeris SNV [0] PRN=10 IODE=150 IODC=150 HEALTH=0
07:30:44 - Ephemeris SNV [0] PRN=23 IODE=194 IODC=194 HEALTH=0
07:30:44 - Ephemeris SNV [0] PRN=26 IODE= 97 IODC= 97 HEALTH=0
07:30:44 - Ephemeris SNV [0] PRN=27 IODE= 79 IODC= 79 HEALTH=0
07:30:44 - Ephemeris SNV [0] PRN=28 IODE=118 IODC=118 HEALTH=0
07:30:44 - ashdataPut:SNV format error
07:30:44 - ashtechExec:Error 395
07:33:32 - Ephemeris SNV [0] PRN=17 IODE=108 IODC=108 HEALTH=0
07:35:32 - Ephemeris SNV [0] PRN=15 IODE= 49 IODC= 49 HEALTH=0
```

Figure 23: CRT GPS Receiver message display [F6]

The GPS receiver message display shows the information flow between the Starfix-HP program and the internal GPS receiver. Any command issued to and the reply from the GPS card can be viewed here.

```
07:41:43                    VBS Positions      page 5                  06 Dec 2002
07:41:42 - vbsposMeas: lock=0
$GPGGA,074129.00,5205.74827,N,00424.27971,E,2,9,1.5,68.65,M,0.00,M,12,0999*58
$GPGGA,074130.00,5205.74826,N,00424.27970,E,2,9,1.5,68.64,M,0.00,M,13,0999*50

$GPGGA,074113.00,5205.74829,N,00424.27981,E,2,9,1.4,68.47,M,0.00,M,10,0999*53
$GPGGA,074114.00,5205.74829,N,00424.27981,E,2,9,1.5,68.47,M,0.00,M,11,0999*54
$GPGGA,074115.00,5205.74829,N,00424.27981,E,2,9,1.5,68.46,M,0.00,M,12,0999*57
$GPGGA,074116.00,5205.74830,N,00424.27980,E,2,9,1.5,68.48,M,0.00,M,13,0999*52
$GPGGA,074117.00,5205.74829,N,00424.27979,E,2,9,1.5,68.47,M,0.00,M,14,0999*55
$GPGGA,074118.00,5205.74829,N,00424.27978,E,2,9,1.5,68.47,M,0.00,M,15,0999*5A
$GPGGA,074119.00,5205.74829,N,00424.27977,E,2,9,1.5,68.48,M,0.00,M,16,0999*58
$GPGGA,074120.00,5205.74829,N,00424.27976,E,2,9,1.5,68.47,M,0.00,M,17,0999*5D
07:41:34 - vbsposMeas: lock=0
$GPGGA,074121.00,5205.74825,N,00424.27976,E,2,9,1.5,68.52,M,0.00,M,9,0999*6B
07:41:35 - vbsposMeas: lock=1
$GPGGA,074122.00,5205.74826,N,00424.27975,E,2,9,1.5,68.54,M,0.00,M,10,0999*56
07:41:36 - vbsposMeas: lock=2
$GPGGA,074123.00,5205.74826,N,00424.27975,E,2,9,1.5,68.55,M,0.00,M,11,0999*57
$GPGGA,074124.00,5205.74827,N,00424.27974,E,2,9,1.5,68.59,M,0.00,M,7,0999*6B
$GPGGA,074125.00,5205.74827,N,00424.27973,E,2,9,1.5,68.58,M,0.00,M,8,0999*63
$GPGGA,074126.00,5205.74827,N,00424.27973,E,2,9,1.5,68.62,M,0.00,M,9,0999*68
07:41:40 - vbsposMeas: lock=0
$GPGGA,074127.00,5205.74827,N,00424.27972,E,2,9,1.5,68.62,M,0.00,M,10,0999*50
$GPGGA,074128.00,5205.74827,N,00424.27972,E,2,9,1.5,68.64,M,0.00,M,11,0999*58
```

Figure 24: CRT VBS position message display [F6]

```
07:42:07                     HP Positions      page 6                  06 Dec 2002
$GPGGA,074145.00,5205.74815,N,00424.27975,E,5,9,1.1,68.02,M,0.00,M,10,0001*5F
$GPGGA,074146.00,5205.74815,N,00424.27975,E,5,9,1.1,68.03,M,0.00,M,11,0001*5C
$GPGGA,074147.00,5205.74815,N,00424.27975,E,5,9,1.1,68.03,M,0.00,M,12,0001*5E
$GPGGA,074148.00,5205.74815,N,00424.27977,E,5,8,1.1,68.07,M,0.00,M,13,0001*57
$GPGGA,074149.00,5205.74815,N,00424.27977,E,5,8,1.1,68.07,M,0.00,M,14,0001*51
$GPGGA,074150.00,5205.74815,N,00424.27977,E,5,8,1.1,68.08,M,0.00,M,15,0001*57
$GPGGA,074151.00,5205.74815,N,00424.27977,E,5,8,1.1,68.07,M,0.00,M,16,0001*5A
$GPGGA,074152.00,5205.74815,N,00424.27976,E,5,8,1.1,68.08,M,0.00,M,17,0001*56
$GPGGA,074153.00,5205.74815,N,00424.27976,E,5,8,1.1,68.08,M,0.00,M,18,0001*58
$GPGGA,074154.00,5205.74815,N,00424.27977,E,5,8,1.1,68.10,M,0.00,M,19,0001*56

$GPGGA,074132.00,5205.74814,N,00424.27975,E,5,9,1.1,67.99,M,0.00,M,9,0001*6B
$GPGGA,074133.00,5205.74815,N,00424.27975,E,5,9,1.1,67.99,M,0.00,M,10,0001*53
$GPGGA,074134.00,5205.74815,N,00424.27975,E,5,9,1.1,67.99,M,0.00,M,11,0001*55
$GPGGA,074135.00,5205.74814,N,00424.27975,E,5,9,1.1,67.99,M,0.00,M,12,0001*56
$GPGGA,074136.00,5205.74815,N,00424.27975,E,5,9,1.1,67.99,M,0.00,M,13,0001*55
$GPGGA,074137.00,5205.74815,N,00424.27975,E,5,9,1.1,68.00,M,0.00,M,14,0001*5C
$GPGGA,074138.00,5205.74815,N,00424.27975,E,5,9,1.1,68.00,M,0.00,M,15,0001*52
$GPGGA,074139.00,5205.74815,N,00424.27975,E,5,9,1.1,68.01,M,0.00,M,16,0001*51
$GPGGA,074140.00,5205.74815,N,00424.27974,E,5,9,1.1,68.00,M,0.00,M,17,0001*5E
$GPGGA,074141.00,5205.74815,N,00424.27974,E,5,9,1.1,68.01,M,0.00,M,18,0001*51
$GPGGA,074142.00,5205.74816,N,00424.27974,E,5,9,1.1,68.01,M,0.00,M,19,0001*50
$GPGGA,074143.00,5205.74815,N,00424.27974,E,5,9,1.1,68.02,M,0.00,M,20,0001*5B
$GPGGA,074144.00,5205.74815,N,00424.27975,E,5,9,1.1,68.01,M,0.00,M,9,0001*65
```

Figure 25: CRT HP position message display [F6]

```
07:42:26                    SCF Corrections   page 7                  06 Dec 2002
24,+0.000,24,230, -1.12,+0.000,28,118, -0.40,+0.000,29,148, -6.40,+0.000
$SCF, 15,07:42:14, 8, 4,201,-21.52,+0.000, 7, 57,-13.92,+0.000, 8, 61,-28.32,+0
.000,10,150,-18.08,+0.000,13,180,-17.36,+0.000,24,230,-30.72,+0.000,27, 79,-32.
48,+0.000,28,118,-18.80,+0.000
$SCF, 11,07:42:15,11, 4,201, +0.96,+0.000, 5,141, -6.40,+0.000, 7, 57, +3.68,+0
.000, 9, 52, -6.32,+0.000,10,150, +9.04,+0.000,13,180,-22.08,+0.000,23,194, -2.
00,+0.000,24,230, +0.96,+0.000,26, 97, -4.72,+0.000,28,118, +2.32,+0.000,29,148
, +2.88,+0.000
$SCF, 43,07:42:16,12, 4,201, -1.60,+0.000, 5,141,-12.08,+0.000, 7, 57, +4.64,+0
.000, 8, 61,-16.00,+0.000, 9, 52, -9.28,+0.000,10,150, +9.28,+0.000,13,180,-17.
52,+0.000,23,194, -1.44,+0.000,24,230, -0.56,+0.000,26, 97, -2.00,+0.000,28,118
, +4.24,+0.000,29,148, +4.48,+0.000
$SCF, 50,07:42:16,10, 4,201, -8.56,+0.000, 5,141, -5.84,+0.000, 7, 57, -4.32,+0
.000, 9, 52, -0.16,+0.000,10,150, +6.80,+0.000,23,194, +0.32,+0.000,24,230, -1.
04,+0.000,26, 97, +1.20,+0.000,28,118, -0.88,+0.000,29,148, +4.08,+0.000
$SCF,620,07:42:16,12, 3,136,-16.80,+0.000, 8, 61, -0.88,+0.000,10,150, -1.84,+0
.000,15, 49, -3.36,+0.000,17,108, +0.40,+0.000,18,169, -3.36,+0.000,23,194, -0.
56,+0.000,26, 97, +3.76,+0.000,27, 79, -7.52,+0.000,28,118, -0.80,+0.000,29,148
, +3.68,+0.000,31,162, -4.88,+0.000
$SCF,144,07:42:16, 9, 5,141, -9.60,+0.000, 9, 52, +0.80,+0.000,10,150, +2.64,+0
.000,17,108, -2.56,+0.000,23,194, -0.56,+0.000,24,230, -7.76,+0.000,26, 97, +2.
88,+0.000,28,118, -4.08,+0.000,29,148, +3.20,+0.000
$SCF,337,07:42:16, 6, 4,201, -7.84,+0.000, 5,141,-19.04,+0.000, 7, 57,-10.16,+0
.000,10,150,-17.60,+0.000,13,180,-14.88,+0.000,24,230,-12.88,+0.000
```

Figure 26: CRT SCF Correction message display [F6]

```
07:42:43                    HP Corrections    page 8                  06 Dec 2002
 -2.82, -1.59,3,29,148, +2.32, +0.83,3,31,162, -0.62, -2.91,3
$HPSCF,571,07:42:32,11, 8, 61, -1.94, -2.08,3,10,150, +0.96, +0.78,3,15, 49, -1
.24, -1.53,3,17,108, +1.94, +1.75,3,18,169, -0.78, -1.75,3,23,194, -1.90, -1.20
,3,26, 97, +2.14, +0.96,3,27, 79, +1.30, -1.20,3,28,118, -2.86, -2.13,3,29,148,
 +1.82, +2.93,3,31,162, +0.54, +0.84,3
$HPSCF,630,07:42:32,12, 3,136, +1.38, -8.91,2, 8, 61, -2.24, -4.63,3,10,150, +0
.48, -3.81,3,15, 49, -1.22, +7.11,3,17,108, +2.12, +6.72,3,18,169, -1.12, -6.05
,3,23,194, -1.64, -7.90,3,26, 97, +2.10, -1.44,3,27, 79, +0.84, -6.94,3,28,118,
 -2.94, -7.44,3,29,148, +2.04, -2.66,3,31,162, +0.22, -1.15,3
$HPSCF,585,07:42:32,11, 8, 61, -2.00, -3.10,3,10,150, +0.60, +0.13,3,15, 49, -1
.16, -1.40,3,17,108, +2.34, +3.08,3,18,169, -0.98, -1.44,3,23,194, -1.70, -1.40
,3,26, 97, +2.14, +0.51,3,27, 79, +1.16, -0.36,3,28,118, -2.72, -2.83,3,29,148,
 +2.14, +0.67,3,31,162, +0.18, +1.67,3
$HPSCF,530,07:42:32,10, 8, 61, -1.50, -1.60,3, 9, 52, -0.74, -2.29,3,10,150, +0
.74, +1.66,3,15, 49, -0.58, -2.04,3,17,108, +2.70, +4.20,3,18,169, -0.30, +2.05
,3,23,194, -1.80, -2.97,3,26, 97, +2.22, -3.31,3,28,118, -2.56, -1.21,3,29,148,
 +1.80, +4.73,3
$HPSCF,620,07:42:32,12, 3,136, +0.36, -6.40,3, 8, 61, -2.10, -0.58,3,10,150, +0
.70, +1.25,3,15, 49, -1.04, -1.31,3,17,108, +2.14, +1.99,3,18,169, -0.76, +2.99
,3,23,194, -1.74, -1.86,3,26, 97, +2.18, -0.45,3,27, 79, +0.82, -1.57,3,28,118,
 -2.62, -1.24,3,29,148, +1.76, -0.27,3,31,162, +0.30, +2.64,3
$HPSCF,431,07:42:32, 9, 8, 61, -2.16, -5.57,3, 9, 52, -0.18, -1.88,3,10,150, -0
.20, +0.12,3,17,108, +3.40, +3.22,3,23,194, -2.22, +0.02,3,26, 97, +1.70, -0.96
,3,27, 79, +1.00, -1.48,3,28,118, -3.26, -0.70,3,29,148, +1.92, -2.40,3
```

Figure 27: CRT HP Correction message display [F6]

```
07:42:58                    RTCM Corrections  page 9                    06 Dec 2002
07:41:47 - PRN=27 D=    771 R=    120 T= 723195660
07:41:47 - PRN=28 D=    152 R=     16 T= 723195660
07:41:47 - PRN=29 D=    224 R=      4 T= 723195660
07:42:00 - RTCM T15 idx=0 id=999  nprn=10 zcount=4200 code=5E414280
07:42:00 - PRN= 8 D=    840 R=     40 T= 723195720
07:42:00 - PRN=10 D=    906 R=     61 T= 723195720
07:42:00 - PRN=15 D=    726 R=     21 T= 723195720
07:42:00 - PRN=17 D=   1157 R=     -9 T= 723195720
07:42:00 - PRN=23 D=    694 R=     21 T= 723195720
07:42:00 - PRN=26 D=    627 R=     22 T= 723195720
07:42:00 - PRN=27 D=   1135 R=    130 T= 723195720
07:42:00 - PRN=28 D=    595 R=     10 T= 723195720
07:42:00 - PRN=29 D=    673 R=     25 T= 723195720
07:42:00 - PRN=31 D=    898 R=     44 T= 723195720
07:42:56 - RTCM T15 idx=13 id=371  nprn=9  zcount=4200 code=1A414380
07:42:56 - PRN= 8 D=    719 R=     83 T= 723195720
07:42:56 - PRN= 9 D=    653 R=     19 T= 723195720
07:42:56 - PRN=10 D=    640 R=     38 T= 723195720
07:42:56 - PRN=15 D=    430 R=     15 T= 723195720
07:42:56 - PRN=17 D=    598 R=     29 T= 723195720
07:42:56 - PRN=23 D=    530 R=     21 T= 723195720
07:42:56 - PRN=26 D=    423 R=     14 T= 723195720
07:42:56 - PRN=28 D=    415 R=      6 T= 723195720
07:42:56 - PRN=29 D=    415 R=     16 T= 723195720
```

Figure 28: CRT RTCM Correction message display [F6]

```
07:43:20                    HP Engine Events  page 10                  06 Dec 2002
07:43:19 - pweNavExec=0 age=21 tow=459799
07:43:19 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.18],tow=459799
07:43:19 - pwePcorPut: 525,5184,2,12,459792
07:43:19 - pwePcorPut: 571,5184,2,11,459792
07:43:19 - pwePcorPut: 585,5184,2,11,459792
07:43:19 - pwePcorPut: 530,5184,2,10,459792
07:43:19 - pwePcorPut: 431,5184,2,9,459792
07:43:19 - pweKalFiltExec=0
07:43:20 - pweNavExec=0 age=8 tow=459800
07:43:20 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.18],tow=459800

07:43:12 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.19],tow=459792
07:43:13 - pweNavExec=0 age=15 tow=459793
07:43:13 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.19],tow=459793
07:43:14 - pweNavExec=0 age=16 tow=459794
07:43:14 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.19],tow=459794
07:43:15 - pweNavExec=0 age=17 tow=459795
07:43:15 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.19],tow=459795
07:43:16 - pweNavExec=0 age=18 tow=459796
07:43:16 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.19],tow=459796
07:43:17 - pweNavExec=0 age=19 tow=459797
07:43:17 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.18],tow=459797
07:43:18 - pweNavExec=0 age=20 tow=459798
07:43:18 - pwmSeed:dn=+0.00m[1.06m],de=+0.00[0.83],dh=+0.00[2.18],tow=459798
```

Figure 29: CRT HP Engine Events message display [F6]

6 Menu Structure

The menus of the Starfix-HP mobile can be selected by pressing [Ent] on the keypad or keyboard. The menu structure when using the CRT or the LCD is identical.

6.1 Main Menu

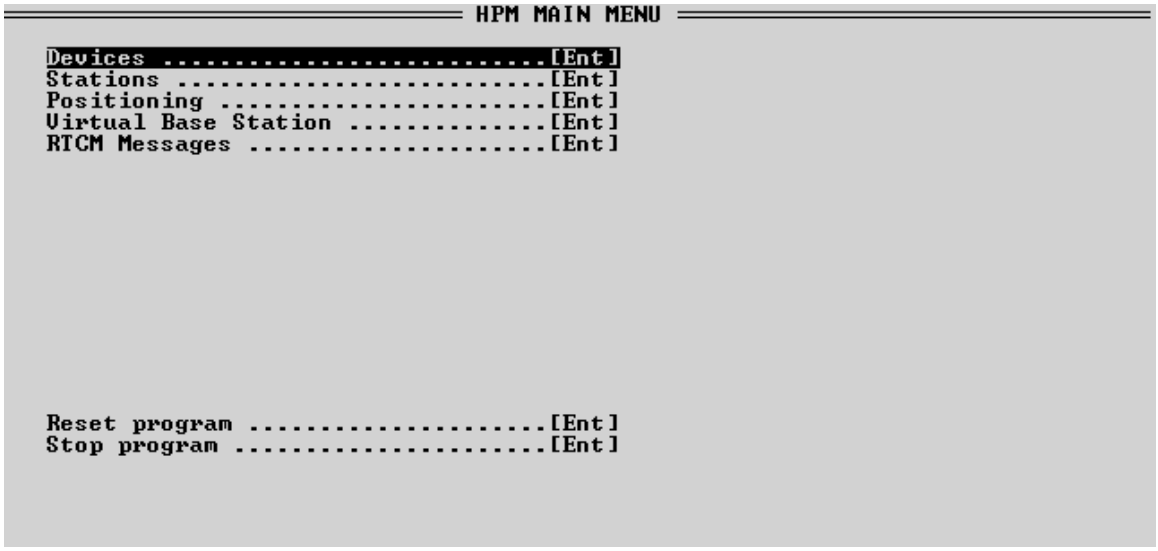


Figure 30: CRT Main menu

Devices	Here, one can configure all internal and/or external devices of the Starfix Mobile such as; GPS Receiver, Comports, Differential corrections.
Stations	Select the reference stations for both, the VBS and HP position calculation
Positioning	Configuration of the position calculations for both, VBS and HP.
Virtual Base Station	Configuration of the Virtual Base Station corrections calculation
RTCM Messages	Configuration of RTCM message output
Reset Program	Complete reset of the program inclusive I/O and Calculations reset
Stop Program	Stop the Starfix-HPM application and return to the Loader program

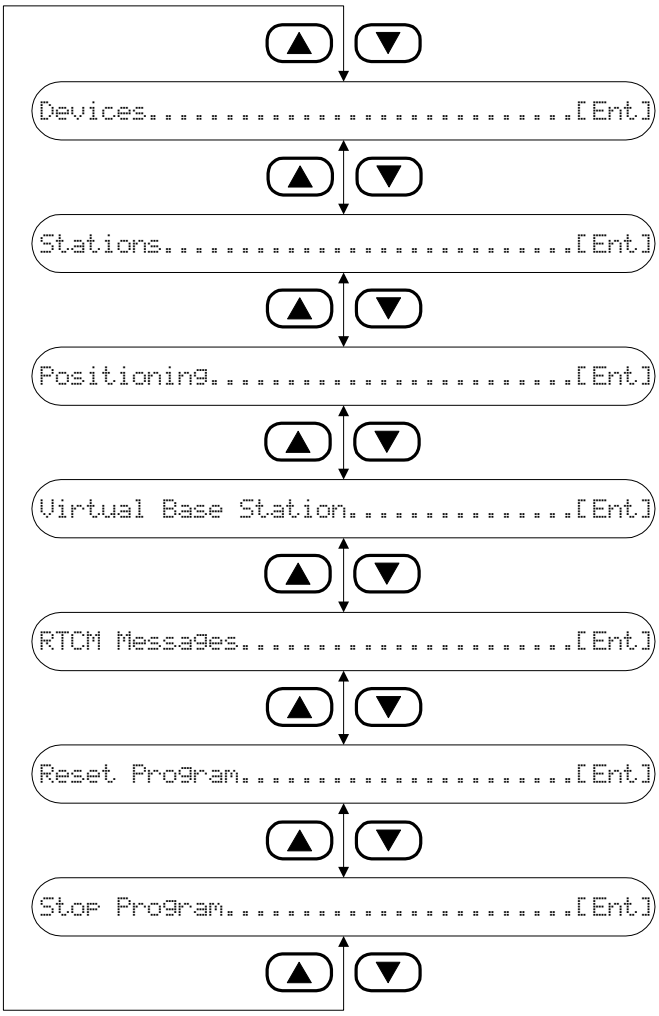


Figure 31: LCD Main menu

6.2 Devices

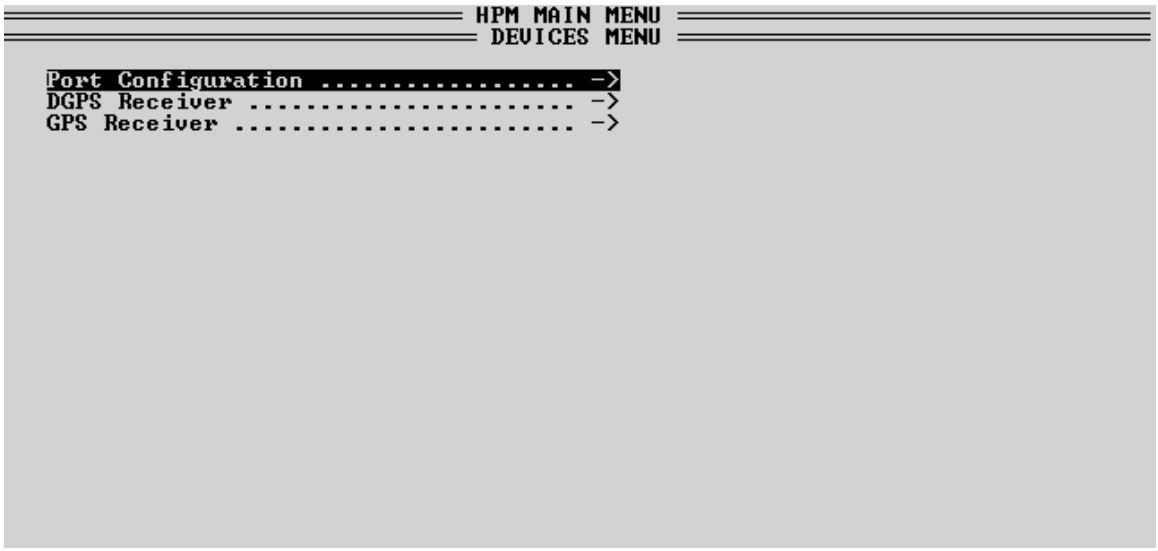


Figure 32: CRT Devices menu

Port Configuration	Assign a device driver or multiplexer to the available Com Ports and select the appropriate Baudrate
DGPS Receiver	Configure broadcast format and preferred source of HP corrections
GPS Receiver	Used to communicate and to configure the internal GPS card. All communications between the program and the GPS card can be viewed using the Message Display (see Chapter 5.6)

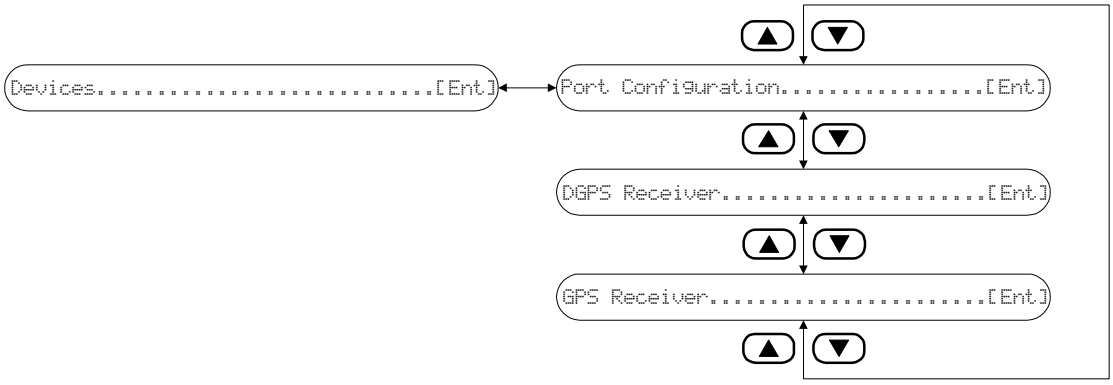


Figure 33: LCD Devices menu

6.2.1 Port Configuration

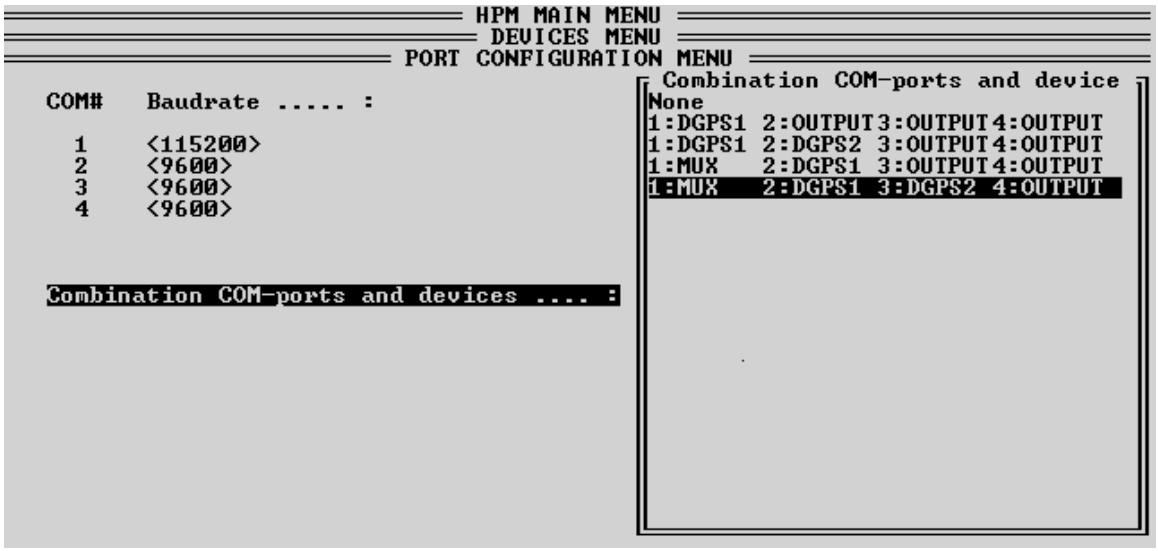


Figure 34: CRT Port Configuration menu

Here, one can select a pre-defined combination of device drivers for COM-port 1, 2, 3 and 4 and set the Baudrate accordingly.

COM-port 5 is hardwired internally to the LCD display (Front Panel). COM-port 6 is hardwired internally to the GPS card receiver.

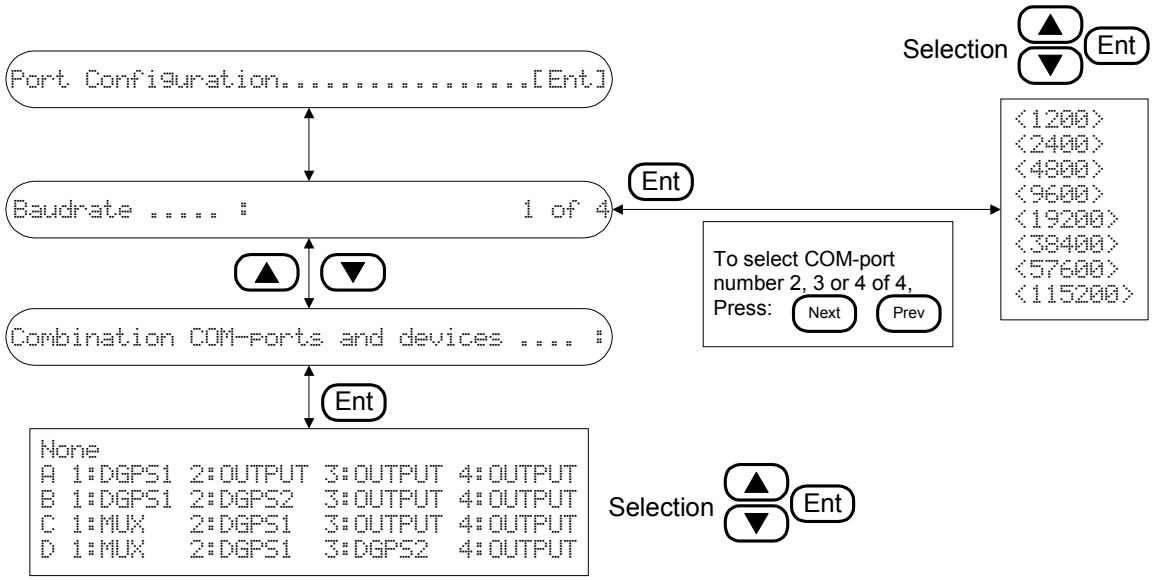


Figure 35: LCD Port Configuration menu

6.2.2 DGPS Receiver

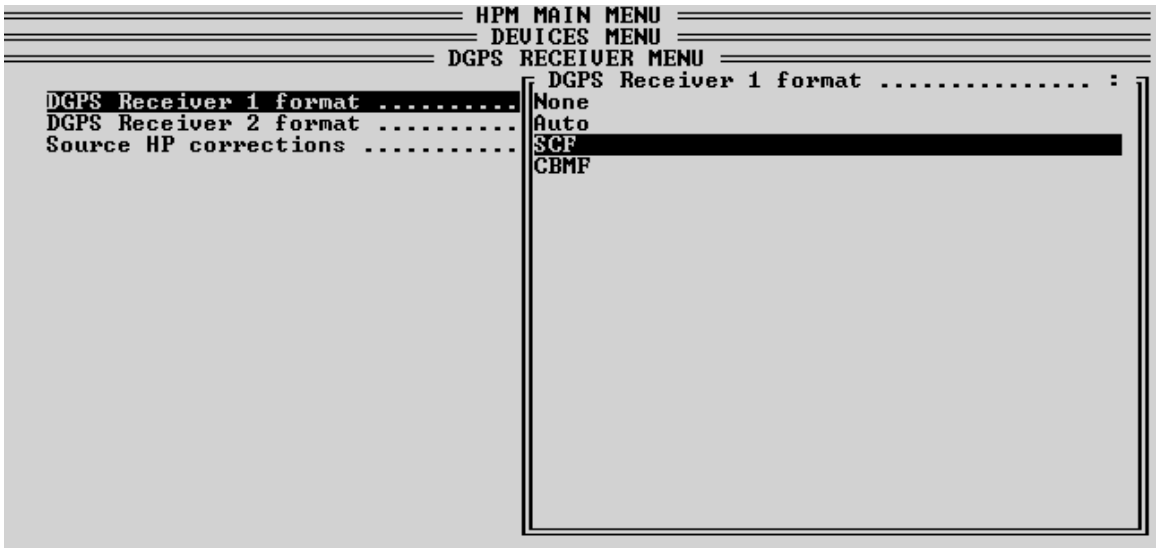


Figure 36: CRT DGPS Receiver menu

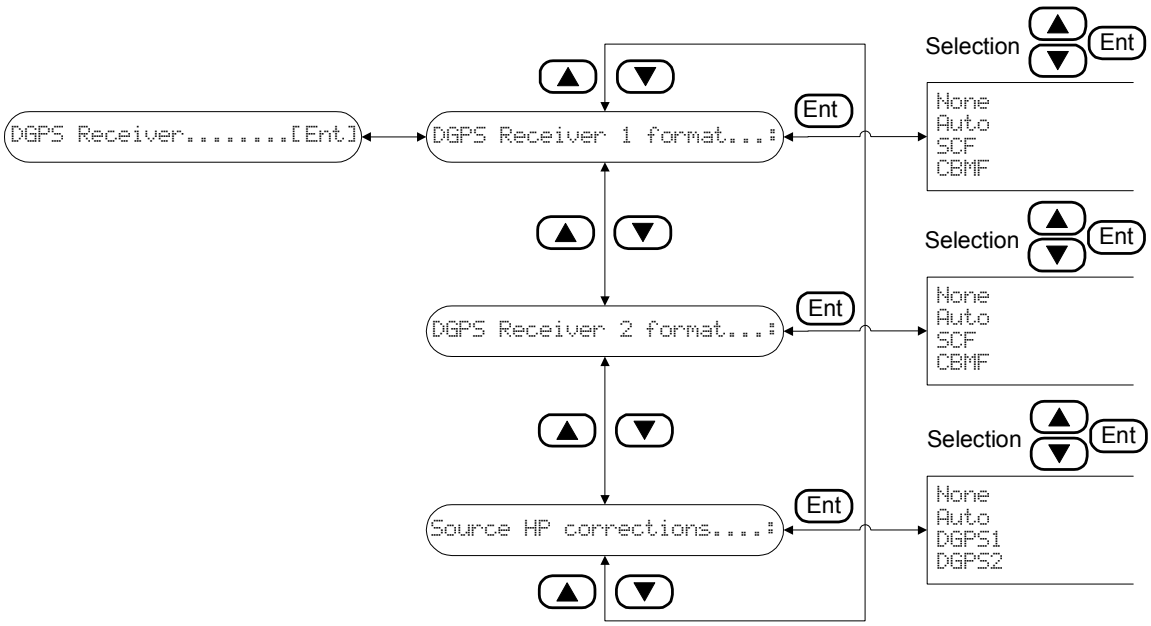


Figure 37: LCD DGPS Receiver menu

Normally all three items should be set to Auto.

6.2.3 GPS Receiver

Figure 38: CRT GPS Receiver menu

This is where the internally connected GPS card is configured. COM 6 of the built-in PC is hardwired internally to port A of the GPS card.

The messages of the executed commands are displayed on the GPS Receiver message display (see Chapter 5.6: GPS Receiver message display [F6]).

Select and execute command is used to select and execute the GPS receiver command from the commands list to the GPS card.

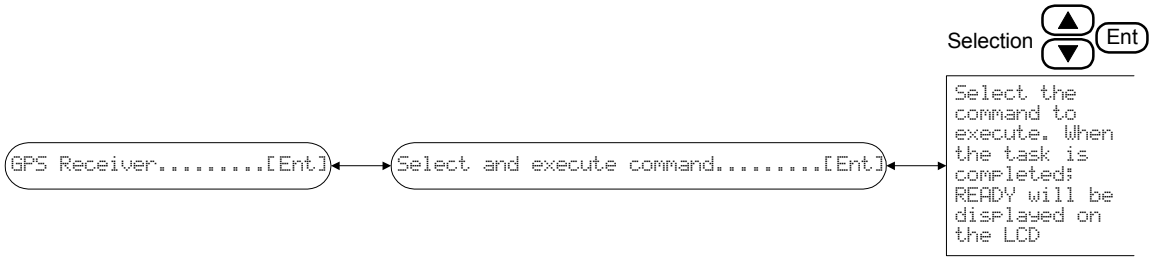


Figure 39: LCD GPS Receiver menu

6.3 Stations

HPM MAIN MENU
STATIONS MENU

Stations advanced ->

#	Station Name	ID	ID+	Latitude	Longitude	Height	E
1	Leidschendam H	525	0	52°05'44.9010"N	4°24'16.5410"E	+67.953	
2	Leidschendam L	521	0	52°05'44.8510"N	4°24'16.5980"E	+67.978	
3	Aberdeen LDGH	571	957	57°11'56.2970"N	2°05'32.3130"W	+101.857	
4	Rogaland H	585	0	58°48'38.0490"N	5°40'23.9900"E	+126.305	
5	Rogaland L	580	0	58°48'38.0110"N	5°40'24.1000"E	+126.293	
6	Shannon LH	530	0	52°41'30.2680"N	8°55'04.7450"W	+78.014	
7	Toulouse LDH	431	943	43°34'01.0080"N	1°29'15.0100"E	+203.453	
8	Vienna LH	480	0	48°07'27.8050"N	16°33'03.6470"E	+235.418	
9	Visby LG	229	0	57°39'13.9220"N	18°22'02.3270"E	+79.959	
10	Torshavn LDH	620	962	62°00'39.3160"N	6°46'19.5610"W	+92.561	
11	Orlandet LDGH	630	963	63°40'58.6650"N	9°35'21.0820"E	+73.512	
12	Bodo L	122	0	67°16'30.1480"N	14°21'28.0970"E	+55.700	
13	Faro LDH	371	937	37°01'13.2010"N	7°58'07.9020"W	+75.733	
14	Malta L	351	935	35°50'56.4180"N	14°29'43.3410"E	+133.875	
15	Tromso LH	690	0	69°39'13.6351"N	18°56'14.4374"E	+141.688	
16	Crete LD	340	934	35°18'37.6332"N	25°09'15.4919"E	+139.405	

Figure 40: CRT Stations menu

This is where you define your reference stations. A more efficient way of defining the Station list is available in the 'Station advanced' menu.

- A database with all known Starfix reference stations is available and can be used to build your reference station list by selecting a Reference station name from the database list. Only differential corrections received from stations in this list are accepted and can be used. All other corrections are ignored.
- Another way to enter a new reference station to the list is; typing in the co-ordinates and height. The entry 'Station Name' can be used to enter your new station name.
- After adding a HP reference station to the station list, the program needs to be re-started.

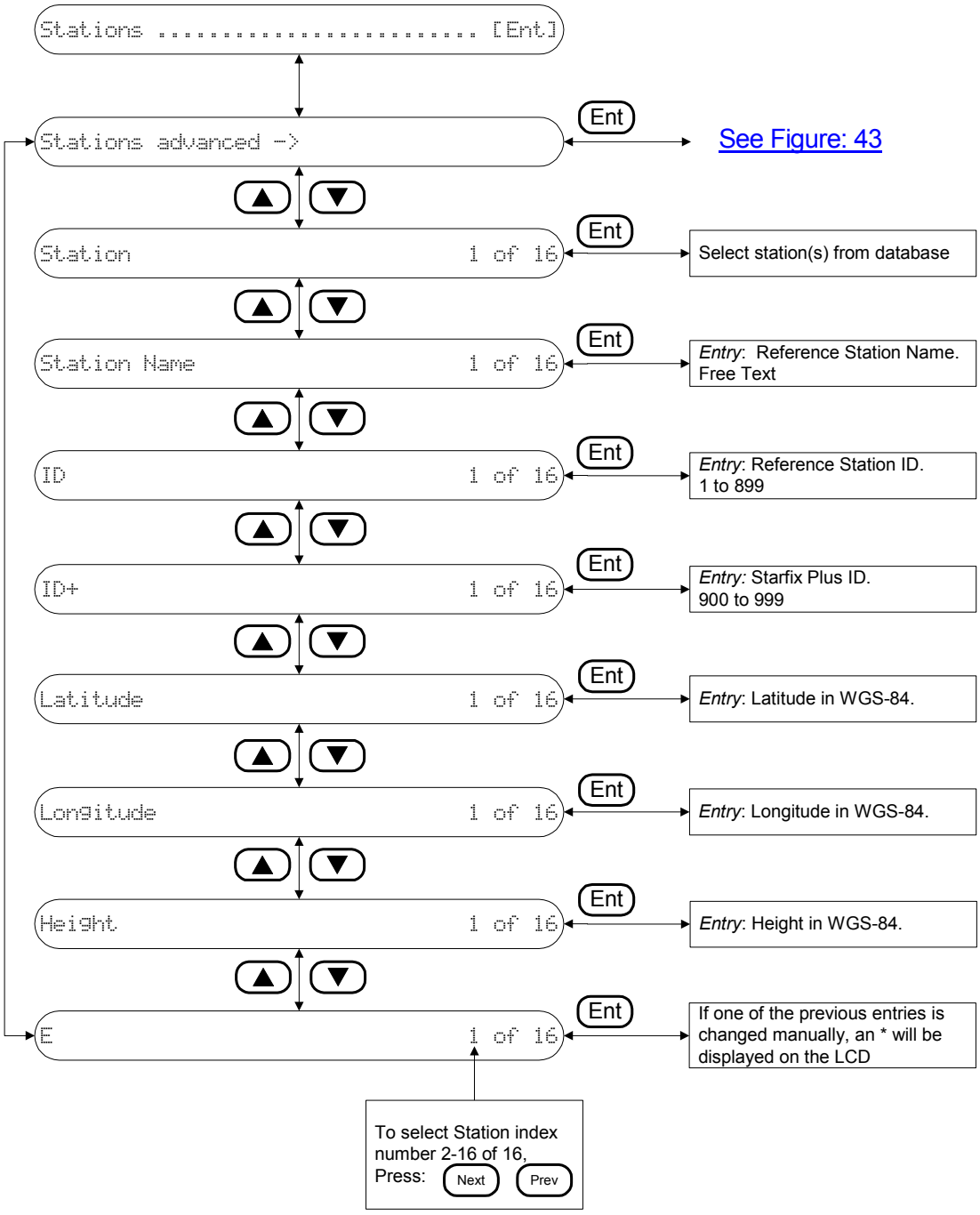


Figure 41: LCD Stations menu

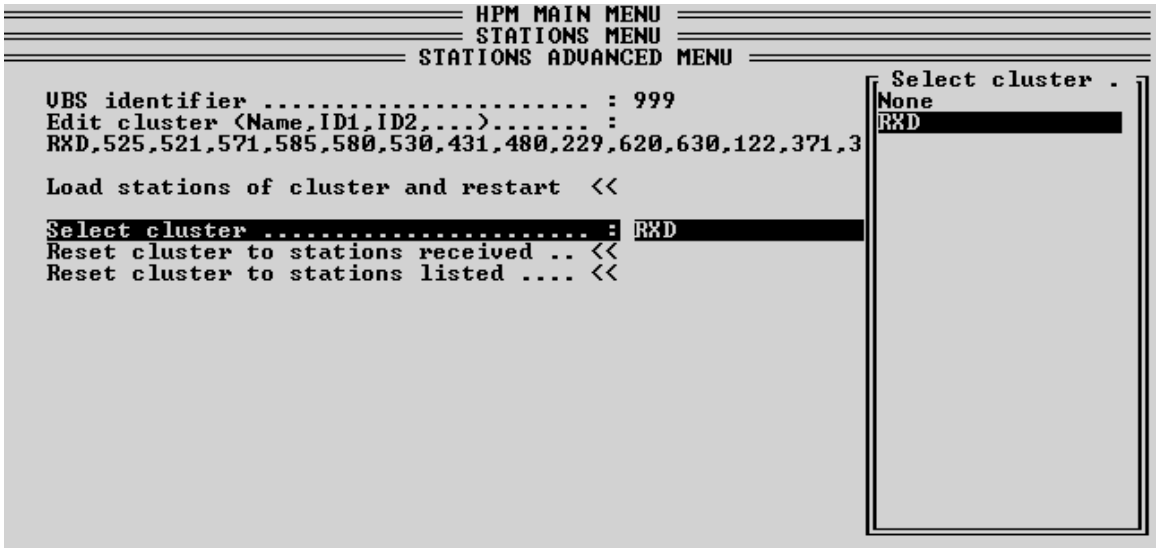


Figure 42: CRT Stations Advanced menu

A cluster is a named sequence of Station ID numbers. The program has two built in clusters: RXD and LST.

RXD : Is the sequence of received stations since start-up. The closest station first.
LST : The sequence of stations in the stations list.

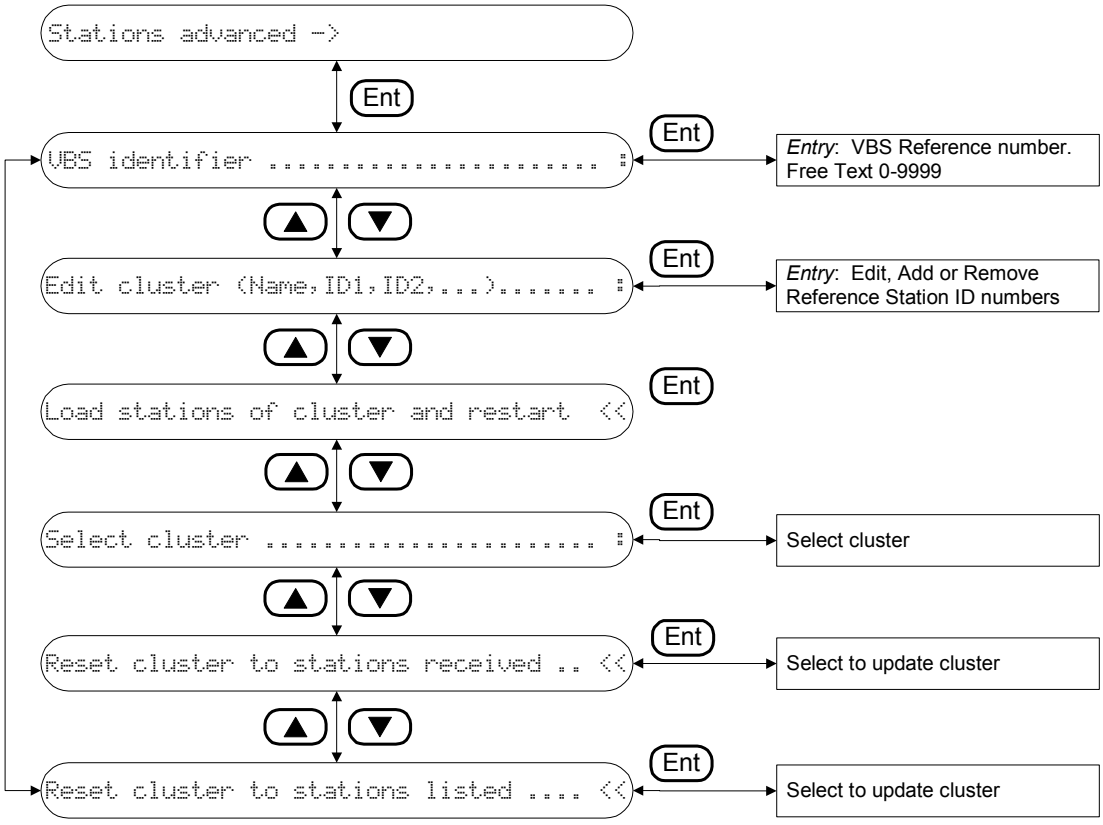


Figure 43: LCD Stations Advanced menu

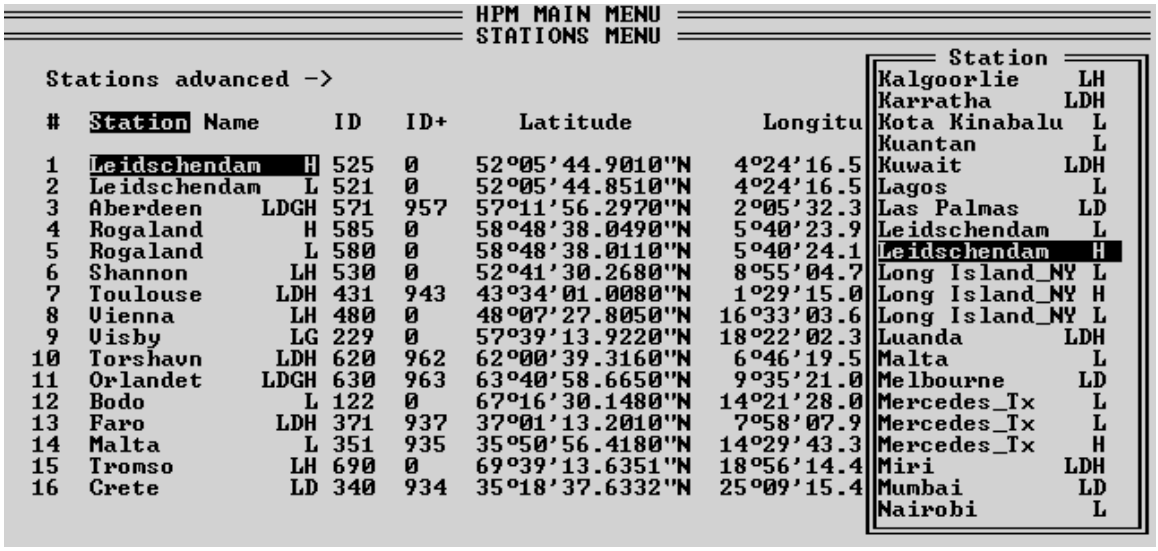


Figure 44: Reference station database

6.4 Positioning

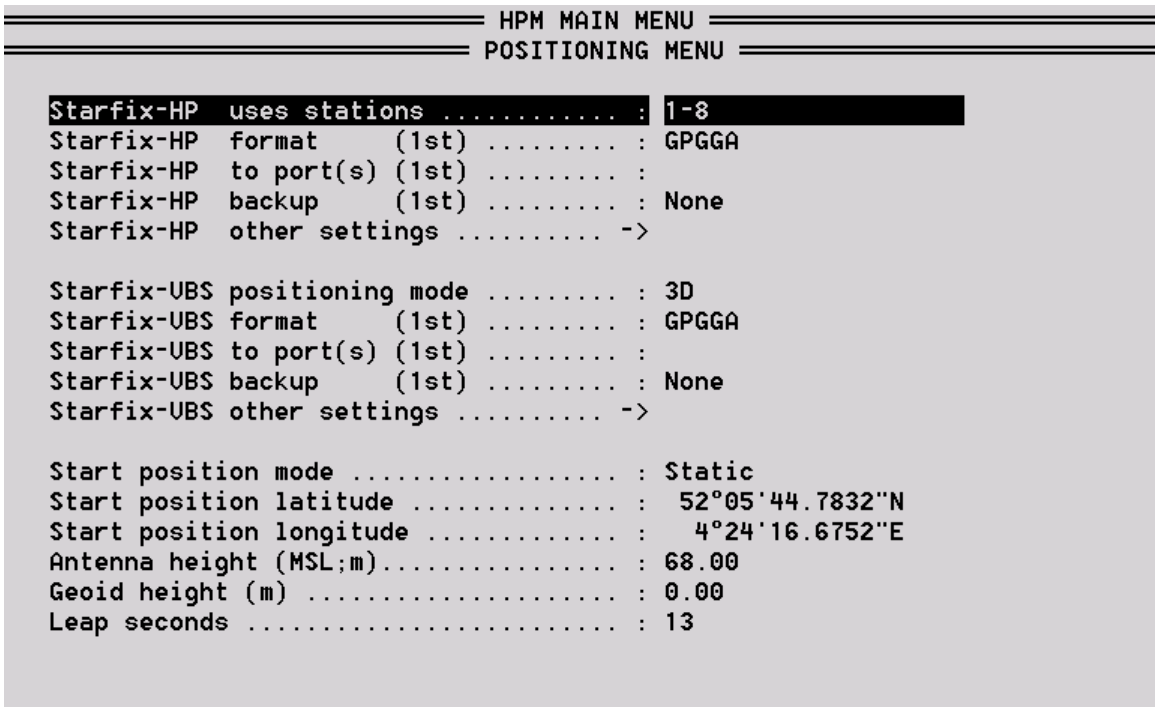


Figure 45: CRT Positioning menu

Starfix-HP user stations		Select the Starfix-HP reference stations which are used in the HP positioning calculation.
Starfix-HP format		Is the selected HP position output format. See Appendix G
Starfix-HP to port(s)		The port(s) to where the HP position is sent. (See Port Configuration)
Starfix-HP backup		See GPS Quality Indicator in the GPGGA output string
	None	If HP drops out, no position output
	VBS	If HP drops out, VBS is used for position output
	VBS_or_GPS	If HP drops out, and no VBS available, standalone position output
Starfix-HP other settings		See chapter 6.4.1
Starfix-VBS positioning mode		
	Off	No VBS position will be calculated
	3D	VBS position will be calculated with NO height aiding
	3D + H	VBS position will be calculated with height aiding
Starfix-VBS format		Is the selected VBS position output format send to the client software. See Appendix G
Starfix-VBS to port(s)		Is used to specify the output port index number to where the VBS position is sent to (See Port Configuration)
Starfix-VBS backup		See GPS Quality Indicator in the GPGGA output string
	None	If VBS drops out, no position output
	GPS	If VBS drops out, standalone position output
Starfix-VBS other settings		See chapter 6.4.2

Start position mode		The start position is used to seed initially the HP and VBS position calculation.
	Static	For monitoring purposes, whereby antenna co-ordinates are known precisely.
	Dynamic	For normal operation purposes, whereby antenna co-ordinates only need to be known within 1 degree
	Update LatLon	The program calculates start Latitude and Longitude accurate to 1 km and changes to Dynamic mode. This option can be used when start position is unknown.
Start position latitude		Enter start Latitude for Static and dynamic mode
Start position longitude		Enter start Longitude for Static and dynamic mode
Antenna height (MSL;m)*		Enter antenna height.
Geoid height (m)*		Enter geoid height.
Leap seconds		GPS minus UTC time; at present +13 seconds

*) The sum of the Antenna height and the Geoid height is used for height aiding in the VBS position calculation. See chapter 6.4.2: Starfix-VBS other settings.

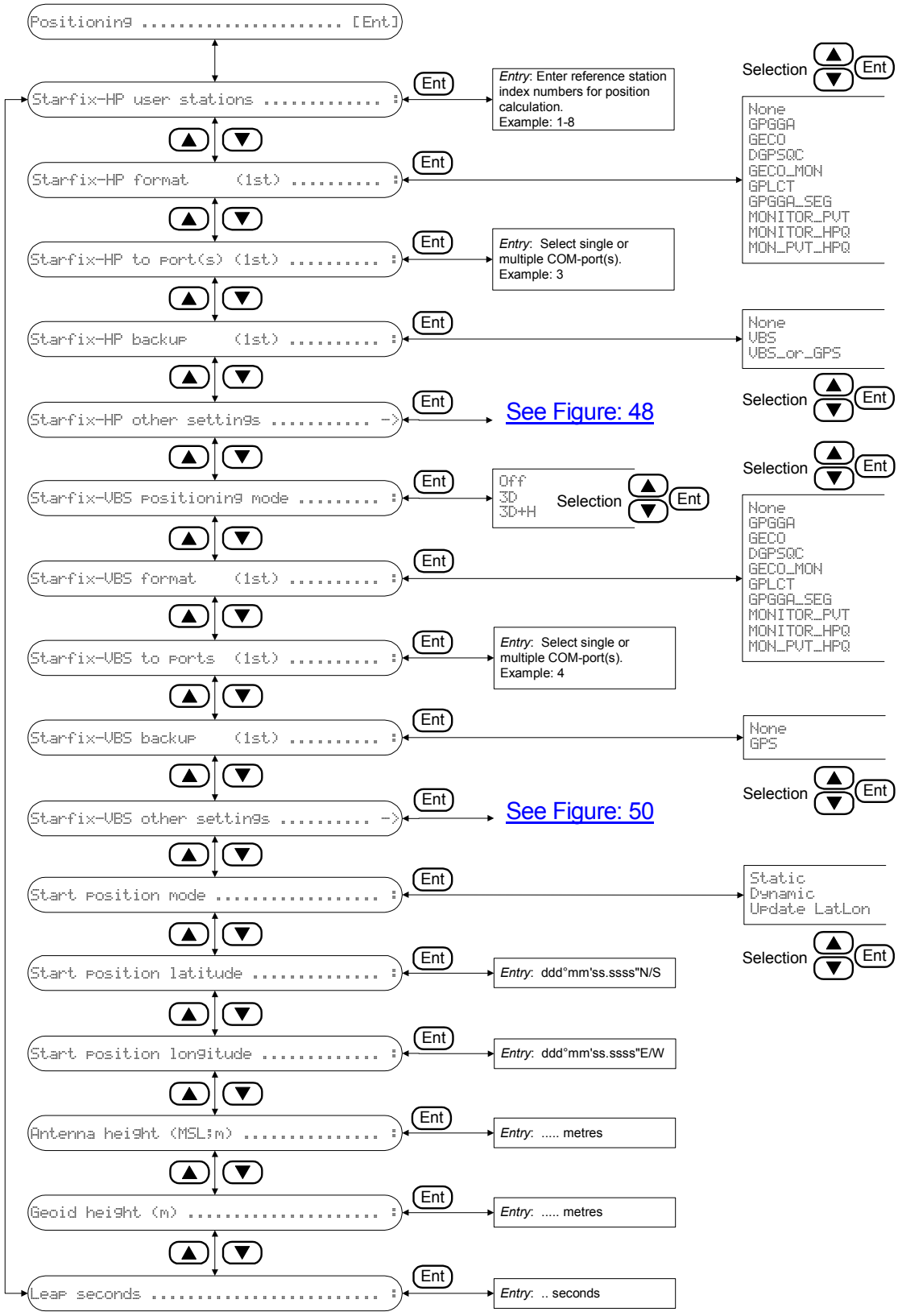


Figure 46: LCD Positioning menu

6.4.1 Starfix-HP other settings

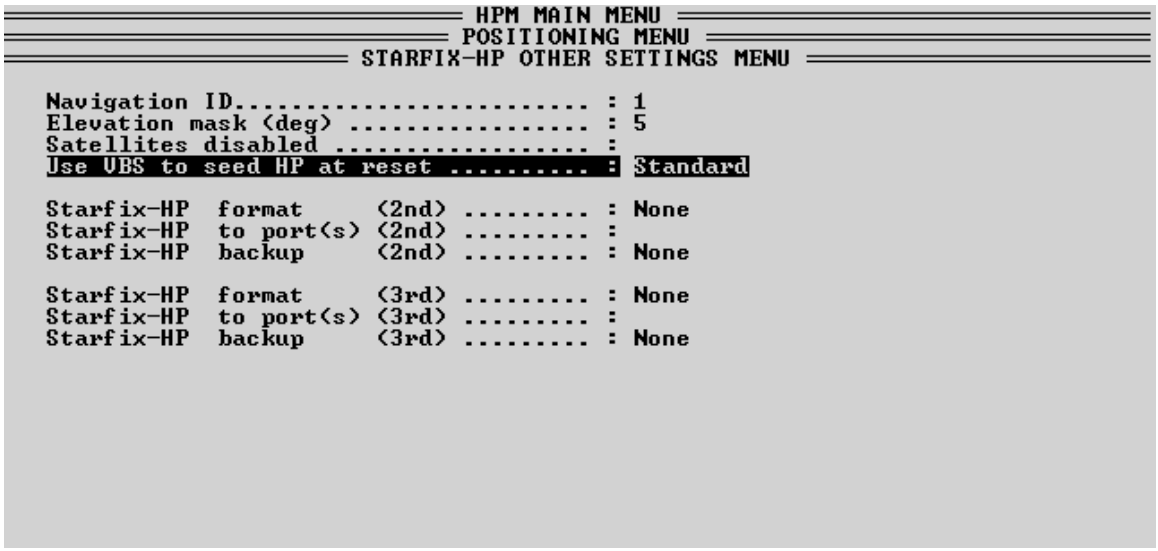


Figure 47: CRT Starfix-HP other settings menu

Navigation ID		This ID is used in some position outputs (Geco, Monitor) to identify the antenna position the vessel.
Elevation mask (deg)		Satellites below the Elevation mask are excluded from the position calculation
Satellites disabled		Satellites specified (Satellite SV numbers) are excluded from the position calculation
Use VBS to seed HP at restart		
	Off	The HP engine computes the start position
	Standard	The VBS position is used as the start position
	Enhanced	The calibrated VBS position is used as the start position (VBS position corrected for the systematic error between VBS and HP)
Starfix-HP format		Is the selected HP position output format. See Appendix G
Starfix-HP to port(s)		The port(s) to where the HP position is sent. (See Port Configuration)
Starfix-HP backup		See GPS Quality Indicator in the GPGGA output string
	None	If HP drops out, no position output
	VBS	If HP drops out, VBS is used for position output
	VBS_or_GPS	If HP drops out, and no VBS available, standalone position output

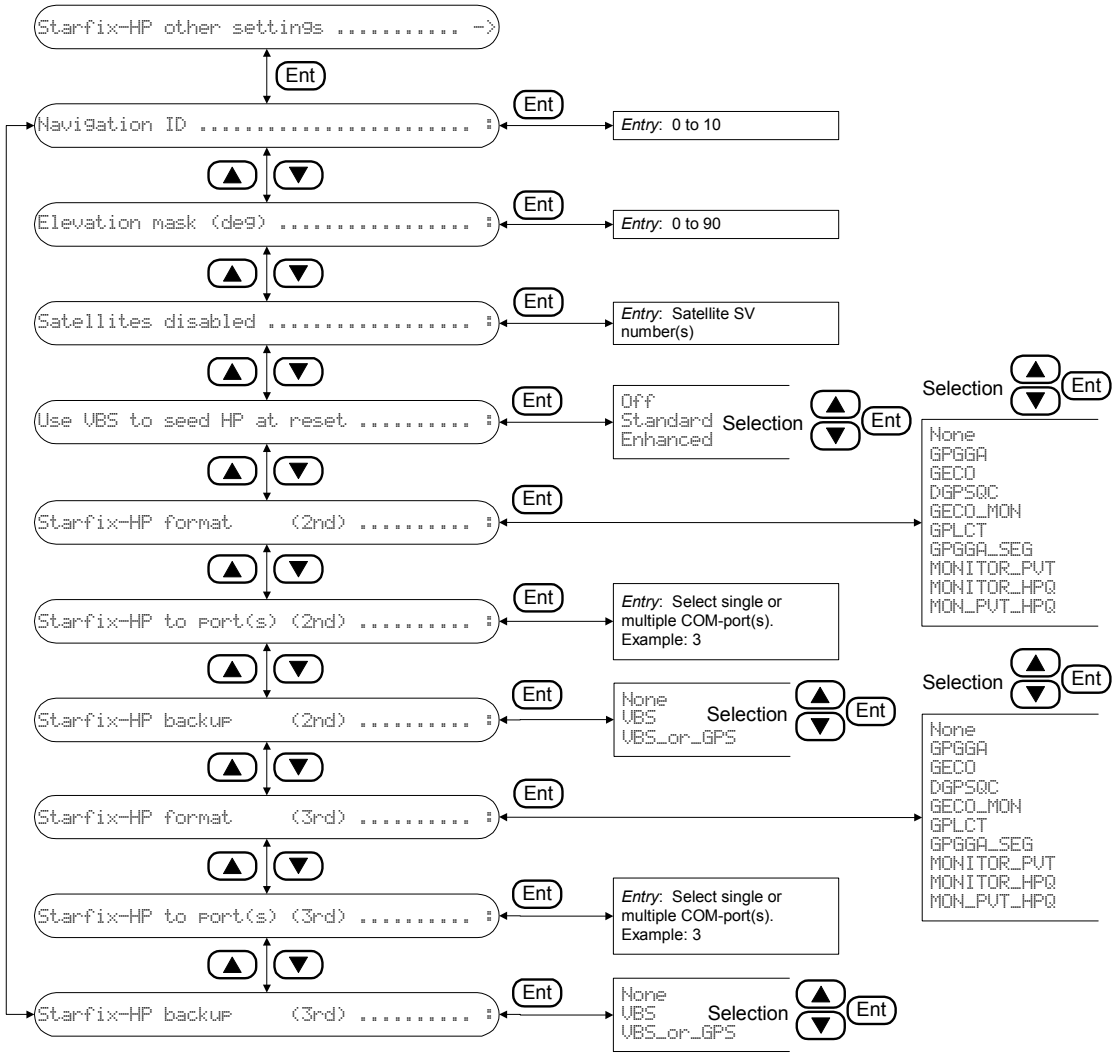


Figure 48: LCD Starfix-HP other settings menu

6.4.2 Starfix-VBS other settings

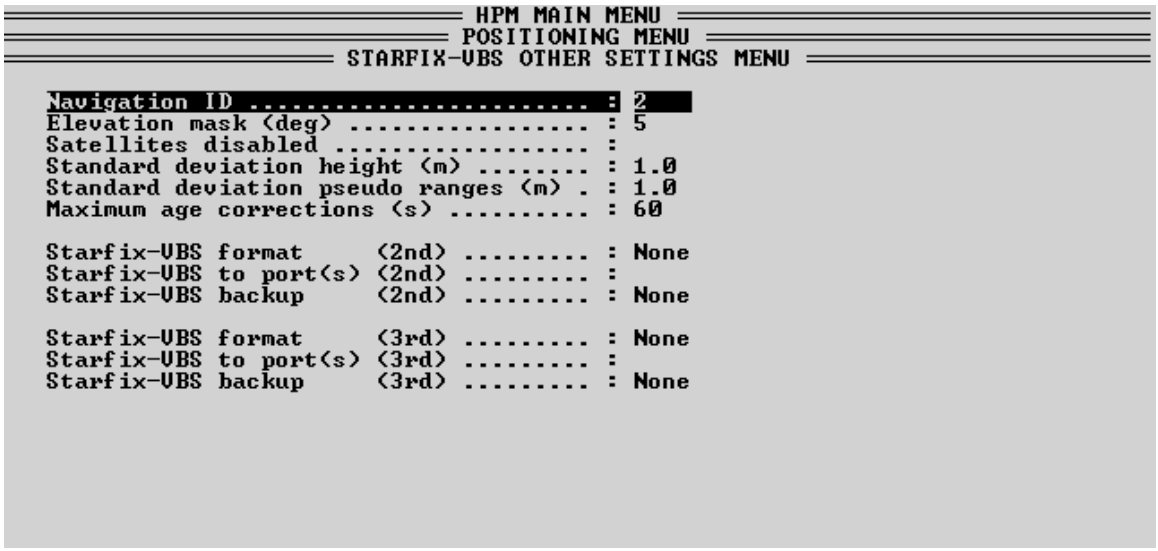


Figure 49: CRT-Starfix-VBS other settings menu

Navigation ID		This ID is used in some position outputs (Geco, Monitor) to identify the antenna position the vessel.
Elevation mask (deg)		Satellites below the Elevation mask are excluded from the position calculation
Satellites disabled		Satellites specified (Satellite SV numbers) are excluded from the position calculation
Standard deviation height (m)		Is a measure for the weight of the height in the VBS 3D+H position calculation
Standard deviation pseudo ranges (m)		Is a measure for the weight of the pseudo range measurements for the VBS position calculation
Maximum age corrections (s)		Recommended value is 60 seconds. Do not use a value less than 15 seconds
Starfix-VBS format		Is the selected VBS position output format. See Appendix G
Starfix- VBS to port(s)		Is used to specify the output port index number to where the VBS position is sent to (See Port Configuration)
Starfix-VBS backup		See GPS Quality Indicator in the GPGGA output string
	None	If VBS drops out, no position output
	GPS	If VBS drops out, standalone position output

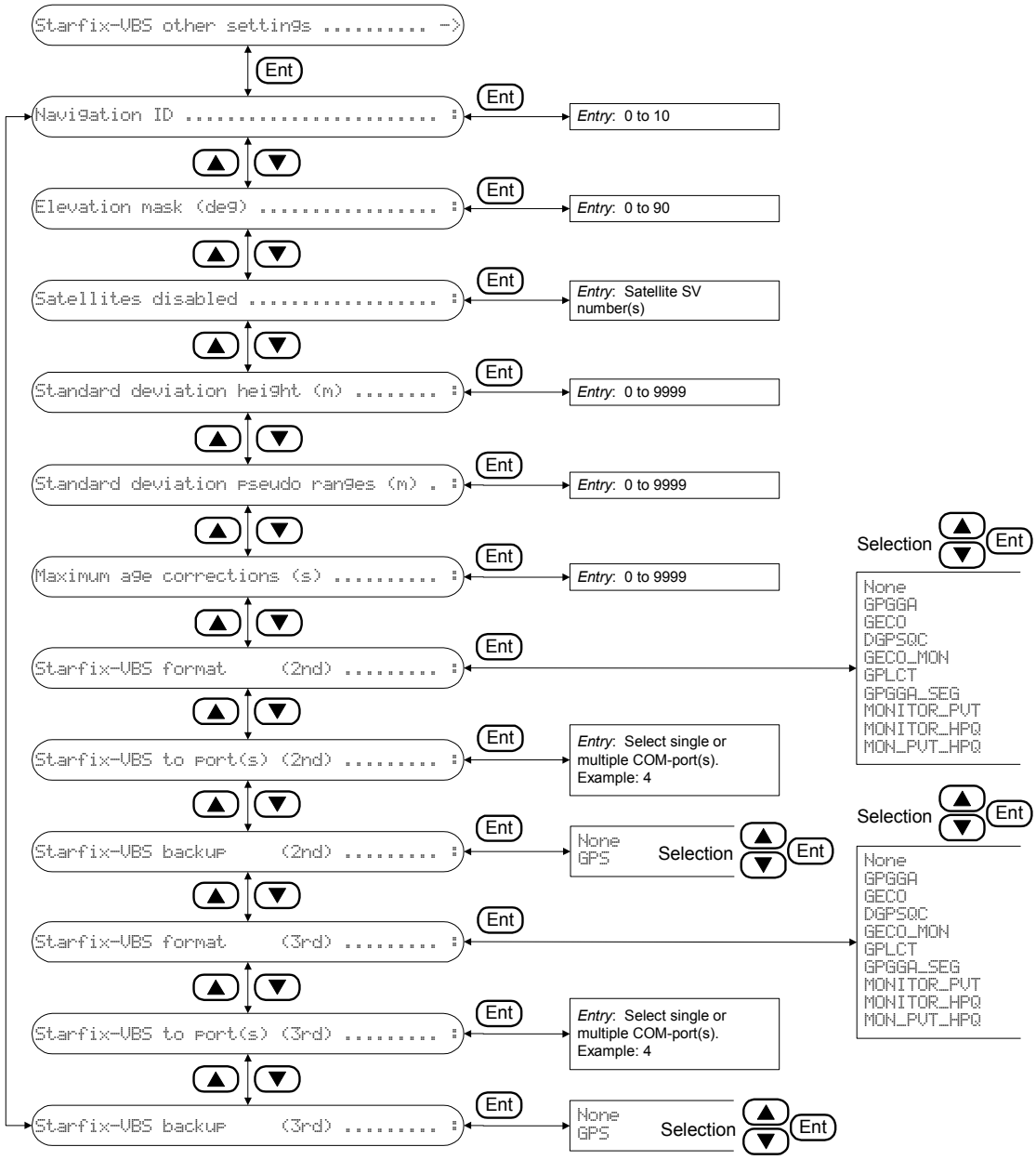


Figure 50: LCD-Starfix-VBS other settings menu

6.5 Virtual Base Station

Figure 51: CRT Virtual Base Station menu

Virtual Base Station	Switches the computation of the VBS corrections On or Off. If no VBS corrections are computed, then the VBS position can not be calculated.
Starfix Stations	Index numbers of Starfix stations (L), to be used in the VBS correction calculation
Starfix-Plus Stations	Index numbers of Starfix-Plus stations (D), to be used in the VBS correction calculation
100% weight range Starfix (km)	Is a distance set in Kilometres. If a station is inside the 100% weight range of the station, 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.
0% weight range Starfix (km)	
100% weight range Starfix-Plus (km)	
0% weight range Starfix-Plus (km)	
Maximum age corrections (sec)	Recommended value is 30 seconds. Do not use a value less than 15 seconds

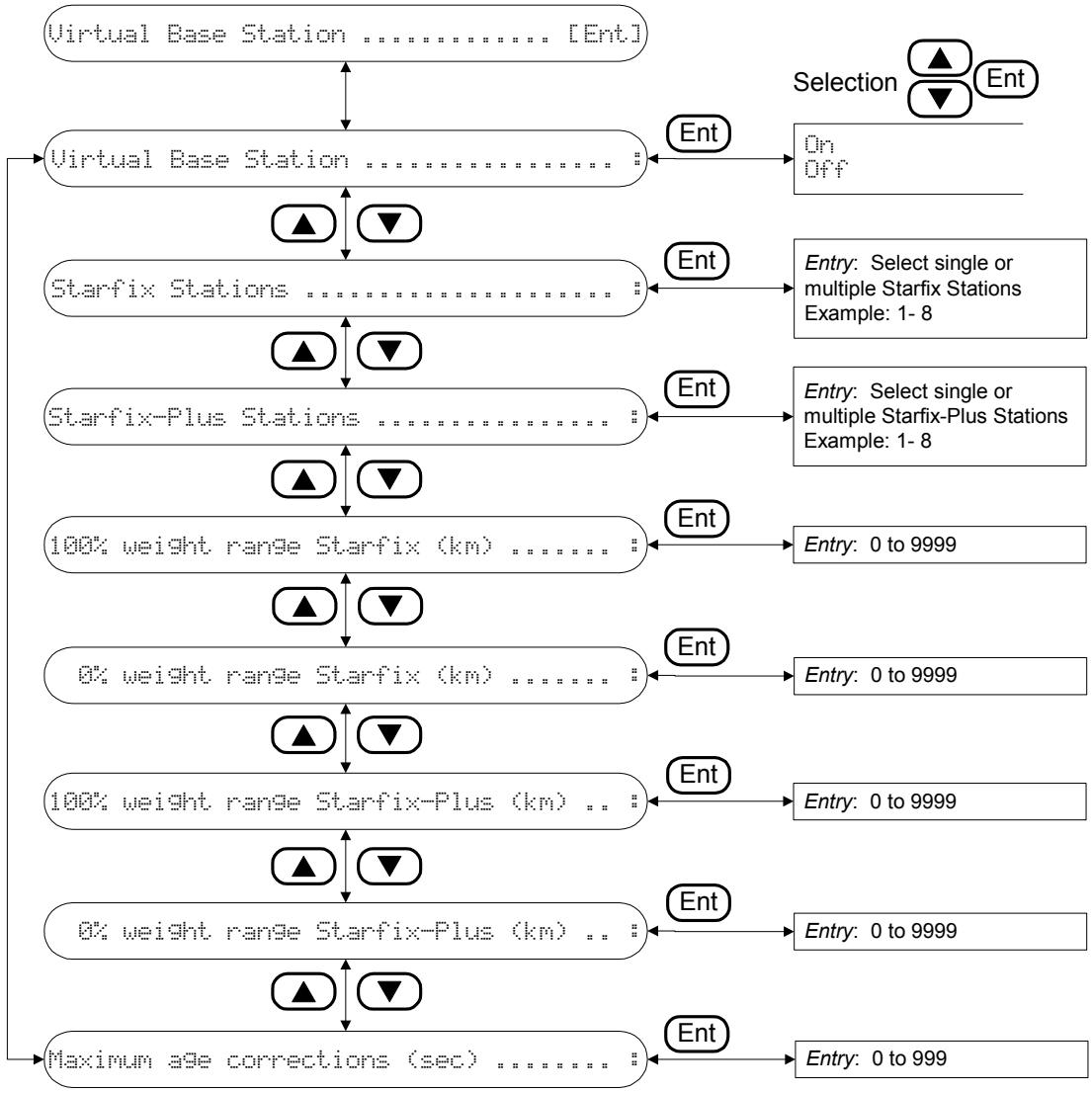


Figure 52: LCD Virtual Base Station menu

6.6 RTCM Messages

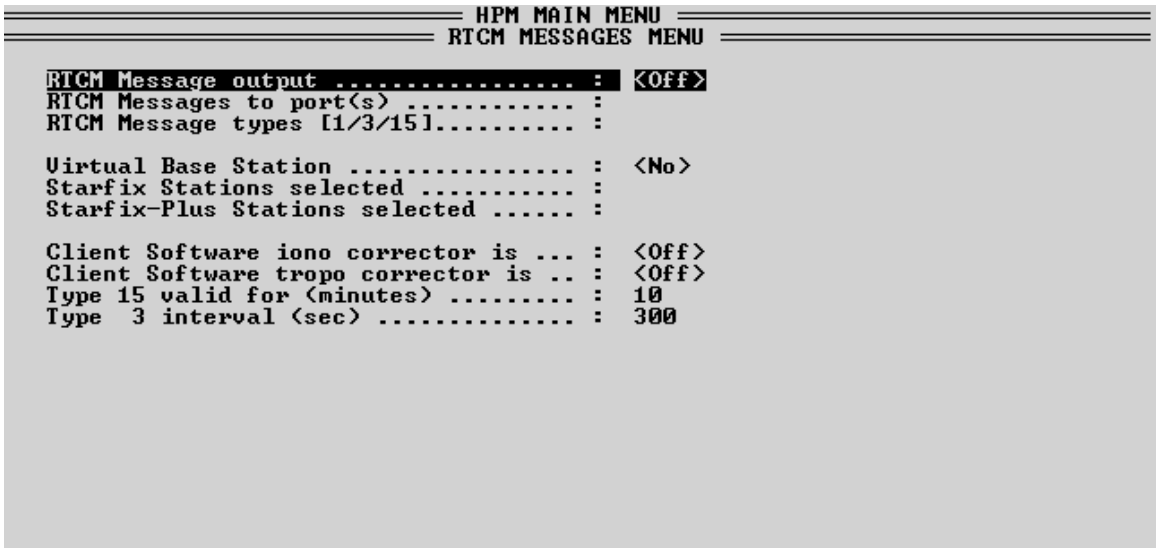


Figure 53: CRT RTCM Messages menu

RTCM Message Output	Switches the output of RTCM messages on or off
RTCM Message to port(s)	Specifies the COM-port(s) for RTCM output
RTCM Message types [1/3/15]	Selects RTCM message types for output
Virtual Base Station	Switches the output for the VBS base station on or off
Starfix Stations selected	Selects index numbers of Starfix stations (L)
Starfix-Plus Stations selected	Selects index numbers of Starfix-Plus stations (D)
Client Software iono corrector is	The Starfix-Plus settings for 'Client Software iono and tropo corrector' specifies which differential atmospheric corrections are applied in the Client's DGPS software position calculation. These settings are critical for the corrections to be applied by Starfix-Plus to ensure accurate positioning by the Client's DGPS software. If the setting 'Client Software iono corrector' is ON, then Starfix-Plus compensates for the Klobuchar corrections (by applying Klobuchar corrections with an opposite sign) which is assumed to be applied by the Client's DGPS software. If the setting 'Client Software tropo corrector' is OFF, then Starfix-Plus applies the differential tropospheric delays. See Appendix: H for additional information.
Client Software tropo corrector is	
Type 15 valid for (minutes)	The maximum age of type 15 corrections. Recommended value is 10 minutes
Type 3 interval (sec)	Output interval between type 3 messages

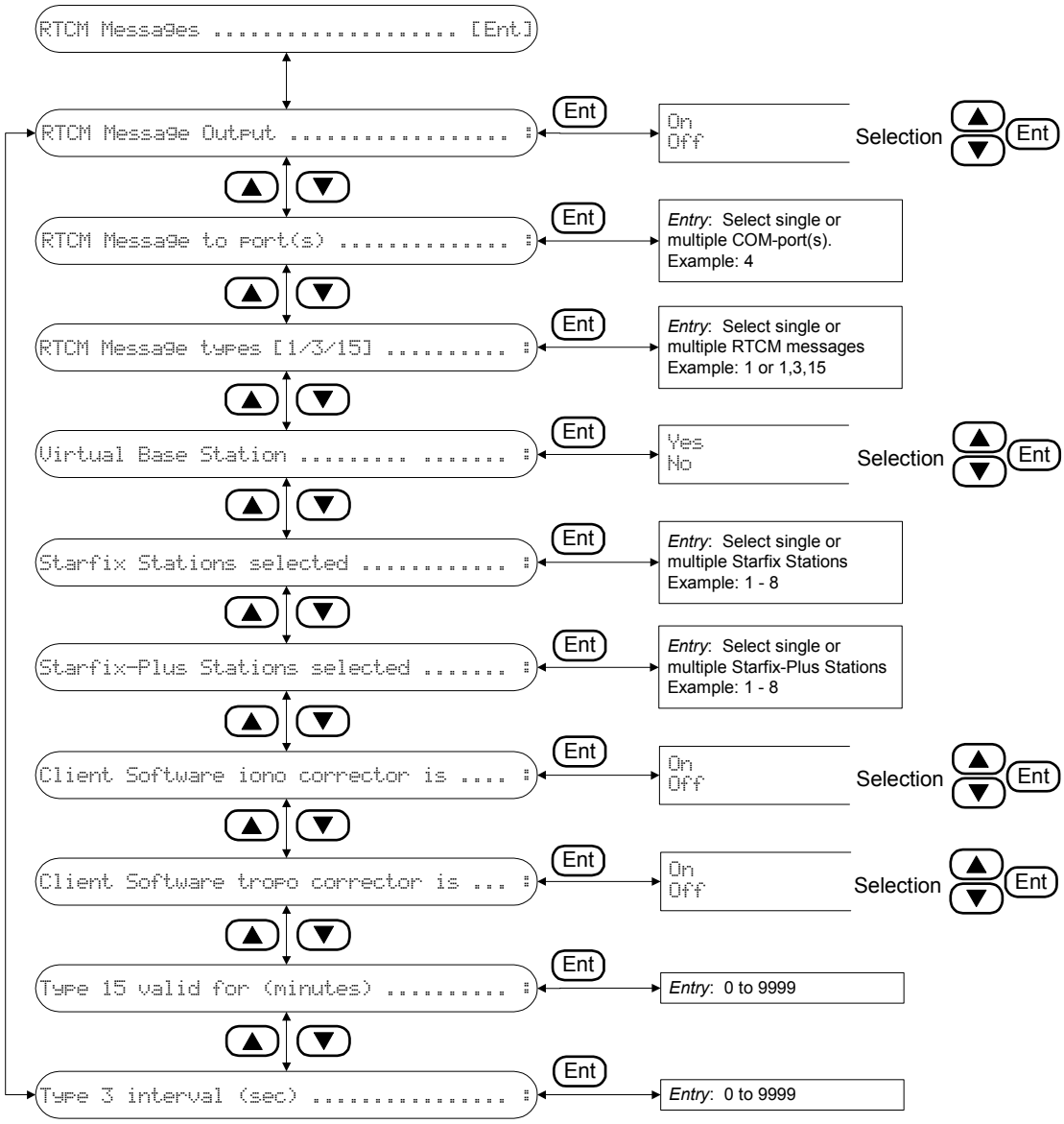


Figure 54: LCD RTCM Messages menu

6.7 Reset Program

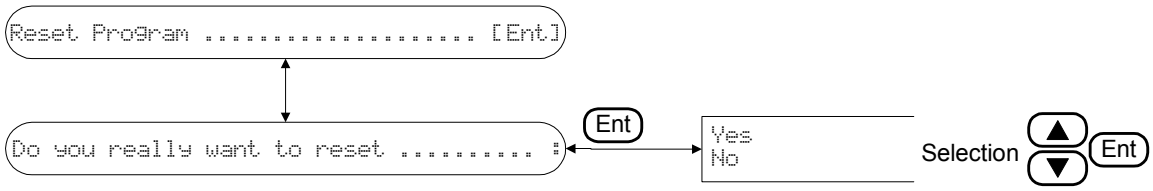


Figure 55: LCD Reset Program menu

If you wants to reset the program, select 'Yes' and press [Ent]. Next press the [Esc] button twice or press [F1] to go to the HPM Main Menu. At that time the program is completely reset inclusive I/O and position calculations.

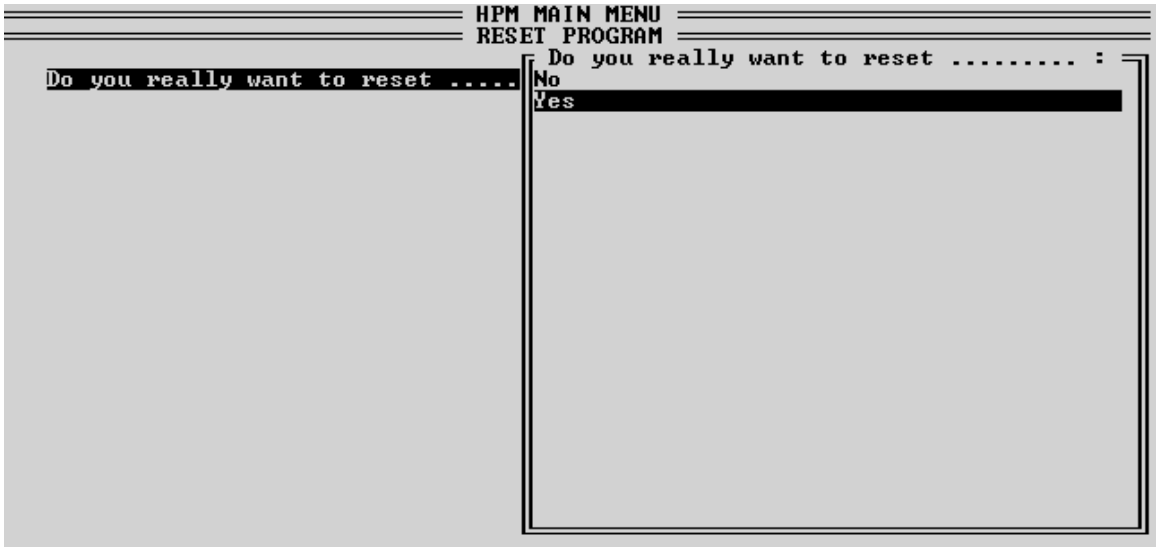


Figure 56: CRT Reset Program menu

6.8 Stop Program

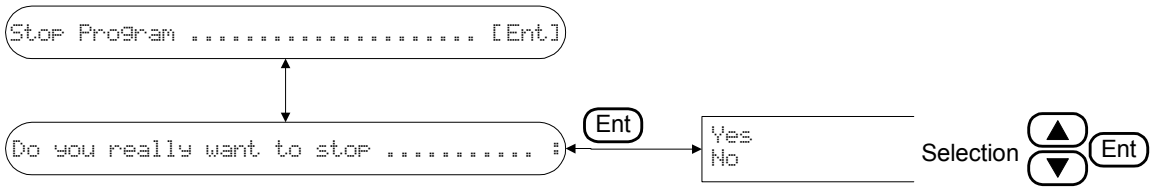


Figure 57: LCD Stop Program menu

Stops the Starfix-HPM application and return to the Loader program immediately after pressing [Ent] when 'Yes' is selected.

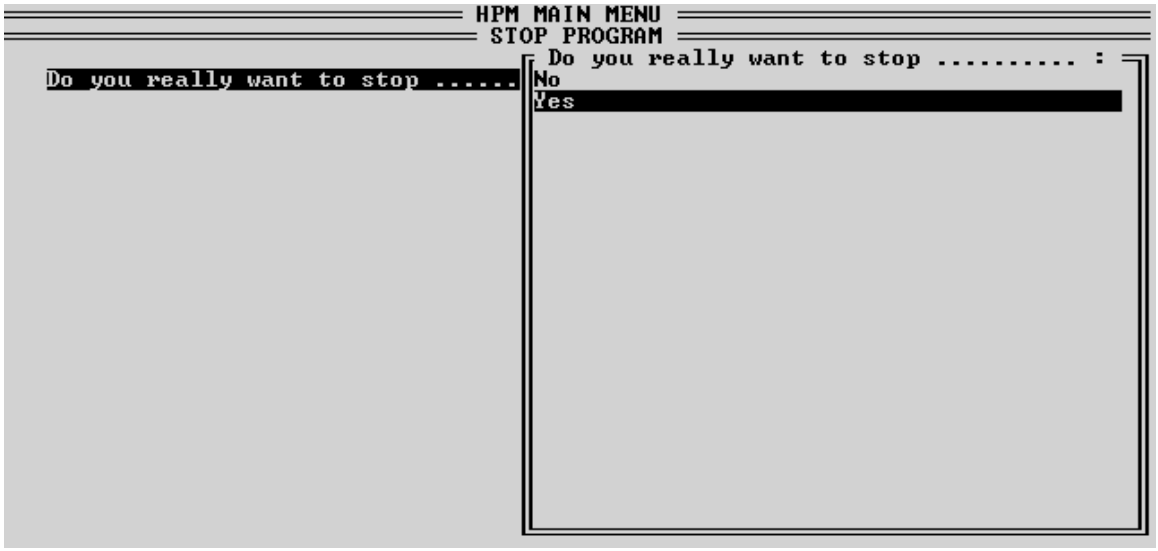


Figure 58: CRT Stop Program menu

APPENDICES

A: Starfix HPM Specifications
B: Backpanel Pin Layout
C: Internal Block Diagram Starfix-HP
D: Firmware upload procedure
E: Remote Control STARFIX Mobile
F: Interfacing a STARFIX mobile to IOWin using SPM Remote Control
G: Starfix HPM Output formats
H: Ionospheric and Tropospheric Corrector Settings

A: Starfix HP Specifications

Accuracy:

Starfix-HP position:
- 0.2m, 95% Horizontal
- 0.3m, 95% Vertical

Starfix VBS position:
- 3m, 95%

Physical, Environmental, Power:
- Size : 19" x 10" x 3.5"
- 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 position message (See appendix: G)
- Starfix VBS position message (See appendix: G)
- Uncorrected and corrected RTCM 104, Type 1, 3 and 15

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

B: Backpanel Pin Layout

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

The STARFIX-HPM also has an option to connect an external keyboard and VGA screen. The pin Layout is shown below:

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: Internal Block Diagram Starfix-HP

The Starfix-HP Mobile is based on an Ashtech and Topcon OEM, L1/L2 GPS receiver with 2 RS232 ports. PortA is internally connected to Com 6 of the internal processor for control purposes, and PortB can be used to relay RTCM 104 type 1 and 3 messages to Com 4 of the PC in Base station mode (only for models with Base options). Com1 to Com 4 are configurable RS232 ports on the back panel for I/O purposes. An external screen and Keyboard can be connected to the Starfix-HP for changes in the configuration and for software updates. An integrated 4x40 character LCD screen/Keypad is integrated into the front panel, and is internally connected to Com 5.

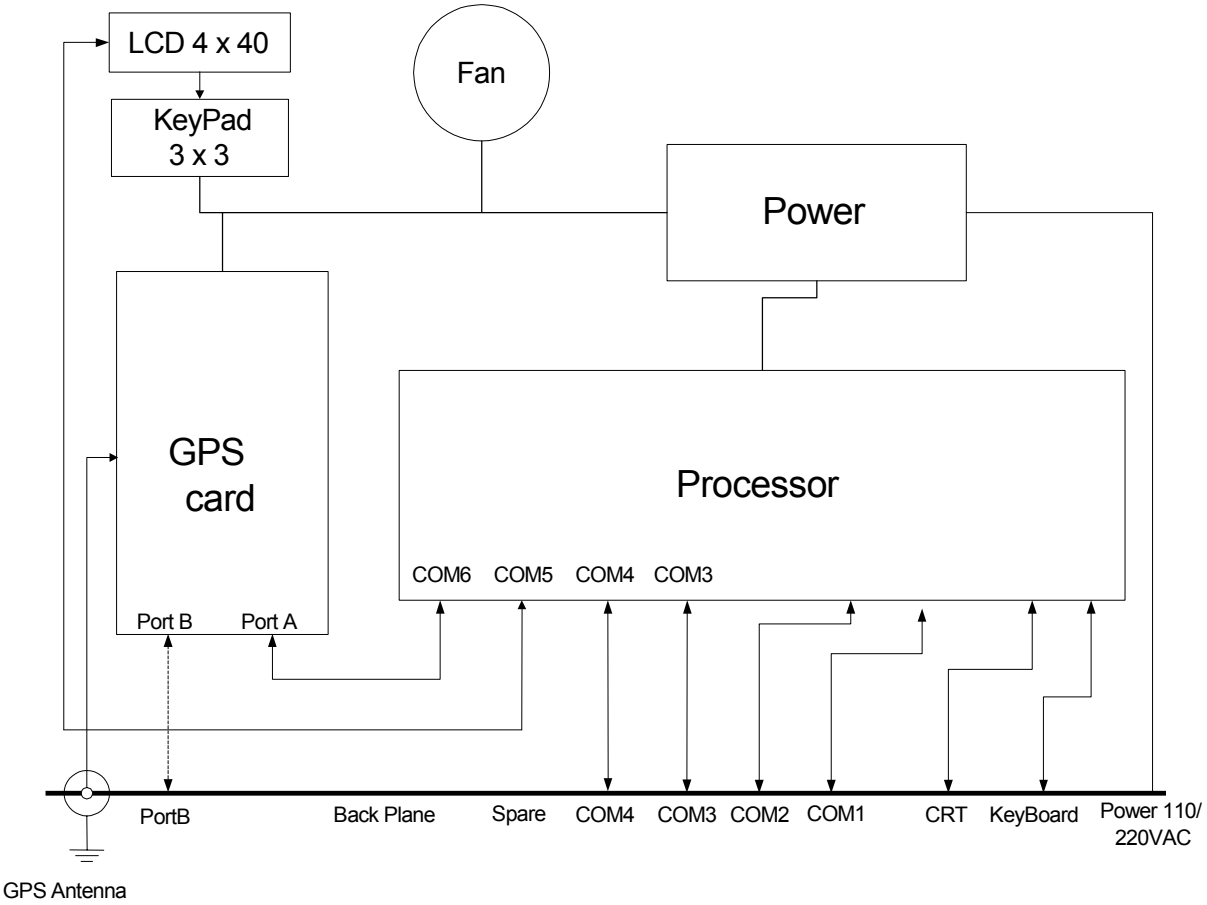


Figure 59: STARFIX-HP Internal Diagram

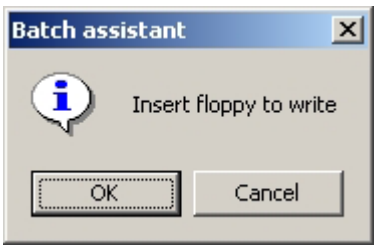
D: Firmware upload procedure

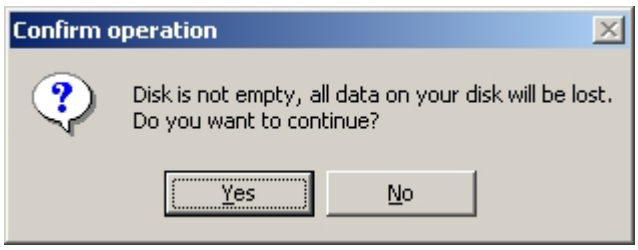
This procedure is applicable to HPM 3.07 and higher.

To upgrade software on the Starfix-Mobile you need:

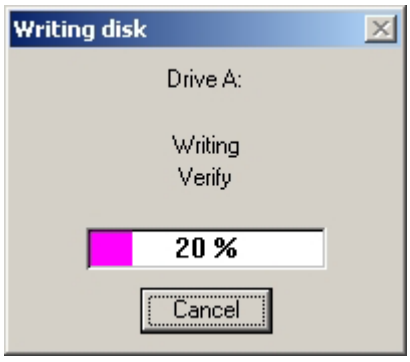
- The Starfix-HPM Software Release executable.
- PC with floppy disk drive and a com-port.
- Null modem cable (at least pins 2,3 and 5) or interface cable provided with the Starfix-Mobile system to connect PC COM1 to SPM port 1.
- Empty Floppy diskette.

The Starfix-HP Software release is a Windows executable, which creates a bootable disk that, can be used to boot your PC with a DOS-system and is configured to establish a peer to peer network connection between your PC and the Starfix-Mobile. Start the Executable and insert a floppy.





The floppy image will now be restored, and is a MS-DOS 6.22 bootable floppy.



Peer to peer network connection between PC and the Starfix-Mobile

The peer to peer network is established with:

- The MS-DOS software floppy and PC.
- The DOS utility DOS INTERLINK SERVR on the Starfix-Mobile.

Setting up the Starfix HP Mobile:

You must start the program DOS INTERLINK SERVER on the Starfix-Mobile. This needs to be done in the sequence below:

- Connect the Null modem cable to Com1 of both your PC and the Starfix-Mobile.
- Power-up the Starfix-Mobile.
- Wait for the following message on the LCD screen:

```
LOADER [8] 23 Oct 2002
Number of Com-Ports = 6
10s before starting Starfix-Mobile HPM
Press <Enter> to select another program
```

- Interrupt the countdown by pressing any key on the keypad of the STARFIX-Mobile.
- Select the **DOS Interlink Server** program in the loader.

Setting up the PC:

- Insert the Starfix-HP Utility diskette in a PC and boot from this diskette.
- Wait for the following message on your PC screen:

```
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.

```
Please Connect an interface cable between the -
Starfix-Mobile COM#1 and your PC COM#1

Pin Layout DB9 Male(PC Comm1) to DB9 Male(Starfix-Mobile Comm1):

DB9 Male (PC Comm1)              DB9 Male(Starfix-Mobile)

      Pin 2 ------------------------ Pin 3
      Pin 3 ------------------------ Pin 2
      Pin 5 ------------------------ Pin 5

Start the DOS Interlink Server program of your Starfix-Mobile

Press (C) to continue when ready!_
```

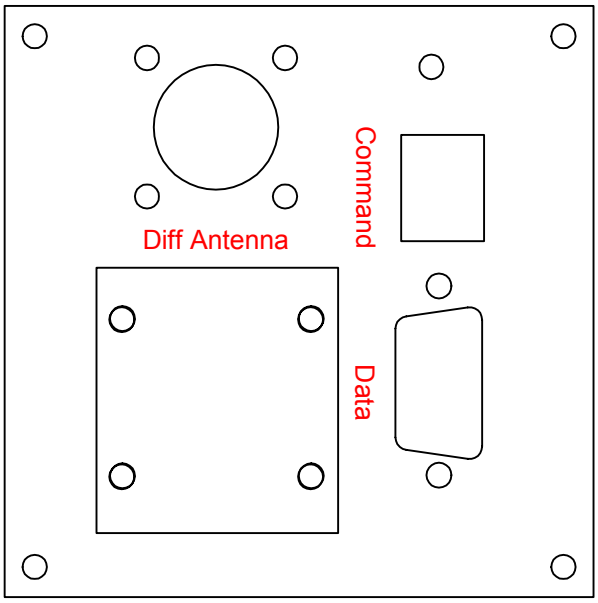
- When the cable is installed and everything is checked, press <C> to continue.
- The Connection between the Starfix-HP mobile and the PC is now tested, if it fails the previous screen will be visible again. If this happens you can check if the cable is wired correctly and the cable is connected to the com-ports described.

- If a previous install is found a similar screen like below will appear:

- Check the serial number on the back of the Starfix Mobile (serial number 481 and lower are Ashtech GPS receivers and serial numbers above are fitted with a TopCon GPS receiver).
- If the unit is fitted with a 3000 demodulator an additional N-Type bulkhead is visible on the back of the unit.
- 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 this screen for further installation if required.
- When all the required software has been installed, power cycle the unit for normal operation and select the Stafix-HP Mobile software to start.

E: Remote Control STARFIX Mobile

The Starfix-HP Mobile can optionally be fitted with a build-in demodulator. In this case on the back of the Starfix HP mobile there are two data connectors and one antenna connector:



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).

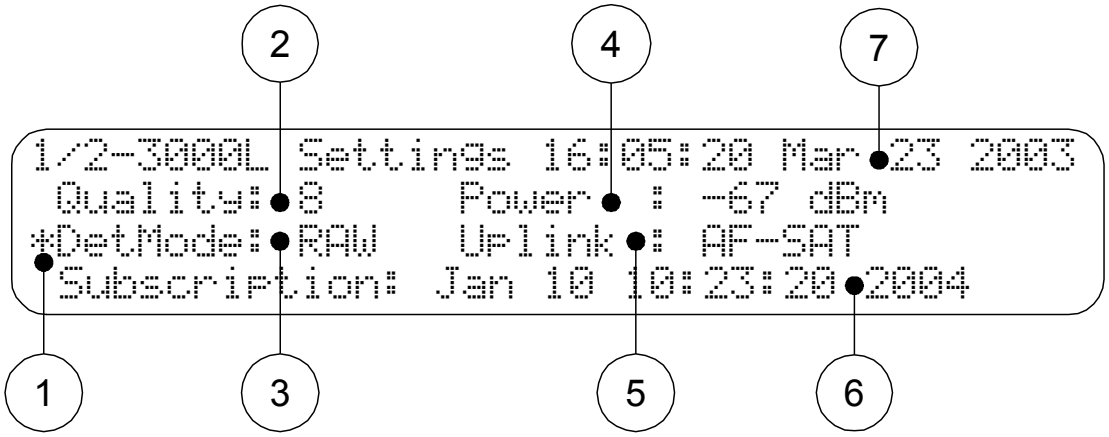
Configuring the 3000LCE demodulator.

- 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 Starfix-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:

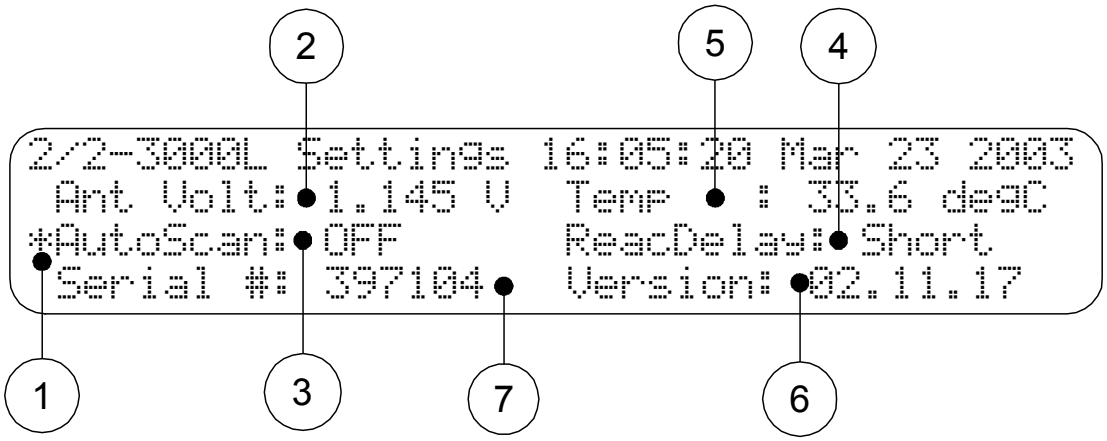


First Settings display**.**

This information display shows the following information:

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 Starfix-Mobile in HP mode or Plus mode, the detector mode must be set to RAW.**



Second Settings display.

This information display shows the following information:

1	Selector Cursor (is used to identify the current selected setting to be edited/changed)
2	Connected Antenna Voltage.
3	Autoscan 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 autoscanning.
5	Internal temperature of 3000Ice demodulator
6	Firmware version of Demodulator.
7	Serial Number of Demodulator.

Settings are changed using the front panel keys.

Front panel keys:

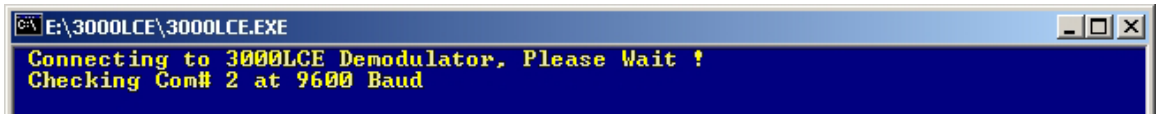
Esc	Stop Program
Prev	Previous Display
Next	Next Display
Ent	Select Next Entry of selected setting
▲	Select Next Entry of selected setting
◀	Move Selector Cursor to Left setting on current display
▼	Select Previous Entry of selected setting
▶	Move Selector Cursor to right setting on current display

Using the front-panel keys there are four settings which can be changed by the user:

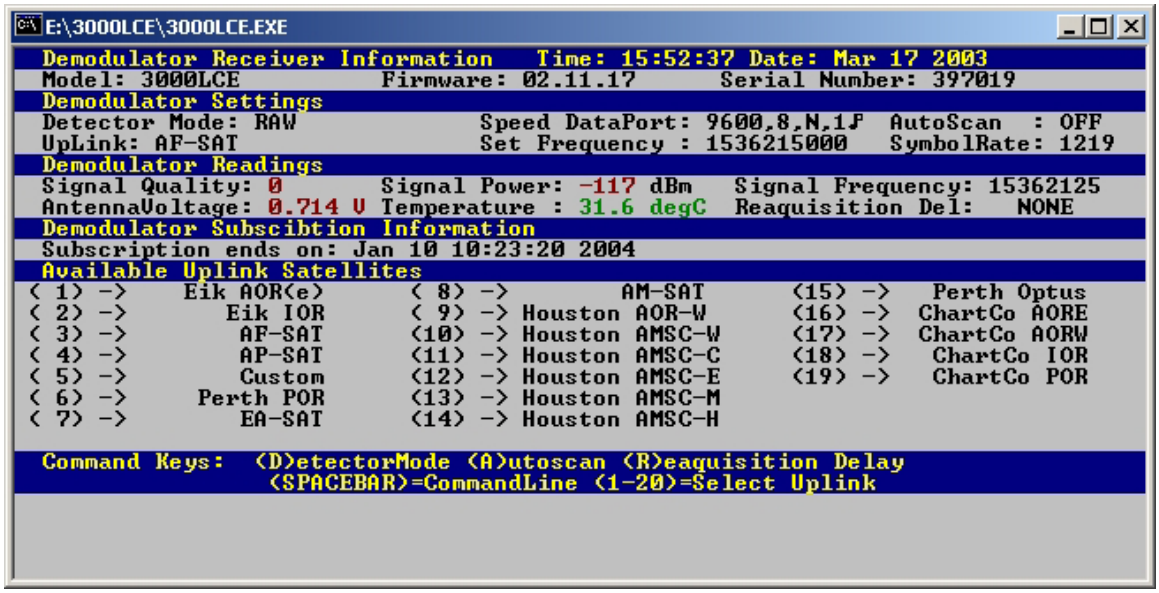
- Autoscan
  - This setting can either switched **on** or **off**. When switched on the demodulator will start cycling through all the available up-link satellite frequencies stored inside the demodulator. When switched off, the demodulator will remain searching the selected up-link frequency when lock 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 starfix-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 STARFIX_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 Starfix-HP mobile to set the Frequency and symbol rate yourself using a Command-Line.**

CRT Displays:

When the Configuration 3000L Program has started the following screen should visible.

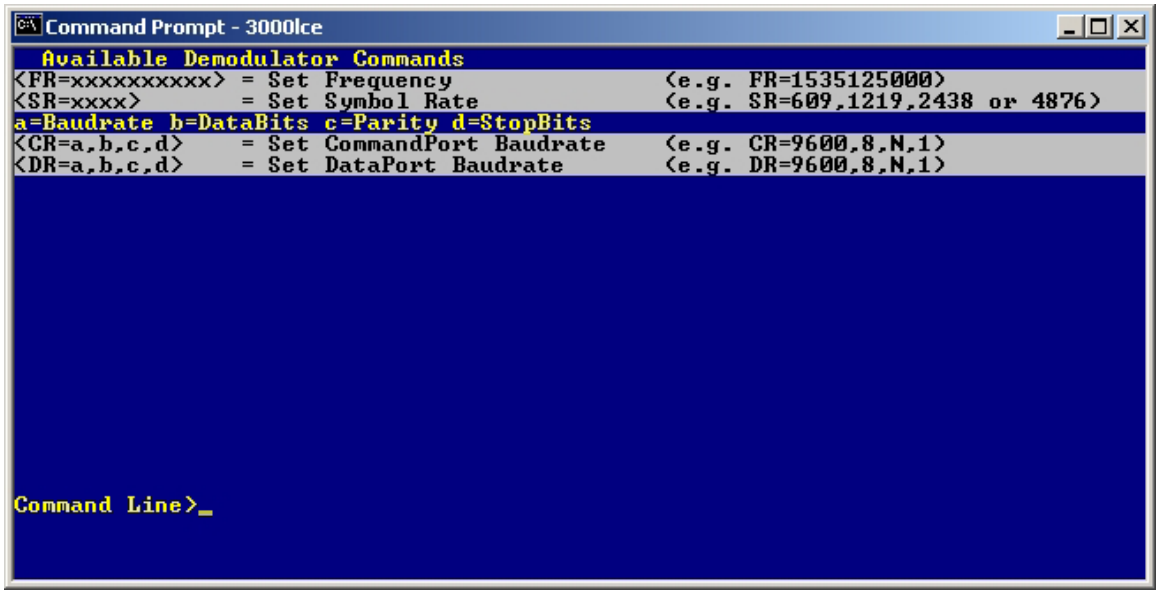


The program will start searching for a connected 3000 demodulator on all available comports. When the program has connected to the demodulator the following screen appears on the screen. There are two displays available:



There are 4 settings and a command line for manual input to change the same settings as previously mentioned:

- Autoscan (Key 'A')
- Reacquisition Delay (Key 'R')
- Detector Mode (Key 'D')
- Uplink (Keys 1 – 9)
  - This is a list of available up-link 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').**



F: Interfacing a STARFIX mobile to IOWin using SPM Remote Control

To run this setup, one needs to be sure than Starfix Suite Release 4.2 SP1 inclusive Release Candidate SpmMon RC2 is installed on your computer.

How to interface a Starfix Mobile to IOWin:

- Make an Interface cable between the Starfix Mobile COM-port 1 and the PC (DB9 Female to DB9 Female or DB9 Female to DB25 Female) as shown in the tables below.

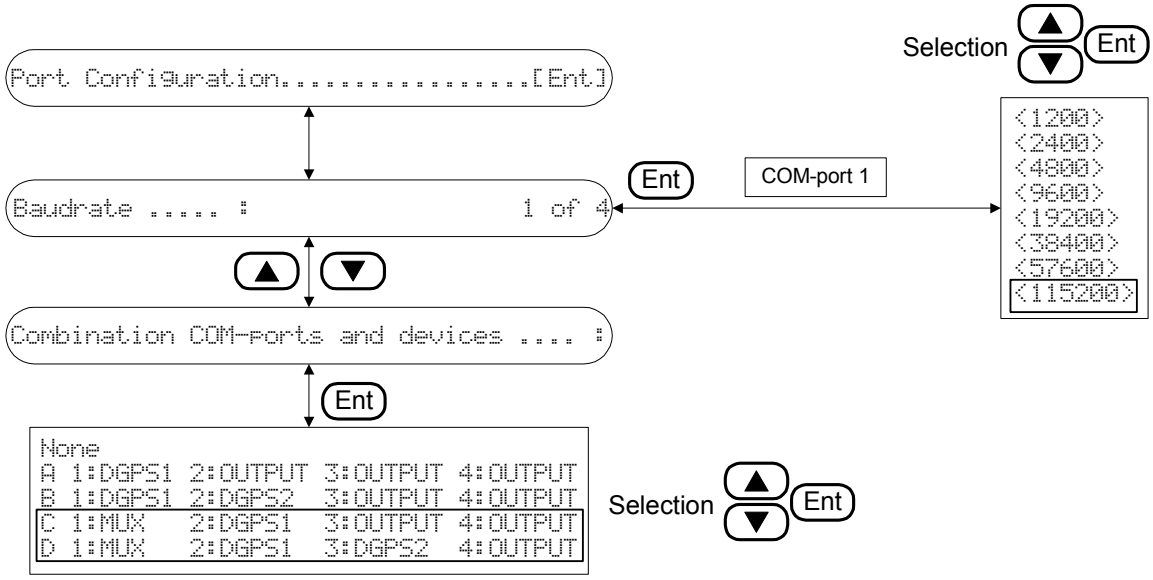
Sub-D Connector DB9 Female		Sub-D Connector DB9 Female	
Pin Number	**Description**	**Pin Number**	**Description**
2	RX	3	TX
3	TX	2	Rx
5	GND	5	GND

Sub-D Connector DB9 Female		Sub-D Connector DB25 Female	
Pin Number	**Description**	**Pin Number**	**Description**
2	RX	2	TX
3	TX	3	Rx
5	GND	7	GND

Note: Both Ports on each side are assumed to be DTE.

How to configure a Starfix Mobile for interfacing with IOWin:

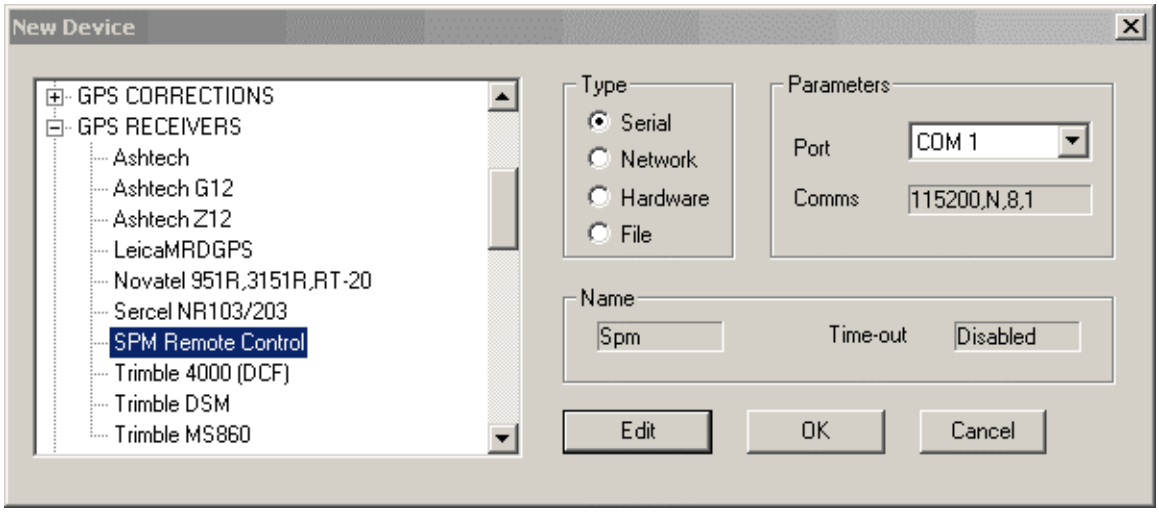
- COM-port 1 of the Starfix Mobile needs to be configured
- Select “Devices” in the LCD “Main Menu”
- Select “Port Cofiguration” in the “Devices” menu



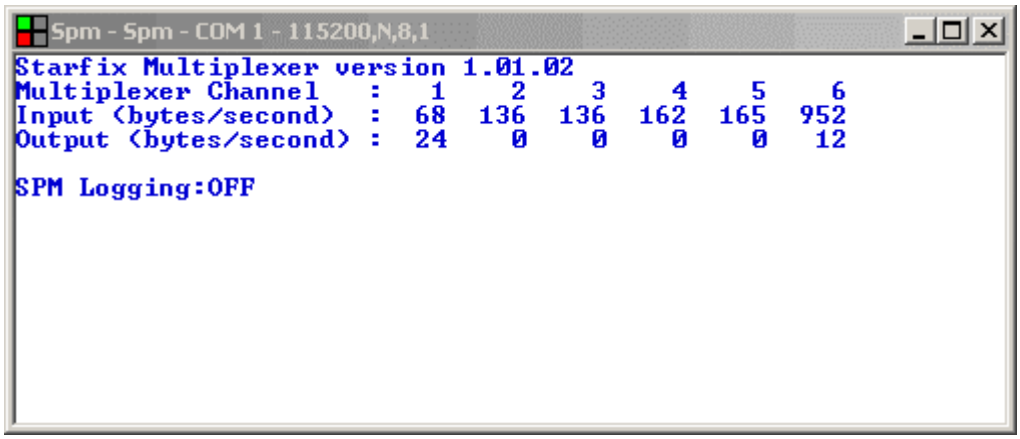
- Select pre-defined combination C or D
- Set Baudrate to 115200

How to configure IOWin:

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



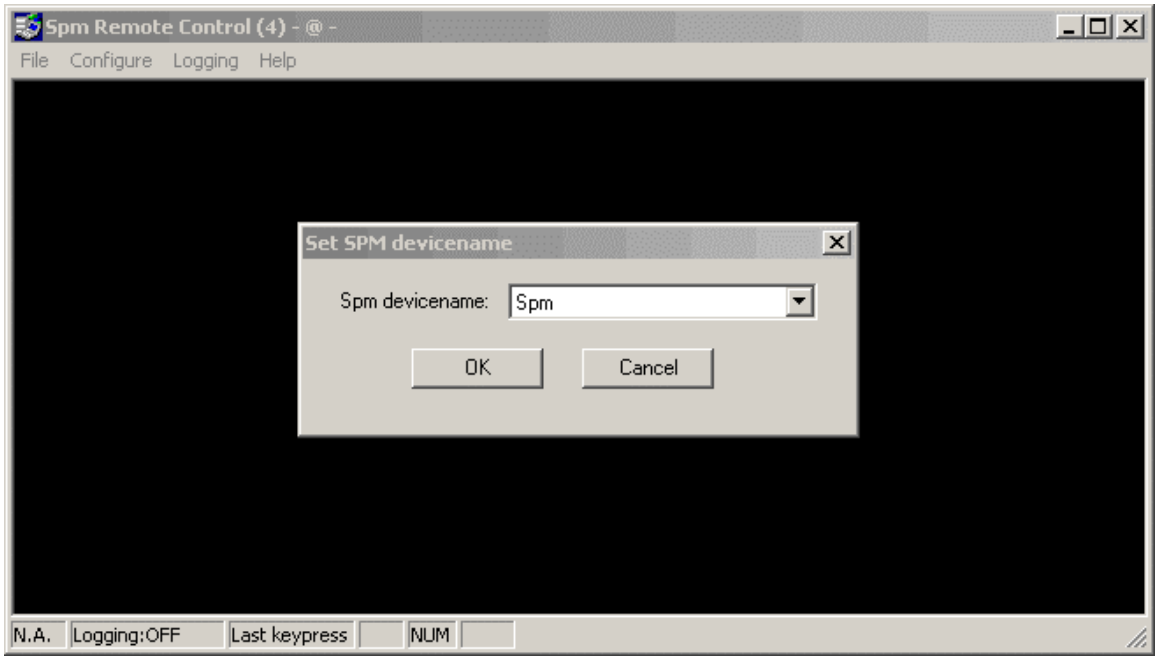
- Make sure the right driver (**SPM Remote Control)** is selected from the “GPS RECEIVERS” list.
- Use the default Baudrate of 115200
- When the OK button is pressed, the next window will be visible in IOWin.



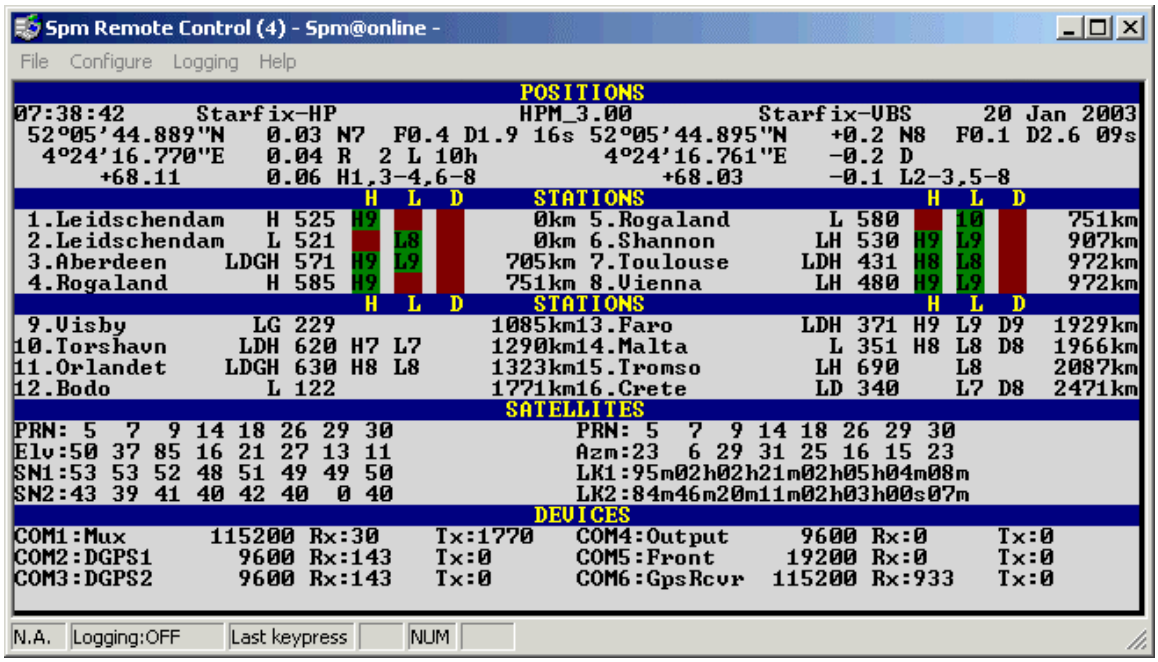
The Multiplexer Channels 1 through 6 are corresponding with:
OIS0x 01 through OIS0x 06 in IOWin. (Where x = connected comport number).

Multiplexer Channels are defined as follows:	
1	Remote Control, used by SPM Mobile for screen info
2	Incoming data on COM-Port 2 of Starfix HPM Mobile
3	Incoming data on COM-Port 3 of Starfix HPM Mobile
4	Configurable Input / Output Channel
5	Configurable Input / Output Channel
6	Raw GPS data from Starfix HPM Mobile. At the moment only the AshtechZ12.dll is available, the TopCon.dll is not supported yet.

- 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.



- This is the program used to remotely control the Starfix HPM.
- When the correct DeviceName is selected, the Spm Remote Control application will be displayed on screen.



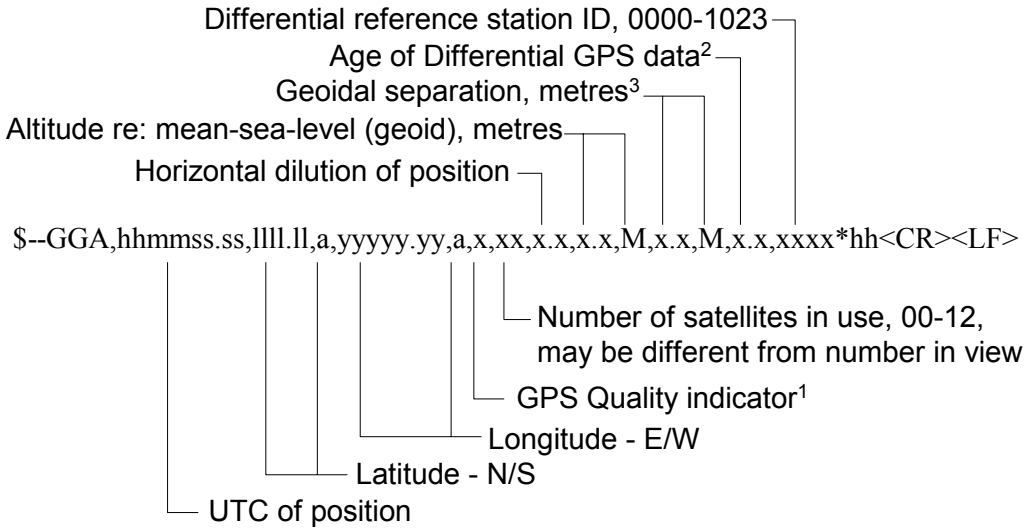
- From here, the Starfix HPM unit could be configured.

G: Starfix HPM Output formats

G1: GPGGA
G2: GECO
G3: DGPSQC
G4: GPLCT
G5: MONITOR_PVT, MONITOR_HPQ

G1: GPGGA

Time, position and fix related data for a GPS receiver



Notes:

1) GPS Quality Indicator:
   - 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

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

2) Time in seconds since last SC104 Type 1 or 9 update.

3) 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.

G2: GECO

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 CRLF 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 no. 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. Sats. 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..	[-]	Sats. used for this fix
Ref. Station Idents	I3*n	.. ...	[-]	Ref stns. used for this fix
End character	A1		[-]	]
CRLF	A2			

Comments

a) The "Nav point no." is a unique integer identifying the position.
- 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) The system name should identify the system (or contractor) and software version (e.g."SEADIFF 2.1" or "MFIX 1.2.3").

c) The "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) WGS84 ellipsoid and datum must be used. The Height must be antenna height above the WGS84 ellipsoid.

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

f) 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 no. 1, Sept. 1994) i.e. a Significance level of test 1% and the Power of the test 80%.
- If values other than those given above are used, this must be explicitly stated by the contractor.
- 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

Format

a) 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

b) The number of decimals for the Variance fields are 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.

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

d) 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.

G3: 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 no. 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. potentional 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				
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.

G4: GPLCT

$GPLCT,2001365,170002.00,2859.836227,N,09304.171413,W,5, -025.13, 090.00,05.55,02.01*64			
Pos	Data Item	Units	Sample - comment
0	Identifier	N/A	$GPLCT – fixed string that identifies the string
1	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.
2	UTC	hhmmss.ss	
3	Latitude	ddmm.mmmmmm	Degrees and decimal minutes, **6** digits on the decimal minutes
4	Latitude Hemisphere	c	N or S
5	Longitude	dddmm.mmmmmm	Degrees and decimal minutes, **6** digits on the decimal minutes
6	Longitude Hemisphere	c	E or W
7	GPS Quality indicator	n	0 = fix not valid 1 = GPS fix 2 = DGPS 5 = Float RTK/Starfix-HP
8	Antenna Height	±mmm.mm	Relative to **ellisoid**, meters; Range: -999.99 to +999.99
9	Course	ddd.dd	Vessel course over ground, degrees from North
10	Velocity	ss.ss	Vessel speed over ground, kts; Range: 0.00 to +999.99
11	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.

G5: MONITOR_PVT, MONITOR_HPQ

Purpose and Scope

This specification defines the Fugro MONITOR telegram to be output from the Fugro HP user mobiles (SPM2000 etc) for monitoring purposes. It is mainly to be used for Fugro internal monitoring purposes (eg with the QCPlot to plot time series plots).

However, if there are special client needs for information that is not available in other standard telegrams, the monitoring telegram could be used. It is also opened up for additional telegrams that may be needed, eg to meet future UKOOA requirements.

The specification is based on the NMEA proprietary message structure. See section 5.3.3 in "NMEA 0183, Standard For Interfacing Marine Electronic Devices" Version 2.20, January 1,1997.

This is a comma delimited format, meaning the number of digits after the decimal point may be changed without having to change the decoder. The number of digits after the decimal point defined below is what is recommended. If information is not available to fill a field, the field is left empty (i. e. two commas in a row).

Information that is available in other standard output telegrams will also be in the monitor telegram, plus additional information. If possible one of the standard telegrams should be used to output to clients.

There is already an action to implement the NMEA VTG velocity message (HP development mtg 31 jul-3 Aug 2001). This message does not have vertical velocity; this is one reason for having velocity in the Monitor telegram (some specialized airborne clients needs it)

In appendix 1, the definition of the Seastar DP position telegram is attached. This was developed in cooperation with Kongsberg for input to DP systems. This telegram can also be encrypted (to avoid non DP user to use the position information, see "SeaSTAR Protection Specification", v1.7, dated 7 Jan 1999). This format shall be implemented in HP units for direct use with DP systems.

Fugro Monitor Telegram Specification

The information required in the Monitor telegram would make it a string of about 270 characters if put into one string. The information will be divided into two separate telegrams:

Monitor telegram 1: Position/Velocity information (PVT)
Monitor telegram 2: Quality Information (HPQ)

The name to be used in mobile unit to activate the output string should be:

MONITOR-PVT
MONITOR-HPQ

FORMAT DEFINITION: PVT

Information in addition to a GGA string includes full date, speed, VDOP, and no of ref stns.

Content	Format	Unit	Comments
Start character		[-]	$ (HEX 24), Start of sentence
Sentence ID		[-]	P (HEX 50), Proprietary sentence ID
Talker		[-]	FGR, Manufactures Mnemonic code
Message info		[-]	PVT, Monitor string position/velocity
Start of comma delimitered fields			
Nav point no	xx		See comment (a)
System name/version	aaaaaaaaaa	[-]	e.g. HPM 3.07
Time	hhmmss.ss	[s]	Time UTC
Day	xx	[-]	
Month	xx	[-]	
Year	xxxx	[-]	
Latitude	ddmm.mmmmm	[dm]	WGS84
North or South	a		N/S
Longitude	dddmm.mmmmm	[dm]	WGS84
East or West	a		E/W
Ellipsoid Height	xxxx.xxx	[m]	WGS84
Speed North	xxx.xxxx	[m/s]	
Speed East	xxx.xxxx	[m/s]	
Speed Up	xxx.xxxx	[m/s]	
Fix status	xx	[-]	See comment (b)
No. of satellites	xx	[-]	Sats. used for this fix
HDOP	xx.xx	[-]	
VDOP	xx.xx	[-]	
Age of corrections	xx.x	[s]	See comment (c)
No. of ref. Stations	xx	[-]	No. Ref stns. used for this fix See 2.2(i)
End of comma delimitered fields			
Checksum field			*<CS>
CRLF			<CR><LF>

Example:

```
$PFGRPVT,01,HPM2.2,223010.00,11,07,2002,,,,,,……,,,*<CS><CR><LF>
```

FORMAT DEFINITION: HPQ

Content	Format	Unit	Comments
Start character		[-]	$ (HEX 24), Start of sentence
Sentence ID		[-]	P (HEX 50), Proprietary sentence ID
Talker		[-]	FGR, Manufactures Mnemonic code
Message info		[-]	HPQ, Monitor string quality
Start of comma delimitered fields			
Nav point no	xx		See comment (a)
System name/version	aaaaaaaaaa	[-]	e.g. HPM 3.07
Time	hhmmss.ss	[s]	Time UTC
Day	xx	[-]	
Month	xx	[-]	
Year	xxxx	[-]	
Reserved	xx.xxx	[m]	
Reserved	xx.xxx	[m]	
Reserved	xx.xxx	[m]	
Reserved	xx.xxx	[m]	
SDUW	xx.xxx	[-]	See comment (g)
Standard Deviation Lat	xx.xxx	[m]	See comment (h)
Standard Deviation Lon	xx.xxx	[m]	See comment (h)
Standard Deviation Height	xx.xxx	[m]	See comment (h)
Reserved	xx.xxx	[m]	
No. of satellites	xx	[-]	Sats. used for this fix
Reserved	xx	[-]	
No. of ref. Stations	xx	[-]	No. Ref stns. used for this fix See (i)
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.
End of comma delimitered fields			
Checksum field			*<CS>
CRLF			<CR><LF>

Example:

```
$PFGRHPQ,01,HPM2.2,223010.00,11,07,2002,,,,,,……,,,*<CS><CR><LF>
```

COMMENTS:

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

e) Reserved

f) Reserved

g) SDUW, Standard Deviation of Unit Weight, square root of Unit Variance, calculated from the normalized residuals in the overdetermined fix.

h) The standard deviation terms are calculated from the Variance-Covariance matrix of the position fix computation.

i) "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.

Telegram for Interface to DP: (NOT IMPLEMENTED YET)

From SeaSTAR Protection Specification

This is the telegram is used out of the Kongsberg Seatex DPS system into the Kongsberg Simrad DP systems. Will also be used out of Fugro units that directly interface to DP systems.

```
1       9  12       21           34             48    53 56    61    66   70   74 ....................78
$PxxxDP,GG,hhmmss.s,ddmm.mmmmm,N,dddmm.mmmmm,E,NN,Q,DD,aa.a,bb.b,ddd,rr.r*<CS><CR><LF>
```

PxxxDP	Proprietary message identificator with talker xxx equal to FUG
GG	Two character code for GPS (GP), GLONASS (GL) or GNSS (GN)
data	
hhmmss.s	Time (UTC)
ddmm.mmmmm,N	Latitude, Latitude sign (N/S)
dddmm.mmmmm,E	Longitude, Longitude sign (E/W)
NN	Total number of satellites (GPS + GLONASS)
QI	DPVOA (UKOOA) Quality indicator (0-9) (see note 1)
DD	DGNSS mode indicator (as defined for NMEA standard telegram $__GNS)
aa.a	Error ellipse (standard deviation semi-major axis, m)
bb.b	Error ellipse (standard deviation semi-minor axis, m)
ddd	Error ellipse (direction, deg)
rr.r	RMS value of the standard deviation of the range inputs to the navigation process (see note 2)

The resulting telegram is shorter than the maximum defined telegram length of 82 characters, even with mm level resolution in Latitude / Longitude.

Note 1: This quality indicator is defined in “Guidelines on the use of DGPS in as a positioning reference in DP Control Systems” IMCA M141, dated Oct 1997 http://www.imca-int.com/publications/marine/imca.html

Note 2: This is the same as the definition in the GST telegram in the “NMEA 183 Standard For Interfacing Marine Electronic Devices” from version 2.20, dated January 1 1997 http://www.nmea.org/0183.htm

H: Ionospheric and Tropospheric Corrector Settings

CLIENT IONO	CLIENT TROPO	STARFIX-PLUS	CLIENT DGPS SOFTWARE	END RESULT
OFF	OFF	CPRC=RPRC+DT15+DTROP	FPRC=CPRC	= RPRC+DT15+DTROP
ON	OFF	CPRC=RPRC+DT15-DKLOB+DTROP	FPRC=CPRC+DKLOB	= RPRC+DT15+DTROP
OFF	ON	CPRC=RPRC+DT15	FPRC=CPRC+DTROP	= RPRC+DT15+DTROP
ON	ON	CPRC=RPRC+DT15-DKLOB	FPRC=CPRC+DKLOB+DTROP	= RPRC+DT15+DTROP

CPRC = corrected pseudo range correction (Starfix-Plus output, Client's input)
RPRC = raw pseudo range correction (Starfix-Plus input)
DT15 = differential ionospheric delay from GPS L1/L2 observable
DKLOB = differential ionospheric delay using the Klobuchar model
DTROP = differential tropospheric delay using the ICD-200 troposphere model

The table above shows the corrections applied to the raw pseudo-range corrections (RPRC) by Starfix-Plus, and the corrections assumed to be applied by the Client's DGPS software to the Starfix-Plus corrected pseudo-range corrections (CPRC). If the Client software does not apply corrections as defined, this can lead to large positioning errors.

The column CLIENT IONO shows the setting for "Client iono corrections"
OFF: Client's DGPS software does not apply differential ionospheric (Klobuchar) corrections.
ON: Client's DGPS software applies differential ionospheric (Klobuchar) corrections.

The column CLIENT TROPO shows the setting for "Client tropo corrections" OFF: Client's DGPS software does not apply tropospheric corrections. ON: Client's DGPS software applies tropospheric corrections.

The column STARFIX-PLUS shows the corrections applied by Starfix-Plus, where a differential delay is the difference between the delay at the reference station and the mobile.

The column CLIENT DGPS SOFTWARE shows the corrections assuming to be applied by the Client's DGPS software, where:
FPRC = Final Pseudo-Range Correction after Client's DGPS differential atmospheric corrections have been applied.

The column END RESULT shows that for all 4 possible cases of CLIENT IONO and CLIENT TROPO the end result is that the raw pseudo range corrections are corrected for differential ionospheric delays from GPS L1/L2 observable and for differential tropospheric delays.
If the Client's software allows 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

Updated 12th December 2002					Fugro World-wide Station Data																					
					UPLINK CHANNEL												CO-ORDINATES									
					EU	EU/Asia	Am	P Rim	Europe		Americas				Asia		LATITUDE				LONGITUDE				Hgt	
STATION - LOCATION		Data Type	REF ID	* Ionosphere Corrected ID	AORE 1535.090	IOR 1535.090	AORW 1535.0975	POR 1535.115	EA-Sat 1535.1525	AF-Sat 1536.215	AM-Sat 1535.1375	AMSC-E 1556.825	AMSC-C 1554.497	AMSC-W 1551.489	Optus 1558.510	APSat 1535.1375	d	m	s	N/S	d	m	s	E/W	m	
Aberdeen	Scotland	SDGH	571	957	S G	S			S G H								57	11	56.297	N	02	05	32.313	W	101.857	
Abidjan	Ivory Coast	SD	050	906	S D				S D	**S D**							05	15	18.979	N	03	55	55.727	W	50.762	
Abu Dhabi	UAE	SDH	016	924		S D			S D H							S D	24	22	55.668	N	54	29	43.942	E	-21.312	
Adelaide	Australia	S	355												S		34	55	51.827	S	138	36	12.785	E	54.360	
Alexandria	Egypt	SD	310	931		S D			S D								31	14	10.964	N	29	57	3.804	E	75.725	
Anadyr*	Russia	S	640	964													64	44	3.000	N	177	31	7.000	E	45.330	
Asahikawa	Japan	SD	430	942				S D								S D	43	44	47.748	N	142	20	33.324	E	155.084	
Astrakhan*	Russia	SD	462	946	S D				S D								46	21	0.000	N	48	02	18.000	E	5.000	
Auckland	NZ	SD	022	936				S							S	S	36	47	33.488	S	174	45	50.207	E	51.400	
Bahrain	Bahrain	S	260			S										S	26	10	18.410	N	50	36	9.083	E	-11.837	
Baku	Azerbaijan	SDGH	400	940	S D	S D G			S D								40	17	31.645	N	49	44	36.953	E	-29.696	
Bali	Indonesia	SDH	096	907		S		S							S D	S D H	08	41	35.705	S	115	12	32.999	E	53.833	
Bangkok	Thailand	SDH	141	916				S								S D H	13	49	37.033	N	100	33	57.702	E	65.900	
Bathurst	Australia	SH	336												S H	S	33	25	46.902	S	149	34	1.960	E	756.800	
Billings_Mt	USA	S	461									S	S	S			45	46	57.836	N	108	30	27.454	W	956.470	
Billings_Mt	USA	H	460										H	H			45	46	57.861	N	108	30	27.495	W	955.790	
Blantyre	Malawi	S	155						S	**S**							15	47	10.362	S	35	00	17.864	E	1061.489	
Bodo	Norway	S	122														67	16	30.148	N	14	21	28.097	E	55.700	
Boulder_Co	USA	S	402									S	S	S			40	01	43.558	N	105	15	9.420	W	1602.461	
Boulder_Co	USA	H	405										H	H			40	01	43.581	N	105	15	9.276	W	1601.571	
Brisbane	Australia	SH	275												S H		27	28	38.507	S	153	01	37.338	E	93.100	
Broome	Australia	SD	185	918				S D							S D	S D	17	57	36.389	S	122	14	32.810	E	45.149	
Buenos Aires	Argentina	S	345				S				S						34	36	45.339	S	58	22	40.477	W	81.450	
Cape Town	S.Africa	S	335						S	**S**							33	54	53.262	S	18	28	21.674	E	42.200	
Caracas	Venezuela	H	108								H						10	30	1.384	N	66	53	57.362	W	958.229	
Caracas	Venezuela	LD	112	911			S D				S D						10	30	1.384	N	66	53	57.362	W	958.229	
Carmen	Mexico	S	110									S	S	S			18	39	10.645	N	91	50	40.365	W	8.690	
Carmen	Mexico	S	182				S				S						18	39	10.654	N	91	50	40.386	W	7.051	
Carmen	Mexico	H	183								H						18	39	10.654	N	91	50	40.386	W	7.051	
Cayman	Grand Cayman	S	192								S						19	18	11.833	N	81	22	56.447	W	9.209	
Cayman	Grand Cayman	H	194								H						19	18	11.833	N	81	22	56.447	W	9.209	
Chennai	India	SD	131	914		S D										S D	13	03	6.865	N	80	14	51.635	E	-65.943	
Cobar	Australia	H	316												H		31	29	57.445	S	145	50	20.339	E	270.088	
Cocoa Beach_Fl	USA	S	120									S	S	S			28	07	9.073	N	80	34	42.447	W	-18.731	
Cocoa Beach_Fl	USA	S	281								S						28	07	9.092	N	80	34	42.456	W	-20.308	
Cocoa Beach_Fl	USA	SG	121				S G										28	07	9.060	N	80	34	42.232	W	-20.620	
Cocoa Beach_Fl	USA	H	282								H	H					28	07	9.092	N	80	34	42.456	W	-20.308	
Crete	Greece	SD	340	934		S D			S D								35	18	37.635	N	25	09	15.497	E	138.170	
Curitiba	Brazil	SD	257	930			S D				S D						25	26	12.838	S	49	16	40.949	W	978.667	
Curitiba	Brazil	H	258								H						25	26	12.838	S	49	16	40.949	W	978.667	
Dakar	Senegal	SD	144	917					S D	**S D**							14	40	33.650	N	17	26	14.240	W	69.329	
Dartmouth	Canada	S	440				S				S						44	42	1.977	N	63	34	54.436	W	69.082	
Darwin	Australia	SD	125	913				S							S D	S D	12	22	25.628	S	130	52	17.261	E	70.361	
Douala	Cameroon	SDH	043	904	S D				S D H	**S D H**							04	00	47.902	N	09	43	0.795	E	47.048	
Duluth_Mn	USA	S	491									S	S	S			46	50	14.216	N	92	12	48.606	W	433.365	
Duluth_Mn	USA	H	492									H	H				46	50	14.247	N	92	12	48.632	W	432.458	

Updated 12th December 2002					Fugro World-wide Station Data																					
					UPLINK CHANNEL												CO-ORDINATES									
					EU	EU/Asia	Am	P Rim	Europe		Americas				Asia		LATITUDE				LONGITUDE				Hgt	
STATION - LOCATION		Data Type	REF ID	* Ionosphere Corrected ID	AORE 1535.090	IOR 1535.090	AORW 1535.0975	POR 1535.115	EA-Sat 1535.1525	AF-Sat 1536.215	AM-Sat 1535.1375	AMSC-E 1556.825	AMSC-C 1554.497	AMSC-W 1551.489	Optus 1558.510	APSat 1535.1375	d	m	s	N/S	d	m	s	E/W	m	
Dunedin	NZ	SD	026	945				S							S		45	52	10.214	S	170	30	39.315	E	25.900	
Durban	S.Africa	S	305						S	**S**							29	50	23.924	S	31	00	3.331	E	139.868	
Everett_Wa	USA	S	555									S	S	S			47	54	15.004	N	122	16	28.995	W	168.222	
Everett_Wa	USA	H	554											H			47	54	15.025	N	122	16	29.048	W	167.873	
Everett_Wa	USA	S	472					S									47	54	15.025	N	122	16	29.048	W	167.873	
Faro	Portugal	SDH	371	937	S D				S D H	**S D**							37	01	13.201	N	07	58	7.902	W	75.733	
Fayetteville_NC	USA	S	130									S	S	S			35	06	20.216	N	78	55	19.644	W	33.730	
Fayetteville_NC	USA	H	350									H					35	06	20.240	N	78	55	19.652	W	32.328	
Guayaquil	Ecuador	S	202				S				S						02	11	24.406	S	79	52	52.762	W	118.786	
Hong Kong	Hong Kong	SD	220	925		S										S D	22	21	55.644	N	114	00	23.654	E	22.400	
Honolulu_Hi	USA	SD	210	927				S D			S						21	20	0.602	N	157	54	33.666	W	67.600	
Houston_TX	USA	S	792									S	S	S			29	43	30.576	N	95	30	33.360	W	1.597	
Houston_Tx	USA	S	793				S				S						29	43	30.594	N	95	30	33.384	W	0.266	
Houston_Tx	USA	H	292								H	H	H	H			29	43	30.594	N	95	30	33.384	W	0.266	
Istanbul	Turkey	SDG	410	941	S D	S D											41	03	25.273	N	28	59	10.255	E	179.266	
Johannesburg	S.Africa	S	262														25	59	14.884	S	28	08	21.127	E	1655.384	
Kalgoorlie	Australia	SH	315												S H	S	30	44	34.718	S	121	28	34.012	E	374.197	
Karratha	Australia	SDH	215	920											S D H	S D	20	37	41.838	S	116	45	24.981	E	7.856	
Kota Kinabalu	Malaysia	S	061													S	05	58	22.362	N	116	04	32.992	E	96.028	
Kuantan	Malaysia	S	041													S	03	48	33.503	N	103	19	49.992	E	23.500	
Kuwait	Kuwait	SDH	290	929					S D H							S	29	15	53.109	N	47	57	56.823	E	37.303	
Lagos	Nigeria	S	060		S				S	**S**							06	27	7.175	N	03	23	27.232	E	95.423	
Las Palmas	Canaries-Sp	SD	280	928	S D				S D	**S D**							27	56	27.244	N	15	23	13.093	W	89.832	
Leidschendam	Netherlands	S	521		S				S								52	05	44.851	N	04	24	16.598	E	67.978	
Leidschendam	Netherlands	H	525						H								52	05	44.901	N	04	24	16.541	E	67.953	
Long Island_NY	USA	S	333									S	S	S			40	56	18.626	N	73	02	6.715	W	31.469	
Long Island_NY	USA	H	334								H	H					40	56	18.655	N	73	02	6.718	W	30.205	
Long Island_NY	USA	S	411				S				S						40	56	18.655	N	73	02	6.718	W	30.205	
Luanda	Angola	SDH	095	909	S D				S D H	**S D H**							08	48	12.774	S	13	14	31.469	E	107.846	
Malta	**Malta**	**SDH**	351	935	S D				S D								35	50	56.418	N	14	29	43.341	E	133.875	
Melbourne	Australia	SD	385	938				S							S D	S	37	48	29.014	S	144	57	48.027	E	82.043	
Mercedes_Tx	USA	S	160									S	S	S			26	06	10.818	N	97	51	24.455	W	-2.500	
Mercedes_Tx	USA	S	263								S						26	06	10.834	N	97	51	24.482	W	-3.872	
Mercedes_Tx	USA	H	264								H		H	H			26	06	10.834	N	97	51	24.482	W	-3.872	
Miri	Malaysia	SDH	042	903				S								S D H	04	24	1.184	N	113	59	41.754	E	57.912	
Mumbai-Arvi	India	SD	191	919		S D										S D H	19	09	0.312	N	73	57	27.674	E	627.900	
Nairobi	Kenya	S	015						S	**S**							01	17	38.051	S	36	48	39.955	E	1729.429	
Ny Alesund	Norway	S	101		S												78	55	46.440	N	11	51	55.699	E	86.400	
Okinawa	Japan	SD	261	926		S		S								S D	26	15	17.939	N	127	42	44.323	E	72.500	
Orlandet	Norway	SDGH	630	963	S G				S H								63	40	58.665	N	09	35	21.082	E	73.512	
Oslo	Norway	H	595														59	55	24.621	N	10	40	41.811	E	71.740	
Pensacola_Fl	USA	S	150									S	S	S			30	28	50.069	N	87	14	55.358	W	11.862	
Pensacola_Fl	USA	H	291								H	H	H				30	28	50.089	N	87	14	55.375	W	10.423	
Pensacola_Fl	USA	S	301								S						30	28	50.089	N	87	14	55.375	W	10.423	
Perth	Australia	SDH	325	932		S									S D H		31	56	40.421	S	115	50	30.361	E	10.973	
Platong	Thailand	S	018													S	09	41	28.741	N	101	24	14.768	E	18.581	

Updated 12th December 2002 — **Fugro World-wide Station Data**

STATION - LOCATION		Data Type	REF ID	* Ionosphere Corrected ID	UPLINK CHANNEL												CO-ORDINATES								Hgt
					EU	EU/Asia	Am	P Rim	Europe		Americas				Asia		LATITUDE				LONGITUDE				
					AORE 1535.090	IOR 1535.090	AORW 1535.0975	POR 1535.115	EA-Sat 1535.1525	AF-Sat 1536.215	AM-Sat 1535.1375	AMSC-E 1556.825	AMSC-C 1554.497	AMSC-W 1551.489	Optus 1558.510	APSat 1535.1375	d	m	s	N/S	d	m	s	E/W	m
Pointe-Noire	Congo	SDGH	045	905	S G D				S D G H	**S D G H**							04	47	48.553	S	11	51	13.799	E	20.892
Port Elizabeth	S.Africa	S	337						S	**S**							33	58	49.043	S	25	35	43.193	E	103.604
Port Of Spain	Trinidad	SD	111	912			S D				S D						10	39	3.321	N	61	30	41.910	W	-5.147
Port Of Spain	Trinidad	SG	113				S G				G						10	39	3.304	N	61	30	41.880	W	-4.691
Port Of Spain	Trinidad	H	115								H						10	39	3.321	N	61	30	41.910	W	-5.147
Punta Arenas	Chile	S	201				S				S						53	09	49.408	S	70	54	27.765	W	53.653
Quincy_II	USA	S	403									S	S	S			40	06	35.823	N	91	01	49.075	W	188.904
Quincy_II	USA	H	404									H	H				40	06	35.849	N	91	01	49.097	W	187.781
Recife	Brazil	SD	075	908	S D		S D				S D						08	03	3.465	S	34	53	22.088	W	20.406
Redding_Ca	USA	S	180									S	S	S			40	33	53.521	N	122	21	48.815	W	134.968
Redding_Ca	USA	H	181											H			40	33	53.540	N	122	21	48.863	W	134.470
Rio De Janeiro	Brazil	SD	225	923	S D		S D				S D						22	53	50.433	S	43	10	49.012	W	109.779
Rio De Janeiro	Brazil	SG	226		S G		S G				G						22	53	50.465	S	43	10	48.948	W	110.180
Rio De Janeiro	Brazil	H	227				H				H						22	53	50.433	S	43	10	49.012	W	109.779
Rogaland	Norway	S	580		S	S			S	**S**							58	48	38.011	N	05	40	24.100	E	126.293
Rogaland	Norway	H	585						H								58	48	38.049	N	05	40	23.990	E	126.305
San Diego_Ca	USA	S	140									S	S	S			32	54	38.920	N	117	10	24.287	W	79.721
San Diego_Ca	USA	H	142											H			32	54	38.938	N	117	10	24.330	W	78.938
San Diego_Ca	USA	S	320					S									32	54	38.938	N	117	10	24.330	W	78.938
Sakhalin*	Russia	SD	510	951				S D								S D	51	49	8.000	N	143	10	19.000	E	39.139
Sao Tome	**Sao Tome**	**SDH**	011	902	S D				S D **H**	**S D H**							00	19	10.193	N	06	44	14.092	E	40.514
Seoul	S.Korea	S	370	939				S D								S D	37	33	48.733	N	126	58	9.460	E	144.740
Shannon	Ireland	SH	530		S		S		S H								52	41	30.268	N	08	55	4.745	W	78.014
Singapore	Singapore	SDH	010	901		S										S D H	01	22	34.381	N	103	58	14.187	E	34.639
St. Johns	Canada	S	470	947			S				S						47	33	28.261	N	52	46	11.425	W	125.124
St. Johns	Canada	H	471				H				H						47	33	28.261	N	52	46	11.425	W	125.124
Subic Bay	Phillipines	SD	151	915		S		S								S D	14	48	57.152	N	120	16	56.204	E	59.255
Torshavn	Faroes	SDH	620	962	S				S H								62	00	39.316	N	06	46	19.561	W	92.561
Toulouse	France	SDH	431	943	S D				S								43	34	1.008	N	01	29	15.010	E	203.453
Townsville	Australia	S	195												S		19	15	52.647	S	146	48	44.108	E	73.100
Tromso	Norway	SH	690		S				S								69	39	13.626	N	18	56	14.452	E	143.294
Vardo	Norway	S	114		S P												70	20	10.936	N	31	01	52.275	E	180.100
Vienna	Austria	SH	480						S H								48	07	27.805	N	16	33	3.647	E	235.418
Visby	Sweden	SG	229														57	39	13.922	N	18	22	2.327	E	79.959
Visby	Sweden	H	576														57	39	13.93	N	18	22	2.3384	E	79.948
Vitoria	Brazil	H	204				H				H						20	18	52.908	S	40	17	39.012	W	38.343
Vitoria	Brazil	SD	205	921	S D		S D				S D						20	18	52.908	S	40	17	39.012	W	38.343
Vitoria	Brazil	SG	206		S G		S G				G						20	18	52.894	S	40	17	38.980	W	38.398
Vung Tau	Vietnam	SDH	012	910		S		S								S D H	10	20	34.177	N	107	05	28.159	E	36.370
Walvis Bay	Namibia	SD	235	922	S D				S D	**S D**							22	57	1.308	S	14	30	12.791	E	36.838
Baud					**1200**	**600**	**1200**	**600**	**1200**	**600**	**1200**	**1200**	**1200**	**1200**	**1200**	**1200**									

N.B. Entries in bold are the most recent changes

*** Ionosphere Corrected ID's are not transmitted, but generated in Starfix Plus Hardware, using Dual Frequency data from reference Station**

D indicates Iono corrections (Dual Frequency Data) broadcast. **H** indicates High Performance broadcast. **P** indicates PROJECT station. **S** indicates Single Frequency L1 corrections.

G indicates Glonass correctionst. AMSC **S** data broadcast in NAD, all others in ITRF. * Anadyr, Astrakhan and Sakhalin stations operated by Svarog, Russia.