Seatex DARPS 132

User's Manual

Issued: 2006-08-16

Blank page

Notice

- All rights reserved. Reproduction of any of this manual in any form whatsoever without prior written permission from Kongsberg Seatex AS is forbidden.
- The content of this manual is subject to change without notice.
- All efforts have been made to ensure the accuracy of the contents of this manual. However, should any errors be detected, Kongsberg Seatex AS would greatly appreciate being informed of them.
- The above notwithstanding, Kongsberg Seatex AS can assume no responsibility for any errors in this manual or their consequences.

Kongsberg Seatex AS
Pirsenteret, N-7462 Trondheim, Norway
Telephone: +47 73 54 55 00
Facsimile: +47 73 51 50 20
Duty phone: +47 73 50 21 11
E-mail: km.seatex@kongsberg.com
www.km.kongsberg.com/seatex

Blank page

Revision log

Document ID	Rev.	Date	Reason for revision
Man_user_DARPS132_r0	0	2006-08-16	First version.

Blank page

Table of contents

Blank page

List of illustrations

List of tables

Blank page

1 INTRODUCTION

DARPS 132 is developed by Seatex specifically for the dynamic positioning (DP) market where GPS position sensors are critical in order to achieve optimum DP capability.

DARPS 132 is a GPS/DGPS positioning system that integrates relative positioning for a vessel referenced to another vessel, a transponder or a fixed point. In the first two cases GPS measurements are transmitted to the vessel over an UHF link. This data, combined with GPS measurements from the vessel itself, is used to calculate the relative position vector, which is independent of correction data from a shore-based reference station. A typical DARPS 132 system is shown in the figure below.

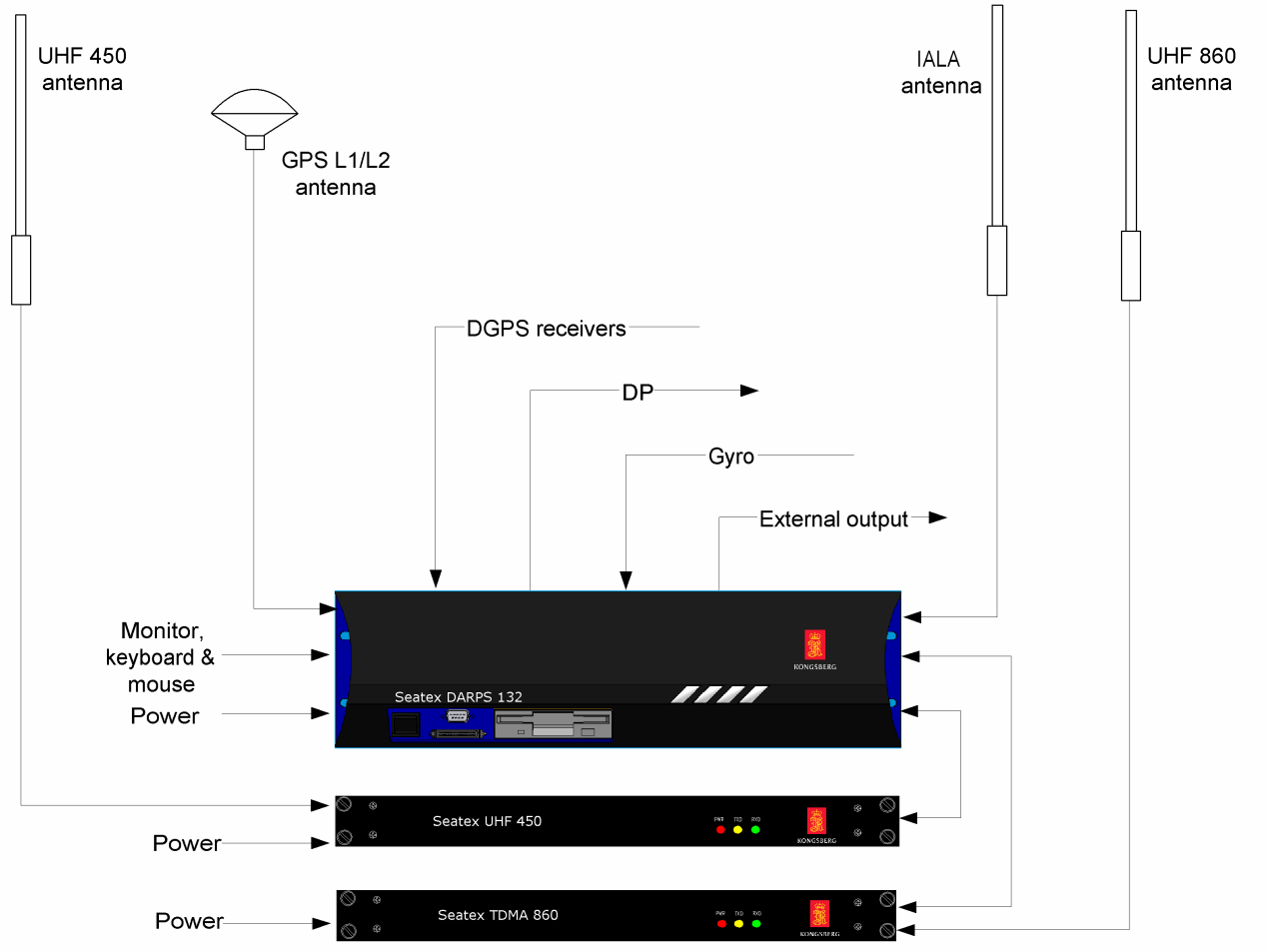


Figure 1 Typical DARPS 132 configuration

1.1 Design principles

DARPS 132 is designed to run on a Windows NT 4.0 operating system. The system has built-in display and text capacity.

The DARPS (Differential Absolute and Relative Positioning Sensor) system combines high-performance sensors for reliable and accurate absolute and relative positioning of two vessels such as a shuttle tanker and an FPSO/FSU.

Using UHF transceivers, relative position is determined through GPS data transmission between vessels or between vessels and loading buoys. The DARPS 132 is based on differential GPS inputs. UHF frequency configuration flexibility ensures maximum availability of the data links.

Key features of the DARPS 132 unit are multiple source capability for differential corrections including DGPS from Inmarsat and Spotbeam. In addition, heading input from a gyrocompass can be used to display the heading and speed on the TMS display. Heading input is also necessary to utilise the built in lever arm compensation. The lever arm compensation in the software enables selection of several measurement points on the vessel.

1.2 About this manual

The purpose of this manual is to provide the user with sufficient information to operate the DARPS 132 equipment correctly.

This manual is organised into the following chapters:

Chapter 1 **Introduction** – A brief overview of this manual with references and abbreviations.

Chapter 2 **System Description** – Describes the GPS system and how DGPS works.

Chapter 3 **Technical Data** – Describes detailed product specification, physical dimensions, required power and environmental restrictions, together with restrictions in use and guarantee.

Chapter 4 **Installation** – Refers to the *Installation Manual* [1].

Chapter 5 **Technical Description** – Describes the system components. Includes a brief description of the positioning determination and of the quality parameters.

Chapter 6 **Operating Instructions** – Describes system operation following installation.

Chapter 7 **Maintenance** – Describes repair and servicing procedures.

Chapter 8 **Troubleshooting** – Describes different status and alarm situations, and contain some hints for troubleshooting.

Chapter 9 **Drawings** – Refers to the *Installation Manual* [1].

Chapter 10 **Parts List** – Lists the parts in the basic delivery and available optional equipment.

In this manual the following notations are used:

CAUTION

Is used to make the user aware of procedures and operational practice which, if not followed, may result in damage to the equipment.

Note A note text has this format and is used to draw the user's attention to special features or behaviour of the equipment.

1.3 References

[1] *DARPS 132 Installation Manual,* Seatex 2006
[2] *NMEA 0183 Standard for Interfacing Marine Electronic Devices*, Version 3.00
[3] *RTCM Recommended Standards for Differential Navstar GPS Service*, Version 2.0
[4] *Guidelines on the Use of DGPS as a Position Reference in DP Control Systems,* United Kingdom Offshore Operators' Association Limited, rev. 2, April 1997
[5] *Seastar 3510LR Receiver User Manual*, Issue 1.0, Fugro Seastar, November 2004

1.4 Definitions

Master vessel	In this manual, used about shuttle tankers.
Slave vessel	In this manual, used about FSUs and FPSOs.

1.5 Abbreviations and acronyms

BT	Bearing to Target
CEP	Circular Error Probability
CMG	Course Made Good
COG	Course Over Ground
DARPS	Differential Absolute and Relative Positioning System
DGPS	Differential GPS
DOP	Dilution of Precision
DP	Dynamic Positioning System
DPO	DP Operator
DQI	Differential GPS Quality Indicator
drms	Distance Root Mean Square

DT	Distance to Target
DTG	Distance To Go
ED50	European Datum of 1950
EGNOS	European Geostationary Navigation Overlay System
EMC	Electro Magnetic Compatibility
EN	European Norm
EPE	Estimated Position Error
ETA	Estimated Time of Arrival
FPSO	Floating Production and Storage Object
FSU	Floating Storage Unit
GPS	Global Positioning System
GUI	Graphical User Interface
HDG	Heading
HDGR	Heading of Remote Vessel
HDOP	Horizontal Dilution of Precision
HDP	Heading
HFSU	Heading of the FSU
HP	High Precision
HWP	Hardware platform
IALA	International Association of Lighthouse Authorities
IEC	International Electrotechnical Committee
IP	Ingress Protection
LED	Light Emitting Diode
MSAS	Multifunctional transport Satellite-based Augmentation System
NA	Not Applicable
NAD27	North American Datum of 1927
NMEA	National Marine Electronics Association
OLS	Offshore Loading System
PPS	Pulse per Second
QA	Quality Assessment
RFI	Radio Frequency Interference
RMS	Root Mean Square
RTCM	Radio Technical Commission of Maritime Services
SBAS	Satellite Based Augmentation System
SCF	Super Compressed Format
SHT	Shuttle Tanker
SL	Speed Along Ship
SMG	Speed Made Good
SOG	Speed Over Ground
ST	Speed Transverse Ship
SW	Software
TBD	To Be Defined
TDMA	Time Division Multiple Access
TMS	Target Monitoring System
TTG	Time To Go
UTM	Universal Transverse Mercator
WAAS	Wide Area Augmentation System

WGS-84	World Geodetic System of 1984
WPT	Waypoint number
XTE	Cross Track Error
XTV	Cross Track Velocity

Blank page

2 SYSTEM DESCRIPTION

2.1 Global Positioning System

The Global Positioning System (GPS) is an American satellite-based navigation/positioning system. The system is originally designed and operated by the U.S. military.

GPS provides highly accurate and continuous navigation service. It provides 24-hour, all weather, global coverage.

The system is divided into the following three segments:

Space segment This segment comprises 21 satellites (plus three active spares) in 12 hour circular orbits. At an altitude of 20 200 km, each satellite is transmitting orbital and clock parameters.

Control segment This segment comprises Ground Control Stations geographically spread for monitoring, up-loading and control of the satellite transmitted characteristics.

User segment This segment comprises GPS receivers installed onboard ships, aircraft etc. to track satellite signals and transform them into position, velocity and time.

Each GPS satellite transmits radio signals at two microwave frequencies in the L band, 1575.43 MHz (L1) and 1227.6 MHz (L2).

The L1 signal is modulated by a precise (P) code for Precise Positioning Service (PPS) and a coarse/acquisition (C/A) code for Standard Positioning Service (SPS). The P-code is for military and authorised personnel only and is encrypted before broadcast to GPS users. The C/A code is for civil users. Until May 1st 2000 the accuracy of the C/A code was degraded to 100 m (2dRMS) horizontal positioning by the use of Selective Availability (SA). However, SA is now switched off and the position accuracy of the system is about 16 metres 95% CEP.

The fundamental technique for GPS is one-way ranging from the satellites. Triangulation, based on ranging from the satellites, is the basis of the system. To triangulate, GPS measures distance using the travel time of a radio message. To measure travel time, timing is crucial. GPS therefore needs very accurate clocks. The transmission is referred to highly accurate atomic frequency standards onboard the satellites, which are in synchronisation with the GPS system time base.

Time differences, from when the signal left the satellites until it is received at the GPS receiver, are measured. The distance is computed by multiplying with the speed of light. Once the distance to a satellite is known, the satellites' position in space must be found. The GPS satellites are launched into very precise orbits and their position is transmitted to the user. Knowing the satellites position and the distance to the user receiver, the user position can be computed. Three perfect measurements can solve a three-dimensional point in space.

However, the crystal clocks in the GPS receivers are drifting, and the position is therefore inaccurate. To calculate a three dimensional position, four unknowns have to be solved (latitude, longitude, height and receiver clock offset). To solve this equation with four unknowns it is necessary with range measurements from four or more satellites.

The geometry of the position calculation varies with the number of satellites available and their location.

Using differential corrections from one or more GPS Reference Stations significantly reduces all major error sources. This principle is called differential GPS (DGPS).

2.2 Differential GPS (DGPS)

The concept of a differential GPS (DGPS) real-time system is illustrated in Figure 2.

The DGPS system improves the position accuracy by using the differential technique. This is accomplished by accurately surveyed GPS Reference Stations which calculate pseudo-range corrections for all the satellites tracked by the Reference Station's GPS receiver.

The DGPS system also utilises a communication link for transmission of correction data from the Reference Station to the vessel.

Each GPS Reference Station compares the measured distance to a satellite with the one calculated based on the satellites' and the reference station's known co-ordinates. The resultant range difference is the correction data, which are broadcasted from the GPS Reference Stations to the Differential GPS correction receiver(s) on board the vessel(s). The correction data can also be broadcast via satellite, e.g. an Inmarsat satellite.

At the vessel, these pseudo-range corrections are applied to correct the pseudo-ranges received by the vessel's GPS receiver, prior to using them for the calculation of a three-dimensional navigation solution.

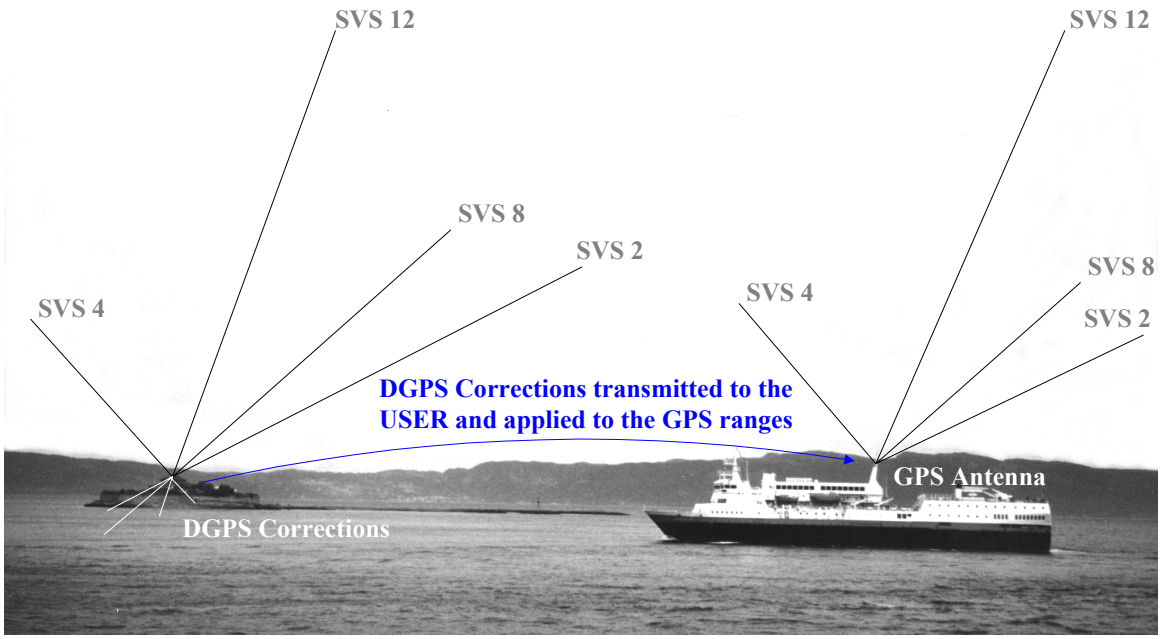


Figure 2 Differential GPS (DGPS) concept

2.3 DARPS

DARPS (Differential Absolute and Relative Positioning System) is a GPS based system which uses simultaneously gathered GPS data from the slave (FPSO) and the master (shuttle tanker) vessels to compute distance to target (DT) and bearing to target (DT). For the computation of relative data between the vessels, a radio link is used for transmission of GPS information. The slave vessel sends GPS pseudo-range measurements, vessel heading, offset between GPS antenna and offloading point and storage ID via UHF to the master vessel. The calculation of the relative vector is independent of correction data from a shore-based reference station. For computation of absolute position, differential corrections are used.

DARPS provides the additional functionality of relative positioning of a vessel referenced to another vessel, a transponder unit or a fixed reference point.

The main functions of the DARPS 132 hardware and software are:

- Providing absolute position and velocity data with integrated quality control.
- Providing a number of various output telegrams for interface with external equipment.
- Providing relative position between this unit and a transponder unit.
- Providing antenna offset compensation using pitch, roll and gyro data.
- Providing TMS software for displaying the vessel's own position relative to an intended location.
- Providing Dynamic Positioning (DP) Interface for dedicated operation as a DP Sensor during various kinds of offshore operations.

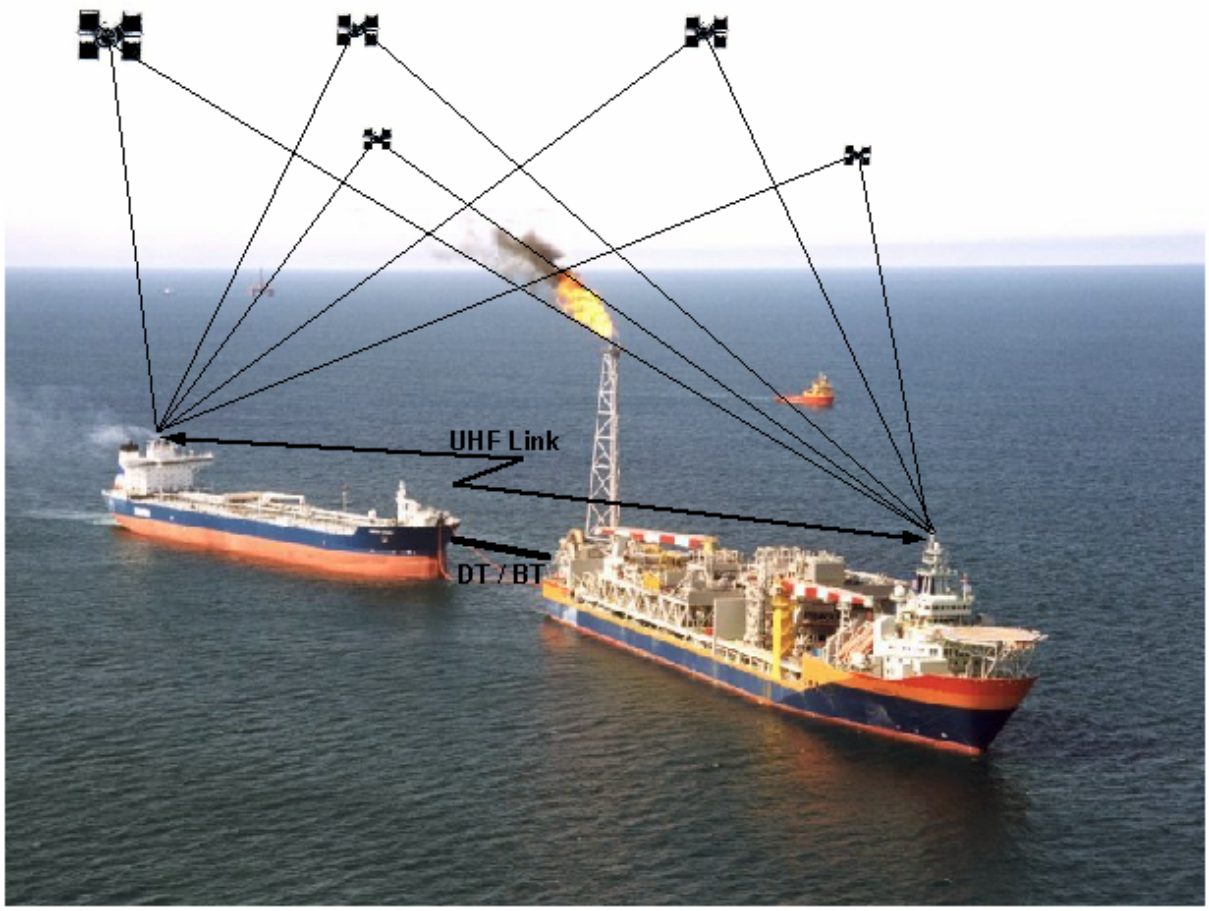


Figure 3 DARPS operational concept

2.4 SBAS system description

SBAS is a generic term for WAAS, EGNOS and MSAS. The three systems are independent, but based on the same principles. The systems are fully interoperable and compatible.

2.4.1 WAAS

WAAS, Wide Area Augmentation System, is an American GPS-based assistance to air traffic, built and operated by the FAA, the Federal Aviation Administration.

The WAAS system provides augmentation information to GPS/WAAS receivers to enhance the accuracy and reliability of GPS position estimates. The signals from GPS satellites are received at many widely spaced wide area reference stations. Each reference station relays the information, via a terrestrial communication network, to WAAS wide area master stations. The master stations use the information collected by the reference stations to develop corrections to the GPS position information. These corrections are sent to a ground uplink station where they are transmitted in the form of a WAAS correction message to a

Geostationary Earth Orbit (GEO) satellite. These GEOs broadcast the WAAS message to users on the same frequency as GPS.

WAAS is designed to improve the accuracy and ensure the integrity of information coming from GPS satellites.

The FAA commissioned WAAS at 12:01AM on July 10, 2003.

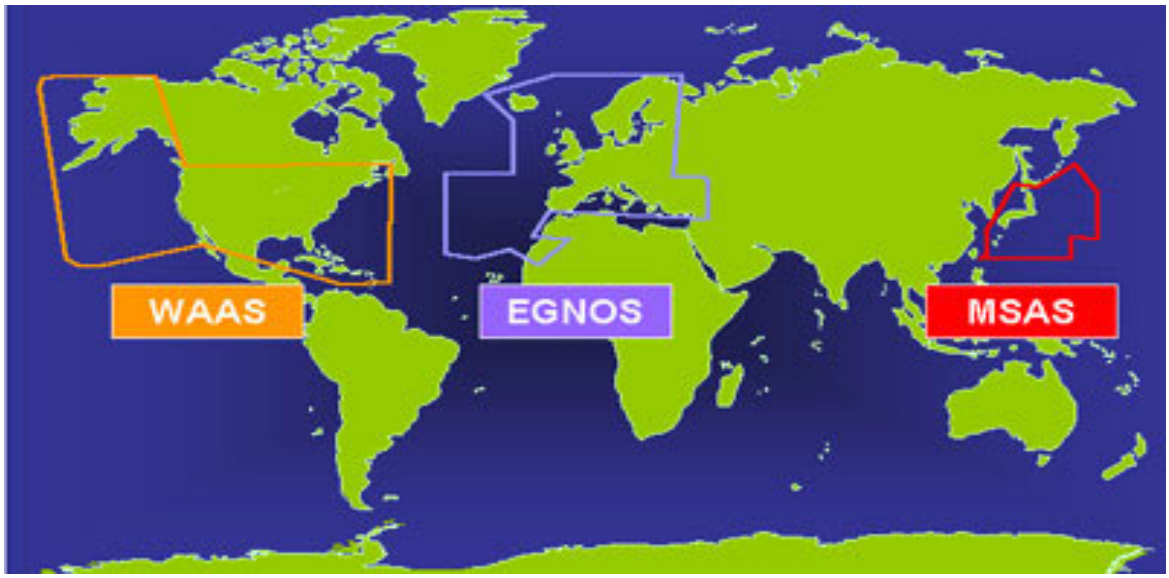


Figure 4 SBAS coverage

2.4.2 EGNOS

EGNOS, European Geostationary Navigation Overlay System, is a European GPS and Glonass-based augmentation system. EGNOS is Europe's first venture into satellite navigation

EGNOS is a joint project of the European Space Agency (ESA), the European Commission (EC) and Eurocontrol, the European Organisation for the Safety of Air Navigation. It is Europe's contribution to the first stage of the global navigation satellite system (GNSS) and is a precursor to Galileo, the full global satellite navigation system under development in Europe.

2.4.3 MSAS

MSAS, Multifunctional transport Satellite-based Augmentation System, is a Japanese augmentation system, implemented by the Japanese Civil Aviation Bureau.

MSAS is planned operable in 2006.

2.4.4 Signal distribution

SBAS signals are distributed by geostationary satellites. At the present there are two satellites serving the WAAS area, Inmarsat III's POR (Pacific Ocean Region) and AOR-W (Atlantic Ocean Region-West). The European area will be served by two Inmarsats, AOR-E (Atlantic Ocean Region-East) and IOR (Indian Ocean Region), and the European Space Agency satellite Artemis. Japan will be served by the MSAS systems own satellites, MTSAT.

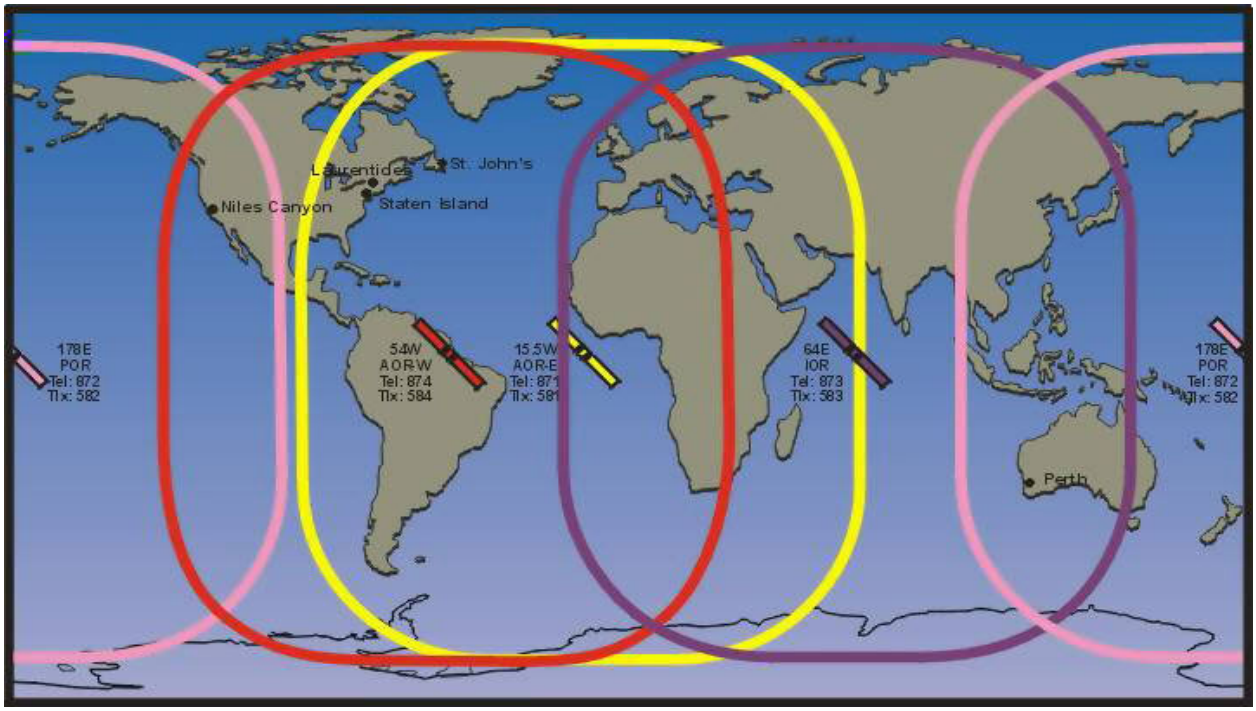


Figure 5 Inmarsat coverage

The following PRNs have been allocated to the SBAS satellites:

Geo satellite	PRN
AOR-E	120
AOR-W	122
Artemis	124
IOR	131
POR	134
MTSAT-1	129
MTSAT-2	137

Table 1 PRN for geo-stationary satellites

3 TECHNICAL DATA

3.1 Health, environment and safety

Operation or troubleshooting of DARPS 132 equipment will not imply any risk of high voltages, explosions or exposure to gas. The DARPS 132 complies with IEC 60950/EN60950 standards regarding product safety (low voltage) and IEC 60945/EN60945 standards on electromagnetic compatibility (immunity/radiation) and vibration.

All DARPS electrical and electronic components have to be disposed separately from the municipal waste stream via designated collection facilities appointed by the government or local authorities. The correct disposal and separate collection of your old appliance will help preventing potential negative consequences for the environment and human health. It is a precondition for reuse and recycling of used electrical and electronic equipment. For more detailed information about disposal of your old appliance, please contact your local authorities or waste disposal service.

3.2 Restrictions in guarantee

The liability of Seatex is limited to repair of the DARPS 132 only under the given terms and conditions stated in the sales documents. Consequential damages such as customer's loss of profit or damage to other systems traceable back to DARPS 132 malfunction are excluded. The warranty does not cover malfunctions of the DARPS 132 resulting from the following conditions:

a) Over-voltage or incorrect power connection.
b) Shorting of GPS antenna cable during operation of the DARPS 132 system.

3.3 Performance data

Absolute position accuracy: ..... 1.0 m (95% CEP)

The performance figures are valid with a minimum of seven visible satellites, HDOP less than 1.5 and high quality multiref DGPS corrections with the closest reference station less than 500 kilometres away.

Relative position accuracy: ..... 1.0 m (95% CEP)

The performance figures are valid with a minimum of seven visible satellites and HDOP less than 1.5.

Excessive multipath, GPS signal obstructions or interference will reduce the performance for both absolute and relative positioning.

3.4 Physical dimensions

DARPS 132 cabinet
See drawing 36200-MA-018 and 36200-MA-022 in [1] *Installation Manual* for physical description.

DARPS 132 unit
Width: ..... 482 mm (19-inch rack)
Height: ..... 132 mm (3 U)
Depth: ..... 430 mm
Weight: ..... 12 kg
Colour: ..... Front anodised black

Transceiver modules
Width: ..... 482 mm (19-inch rack)
Height: ..... 44.5 mm (1 U)
Depth: ..... 350 mm
Weight: ..... 3 kg
Colour: ..... Front plate, black

GPS antenna
Height: ..... 78.7 mm
Diameter: ..... 177.8 mm
Net weight: ..... 0.5 kg
Voltage input: ..... 5 V DC from DARPS 132 unit
Colour: ..... White

The GPS antenna is a right-hand circular polarised L-band antenna with an integral low-noise amplifier. The internal thread is 5/8 -11 UNC (standard marine mount).

450 MHz antenna
Height: ..... 1400 mm
Net weight: ..... 1.3 kg

The antenna is a vertically polarised omnidirectional antenna.

860 MHz antenna
Height: ..... 1510 mm
Net weight: ..... 1.4 kg

The antenna is a vertically polarised omnidirectional antenna.

Broadband antenna
Height: ..... 550 mm
Net weight: ..... 2.5 kg

The antenna is a vertically polarised omnidirectional antenna.

IALA Beacon antenna
Height: ..... 1100 mm
Net weight (including U-bolts): ..... 0.9 kg

The IALA Beacon antenna is a vertically polarised omnidirectional antenna. The antenna can be mounted on vertical or horizontal mast tubes with 16 to 54 mm in outer diameter.

3.5 Power

Voltage: .....110-240 V AC
Power consumption: .....75 W
Batteries:..... None, connection to UPS recommended

3.6 Environmental specification

The DARPS system is tested and compliant to EN 60945 / IEC 60945. This standard includes EMC, vibration and other environmental conditions.

DARPS 132 unit
Enclosure material:..... Aluminium
Enclosure protection:..... IP-32
Operating temperature range:..... +5 to +40ºC[1]
Recommended operating temperature range:.....+20 to +25ºC
Operating humidity: ..... Max. 95% non-condensing
Storage temperature range:.....-20 to +60ºC
Storage humidity: .....Less than 55%

GPS antenna
Enclosure material:.....Polymer
Operating temperature range:.....-40 to +70ºC
Operating humidity: .....Max. 100%

Transceiver modules
Enclosure material:..... Aluminium
Enclosure protection:..... IP-44
Operating temperature range:..... 0 to +55ºC
Operating humidity: ..... Max. 95% non-condensing
Storage temperature range:.....-20 to +60ºC
Storage humidity: .....Less than 55%

[1] Operating temperature up to +55ºC for 10 hours.

3.7 Radio frequencies

GPS receiver ZX-Eurocard .... 1575.42 MHz ± 10 MHz and 1227.60MHz± 10 MHz (Rx only)
IALA Beacon receiver .....280 - 320 kHz (Rx only)
450 MHz Antenna: .....440 - 470 MHz
860 MHz Antenna: .....824 - 894 MHz
Broadband Antenna: .....185 - 2000 MHz

3.8 Cable specification

Coax cable specifications (For details, see [1])
Type: ..... 1/2" Cellflex Superflexible
Attenuation: ..... 14 dB/100 m (at 1.5 GHz)
Maximum length: ..... 100 m
Diameter: ..... 13.7 mm
Minimum bend radius: .....32 mm, single bend
Flame retardation: .....IEC 60754-1, -2, IEC 60332-1, -3.C, UL 1581,
.....UL 1666, NEC type CATVR

3.9 Compass safe distance

DARPS 132 unit
Steering magnetic compass: ..... 1.1 m
Standard compass: ..... 1.9 m

Note If the DARPS 132 unit is not marked with a compass safe distance label, the unit shall be placed seven metres from both the steering compass and the standard compass.

3.10 Other data

Data I/O
Configuration: .....External PC connected to the DARPS 132 unit
Data outputs: .....Up to 15 RS-232/RS-422 serial lines
Data inputs: .....Up to 15 RS-232/RS-422 serial lines
DGPS corrections: .....RTCM 104 ver. 2.0, Fugro SCF format
Optional external gyrocompass: .....NMEA 0183 HDT, LR-10 Bit
MTBF: ..... 18500 h

No hardware or software handshake is used on the serial lines.

Note The system has up to 15 output serial lines and up to 15 input lines. However, the total number of serial lines is limited to a maximum of 15.

4 INSTALLATION

For installation description of the DARPS 132, please see the *Installation Manual* [1].

Blank page

5 TECHNICAL DESCRIPTION

5.1 Position determination

5.1.1 Absolute position determination

Position and velocity of the GPS antenna is measured by use of satellite measurements using phase-smoothed pseudo-range and Doppler observations. Differential corrections from up to 24 reference stations are combined to obtain the best position and velocity solution. If data from more than 24 stations are available, the nearest 24 stations are used. Reference station data can be interfaced to DARPS 132 either by using the RTCM SC-104 or the Super compressed data format (SCF). See the *Installation Manual* [1] for information about the reference stations.

5.1.2 Relative position determination

Position and velocity of the GPS antenna on the master vessel is measured by use of satellite measurements using phase-smoothed pseudo-range and Doppler observations. In addition, GPS measurements from the slave vessel are transmitted to the master vessel via an UHF link. These two data sets are used to compute the relative position vector between the vessels. The position vector is independent of correction data from a shore-based reference station.

5.2 Quality assessment of position data

The quality assessments of the absolute and relative positions are computed equally.

Quality assessment of GPS data is equally important as highly accurate positions. The methods for quality assessment implemented in DARPS 132 are in accordance with [4].

The parameters used are:

Type of measure	Parameter	Definition
Precision	95% aposteriori horizontal error ellipse	An ellipse describing the 95% confidence level of the position i.e. 95% of the position solutions will have an error inside the boundaries of the ellipse
Precision	EPE (Estimated Position Error)	The estimated 2σ horizontal position error in metres

Table 2 Quality parameters

5.2.1 The absolute DQI figure

The quality indicator DQI is a single integer between 0 and 9, which reflects the status and quality of the position solution.

DQI	Status of Solution	Precision 95% confidence level	Comments
0	Failed solution	NA	
1	Uncorrected	NA	Position solved but no differential correction applied.
2	Corrected position but no redundancy	NA	Minimum DGPS solution, unreliable.
3	Corrected position. Redundancy of 1	Poor	Poor satellite geometry (DOP).
4	Corrected position. Redundancy observation > 1	< 10 m	Adequate DOP/ satellite geometry.
5	Corrected position. Redundancy observation > 2	< 10 m	Ability to reject outlier. Poor DOP.
6	Corrected position. Redundancy observation > 2	< 10 m	Ability to reject outlier. Gradual improvement in DOP.
7	Corrected position. Redundancy observation > 2	< 4 m	Ability to reject outlier. Gradual improvement in DOP.
8	Corrected position. Redundancy observation > 2	< 2 m	Ability to reject outlier. Gradual improvement in DOP.
9	Corrected position. Redundancy observation > 2	< 0.5 m	Ability to reject outlier. Gradual improvement in DOP.

Table 3 DQI specifications

An important point to note is the prerequisite for the successful pass of a statistical test. The statistical methods used are in accordance with [4].

Bearing in mind the number of parameters present in the $DPGGA sentence, it is sufficient for the DQI to provide a statement on the status and quality of the positioning. DQI values 5 to 9 represent a grading system under normal operating conditions.

The DQI is passed along with other quality indicators and each raw unfiltered position into the DP control system. These indicators are put into free (null) fields in the NMEA 0183 standard format $GGA to produce the new $DPGGA format.

In addition to providing a meaningful and easily assimilated indication of DGPS quality, the DQI also gives an indication of improving or degrading positioning. The latter could give a countdown to system rejection, enabling suitable action to be taken in advance. This is impossible when using only a DGPS good/bad indicator. The DQI should reduce the cases where DGPS is reported to have dropped out for no apparent reason.

The DQI does not need to be used at all in the DP control system, but should be implemented according to the standard so that DP control system providers has the option of applying it. The recommendation is to provide position and quality factors (including DQI) as most DGPS systems diagnose their own fix quality more rigorously compared to similar diagnostics done by the DP system. The DP control system itself ultimately decides if it will accept the position sensor or not. If not displayed or used in the DP control system, the DQI is available on the DARPS 132 display to assist DP operators in evaluating position quality.

5.2.2 The relative DQI figure

The quality of the relative position solution is independent of correction data from a reference station. However, the quality is dependent of common satellites between the two vessels. More common satellites give a more stable and accurate relative solution.

DQI	Status of Solution	Precision 95% confidence level	Comments
0	Failed solution	NA	
1	Failed solution	NA	No relative solution available.
2	Failed solution	NA	No relative solution available.
3	Redundancy of 1	> 10 m	Minimum relative solution, unreliable.
4	Redundancy of 1	< 10 m	Adequate DOP/ satellite geometry.
5	Redundancy > 1	> 10 m	Ability to reject outlier. Poor DOP.
6	Redundancy > 1	< 10 m	Ability to reject outlier. Gradual improvement in DOP.
7	Redundancy > 1	< 4 m	Ability to reject outlier. Gradual improvement in DOP.
8	Redundancy > 1	< 2 m	Ability to reject outlier. Gradual improvement in DOP.
9	Redundancy > 1	< 0.5 m	Ability to reject outlier. Gradual improvement in DOP.

Table 4 Relative DQI specifications

5.3 System components

This subsection describes the components and the external interfaces of the DARPS 132. A standard system delivery consists of:

1. DARPS 132 unit
2. Cabinet 6U
3. Keyboard with rollerball
4. GPS antenna
5. IALA Beacon antenna
6. DARPS 132 User's Manual
7. DARPS 132 Installation Manual
8. DARPS 132 Site Manual
9. Interconnection cable
10. Mains cable
11. GPS antenna mounting rod

DARPS 132 is supplied in different configurations depending on application and specific user needs. In addition to the above mentioned system components, the following radio modules can be delivered:

Radio Module 1
UHF 450
UHF antenna, 450 MHz
UHF data and programming cable

Radio Module 2
UHF 450 - 9600
UHF antenna, 450 MHz
UHF data and programming cable

Radio Module 3
TDMA 450 or TDMA 455
UHF antenna, 450 MHz
TDMA data, programming and PPS cable

Radio Module 4
TDMA 860
UHF antenna, 860 MHz
TDMA data, programming and PPS cable

Radio Module 5
TDMA 860
UHF 450
Broadband antenna, 180 - 2000 MHz
Combined UHF & TDMA data, programming and PPS cable

Radio Module 6
TDMA 860
TDMA 450 or TDMA 455
Broadband antenna, 180 - 2000 MHz
Dual TDMA data, programming and PPS cable

Radio Module 7
TDMA 450
TDMA 455
Two UHF antennas, 450 MHz
Dual TDMA data, programming and PPS cable

The DARPS 132 cabinet contains the DARPS 132 unit, the radio module(s) and the keyboard with rollerball.

This UHF antenna is for transmitting and receiving data between the DARPS vessels. The TDMA 860 radio may be delivered with or without a diplexer. If a broadband antenna is used, a diplexer is necessary to split the UHF signals.

In addition to the above supplied parts the following is needed if external DGPS is used:

- Additional cables for input of DGPS corrections.
- Additional cables for output lines to external DGPS equipment.

5.3.1 DARPS 132 unit

The DARPS 132 unit comprises the following main parts:

- Hard disk
- 3.5 inch floppy disk drive
- Serial I/O board
- Computer main board
- GPS receiver
- Power supply
- Seatex multifunction board
- IALA Beacon receiver

The front panel includes the following user communication and operation capabilities:

- Power switch
- Communication interface through Com1 (for service personnel only)
- A 3.5 inch floppy disk drive for software installation and update
- SCSI CD ROM interface
- LED indicators

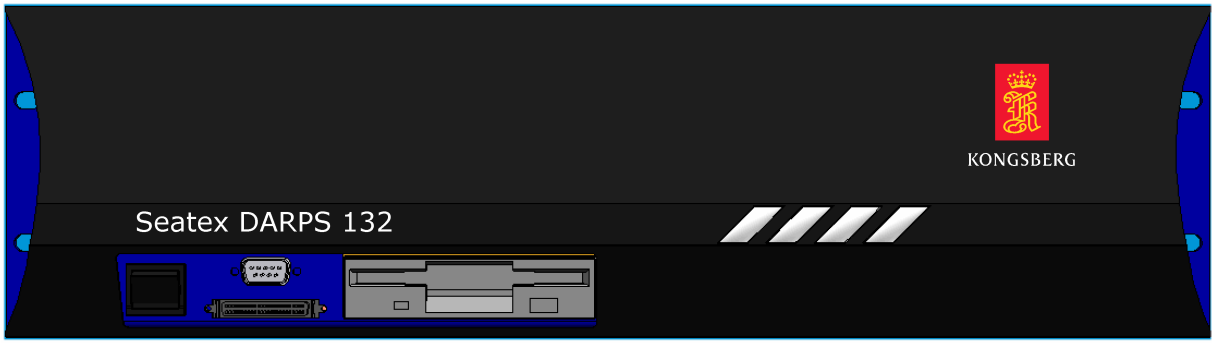


Figure 6 Front panel of the DARPS 132 unit

When power is turned on, the LED indicator to the left will be green. The LED indicator to the right will blink green every second if a PPS pulse exists internally in the DARPS 132 unit.

The rear panel of the DARPS 132 unit contains communication ports for interfacing to external systems. These ports are individually galvanically isolated.

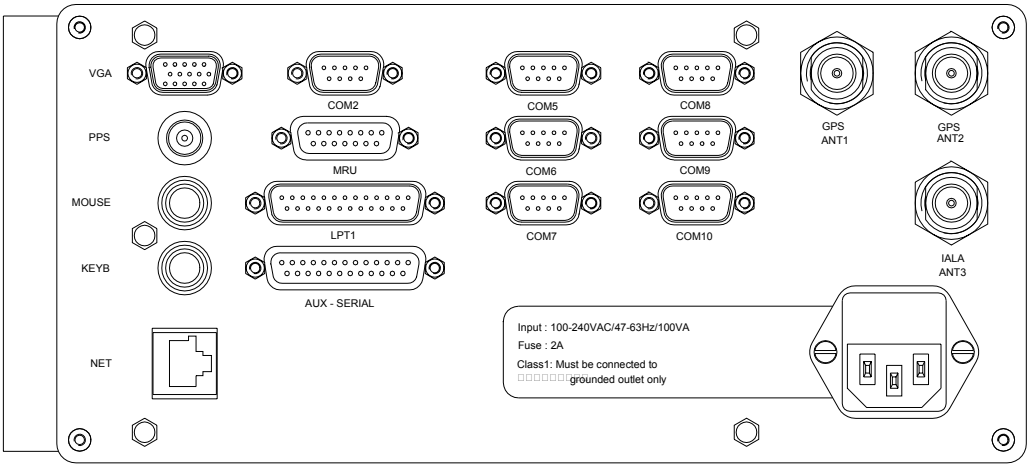


Figure 7 Rear panel of the DARPS 132 unit

5.3.2 Transceiver Modules

The radio modules, the UHF Transceiver Module and the TDMA Transceiver Module, have same physical dimensions and environmental specifications but comprises different parts.

The UHF Transceiver Module comprises the following main parts:

- radio
- power supply

- interconnection board
- modem

The TDMA Transceiver Module comprises the following main parts:

- a motherboard for the electronics and the DC/DC power supply
- a processor module
- a telemetry transceiver
- interconnecting cables

Figure 8 Front panel of the Transceiver Modules

The purpose of the LED indicators on the front panel for both Transceiver Modules is as follows:

PWR This red LED is lit when the MAIN POWER switch is set to ON and power is supplied to the unit.

Note If a TDMA Transceiver Module is connected to the DARPS 132 unit, the power LED will blink OFF every second when the Transceiver Module is receiving a PPS pulse.

RXD This green LED is lit when the radio receives data.

TXD This yellow LED is lit when the radio transmits data.

The rear panel of the units contains communication interface ports for interfacing to external systems, a power switch, a main AC power input and a female N connector for the UHF antenna.

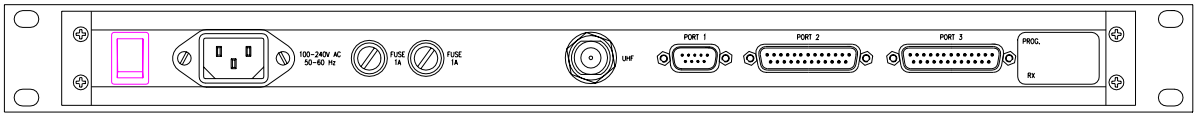


Figure 9 Rear panel of the Transceiver Modules

Note If two Transceiver Modules are used together with one DARPS 132 unit and the Transceiver Modules use the same UHF antenna, there will be two female N connectors at the rear of the TDMA Transceiver Module.

5.3.3 External input and output serial lines

DARPS 132 communicates with external equipment through RS-232 and RS-422 serial lines. It is necessary to input one or more differential GPS correction signals to the system to solve an accurate absolute position. It is not necessary to input DGPS corrections to solve an accurate relative position. Heading from a gyrocompass or similar device is also necessary. Output data are absolute position, velocity and time to dynamic positioning systems and navigation computers etc, see the *Installation Manual* [1].

6 OPERATING INSTRUCTIONS

6.1 Start procedure

The DARPS 132 software will start automatically after power on.

6.2 Operation

The DARPS 132 has a graphical user interface. Normally, the unit outputs signals on the serial lines without any involvement from the user. In the following chapters, the different display pages in the DARPS 132 SW will be described for a better understanding of the displayed parameters.

6.3 DARPS 132 SW applications

The **DARPS 132 Control** toolbar launches the different applications in the DARPS 132 software.

The DARPS 132 SW is built up with a set of display pages and the **DARPS 132 Control** toolbar. The different display pages are described below.

TMS Display

The **TMS** display is used to monitor the vessel movement relative to another vessel or a target point. The information on this display is a mix of animated graphics, alphanumeric information and statistics.

Navigation Display

The **Navigation** display is primarily for navigation purposes and is a copy of the Navigation Display Page available in the former DARPS 12 system.

Satellites in Sight Display

The **Satellites in Sight** display is mainly for monitoring of satellite constellation. If the vessel is operating in an area where parts of the sky are blocked by obstructions, the **Satellites in Sight** display shows which satellites might be lost during operation. Thus, necessary action can be taken to avoid unsafe operation due to few satellites resulting in poor or lost position.

6.4 Control toolbar

The **DARPS 132 Control** toolbar is a set of icons that launches the main applications in the DARPS 132 SW. During start-up, the **TMS** display and **DARPS 132 Control** toolbar are launched automatically. Further applications can be launched either from the toolbar or from the **TMS** display.

Target Monitoring display (TMS)

Navigation display

Satellites in Sight display

Reference Station Status display

Audible Alarm display

Set Night/Day Illumination

6.5 TMS description

The following icons are presented in the **TMS** display, independent of operating mode. The mouse activates each item.

Zoom In

The active part of the GUI is zoomed in. By activating the icon several times, the scale will be enhanced to maximum. The maximum zoom yields a 20x20 meter grid in the display area.

Zoom Out

The active part of the GUI is zoomed out. By activating the icon several times, the scale will be reduced to minimum. The minimum zoom yields a 20x20 km grid in the display area.

Toggle Grid On/Off

By selecting this button you can either activate or de-activate the grid.

Grid Spacing

The **Grid Spacing** button increases/decreases the grid scales.

Track Plot On/Off

If the **Track Plot** is active, vessel positions will be plotted on the screen. It is recommended to use this option if the vessel is drifting.

Change and Edit Target

Insert Current Position as Target Point

NA for master vessel in DARPS mode when the DP has selected target.

Audible Alarm

Navigation display

Satellites in Sight display

Satellite Prediction display

Reference Station Status display

Navigation Mode

When selecting this button, the system will change to Navigation mode. The system mode will toggle between Navigation mode and DPS mode each time the button is pressed.

Heading display

When selecting this button, the **Heading** display will appear.

Set Colour Intensity

By selecting this button, the colour intensity toggles between day and night mode.

In addition to the icons, visual and operational options can be selected from the toolbar in the **TMS** display, as shown in Figure 10. Several shortcut keys are also available.

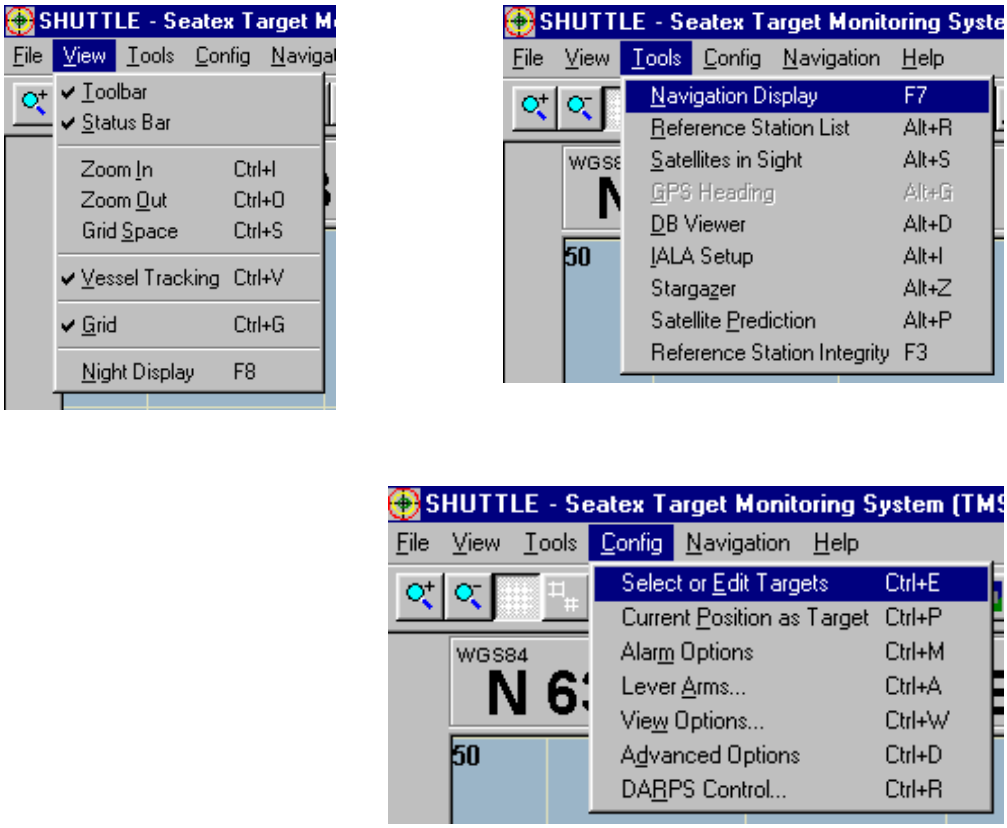


Figure 10 Visual and operational options selected from the TMS toolbar

6.5.1 Keyboard shortcut keys

F6 If this key is pressed when **TMS** or **Navigation** display is the active window, the system will switch to the next available colour palette defined for either daylight or night display mode.

F7 If this key is pressed when **TMS** is the active window, the system will activate the **Navigation** display. If this key is pressed in the **Navigation** display, **the Reference Station Status** display or the **Satellites in Sight** display, the **TMS** display will be re-activated.

F8 If this key is pressed in the **Navigation** display, the **TMS** display, the **Reference Station Status** display or the **Satellites in Sight** display, the system will toggle between night and day display modes.

6.6 Modes of operation

Basically, the DARPS 132 unit can operate in three modes, the DPS mode, the DARPS mode and the Navigation mode.

DPS Mode: When operating in DPS mode, the unit works as a standalone DGPS position sensor and computes absolute position for the vessel. It is not connected to a slave or master vessel.

DARPS Mode: When operating in DARPS mode, the master vessel has connection to a DARPS slave system via an UHF link. The DARPS units compute relative position and bearing between the two vessels.

Navigation Mode: When operating in Navigation mode, sailing routes may be defined. The current selected sailing route will be displayed and information of the current leg as time to go to the next leg, distance to the next leg and cross-track error are available. In addition, information of the whole route is displayed in the same window. The unit works as a standalone DGPS position sensor and computes absolute position for the vessel.

The operator of the DARPS system will have the opportunity to select either Navigation mode or DPS/DARPS mode.

6.7 DPS mode

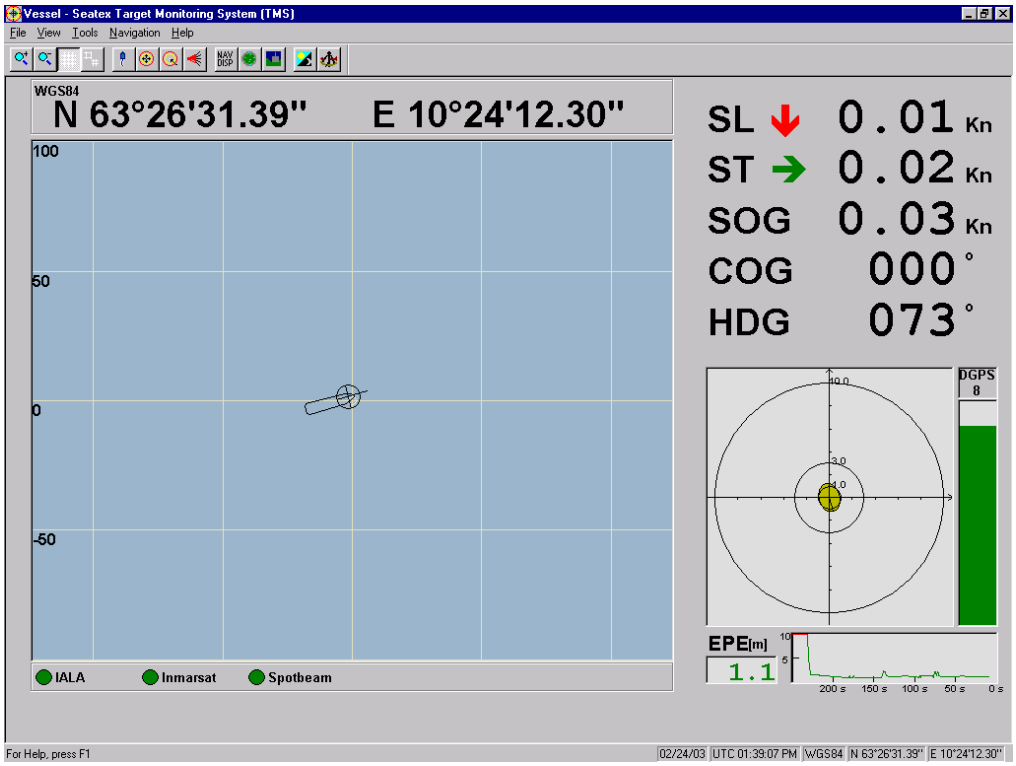


Figure 11 TMS display in DPS mode

The **TMS** display is the main page in the DARPS 132 system. The page gives a graphical presentation of the vessel. In DPS mode, the following parameters are used:

SL: Vessel speed along ship displayed in knots, ft/s or m/s. The arrow indicates movement direction.

ST: Vessel speed transverse ship displayed in knots, ft/s or m/s. The arrow indicates movement direction.

Note SL and ST directions will not be displayed when the master vessel is in a static mode.

HDP: Vessel heading in degrees.

Note SL, ST and HDP is available only if gyro is interfaced to the DARPS 132 unit.

SOG: Vessel speed over ground displayed in knots, ft/s or m/s.

COG: Vessel course over ground displayed in degrees.

DT: Distance to a selected target. Distance from a selected point on the vessel to the intended position inserted as Target point. Default unit is metres, but can be set to feet, see section 6.10.

BT: Bearing to target. Bearing from vessel to target with respect to true north. Unit is degrees.

EPE: Estimated Position Error. Position quality parameter for the DGPS position. Unit is metres. The EPE graphical plot is green when operating in DPS mode. The time span in the horizontal axis that is displayed, is 250 seconds.

In the lower right corner the following data are presented:

- Date
- UTC time
- Datum
- Position

The position quality indicator at the bottom of the **TMS** display gives the following information when the vessel is in DPS mode:

The status of the differential correction links changes from green to red if the differential corrections are lost or missing. If there are several differential correction sources, additional status Difflinks with indicators will be displayed.

The DQI bar is green in DPS mode and indicates the status and the quality of the absolute position of the vessel. If the quality of the position is less than 5, the background colour of the bar changes from white to yellow. If it is less than 2, it is red. The DQI is described in the quality parameter description in section 5.2.

The GPS status is shown on top of the DQI bar. The GPS status is **DGPS** when differential corrections are used in the position or **GPS** when no corrections are used.

The Error ellipse describes the position quality and the geometry of the position solution. The Error ellipse is described in the quality parameter description in section 5.2. The colour of the ellipse indicates the quality of the position:

Green: The semi-major axis of the ellipse is below 1 m (3.3 feet).
Yellow: The semi-major axis of the ellipse is between 1 and 3 m (3.3 and 9.8 feet).
Purple: The semi-major axis of the ellipse is between 3 and 10 m (9.8 and 32.8 feet).
Pink: The semi-major axis of the ellipse is above 10 m (32.8 feet).

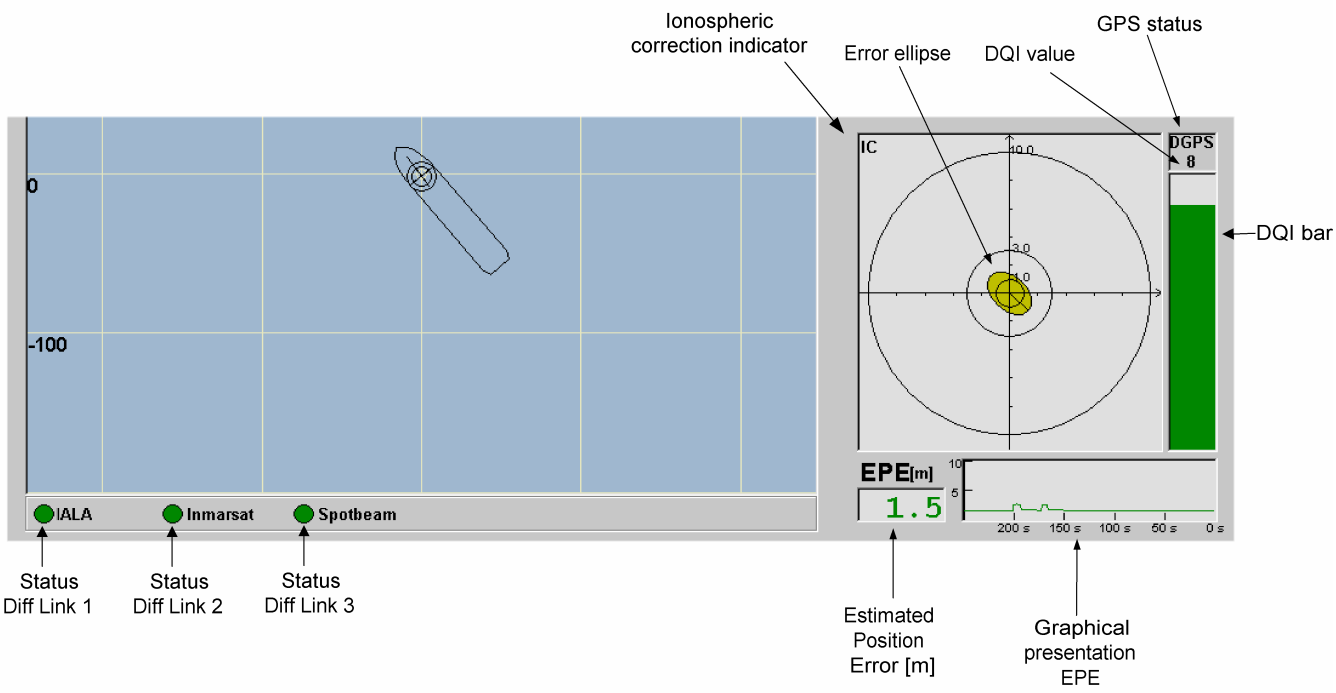


Figure 12 TMS QA indicators in DPS mode

6.8 DARPS mode

In DARPS mode, the system can use two different protocols to communicate with the other vessel; the UHF or the TDMA protocol. The UHF protocol is compatible with the older DARPS systems, the TDMA protocol is not.

The TDMA protocol is a two-way communication format. Instead of just receiving data from the slave, the master system also transmits data, such as vessel information. This information is used to visually present the master vessel in the **TMS** display on the salve.

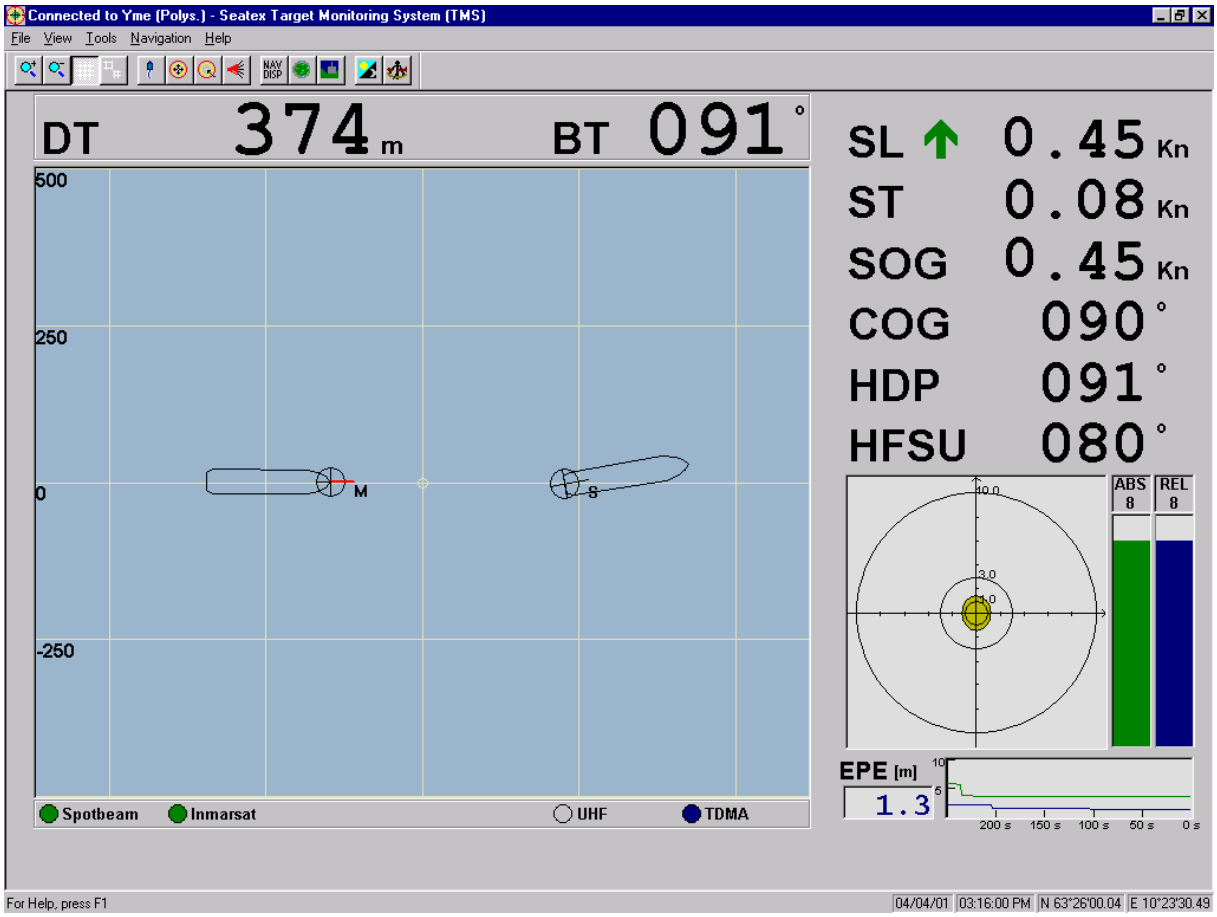


Figure 13 The Master vessels TMS display in DARPS mode

6.8.1 TMS display on master vessel

In DARPS mode, the **TMS** display on the master vessel is slightly different from the **TMS** display when operating in DPS mode. The page gives a graphical presentation of both the master and slave vessels including the following parameters:

SL: Master vessel speed along ship displayed in knots, ft/s or m/s. The arrow indicates movement direction.

ST: Master vessel speed transverse ship displayed in knots, ft/s or m/s. The arrow indicates movement direction.

Note SL and ST directions will not be displayed when the master vessel is in a static mode.

HDP: Master vessel heading in degrees.

Note SL, ST and HDP is available only if a gyro is interfaced to the DARPS 132 unit.

HFSU: Slave vessel heading in degrees. Information received via an UHF link.

SOG: Master vessel speed over ground displayed in knots, ft/s or m/s.

COG: Master vessel course over ground displayed in degrees.

DT: Distance to slave vessel. Distance from a selected point on the master vessel to the intended position inserted as Target point. Default unit is metres, but can be set to feet, see section 6.10.

BT: Bearing to slave vessel. Bearing from master vessel to slave vessel with respect to true north. Unit is degrees.

EPE: Estimated Position Error. Position quality parameter for the relative position. Unit is metres. The EPE graphical plot is blue when operating in DARPS mode. The time span in the horizontal axis is 250 seconds.

In the lower right corner the following data are presented:

- Date
- UTC time
- Datum
- Position

The position quality indicator at the bottom of the **TMS** display gives the following information when the master vessel is in DARPS mode:

The status of the differential correction links changes from green to red if the differential corrections are lost or missing. If there are more differential correction sources, additional status Difflinks with indicators will be displayed.

The colours on the DARPS links indicate which status the system is in:

Blue: The master vessel receives data from correct target.
Red: The master vessel has polled the slave, but does not receive data.
Yellow: The master vessel has polled the slave, but receives data from wrong target.
Green: The master vessel receives data from others than expected.
Grey: The link is passive.

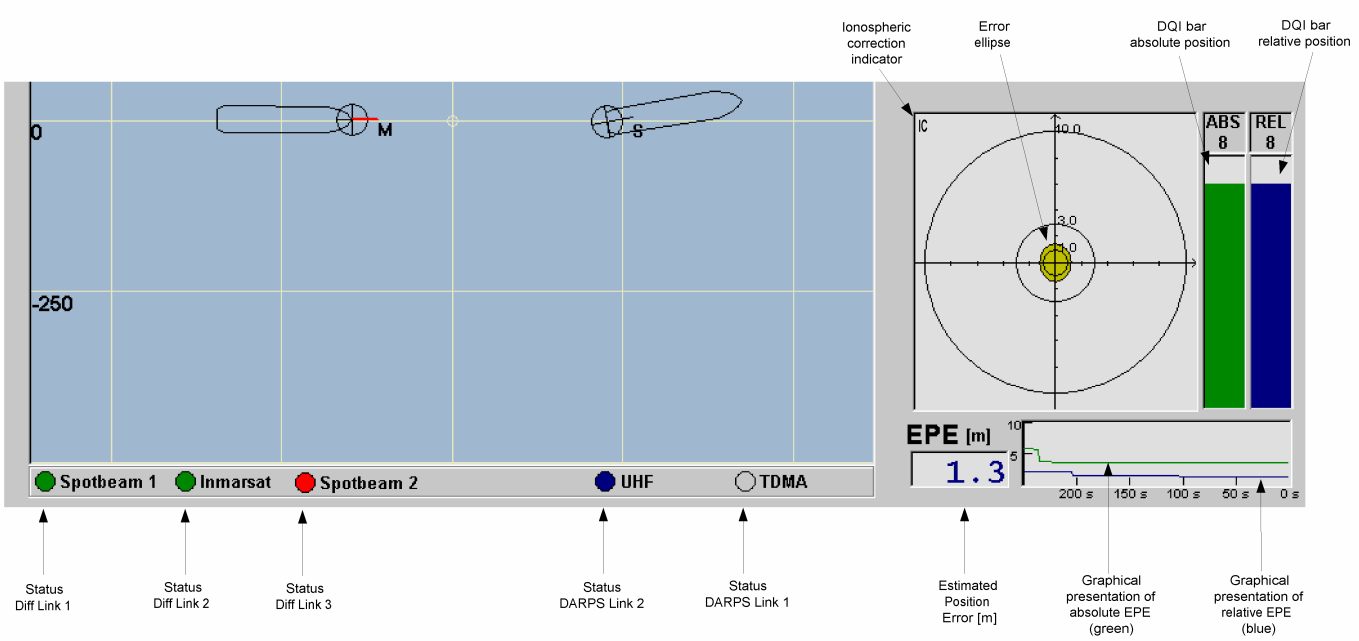


Figure 14 TMS QA indicators in DARPS mode

In DARPS mode, two DQI bars are displayed. The green bar indicates the status and quality of the absolute position of the master vessel, as in DPS mode. The blue DQI bar indicates the status and the quality of the relative position between the master and the slave vessel. If the quality of the position is less than 5, the background colour of the bar changes from white to yellow. If it is less than 2, it is red.

The DQI parameters and the error ellipse are described in the quality parameter description in section 5.2.

6.8.2 TMS display on slave vessel

The **TMS** display on the slave vessel differs from the display on the master vessel. On the slave vessel HDG (slave vessel heading) and HDGR (heading remote vessel) are displayed instead of HDP and HFSU.

Beyond that, the **TMS** display on the slave vessel is identical to the **TMS** display on the master vessel when TDMA protocol is used and if the **Show relative DT, BT and EPE** option in the **DARPS Control** dialogue is selected, see 6.12. If the option is not selected, only the relative link indicator will be displayed while the rest of the **TMS** display is as in DPS mode. This will also apply if the UHF protocol is selected. If UHF protocol is used and the **Show relative DT, BT and EPE** option is checked, the **TMS** display will be as in Figure 15. Therefore, the **Show relative DT, BT and EPE** option shall only be selected when TDMA protocol is used.

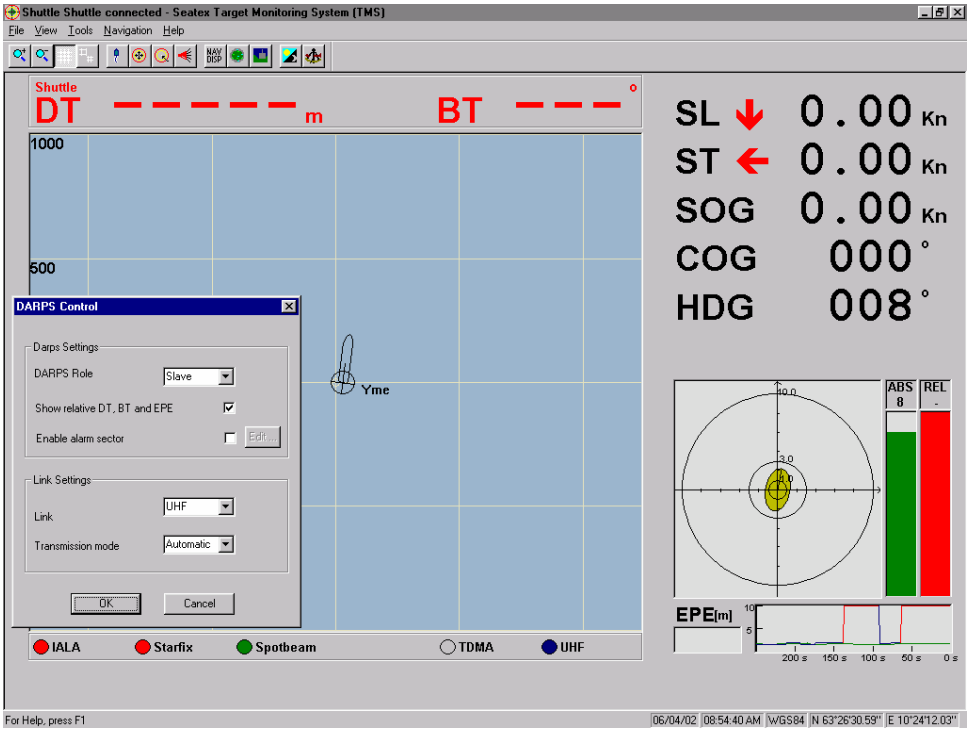


Figure 15 TMS display on slave vessel with UHF protocol

Note If the slave system has selected a target, and the **Show relative DT, BT and EPE** option is not checked, the DT and BT figures will refer to this target and not the master vessel.

The colours on the DARPS links on the slave vessel have a slightly different meaning than on the master system:

Blue: The slave vessel transmits data.
Green: The slave vessel receives data from others than expected.
Grey: The link is passive.

6.8.3 TDMA technique and slot numbers

The TDMA technique makes it possible for several systems to operate at the same frequency as long as different time slots are used. The technique utilises that a second is divided into 13 time slots. Data from a system will be transmitted in the slot which the system is set up to use. If two systems are accidentally assigned to the same time slot, data will be lost. If one unit has much stronger signal, e.g. has shorter range, it may be received correctly but will mask the data from the weaker unit. If the signal strengths are similar, data from both units will be corrupted.

In DARPS operation, the master and slave vessel slot number can be set up as shown below, where the master vessel has slot number 1 while the slave vessel has slot number 7.

1 sec													2 sec											
0	1	2	3	4	5	6	7	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11	12

Each second, the master vessel will transmit data in slot 1, while the slave vessel will transmit data in slot 7. Both the master and the slave vessel use two slots each to transmit all necessary data.

The slot number on the slave vessel is set in the slave vessel's setup file. The master slot number, and frequency, is varies depending on which target the master vessel is going to connect to. However, the master vessel's slot number, and frequency, is set as described in section 6.9.

6.9 Change and edit target

To change or edit targets, select the **Change and Edit Target** icon and the dialogue box below appears.

To select or deselect a target, choose the **Select** or **Deselect** button. If the DP has selected target, these buttons will not be available.

When the **Edit** or **Add** function is selected, the dialogue box in Figure 17 appears. In this box target information, target position and target alarms are configured and enabled.

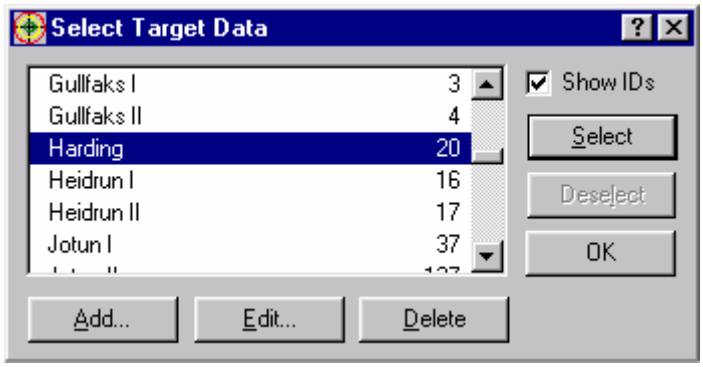


Figure 16 Select Target Data dialogue box

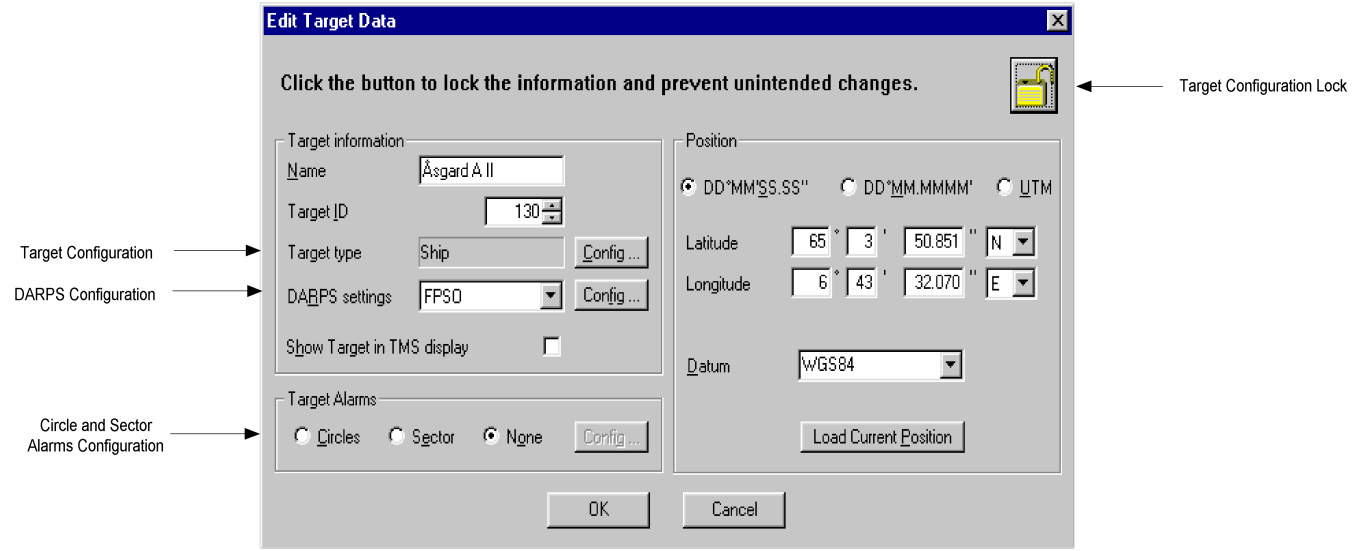


Figure 17 Edit Target Data dialogue box

To prevent unintended changes on the targets, a lock functionality is enabled. The lock functionality may be locked, unlocked or disabled.

The lock is closed and the target information cannot be changed. To open the lock, click the button and enter password. The password is "stx".

The lock is opened and target information may be changed. Click the button to lock the information.

The lock functionality is disabled.

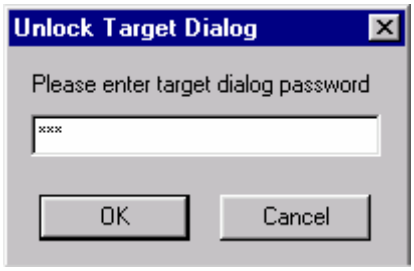


Figure 18 The Unlock Target Dialog

Note Only authorised personnel shall unlock and edit targets.

6.9.1 Target information

In the **Target information** area, the name, type and ID of the target point can be decided.

Each target has a unique Target ID.

- OLS
- Transponder
- FPSO/FSU
- OLS_STL
- Transponder_STL
- Waypoint
- Buoy
- Harbour
- Rig

When selecting the **Show Target in TMS display** feature, the DARPS targets can be displayed in the **TMS**. The targets are displayed as circles as shown in the figure below.

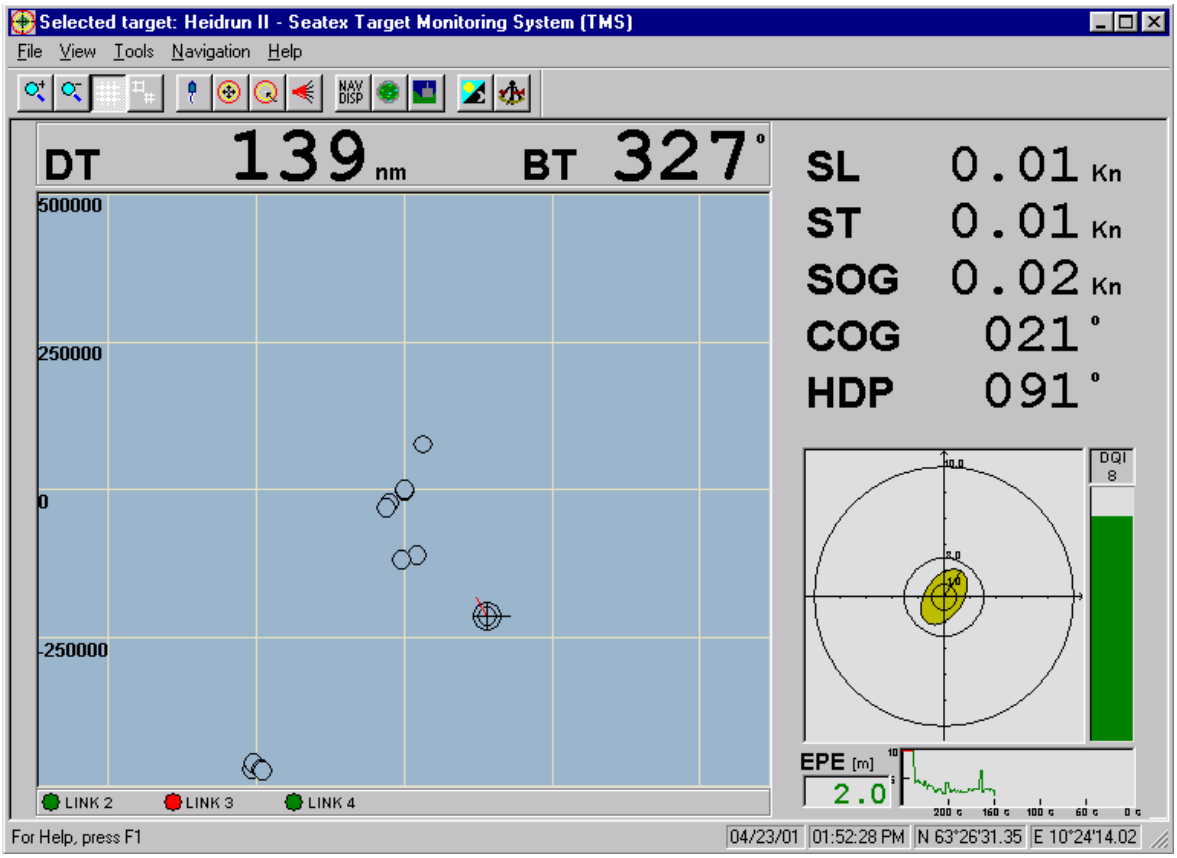


Figure 19 DARPS targets displayed in TMS

The **DARPS Target Settings** window is only available in DARPS mode.

6.9.2 Target configuration

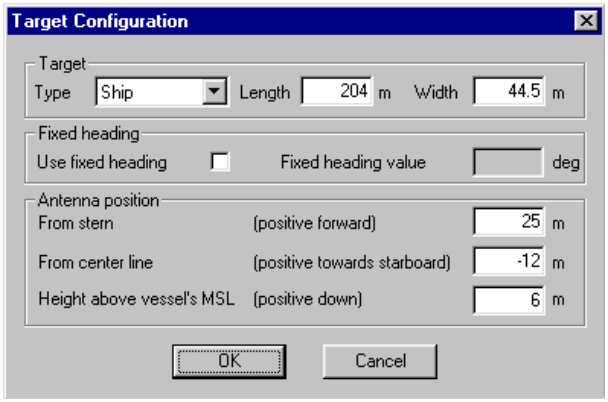


Figure 20 The Target Configuration window

The **Target Configuration** window is divided into three areas. In the **Target** area the target type and dimensions can be set.

The **Fixed heading** functionality makes it possible to set the target's heading.

Note When using the fixed heading functionality, the heading value transmitted from the target is ignored and the input value is used in the computations and in the **TMS** display.

In the **Antenna position** area the antenna position on the slave vessel, the target vessel, can be set. The antenna position is relative to the stern of the vessel:

X: Distance along ship from stern of vessel to antenna.
Entered in [m], positive forwards.
Y: Distance across ship from centre line of vessel to antenna.
Entered in [m], positive to starboard.
Z: The height of the antenna above mean sea level.
Entered in [m], positive downwards.

6.9.3 DARPS configuration

The **DARPS configuration** dialog on a master vessel reflects the DARPS links available on the slave vessel. The options are UHF and/or TDMA. When selecting TDMA, Radio Type must be selected.

When a target is selected, the master vessel will start polling on the DARPS links selected in this dialogue, if available on the master vessel.

In the Misc area, the **Use received target settings if available** feature can be selected. When using a TDMA link, data received from the slave, e.g. vessel dimensions, will be used to display the slave vessel. If this feature is not selected, the slave vessel dimensions entered in the **Edit Target Data** dialogue will be used to display the slave vessel.

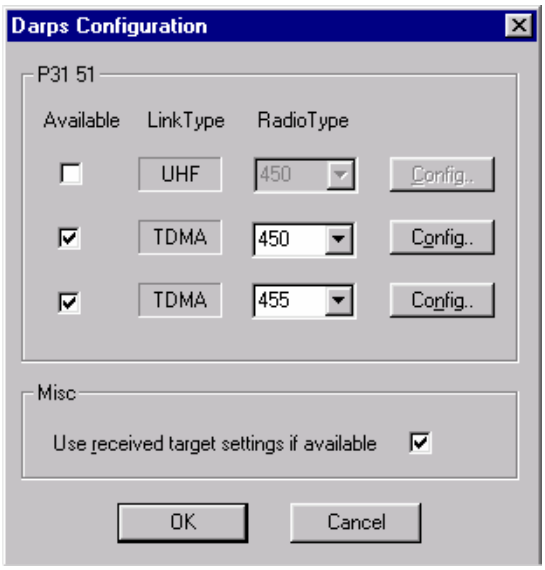


Figure 21 The DARPS Configuration window

Note The use of UHF and TDMA radios may be switched on and off even if the target information is locked. However, no information is permanently stored unless the **Edit Target Data** dialogue is unlocked.

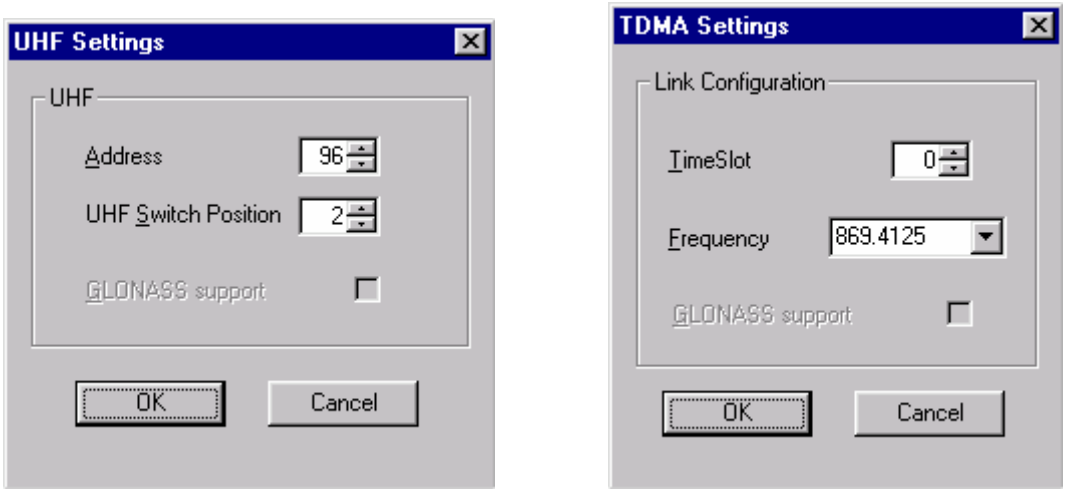


Figure 22 The UHF Settings and the TDMA Settings windows

When pressing the **Config…** buttons in the **DARPS Configuration** dialogue, the **UHF** and **TDMA Settings** dialogue boxes will be available. In these windows the communication options can be set.

UHF Settings

Address: The address to which the master vessel is set to transmit.

UHF Switch Position: The UHF switch position decides which frequency the UHF Transceiver should search for when connecting to a DARPS slave. When changing the UHF switch position, the SEL. ID in the **Navigation** display is changed.

TDMA Settings

Time Slot: The time slot on which the master is set to transmit data.

Frequency: The frequency on which the master is set to transmit.

Note The frequency and time slot used by the slave are set in the slave vessel's setup file, see the *Installation Manual*.

For a complete target list, see the *Installation Manual*.

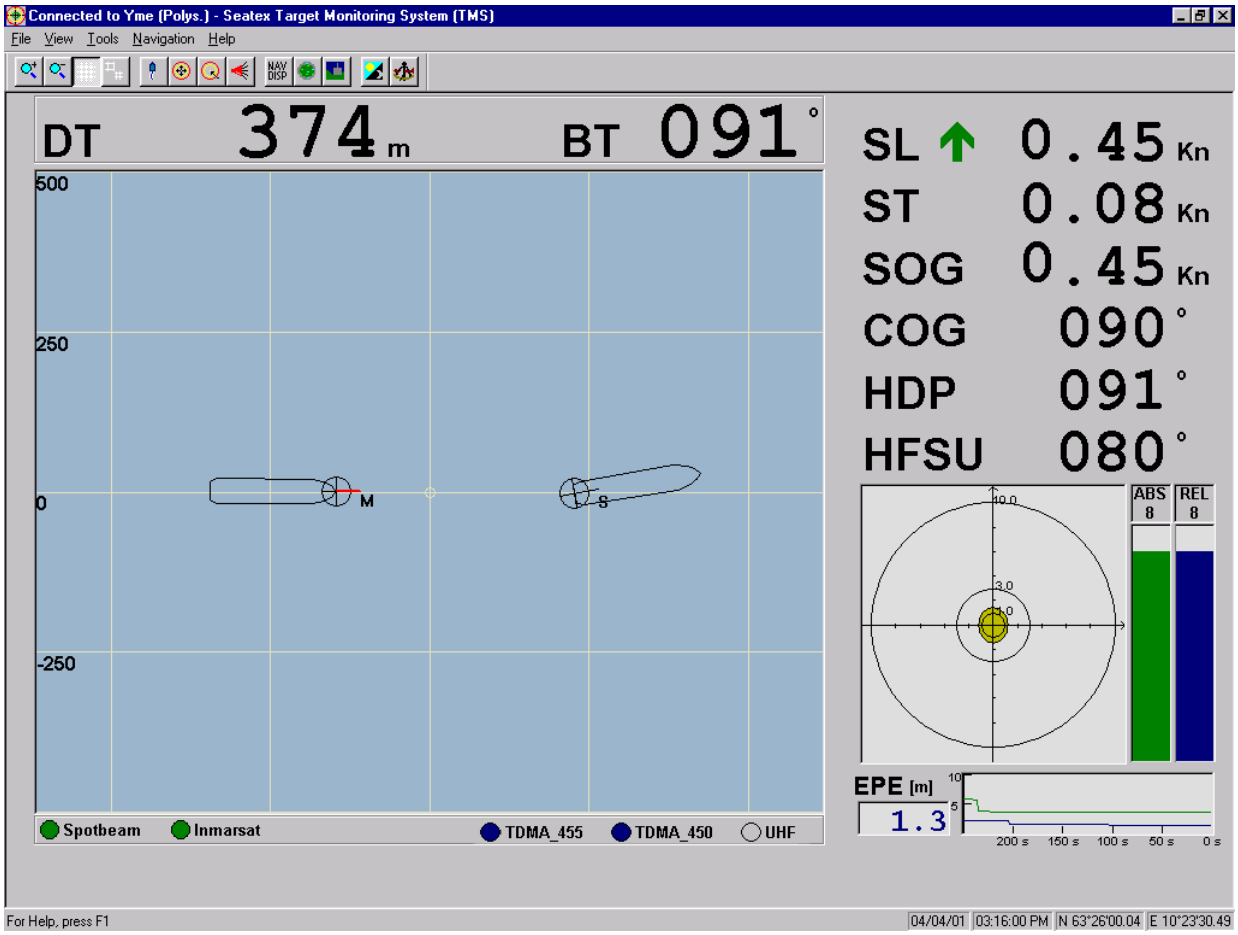


Figure 23 TMS display with two TDMA links active

6.9.4 Circle and sector alarms on Master vessel

Two types of **Target Alarms** can be selected, **Circle Alarms** or **Sector Alarms**. By pressing the **Config…** button, see Figure 17, configuration of the circle or sector alarm can be set.

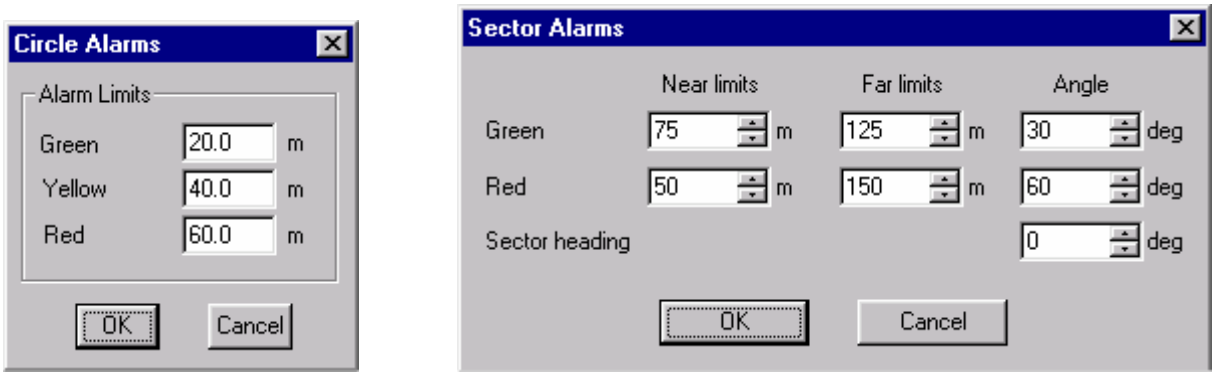


Figure 24 Circle and Sector Alarms window

In the **Circle Alarms** window, green, yellow and red circle alarm limits are specified. The limits set are the radius value of the circle. The circles originate from the target position, which is corrected for the lever arm selected. An alarm is activated when the target position crosses the circles outwards.

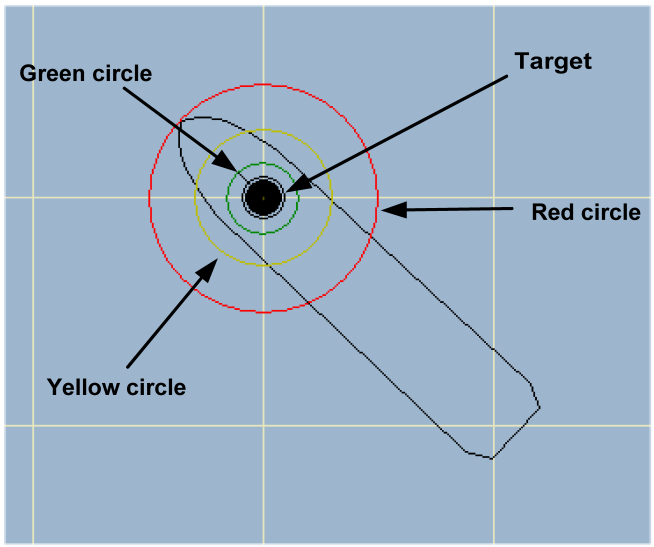


Figure 25 Circle alarms description

In the **Sector Alarms** window, near and far limits and sector angles are specified. In addition the sector heading is defined. The sector heading is the angle between the slave vessel's heading and the alarm sectors' centre line. The alarm sectors' centre is at the slave vessel's offloading point. An alarm is activated when the master vessel's reference point crosses the limits.

See section 6.18 on how to enable the alarms and how the alarm status is identified.

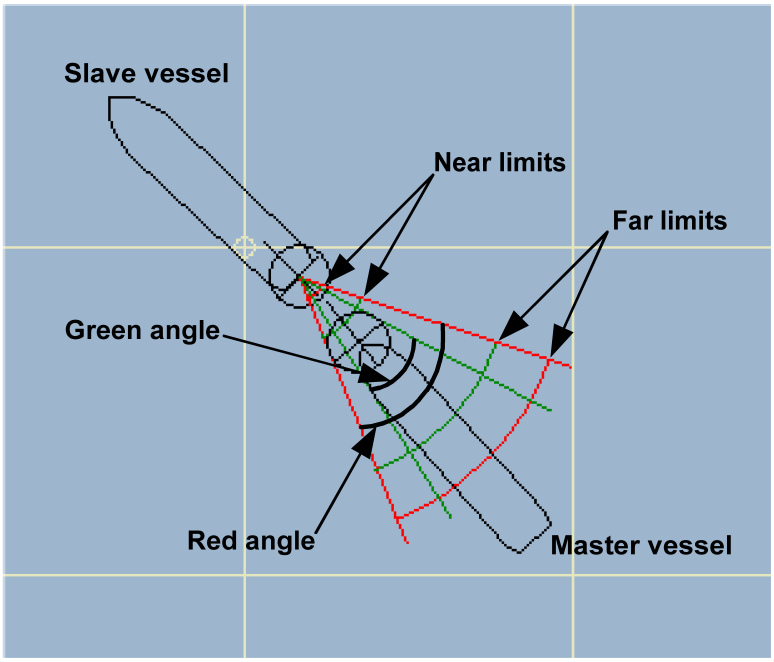


Figure 26 Sector alarms description on master vessel

6.9.5 Circle and sector alarms on Slave vessel

On a slave vessel it is also possible to select target alarms. The alarm configuration is set similar to the master vessels, see section 6.9.4.

However, on a slave vessel it is also possible to configure local alarm sectors by checking the **Enable Local alarm sector** field in the **DARPS Control** dialogue, as seen in Figure 27. The dialogue is found under **Tools** in the **TMS** display. Local alarm sectors are typically used to warn the slave vessel when the master vessel is too close to the slave vessel. The alarm is triggered when the master vessel crosses the sector lines. See section 6.18 on how to enable the alarms and how the alarm status is identified.

It is possible to use the target and local alarms simultaneously.

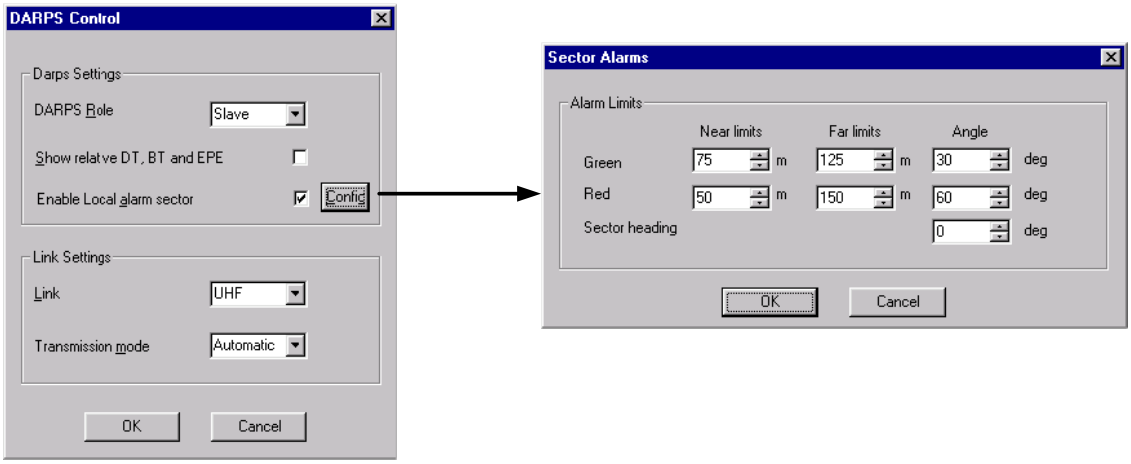


Figure 27 Enabling local alarm sectors

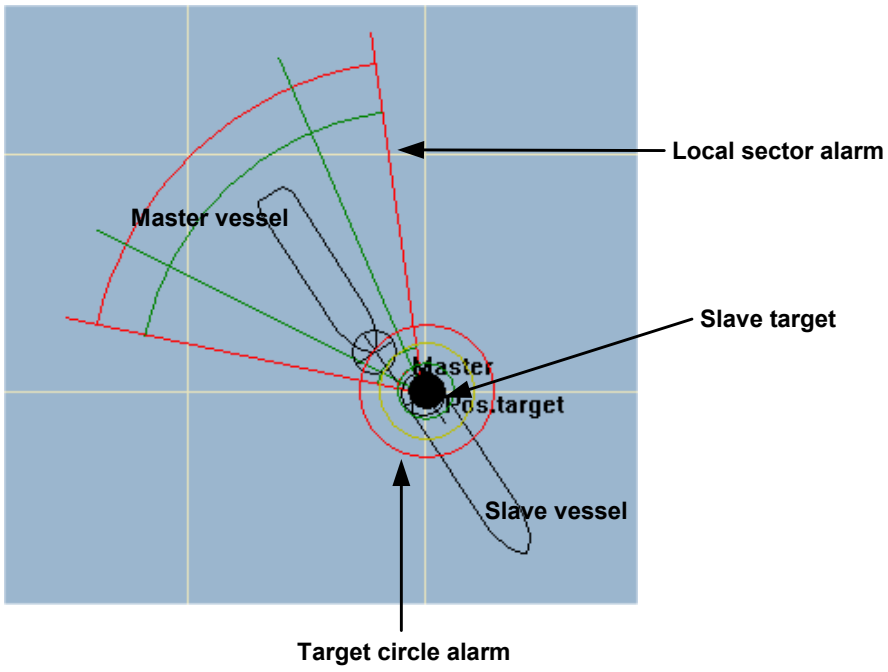


Figure 28 Local and target alarms on slave vessel

6.9.6 Hysteresis

When a reference point has crossed a sector or circle alarm limit and is entering the alarm area again, it has to be within the hysteresis limit to be cleared. If the reference point has not crossed the hysteresis, that is, it is between the alarm and hysteresis limit, the alarm will not be triggered if the reference point crosses the alarm limit again.

The default limits of the sector and circle alarm hysteresis are described in the table below. Contact Seatex if the limits need to be changed.

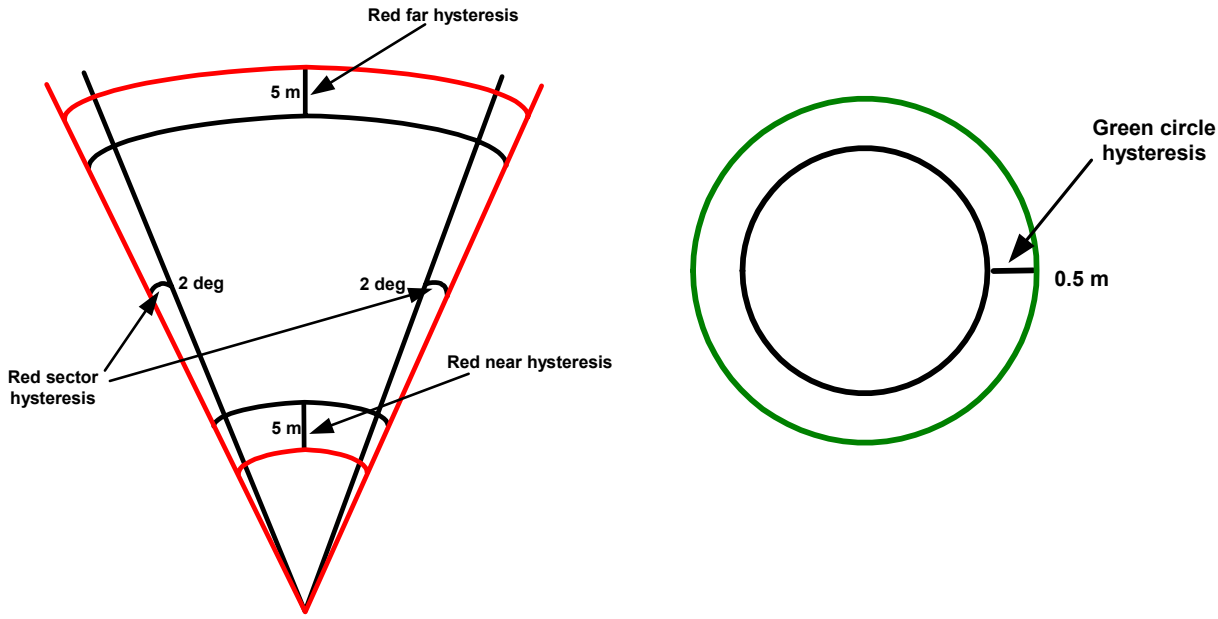


Figure 29 Description of sector and circle hysteresis

Sector alarm hysteresis

Hysteresis	Limit
Green sector	2.0°
Green far	5.0 m
Green near	5.0 m
Red sector	2.0°
Red far	5.0 m
Red near	5.0 m

Circle alarm hysteresis

Hysteresis	Limit
Green	0.5 m
Yellow	1.0 m
Red	5.0 m

Table 5 Hysteresis limits

6.9.7 Target position

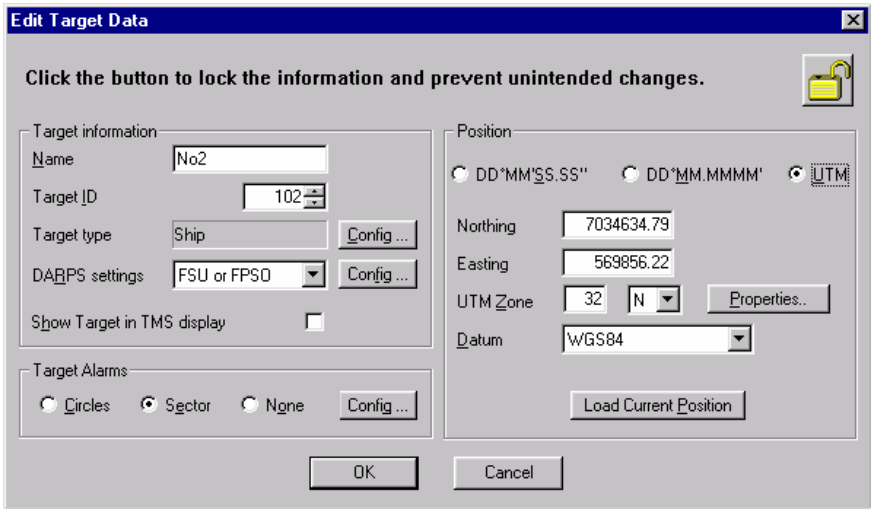


Figure 30 Target position in UTM co-ordinates

The target position can be inserted and viewed in latitude and longitude or UTM co-ordinates. In addition a datum must be selected since a global position must be related to a specific datum to be unambiguous. Available datums are WGS84, NAD27 and ED50.

Note When the target is locked, the **Position** window works as a calculator. The inserted position can be viewed in latitude and longitude or UTM co-ordinates. However, when the target is unlocked, the **OK** button must be pressed and the target locked before the input position is displayed in other co-ordinates than the selected input co-ordinates.

UTM properties
UTM position is presented in north and east distance and **UTM zone**. In addition, **False Northing** and different **Zone options** may be specified when selecting the **Properties** button.

When selecting **False Northing**, positions south of the equator will always be presented as positive. A fixed offset of 10 000 000 m is added to the north/south component before it is displayed in the **TMS** display.

Figure 31 The UTM Properties dialogue box

When selecting **Auto** zone, the system zone is automatically calculated in accordance with the inserted co-ordinates.

The **Auto extended** zone option is only applicable between 56 degrees to 64 degrees north and 3 degrees to 6 degrees east. The 32V zone is extended west to 3 degrees east, so when selecting the **Auto extended** zone in this area, zone 32V is used. When outside the current area and **Auto extended** zone is selected, the used zone is equal to the zone used when selecting **Auto** zone.

Selecting **Manual** zone makes it possible to define which Zone and Zone offset to use. The **Zone offset** option allows a fixed offset to be applied to the longitude degrees. The UTM zone can be offset up to ±3 degrees. The Zone offset is typically applied where the maps used have an offset.

Note The position properties selected in the **Edit Target Data** dialogue are only for display purposes. For position properties output on a DP port, see the *Installation Manual* [1].

6.10 Change of datum

Under the menu **Tools** and **Options** menus in the **TMS** display, datum and geographical co-ordinates to be displayed in the **TMS** display, can be selected. The position can be displayed in UTM or geographical co-ordinates and WGS-84, ED50 or NAD27 datum. It is also possible to select between knots and metric system in this box. In addition, the **Show vessel ID** option can be selected. When this option is checked in DARPS mode, the name of the selected target is displayed close by the vessel in the **TMS** display.

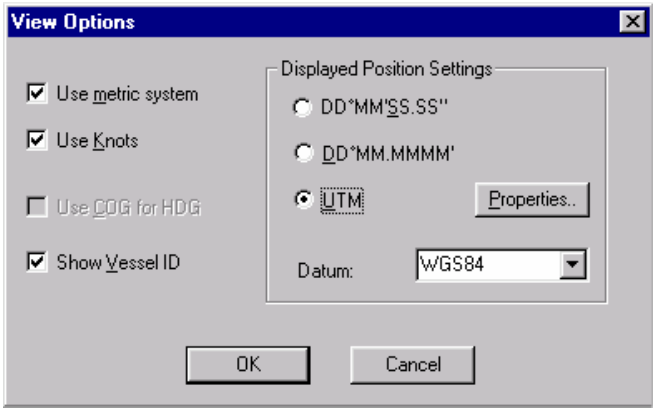


Figure 32 TMS_NT Options dialogue box

6.11 Lever arm compensation

From the **TMS** display several lever arm points can be selected. By selecting **Lever Arm** in the **Config** menu, the menu box shown in Figure 33 appears. Several points can be defined as lever arm reference points. These points are defined in the system setup, see the *Installation Manual*.

Note The lever arm option does only work properly if heading from a gyro compass or similar device is interfaced.

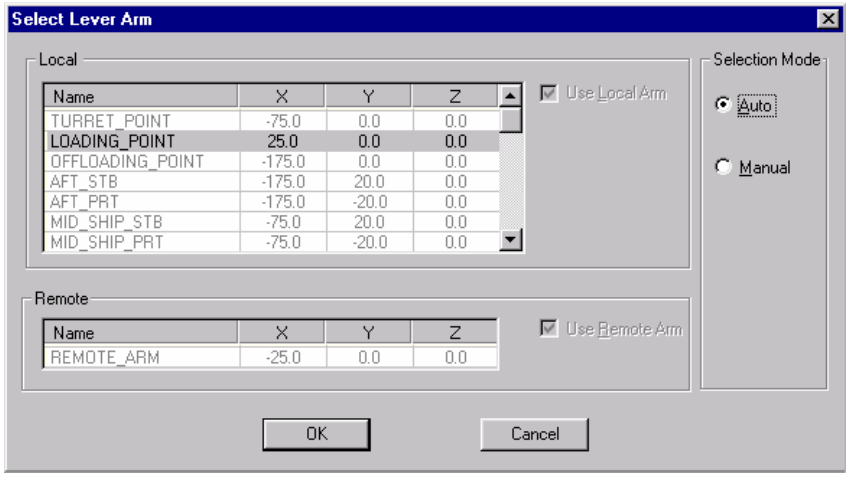


Figure 33 Lever arm setup

In the **Select Lever Arm** dialogue it is possible to select **Auto** or **Manual** mode.

Auto: Loading_point on the master vessel and Remote_arm on slave vessel are used. Remote_arm is always the slave vessel's offloading point. When OLS_STL and Transponder_STL targets are selected, Turret_point is automatically selected as lever arm on the master vessel. No remote arm is used.

Manual: When selecting Manual mode the user can decide if lever arms are going to be used or not. In addition, the user can select which arms to use on the master vessel. If no arms are used, the vessels' respective antenna position is used.

6.12 Advanced settings

In the **TMS** display there is a dialogue box that offers the possibility of changing ionosphere activity and heading source. The dialogue box is named **Advanced Settings** and is accessed from the **Tools** menu.

Near a solar spot maximum (year 2000/2001) the electron content of the ionosphere showed rapid and local variations affecting the performance of DGPS. Due to this, the accuracy was degraded.

Since the ionospheric activity will vary from day to day and even during some hours, a feature for manually adjusting the ionospheric activity mode is implemented.

The options for ionosphere activity settings are Normal, Medium and High which represent the expected ionospheric activity level. Selections different from Normal should only be used if the operator is confident that the ionospheric activity is higher than normal. An indicator of this is rapid position jumps due to rejected satellites during evening hours in areas e.g. outside Brazil.

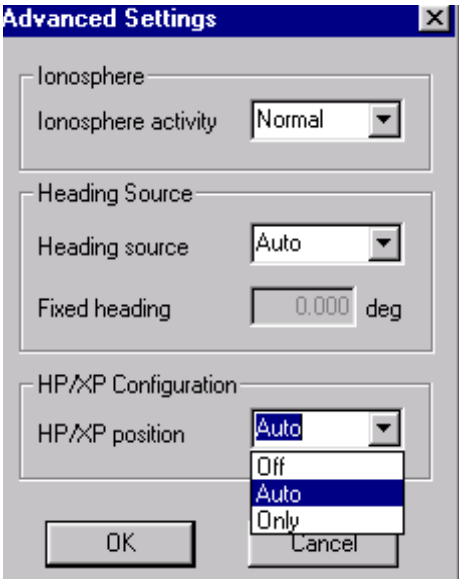


Figure 34 The Advanced Settings dialogue box

The **Heading Source** functionality makes it possible to select between Auto and Fixed heading. Default value is Auto and received heading from gyro or DP is used. By selecting Fixed heading, the heading value inserted is used in position computations and in the **TMS** display.

The **HP/XP Configuration** settings are described in section 6.22.

6.13 DARPS Control

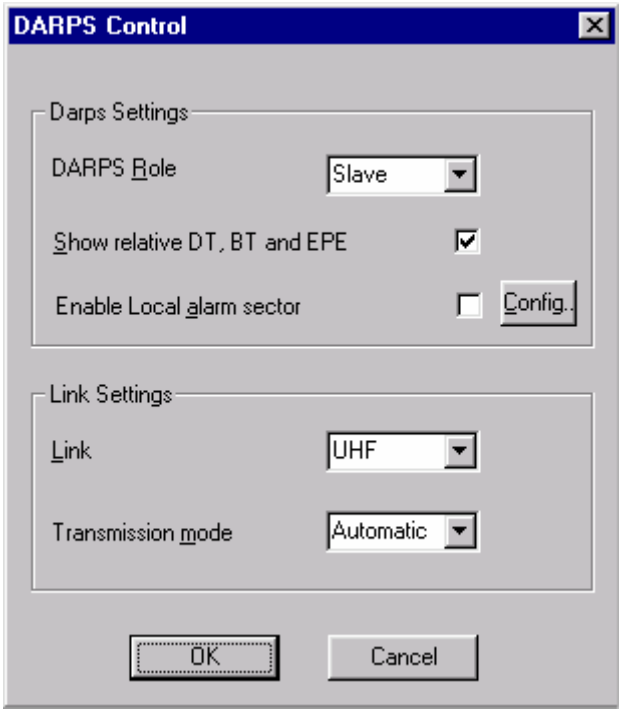


Figure 35 The DARPS Control dialogue box on slave system

From the **Tools** menu, the **DARPS Control** dialogue is opened. The **DARPS Role** option gives a slave system the opportunity to operate as a master system, or reversed, a master system to operate as a slave system.

By selecting the **Show relative DT, BT and EPE** option on a slave system, relative data related to the loading point on the master system will be displayed in the **TMS** display. This includes the DQI bar and the relative EPE graph. If this option is not selected, the distance and bearing information on the slave **TMS** display will be related to a target selected by the slave system. If no target is selected, the absolute position to the slave will be displayed in the **TMS**. This feature is only available when using the TDMA protocol. If selecting the option using UHF protocol, relative DQI bar, the EPE graph and the DT/BT figures will be displayed red.

The **Enable local alarm sector** functionality is only available on a slave vessel. The sector will originate from the slave vessel's offloading point, see section 6.9.5

On a slave system it is possible to set up the system to send data without being polled by a master. This is done by setting Transmission mode to ON. If selecting Transmission mode to OFF, data from the slave system will never be sent. Default setting is Automatic. The Transmission mode options are not available on a master system.

6.14 Navigation display

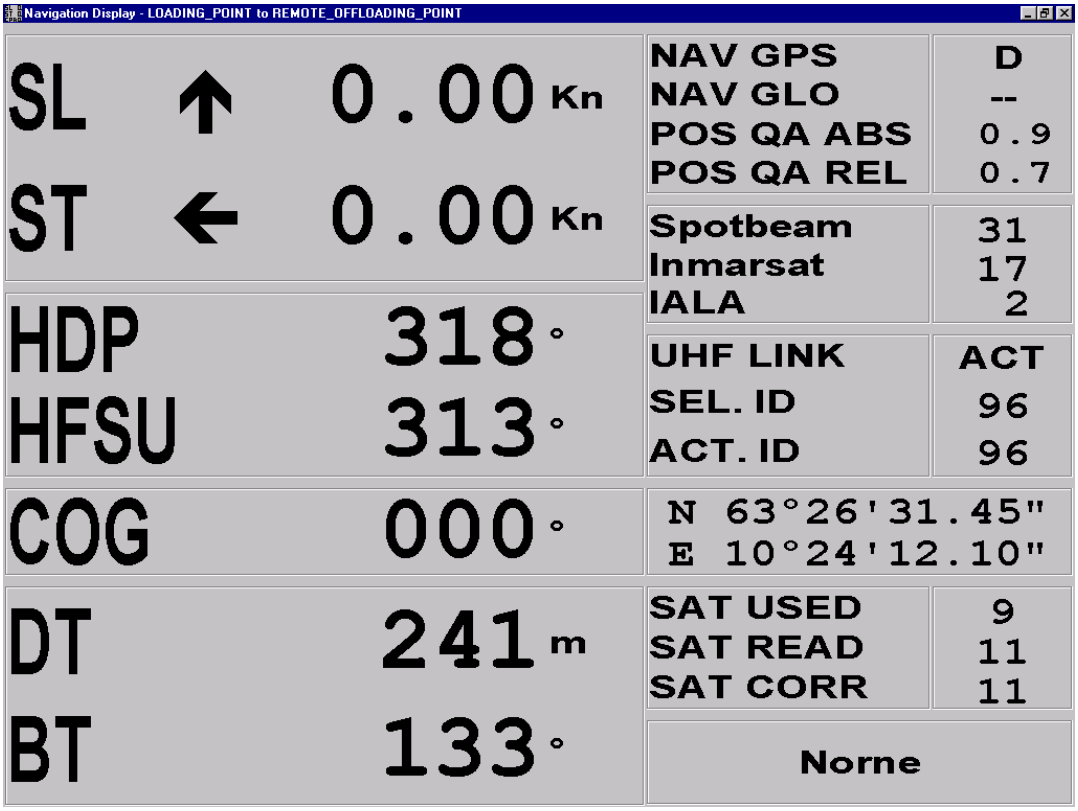


Figure 36 The Navigation display

Note In the previous versions the Navigation Display would indicate an alarm situation if there were no gyro connected to the DARPS system. It is now possible to configure the Navigation Display to ignore missing gyro data. This feature is not default available.

SL: Vessel speed along ship. Displayed in knots, ft/s or m/s.

ST: Vessel speed transverse ship. Displayed in knots, ft/s or m/s.

The sign indicates the direction of movement. For SL a +/- sign indicates that the vessel is moving forward or backward respectively. For ST a +/- sign indicates that the vessel is moving toward port or starboard respectively.

HDP: Master vessel heading. Displayed in degrees.

Note SL, ST and HDP is available only if gyro is interfaced to the system.

HFSU: Slave vessel heading. Displayed in degrees. Information received via an UHF link.

Note The **Navigation** display on the slave vessel differs from the display on the master vessel. On the slave vessel HDG (slave vessel heading) and HDGR (heading remote vessel) are displayed instead of HDP and HFSU.

CPA: Closest point of approach to the target point. Displayed in metres.
TCPA: Time to closest point of approach. Displayed in minutes and seconds.

Note HDP and HFSU are only displayed when the UHF/TDMA link is active. If the link is passive, CPA and TCPA will be displayed.

COG: Vessel course over ground. Displayed in degrees.

DT: Distance to Target. Distance from a given point on the vessel to the intended position inserted as Target point. Unit is metres or feet.

BT: Bearing to Target. Bearing from vessel to target with respect to true north. Unit is degrees.

Information from the right hand part of the screen:

NAV GPS: The position status indicator. The status has one of the following values:

- D: Differential corrections applied from a single reference station or multiple reference stations.
- ND: No differential corrections.
- --: No GPS communication.

NAV GLO: NA

POS QA ABS: Position quality for the absolute position - the drms value of the computed position. Unit in metres.

POS QA REL: Position quality for the relative computed range and bearing - the drms value of the computed position. Unit in metres. Only available when the DARPS 132 unit operates in DARPS mode.

DIFF CORR LNK name. Shows the number of reference stations received from the actual link. The link names are equal to the link names in the **TMS** display.

UHF LINK: Shows the state of the UHF/TDMA link. Only available when the DARPS 132 unit operates in DARPS mode. The link has one of the following states:

- PAS: Passive, not activated from DP, no target is selected.
- ACT: Active, a target is selected and contact with the slave vessel is established. Data from the slave vessel is received.

MIS: Missing, a target is selected, but no contact is established with the slave vessel. MIS will also be displayed if the master vessel has lost contact with the slave during a loading operation.

SEL. ID: Information about the slave vessel's DARPS ID which the master vessel has selected to connect to. Only available when the DARPS 132 unit operates in DARPS mode.

ACT. ID: Information about what target the master vessel receives data from. The slave vessels DARPS ID will be displayed here. If the SEL. ID number and this number are the same, the master receives data from correct target. If the numbers are different, data from another vessel than expected, are received. Only available when the DARPS 132 unit operates in DARPS mode.

Geographical vessel position in selected datum.

SAT USED: Number of satellites used in the position calculation. Due to different elevation masks used at the vessel and at the reference station, this number can be different from both the number in the SAT READ and SAT CORR fields.

SAT READ: Number of satellites tracked by the GPS receiver.

SAT CORR: Number of satellites with valid differential corrections.

YME: The name of the selected target point.

6.15 Satellites in Sight display

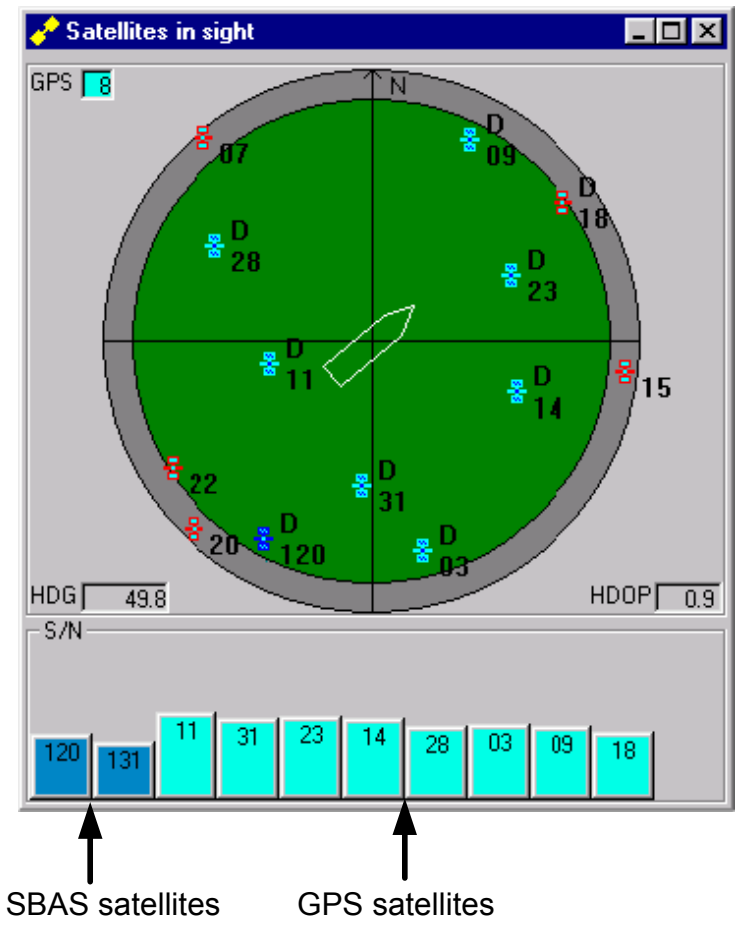


Figure 37 The Satellites in Sight display

The **Satellites in Sight** display shows which satellites the DARPS 132 is tracking. The satellites are presented according to satellite geometry. The grey outer field represents the elevation mask. Satellites under the set elevation mask are marked red. The satellite azimuth angle is according to the north-south axis.

In the upper left corner, the number of GPS satellites tracked is presented. The bars at the bottom of the page represent the signal-to-noise level for each satellite. If the satellite has valid differential corrections, this is marked with a D.

In this Satellites in Sight display example also SBAS satellites are shown.

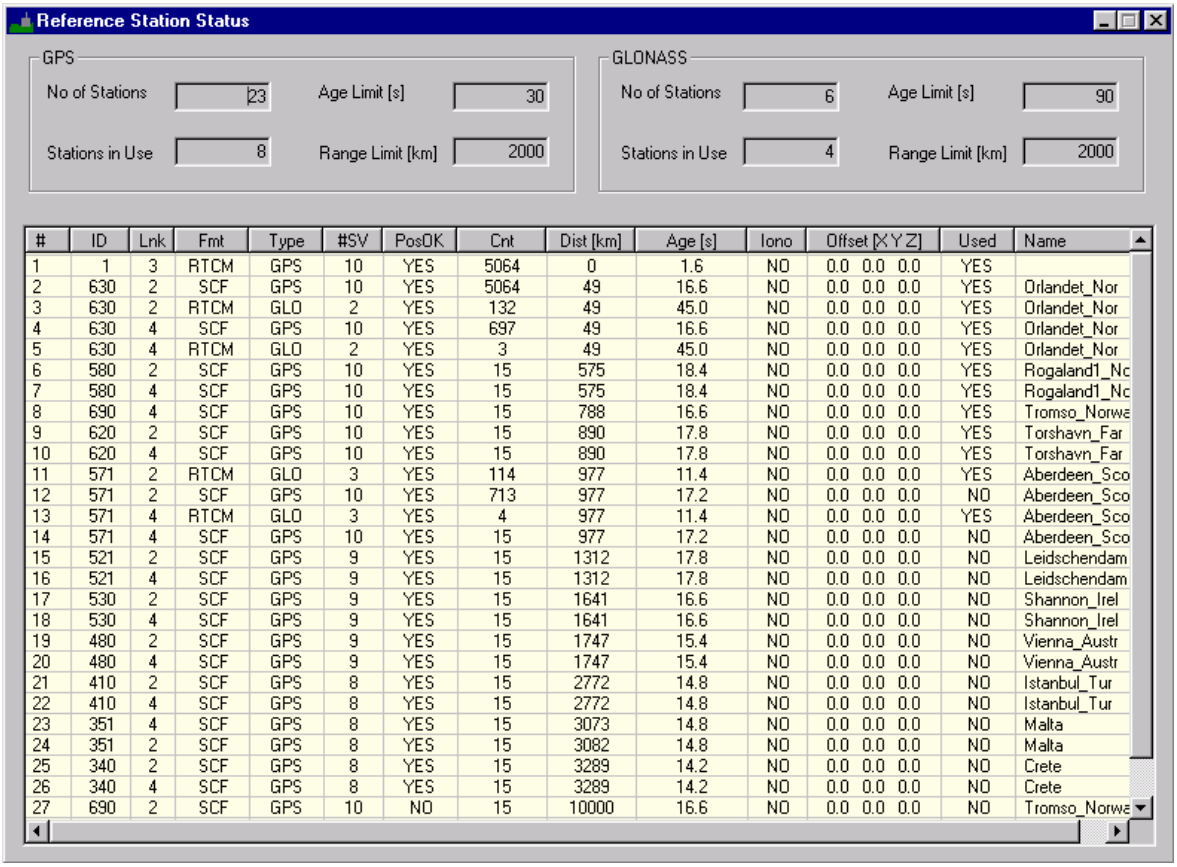
If you click on one of the satellites with the left mouse button, a dialogue box will appear with the status of the satellite including azimuth, elevation, signal-to-noise ratio and differential correction availability.

Figure 38 Satellite status dialogue box

If you click on one of the satellites with the right mouse button, you can disable/enable the satellite. If disabling a satellite, the current satellite will not be present in the position solution.

If the vessel has gyro interface, the **Satellites in Sight** display shows the vessel oriented in the gyro direction.

6.16 Reference Station Status display



#	ID	Lnk	Fmt	Type	#SV	PosOK	Cnt	Dist [km]	Age [s]	Iono	Offset [X Y Z]	Used	Name
1	1	3	RTCM	GPS	10	YES	5064	0	1.6	NO	0.0 0.0 0.0	YES	
2	630	2	SCF	GPS	10	YES	5064	49	16.6	NO	0.0 0.0 0.0	YES	Orlandet_Nor
3	630	2	RTCM	GLO	2	YES	132	49	45.0	NO	0.0 0.0 0.0	YES	Orlandet_Nor
4	630	4	SCF	GPS	10	YES	697	49	16.6	NO	0.0 0.0 0.0	YES	Orlandet_Nor
5	630	4	RTCM	GLO	2	YES	3	49	45.0	NO	0.0 0.0 0.0	YES	Orlandet_Nor
6	580	2	SCF	GPS	10	YES	15	575	18.4	NO	0.0 0.0 0.0	YES	Rogaland1_Nc
7	580	4	SCF	GPS	10	YES	15	575	18.4	NO	0.0 0.0 0.0	YES	Rogaland1_Nc
8	690	4	SCF	GPS	10	YES	15	788	16.6	NO	0.0 0.0 0.0	YES	Tromso_Norwe
9	620	2	SCF	GPS	10	YES	15	890	17.8	NO	0.0 0.0 0.0	YES	Torshavn_Far
10	620	4	SCF	GPS	10	YES	15	890	17.8	NO	0.0 0.0 0.0	YES	Torshavn_Far
11	571	2	RTCM	GLO	3	YES	114	977	11.4	NO	0.0 0.0 0.0	YES	Aberdeen_Sco
12	571	2	SCF	GPS	10	YES	713	977	17.2	NO	0.0 0.0 0.0	NO	Aberdeen_Sco
13	571	4	RTCM	GLO	3	YES	4	977	11.4	NO	0.0 0.0 0.0	YES	Aberdeen_Sco
14	571	4	SCF	GPS	10	YES	15	977	17.2	NO	0.0 0.0 0.0	NO	Aberdeen_Sco
15	521	2	SCF	GPS	9	YES	15	1312	17.8	NO	0.0 0.0 0.0	NO	Leidschendam
16	521	4	SCF	GPS	9	YES	15	1312	17.8	NO	0.0 0.0 0.0	NO	Leidschendam
17	530	2	SCF	GPS	9	YES	15	1641	16.6	NO	0.0 0.0 0.0	NO	Shannon_Irel
18	530	4	SCF	GPS	9	YES	15	1641	16.6	NO	0.0 0.0 0.0	NO	Shannon_Irel
19	480	2	SCF	GPS	9	YES	15	1747	15.4	NO	0.0 0.0 0.0	NO	Vienna_Austr
20	480	4	SCF	GPS	9	YES	15	1747	15.4	NO	0.0 0.0 0.0	NO	Vienna_Austr
21	410	2	SCF	GPS	8	YES	15	2772	14.8	NO	0.0 0.0 0.0	NO	Istanbul_Tur
22	410	4	SCF	GPS	8	YES	15	2772	14.8	NO	0.0 0.0 0.0	NO	Istanbul_Tur
23	351	4	SCF	GPS	8	YES	15	3073	14.8	NO	0.0 0.0 0.0	NO	Malta
24	351	2	SCF	GPS	8	YES	15	3082	14.8	NO	0.0 0.0 0.0	NO	Malta
25	340	2	SCF	GPS	8	YES	15	3289	14.2	NO	0.0 0.0 0.0	NO	Crete
26	340	4	SCF	GPS	8	YES	15	3289	14.2	NO	0.0 0.0 0.0	NO	Crete
27	690	2	SCF	GPS	10	NO	15	10000	16.6	NO	0.0 0.0 0.0	NO	Tromso_Norwe

Figure 39 The Reference Station Status display

The **Reference Station Status** display is obtained by entering **Reference Station List** in the **Tools** menu. It shows information about available reference stations. The reference stations are presented according to the distance to the vessel. The upper field of the display presents the number of stations available and the number of stations used by the system. In addition, the age limit and range limit set in the setup file are displayed.

The lower field of the display shows the following:

#: The number of reference stations.

ID: The reference stations' identification number.

Link: The number of the link that receives data from the reference station.

Fmt: The format on which data are received (SCF or RTCM).

Type: The type of reference station, GPS or Glonass.

#SV: The number of satellites tracked by the reference station.

PosOK: This column shows if the system has the reference stations' position.

Cnt: This column shows how many times data have been received from the reference station. The number is updated every time new position information from the reference station is received.

Dist [km]: The distance between the vessel and the reference station in kilometres. The reference stations are presented according to the distance to the vessel.

Age [s]: This column shows how many seconds it is since data from the reference station have been received.

Iono: This column shows if the corrections are compensated for ionosphere difference between reference station and mobile station.

Offset [XYZ]: This column shows if an offset for the reference station position is set. Some links can deliver differential corrections from reference stations measured in a different co-ordinate system (not WGS-84). This offset will compensate for such an error. The option can be set in the setup file.

Used: This column shows if the reference station data are used in the position computation.

Name: The name of the reference station. If the reference station does not exist in the ST_COOD_DEF.TXT file, "???" will be displayed.

To disable reference stations, select the current station in the **Reference Station Status** display with the mouse and press the left mouse button. A dialogue box, as shown in Figure 40, will appear.

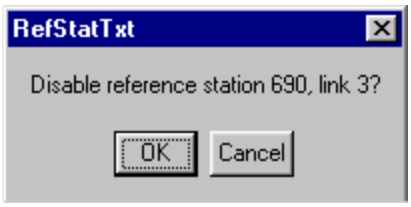


Figure 40 Disabling reference stations

When a reference station is disabled, data from the current station is not included in the calculated position. A disabled reference station is marked "DIS" in the **Reference Station Status** display.

To enable reference stations, select the current station with the mouse and press the left mouse button. A dialogue box, as shown in Figure 41, will appear. When the reference station is enabled, the status of the station will change to "YES".

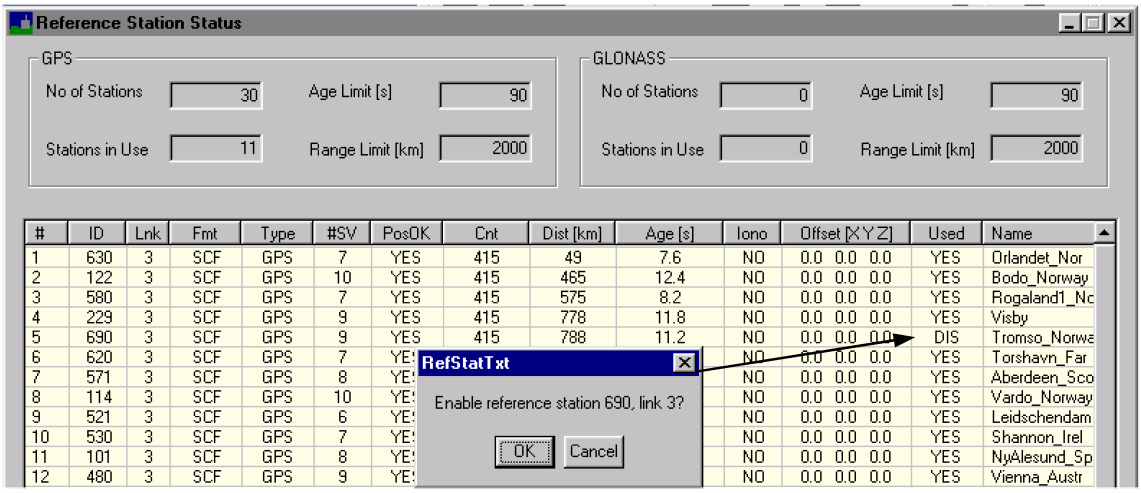
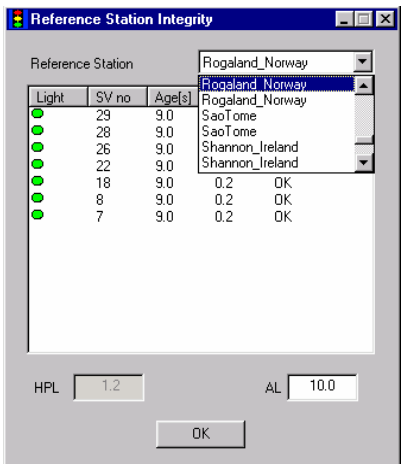


Figure 41 Enabling reference stations

6.17 Reference Station Integrity

A reference station integrity monitor is available from the **Tools** menu.



6.18 The Audible Alarms

The **Audible Alarm** option is implemented in order to warn the operator when the software has detected an alarm status. The audible alarms are enabled and configured in the **Edit Target Data** window, see section 6.9, and in the **DARPS control** dialogue, see section 6.13.

The **Audible Alarms Configuration** dialogue can be enabled from the **Tools** menu under **Alarm options**.

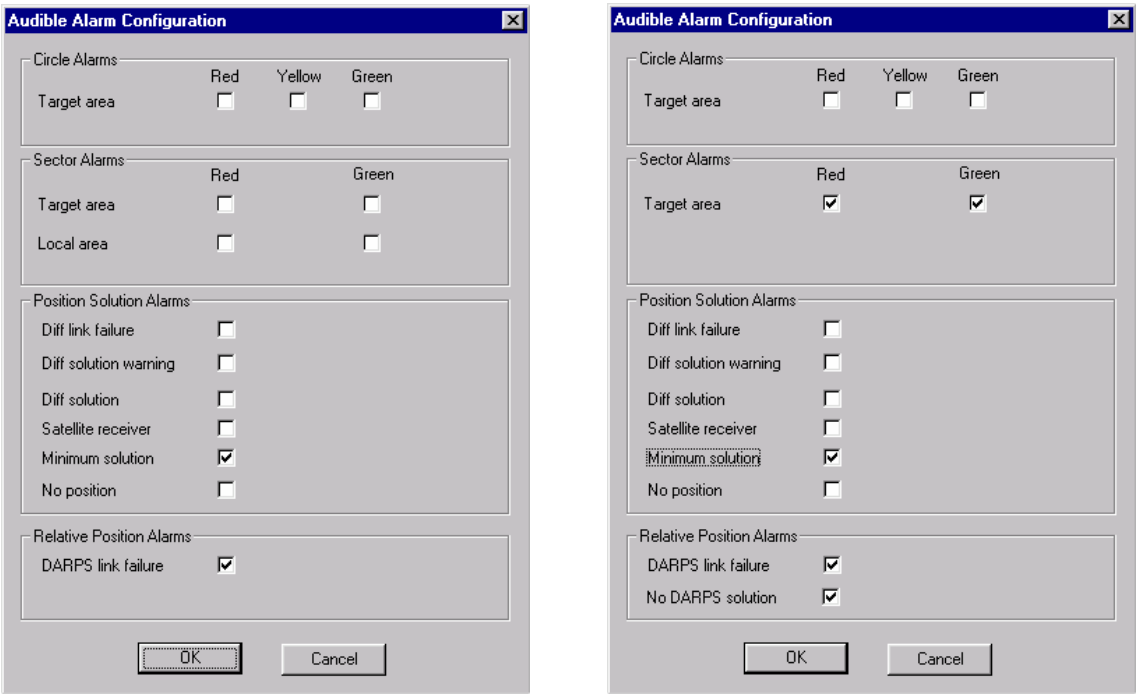


Figure 42 Audible Alarm Configuration dialogue for slave (left) and master (right) vessel

Checking the box to the right of the item enables the alarms.

When an alarm arises, the **Alarm Status** dialogue will pop up and indicate which alarm situation has arisen. The box to the right of the current alarm will be red. In addition, an audible alarm will start. When the alarm has been acknowledged by pressing a key on the keyboard, the audible alarm will stop. When the alarm has been acknowledged, but the alarm situation still exists, the box turns purple. When the situation, which caused the alarm, is ok and the alarm has not been acknowledged, the box turns green, see Figure 44.

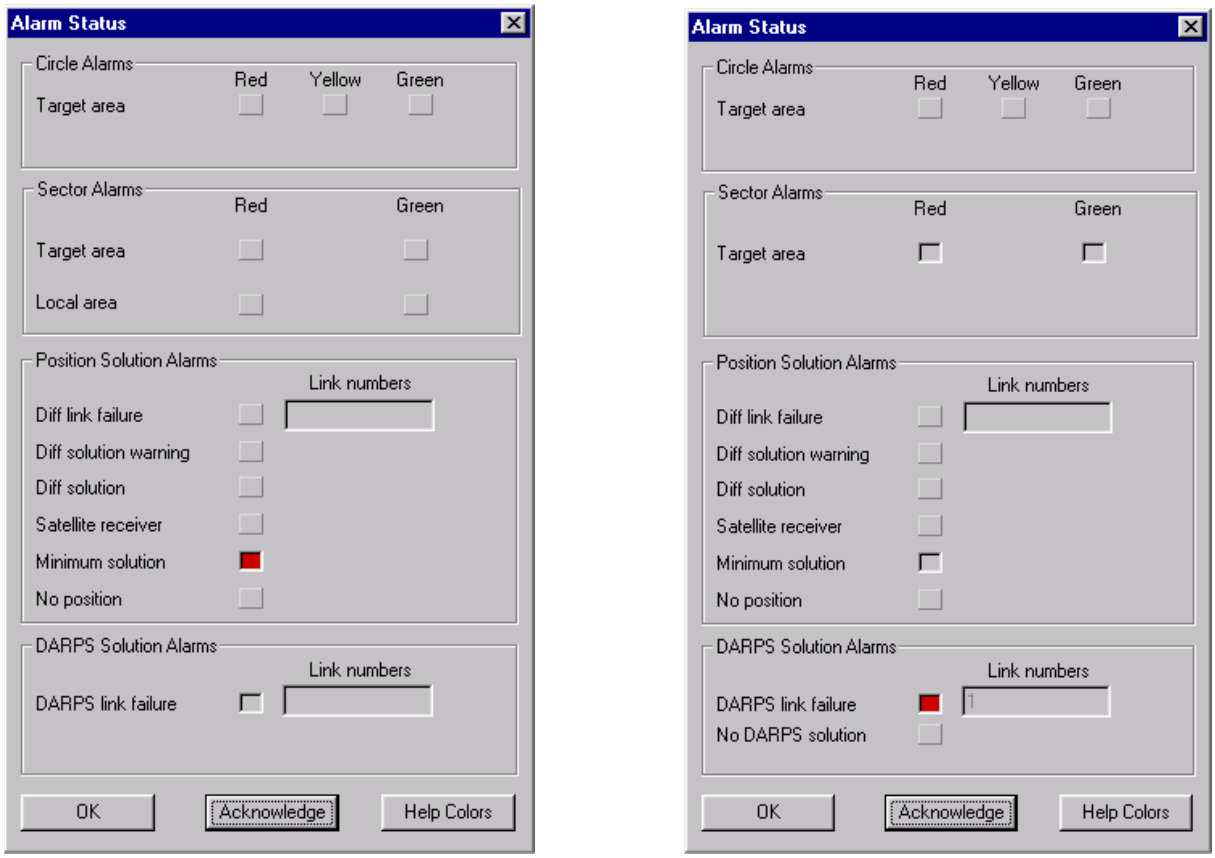


Figure 43 The Alarms Status dialogue for slave (left) and master (right) vessel

Figure 44 The Alarm Color Codes

6.18.1 Circle alarms

This alarm is triggered if the vessel is moving out of the area that is defined by the red, yellow or green alarm circle in section 6.9.4 and 6.9.5. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

6.18.2 Sector alarms

Two types of sector alarms are selectable, **Target alarm** and **Local alarm**.

Master vessel
On a master vessel, only **Target alarm** is available. The sector will originate from the selected target's loading point, received via TDMA link, UHF link or from a fixed target, which is a vessel with fixed heading, see section 6.9.4. The alarm is triggered if the master vessel's reference point is moving out of the red or green sector.

Slave vessel
On a slave vessel, both Target and Local alarms are available. The **Local alarm** sector is defined as described in section 6.9.5. The alarm is triggered if a master vessel during connect crosses the red or green sectors. The **Target alarm** sector will originate from the selected target's position. The sector is defined for each target as described in section 6.9.4. The alarm is triggered if the slave vessel's reference point crosses the sector limits.

The audible alarms will last until the **Acknowledge** button is selected in the dialogue box

6.18.3 Position solution alarms

Diff link failure
This alarm event is set if there are no decodable correction data on a serial port for a pre defined time, the default timeout is eight seconds. When an alarm arises, the current link number is displayed. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

Diff solution warning
This alarm event is set if the age of the differential correction data exceeds stated limits or all difflinks are missing. The default limit is 70 seconds. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

Diff solution
This alarm event is triggered when the age of the differential corrections exceeds the age limit set in the set-up file, see *Installation Manual* [1]. The default age limit is 90 seconds. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

Satellite receiver
This alarm event is triggered when the contact with the GPS receiver is lost, and no data are received. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

Minimum solution
This event occurs when the GPS receiver tracks a minimum number of satellites to calculate a position, it means that if one extra satellite is lost, the position solution will be lost. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

No position
This event occurs when there are too few satellites to compute a position fix. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

6.18.4 Relative position alarms

DARPS link failure
The alarm is triggered when a DARPS link fails. When an alarm arises, the link number is displayed. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

No DARPS solution
The alarm is triggered if there is no contact between the vessels or between a vessel and transponder and no data have been received for a pre-defined time. The default timeout is eight seconds. This alarm is only available on master vessels. The audible alarm will last until the **Acknowledge** button is selected in the dialogue box.

6.19 Navigation mode

Navigation mode features are available in the **TMS** window.

In Navigation mode, the **TMS** display differs slightly from the appearance in the DPS mode. The page gives a graphical presentation of the active route with the visible legs and waypoints. The waypoints are displayed as a circle with the waypoint number beside. The current leg, the leg the vessel is sailing on, is marked in bold. The following parameters are also displayed:

WPT: Route name and waypoint number.

ETA: Estimated Time of Arrival. The time of arrival to the end of the active route (to the last waypoint). Unit in hours and minutes.

XTE: Cross-Track-Error. The distance from the vessel's present position to the closest point on the active leg. Unit in metres.

CMG: Course made Good. The heading from the vessel's present position to the active waypoint. Unit in degrees.

DTG: Distance To Go. The remaining distance of the current leg. Unit in nautical miles.

TTG: Time To Go. The remaining time of the current leg. Unit in minutes and seconds.

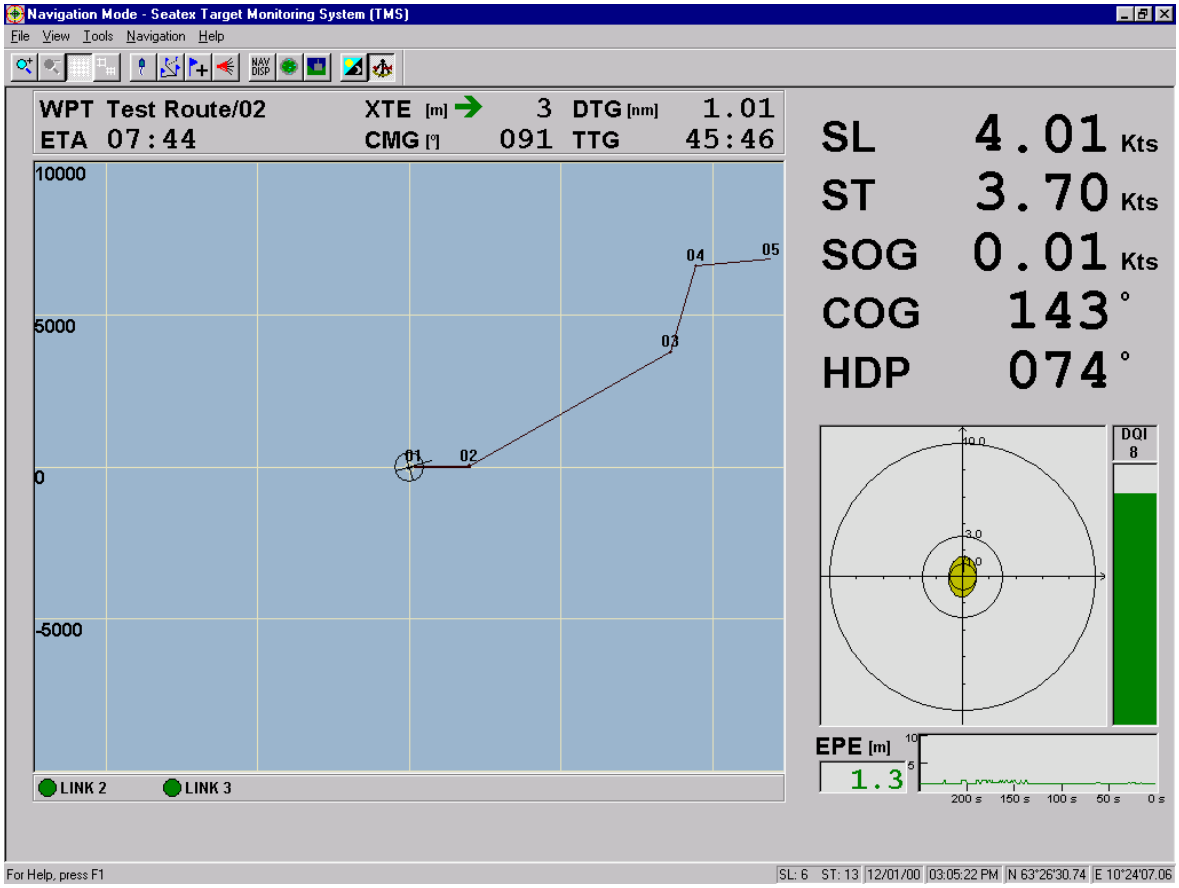


Figure 45 TMS display in Navigation mode

6.19.1 Toolbar buttons

When Navigation mode is selected, the **Target Select** button will be replaced by the **Route Select** button and the **Insert Current Position as Target** button will be replaced by the **Next Leg** button.

The TMS Toolbar will be displayed as in the figure below:

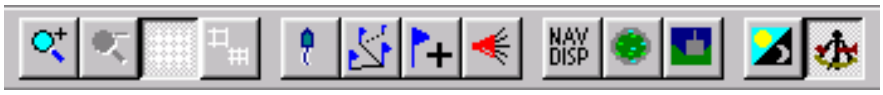


Figure 46 TMS Toolbar in Navigation mode

 Navigation Mode
When selecting this button, the system will change to Navigation mode. The system mode will toggle between Navigation mode and DPS mode each time the button is pressed.

 Select Route
By selecting this button, the Select Route dialouge is presented.


Next Leg
By selecting this button, the next leg of the route is selected as current leg.

The toolbar buttons are also available from the text menu, as shown in the Figure 47.

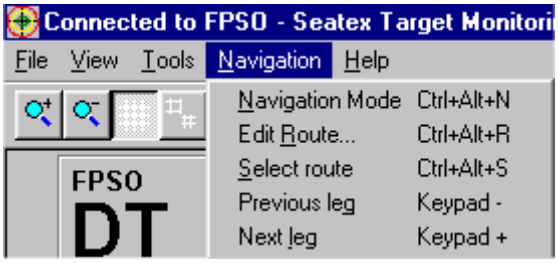


Figure 47 Available tools

6.19.2 Description of waypoints and legs

Sailing route

A sailing route is described as a consecutive number of geographically fixed points (waypoints) interconnected by straight lines (legs). Figure 48 shows a vessel sailing along the leg between waypoint 22 (FROM waypoint) and waypoint 23 (TO waypoint). The vessel is on the starboard side of the leg. Consequently, the vessel has a cross track error (XTE), which a navigator will try to reduce by setting the course towards the leg.

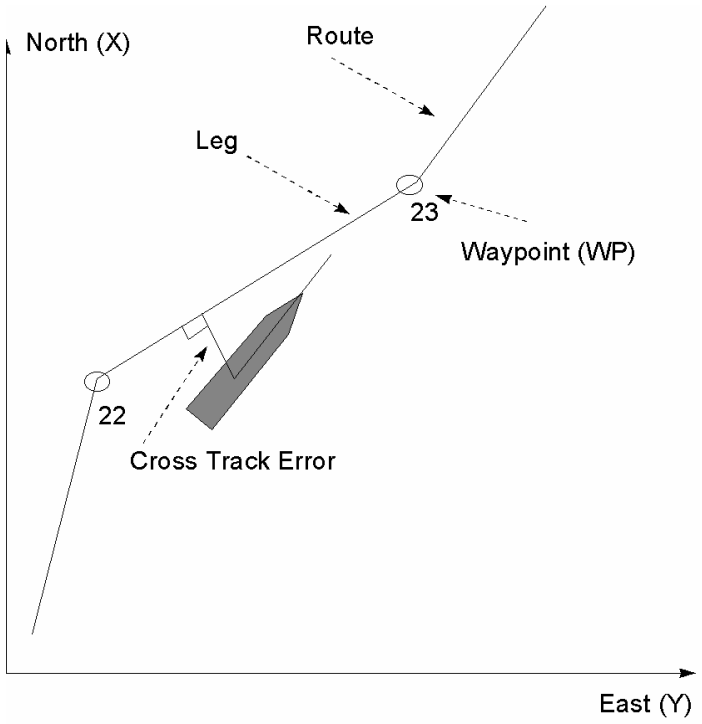


Figure 48 Waypoints and routes

Waypoint change

A new TO waypoint will be selected automatically by the system. Automatic waypoint change is based on the following algorithm (Figure 49):

1. The operator can define a circle around each waypoint, referred to as the turning (or arrival) circle. The default radius is 40 metres. The system will automatically change to the next waypoint of the route as soon as the vessel crosses the circle. DTG for the next leg is also calculated from this point. In addition, a specific turning circle radius can be entered for selected waypoint in the **SeaRoute** main window, see Figure 51.
2. If the vessel's cross track error is larger than the radius of the circle, the next waypoint will be selected when the vessel passes a line which runs through the TO waypoint and is perpendicular to the current leg (beam).

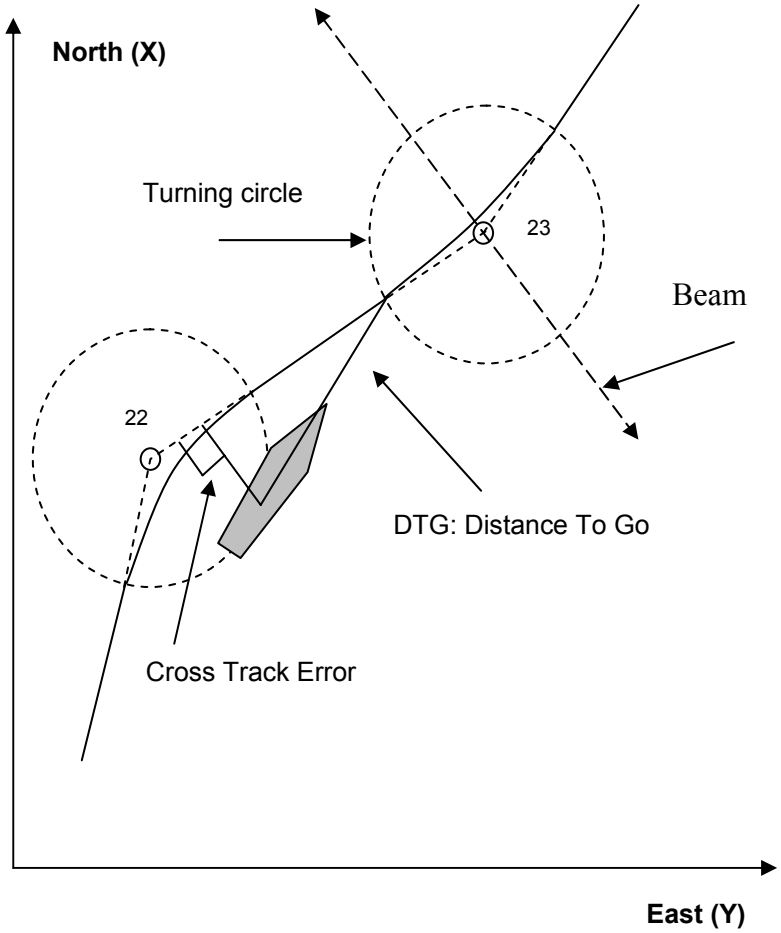


Figure 49 Change of waypoints

6.19.3 Operation

Activating a route

By pressing the **Select Route** button in Navigation mode, the **Select Route** dialogue box will appear, see Figure 50 below.

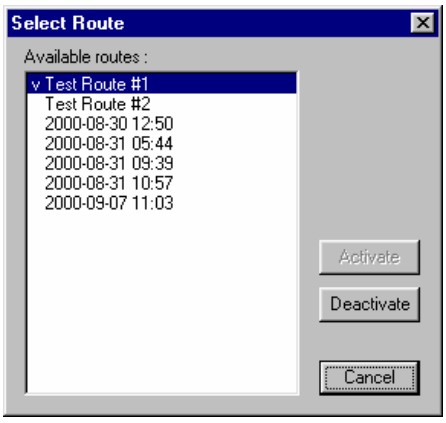


Figure 50 Route Selection dialogue box

If a route is already activated when opening the dialogue box, this route will be the selected item in the list presented. In addition, the active route will be indicated with a √.

The dialogue box contains a list of available routes. To select a route, mark the desired route and press **Activate**. It is not necessary to deactivate a route before activating a route. The **Activate** button is disabled if no route is selected or when the selected route is the currently active route. When the selected route is the active route, the **Deactivate** button is enabled.

A route may not be selected if no valid position is available from the DPS. An error message is presented if route selection is unavailable.

Editing a route

By selecting **Edit Route** in the **Navigation** menu, the **SeaRoute** dialogue box, see Figure 51, will appear and editing of navigation routes is available.

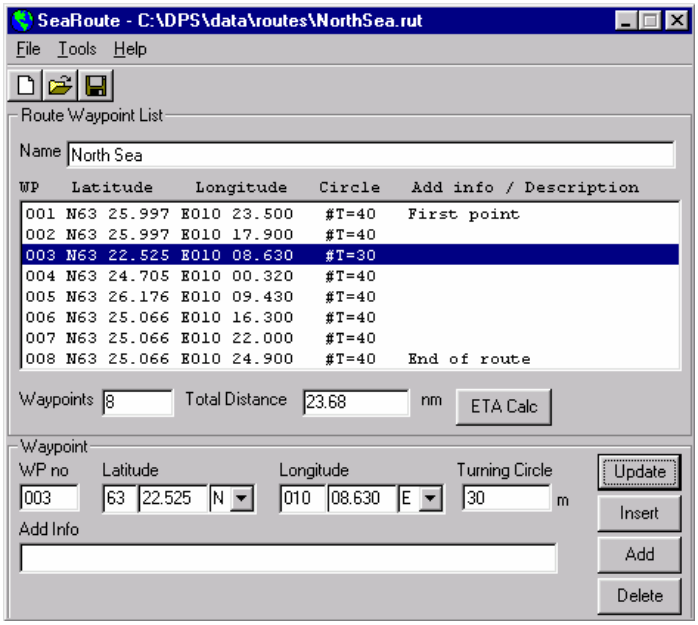


Figure 51 SeaRoute main window

All waypoints in a route are displayed in the upper section of the **SeaRoute** dialogue window. The section displays the route name, the waypoint number, the waypoint position, the waypoint turning circle and description of the point. In addition, the total number of waypoints and the route distance are displayed. By pressing the **ETA Calc** button, more information about the route is available.

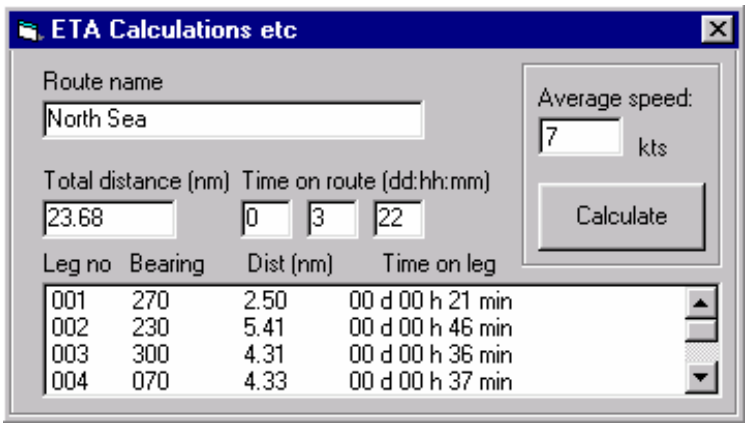


Figure 52 ETA Calculation.

In the lower section of the **SeaRoute** window, new waypoints can be added to the route. To add a new waypoint, type correct waypoint number, latitude and longitude, radius of turning circle (if different from default value) and point description and press **Add**. To edit an already existing waypoint, highlight the current waypoint to edit, edit the waypoint and press **Update**. To insert a new point between two already existing points, highlight the point that shall be after the new point, edit the point and press **Insert**. To delete a waypoint, highlight the current point and press **Delete**.

Note Navigation routes can also be edited in DPS mode.

To edit another route than the current one, select **File|Open** in the **SeaRoute** window and select wanted route. It is also possible to select a blank route (**New**), **Save** the edited route, save a route with a new name (**Save as**), activate a new route (**Activate Route**), deactivate the current route (**Clear Route**) and reverse a route (**Reverse Route**). When reversing a route all points in the route are reversed, i.e. the last point becomes the first point. To activate the reversed route **Active Route** must be selected.

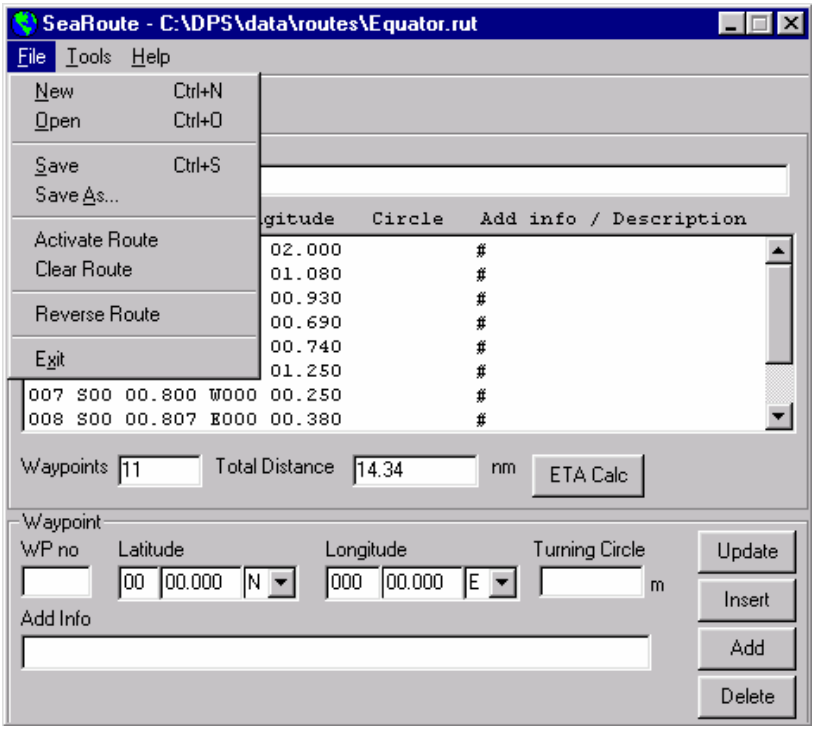


Figure 53 Options in the SeaRoute window

Under the **Tools** menu the functions **Great Circle Calc** and **Quick Calc** is found. With the **Great Circle Calc** function, the great circle distance between two points can be computed. **Quick Calc** is a useful tool to compute speed, distance and time.

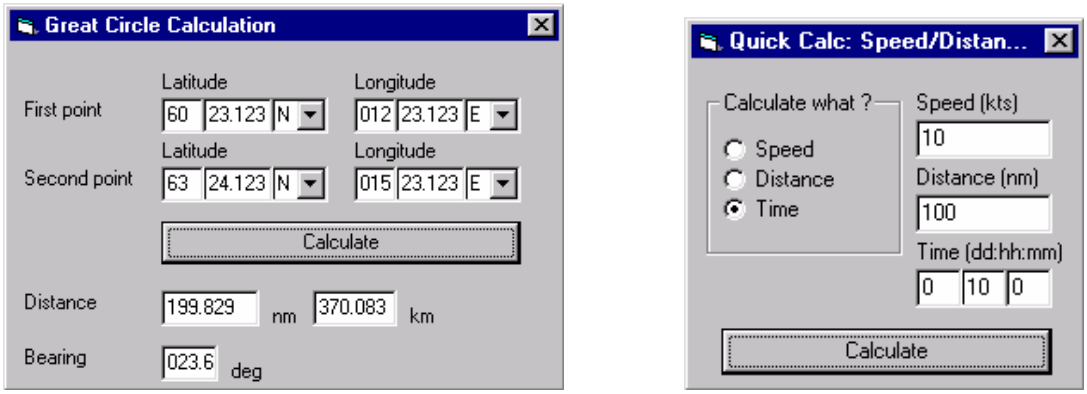


Figure 54 Great Circle Calc and Quick Calc dialogue boxes

6.19.4 DP Control

If a DP requests a target during Navigation mode, the system will proceed as a normal DARPS operation. However, the TMS will display navigation information until the system is within the DARPS radius. Then the TMS will display DARPS information.

6.19.5 Remote features

The remote feature makes it possible to create and edit a route from a remote computer. This feature is only available if the system has been delivered with a network adapter board.

To enable these features do the following:

1. Make sure the hardware platform (the DPS/DARPS) and the remote computer are connected to the LAN and that the directory structure containing the routes is shared.
2. Also make sure that the remote computer has access to the DPS/DARPS system. If not, create the remote computer as a new user on the DPS/DARPS system.
3. Copy the following software modules from the DPS/DARPS system to a suitable directory on the remote computer:
    - c:\dps\bin\SeaRoute.exe
    - c:\dps\bin\ConfigAndSetup.exe
    - c:\dps\bin\sl100db.dll

4. Start ConfigAndSetup.exe on the remote computer. Select the **RecordingSetup** tab, type the path on the DPS/DARPS system in the path edit box. The syntax shall be: \\<computer>\c\dps\data.
5. Select the **Apply** button and close the window.
6. Start SeaRoute.exe on the remote computer.
7. Select **File|Open** and verify that the files indicated are those of the DPS/DARPS system.
8. Create a new route or edit an existing route. Save and exit the SeaRoute program.
9. The new or edited routes shall now be available on the DPS/DARPS system

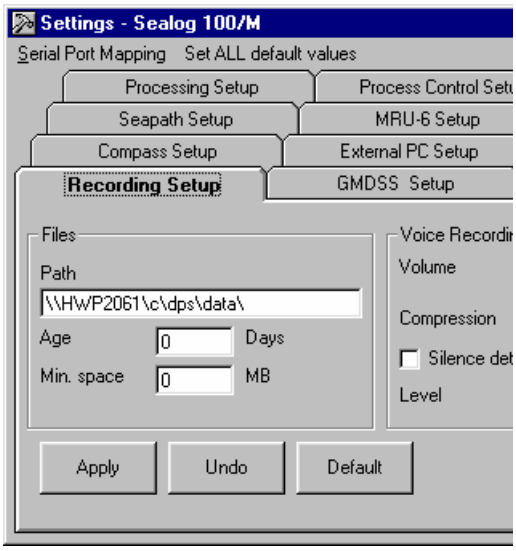


Figure 55 The Recording tab on the ConfigAndSetup program

6.20 GPS based heading

The GPS based heading feature is available from the **TMS** window. The heading calculation is based on raw data, pseudo-range and carrier phase.

 Heading Display
When selecting this button from the **TMS** display the **Heading Display** will appear.

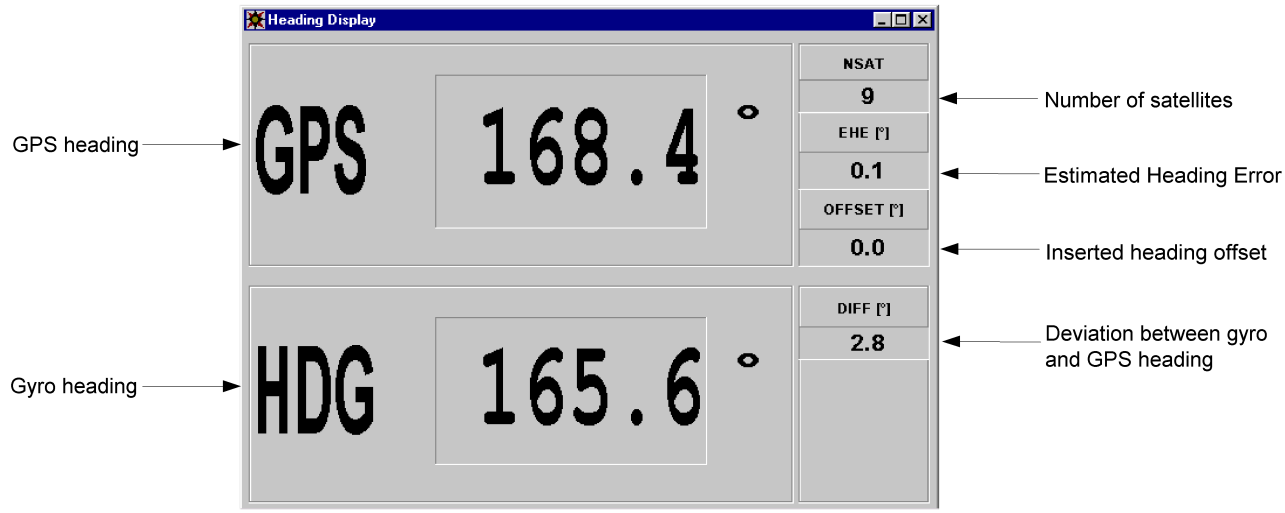


Figure 56 Heading Display

GPS: GPS based heading. Displayed in degrees.

HDG: Gyro or DP heading. Only available if gyro or heading from DP is interfaced to the system. Displayed in degrees.

NSAT: Number of satellites used to compute the GPS heading solution.

EHE: Estimated Heading Error. Displayed in degrees.

OFFSET: Inserted heading offset. Displayed in degrees.

DIFF: Deviation between GPS heading and gyro. Displayed in degrees.

GPS heading is defined by the baseline between two GPS observation points. Thus, two DARPS units must be available. Both DARPS units are transmitting and receiving raw GPS data via serial line. Some initialisation time is required to obtain a high accuracy heading. Until the configured level is reached, which default is 1°, accuracy is based on pseudo-range measurements and is gradually improved until the limit of carrier phase float accuracy is reached. During this initialisation time, the **GPS** heading and the **EHE** fields are displayed with yellow background, see Figure 57.

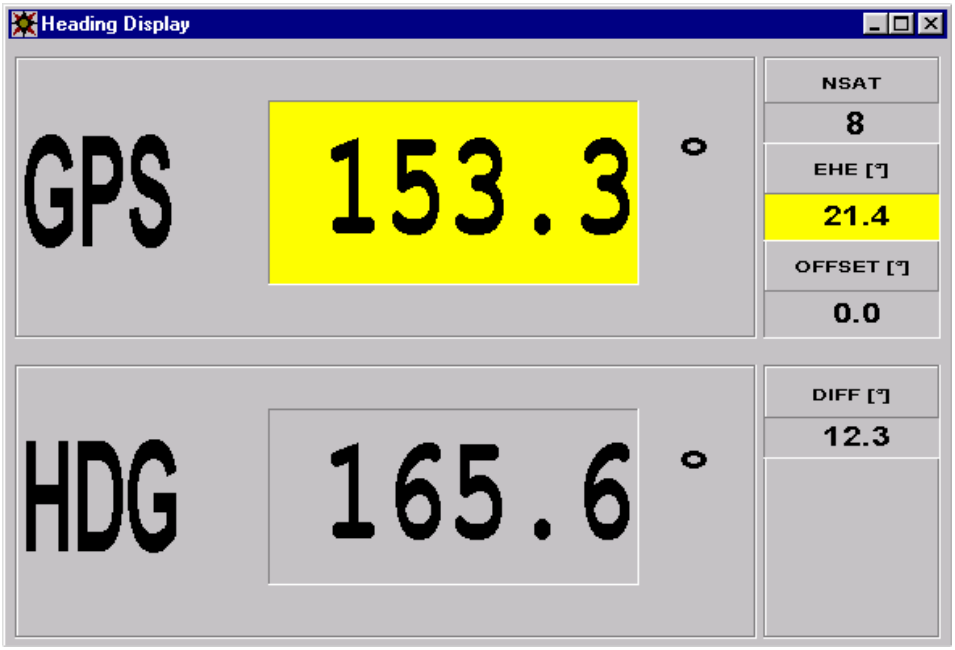


Figure 57 Heading Display during the initialisation period

6.21 Satellite prediction

During some periods the satellite coverage over some areas is rather poor and in addition operations close to large equipment will often result in shadowed satellites and decrease the number of satellites available. This is a major risk for safety operations. The satellite prediction feature is a helpful tool to plan an operation where good accuracy throughout the operation is necessary and it will help the operator to plan when a safety operation could take place and to identify periods of poor satellite geometry.

Satellite Prediction

When selecting this button from the **TMS** display, the **Satellite Prediction Config** dialogue will appear.

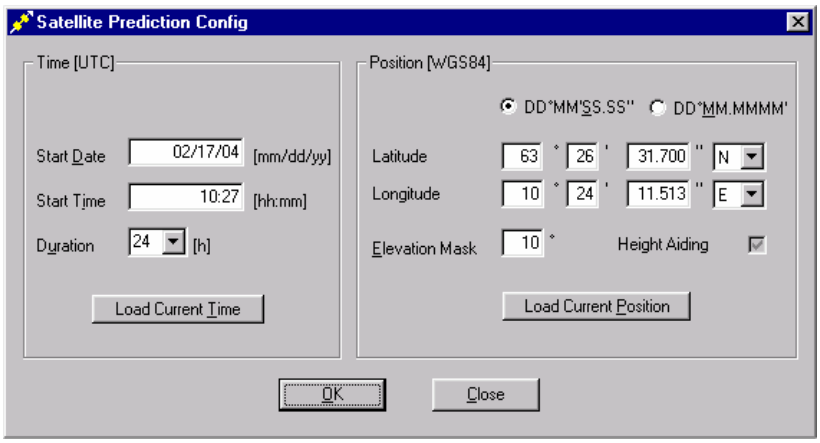


Figure 58 Satellite Prediction Config dialogue

In the **Satellite Prediction Config** dialogue the **Start Date**, **Start Time** and **Duration** of the prediction must be entered. Press the **Load Current Time** button if current date and time is preferred as start time. The prediction period is limited to 1, 2, 4, 12 or 24 hours.

The position, for which the prediction shall be performed, shall be input together with the elevation mask for the calculation. Press the **Load Current Position** button if current position is preferred. If height aiding is enabled in the setup file, see the *Installation Manual*, the **Height Aiding** option is checked in the configuration dialogue. The **Elevation Mask** value is default identical to the elevation mask in the setup file. However, this value can be changed.

When all parameters have been inserted, press the **OK** button to open the **Satellite Prediction** display.

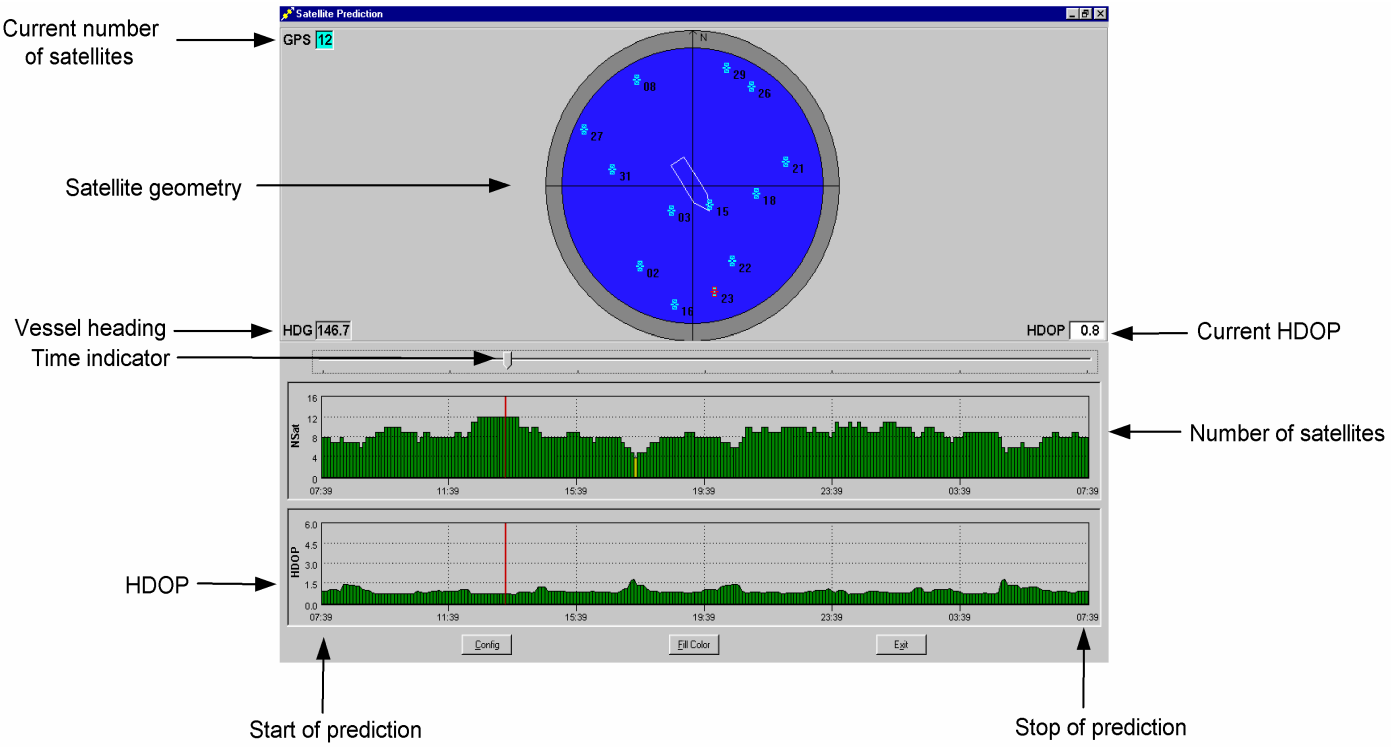


Figure 59 Satellite Prediction display

The **Satellite Prediction** display shows one graph with the number of satellites available and one graph with the corresponding HDOP values for the selected period. The selected period is displayed, in GPS-time, along the x-axis. In addition, the satellite constellation on the sky is displayed together with the current number of satellites, vessel heading and HDOP.

By dragging the **Time indicator,** the satellite constellation will change according to the time shown by the Time indicator. Page Up and Page Down or the left and right arrow keys on the keyboard operates the Time indicator. When using the Page Up and Page Down keys, the Time indicator will jump in greater intervals than if using the arrow keys.

The **Fill Color** button may be used to toggle fill colours on and off.

The colours used on the Number of satellites graph indicate the status of the satellite constellation.

Green: ≥ 5 satellites visible.
Yellow: 4 satellites visible.
Red: ≤ 3 satellites visible.

The colours on the HDOP-graph indicate the satellite geometry (default values):

Green: HDOP < 2.5.
Yellow: 2.5 < HDOP < 4.
Red: HDOP > 4.

Note The limit for the HDOP to turn red is identical to the HDOP limit set in the setup file, see the *Installation Manual*.

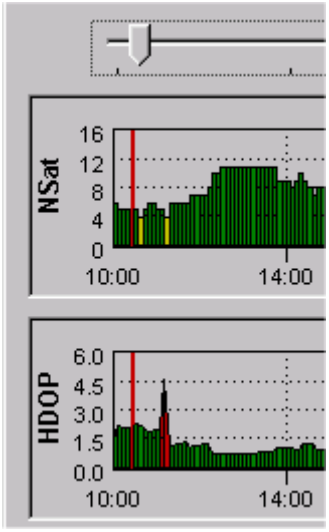


Figure 60 Close-up of satellite prediction graphs

By pressing the left mouse button directly on a satellite, it is possible to display azimuth and elevation information for each satellite present.

By pressing the right mouse button on a satellite, the satellite will be disabled and will not be included in the calculations. This will reflect the number of satellites and HDOP graphs as long as the current satellite is present. When disabling satellites, both graphs are immediately updated.

The colours of the satellites indicate the following:

Light blue: GPS satellites.
Light green: Glonass satellites (only for DARPS 200).
Yellow: The satellite is disable by the user.
Red: The satellite is below the elevation angle, is rejected by the DARPS position calculation algorithms or is reported unhealthy from the almanac. Red satellites are not included in the calculations.

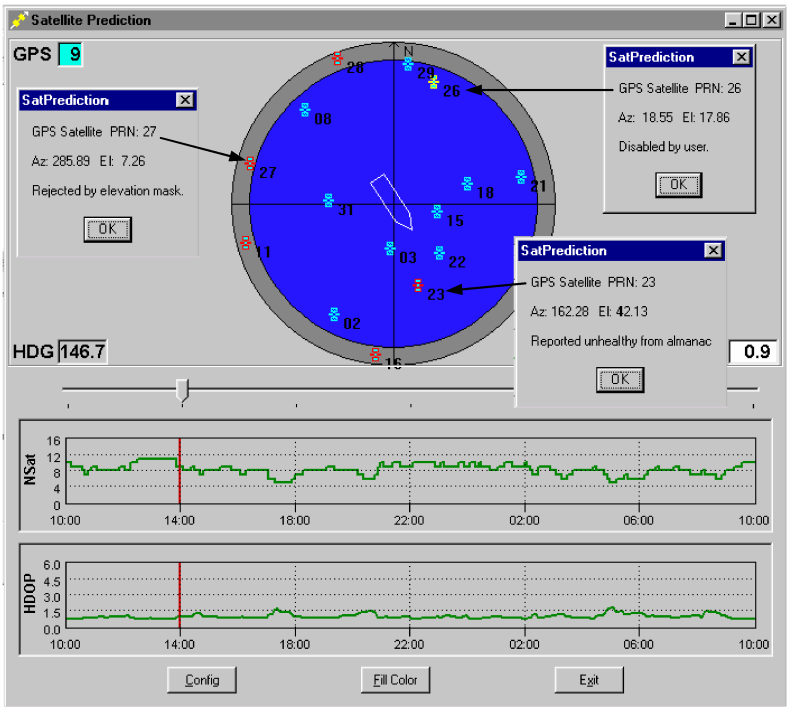


Figure 61 Satellite information in the Satellite Prediction display

The disable-of-satellite feature is a very helpful tool when planning operations where good accuracy throughout the operation is necessary. If shadowing of satellites in parts of the sky is known, satellites in this region can be disabled. The graphs will then display number of satellites and HDOP where these satellites are omitted. This will help the operator to decide if the availability and accuracy is good enough throughout the operation and if the operation should be performed.

The satellite prediction is based on the satellite's almanac data received from the GPS receiver.

6.22 High precision position

Starfix-HP

The DARPS 132 can make use of the wide-area decimetre level DGPS service, Starfix-HP, offered by Fugro SeaStar. The service offers decimetre level positioning accuracy, even several hundred kilometres from the reference stations. The service is covering most areas around the world with offshore activity. In order to obtain a position solution with decimetre accuracy, Starfix –HP uses ionosphere-corrected measurements in combination with the observed signal carrier phase.

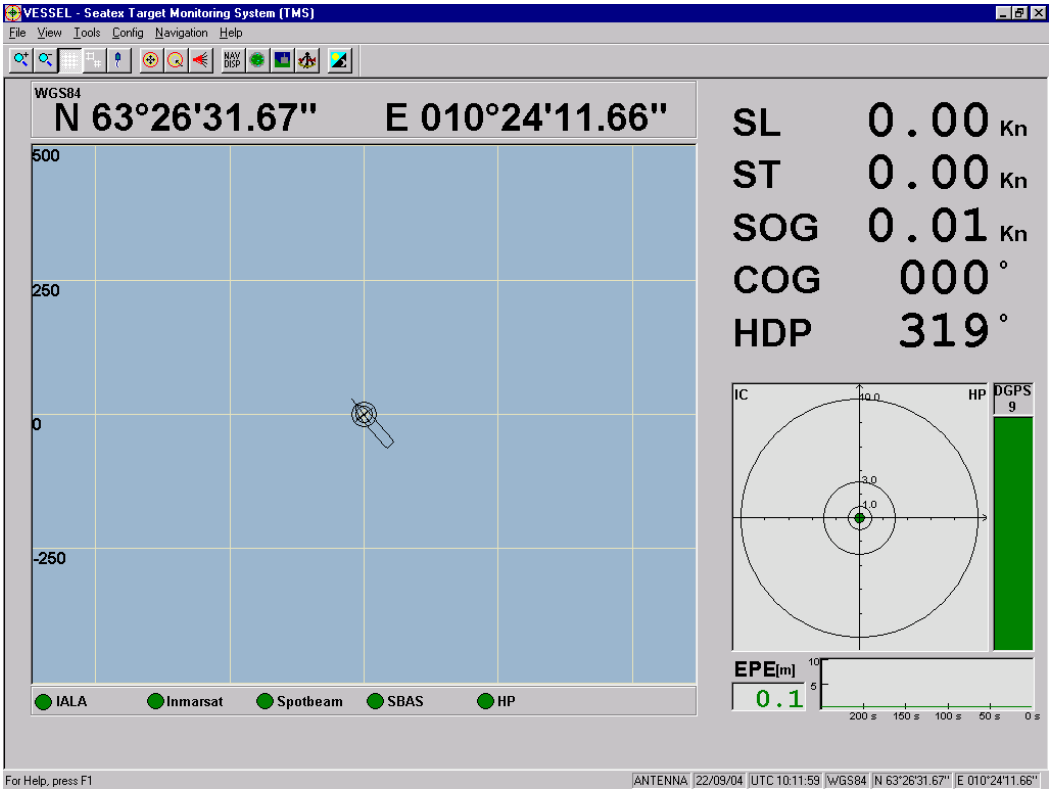


Figure 62 TMS display with HP corrections used

SeaSTAR-XP

SeaSTAR XP is a decimetre level phase based DGPS service, using orbit/clock data valid worldwide based on GPS L1 and L2 frequencies. This concept utilizes reference stations with a worldwide spread to calculate the orbit and the clock value of each GPS satellite more accurately than the broadcast GPS ephemeris. Orbit and clock corrections to the broadcast ephemeris are then transmitted to the user. These corrections are valid worldwide and the distance from the nearest reference stations to the user does not affect performance. This is a decimetre level DGPS augmentation service that provides High Accuracy positioning for the marine user. SeaSTAR HP, introduced in software version 3.3.00, is another decimetre level DGPS service.

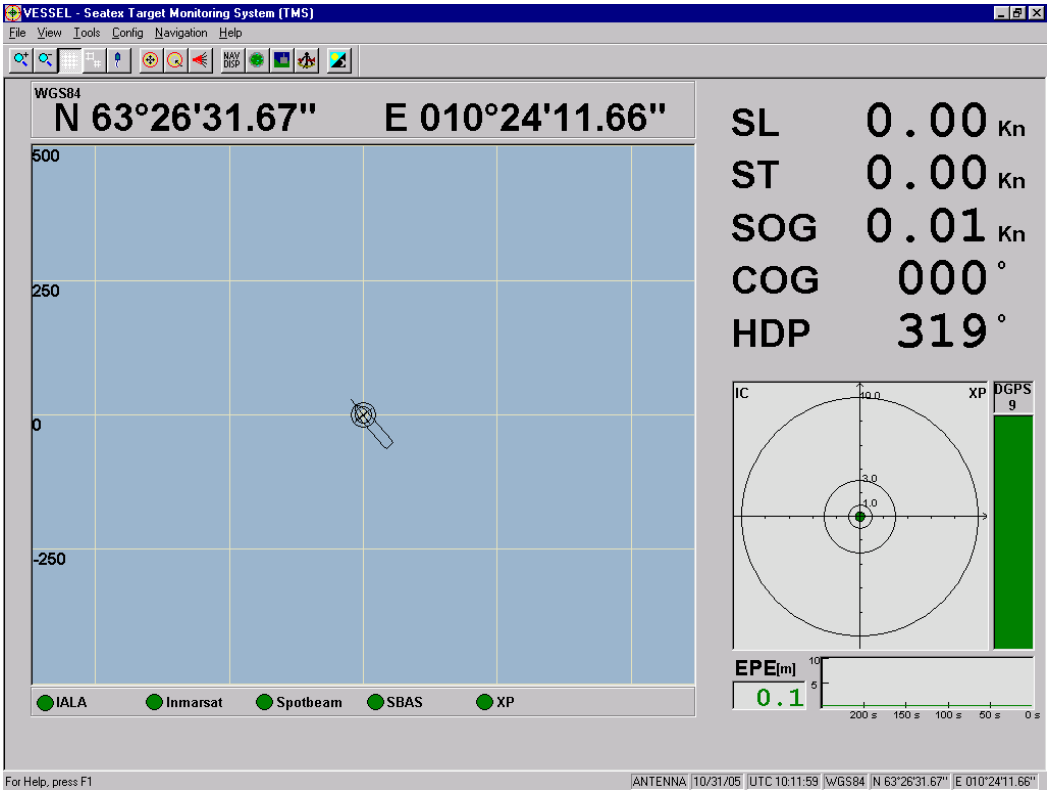


Figure 63 TMS display with XP corrections used

DARPS 132 is capable of simultaneous integration of SeaSTAR-XP **or** SeaSTAR-HP, IALA/USCG corrections, and subscription based differential correction services. In addition the DARPS 132 fully utilizes the SBAS (WAAS, EGNOS and MSAS), free of charge, differential correction service. The DARPS 132 can in parallel make use of DGPS correction signals received from up to 24 reference stations. In order to increase the reliability and accuracy, multiple positions are calculated. This results in a primary position with improved quality compared to a traditional DGPS solution.

From the **Advanced Settings** dialogue box, the **HP /XP Configuration** may be set. The options are Off, Auto and Only.

Off: The HP/XP position is not used in the primary position solution.

Auto: The HP/XP position is integrated in the primary position solution together with all differential positions available in the system.

Only: The HP/XP position only is used as the primary position.

Default configuration is Off.

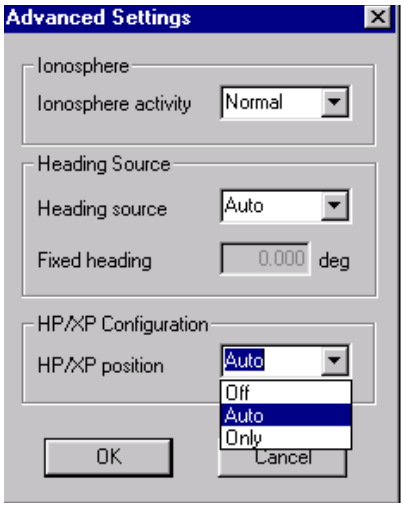


Figure 64 The Advanced Settings dialogue

When HP/XP corrections are available, an **HP or XP status link indicator** is enabled at the bottom of the TMS display. The colour of the link indicates if HP/XP corrections are available. If the link is red, no HP/XP corrections are available. If the indicator is green, HP/XP corrections are available

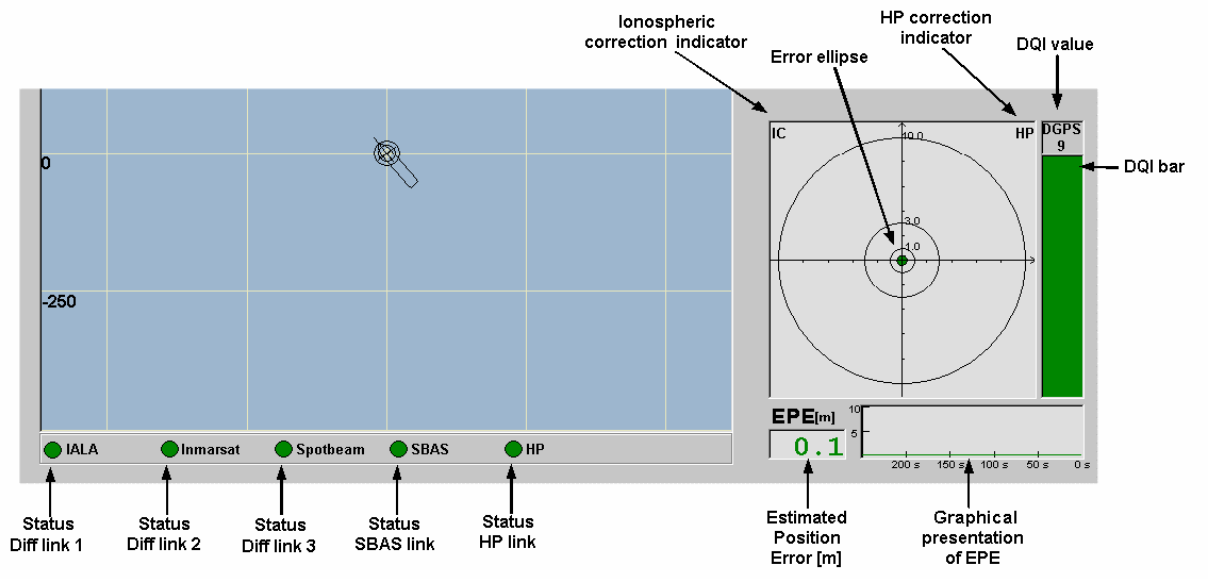


Figure 65 TMS QA indicators with HP

The **correction indicator, HP or XP**, in the upper left corner of the error ellipse area in the **TMS** display, indicates if HP/XP correction data is present in the system. The indicator is displayed with black letters if the computed HP or XP position is used in the primary position and red if not. In addition to the correction indicator, the use of HP/XP corrections is indicated on the EPE figure, the error ellipse, the EPE graph and the DQI-bar. Due to decimetre accuracy, the error ellipse becomes very small, the EPE value and graph is below 1 m and the DQI value is 9 when HP or XP corrections are used, see Figure 65 and Figure 66.

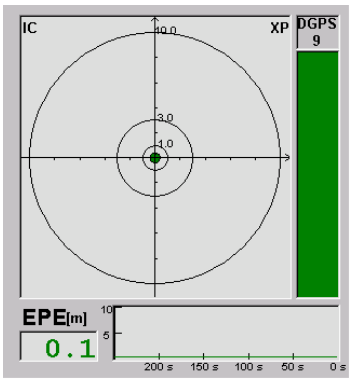


Figure 66 TMS QA indicators with XP

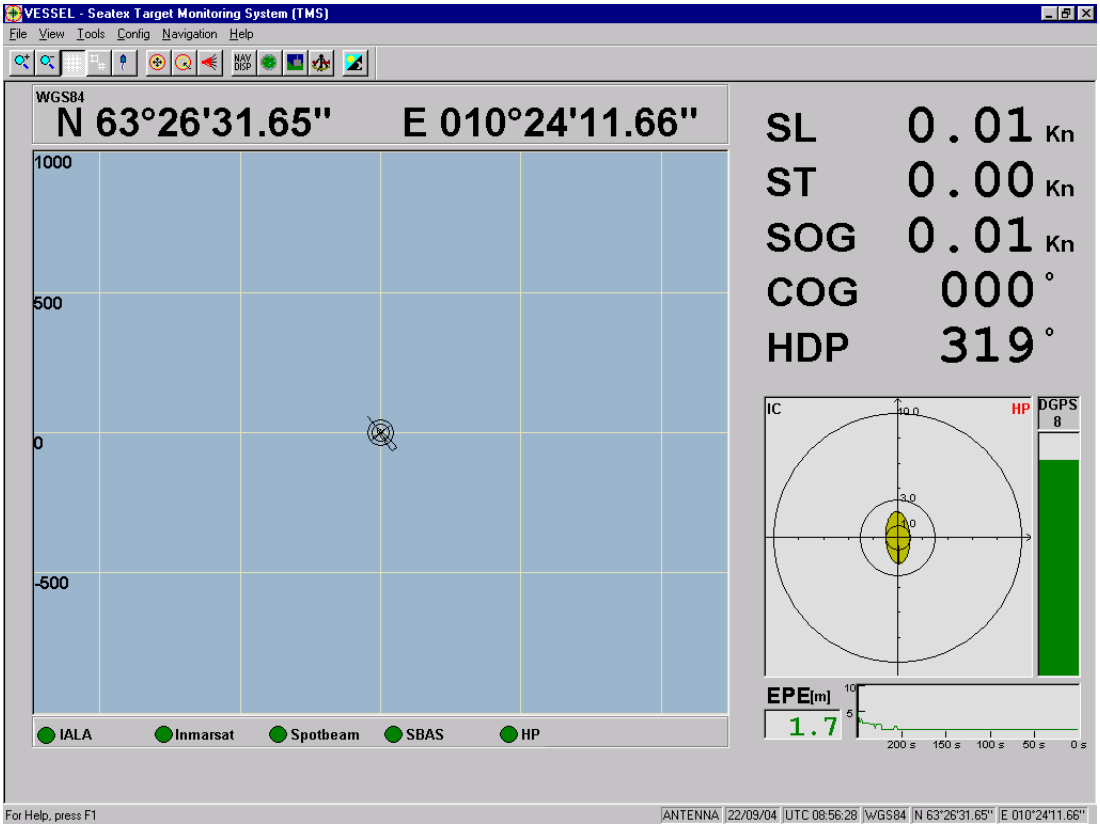


Figure 67 TMS display above indicates that HP corrections are available but not used

DBViewer

There are three databases containing information about the HP/XP correction data.

- HP/XP-Subscription – subscription status information
- HP/XP-PosResults – position fix information for each fix calculated
- HP/XP-Data – list of reference stations currently being used in the calculation of the position fix

6.23 SBAS status

SBAS is abbreviation for "Satellite Based Augmentation System" and is a generic term for the WAAS, EGNOS and MSAS systems. See description in chapter 2.4 SBAS system description.

In DBViewer there is a database displaying the status of the active SBAS satellites available.

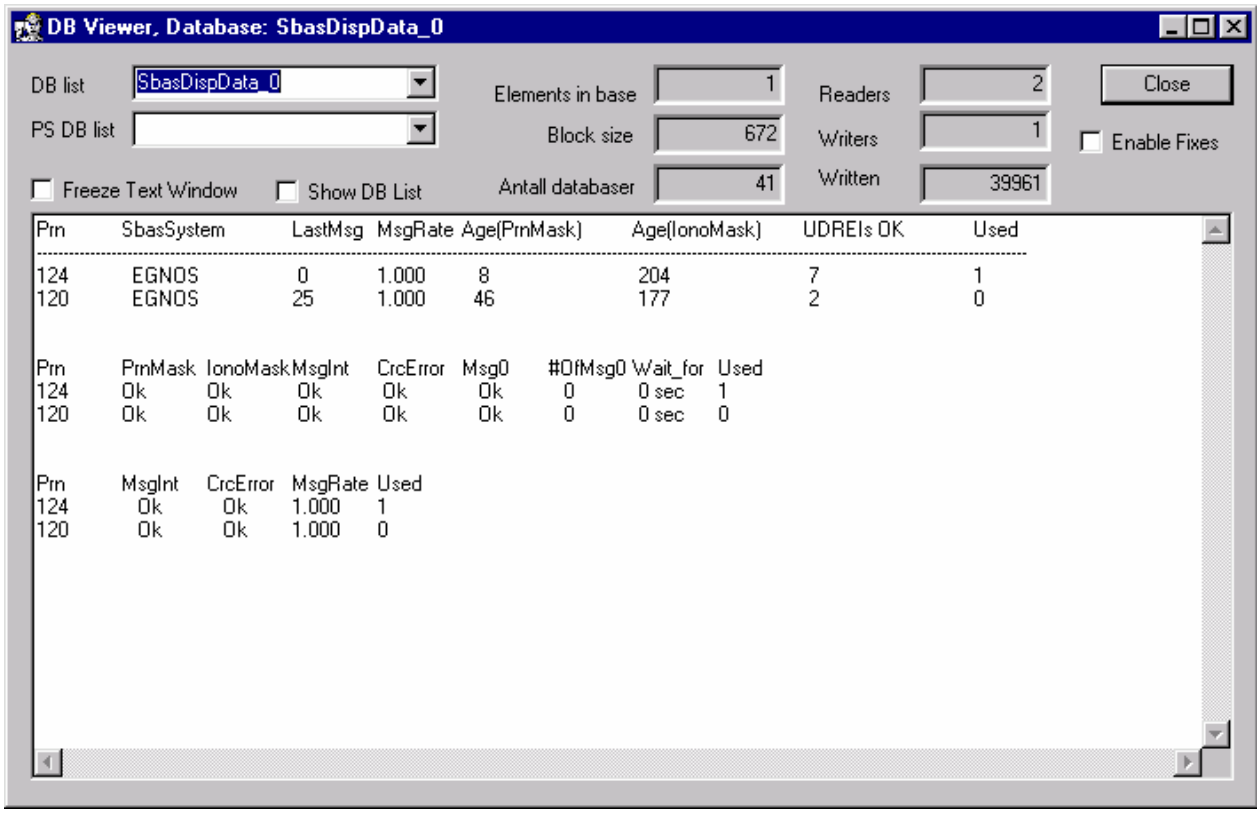


Figure 68 DBviewer display with SBAS satellites

The SBAS satellites are also shown in the **Satellites in Sight** display. See Figure 37.

Note The SBAS functionality (both ranges and corrections) is default disabled since the EGNOS system is still in test mode. The functionality should only be enabled if the DARPS system is operating within the WAAS coverage area.

In the **TMS** display example below, the position is calculated using SBAS corrections.

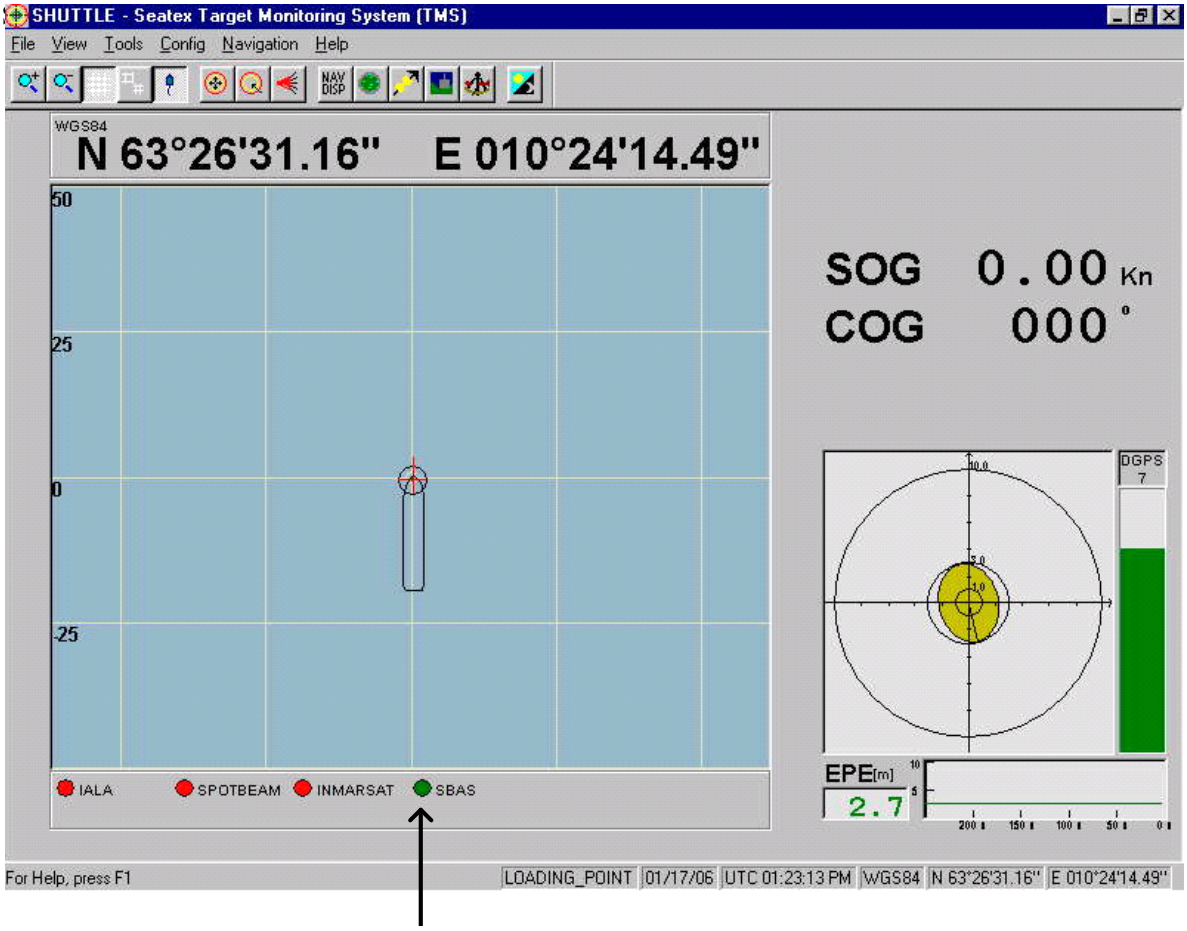


Figure 69 TMS display with SBAS link

Automatic logging

Raw data and data telegrams from the DP ports are automatically logged. The data are saved at the E:\StxData folder in files with maximum size of 1380 kB. By selecting **Log Data** from the **File** menu as described in Figure 70, logging information is displayed, as described in Figure 71. In the **Replay Logger** dialogue, the current files logged and their size are displayed.

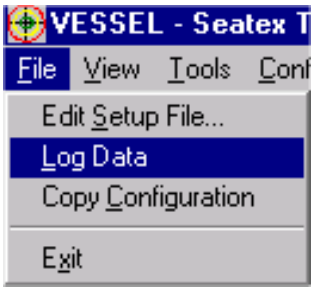


Figure 70 How to access the Replay Logger window

Note If several DP ports are enabled, only one is shown in the dialogue even if data are output on several ports.

The disk space left on the system is also displayed. When the disk space limit, which is 40% of the disk, is reached, the system will automatically delete the oldest files.

Note If logged data are needed, contact Seatex.

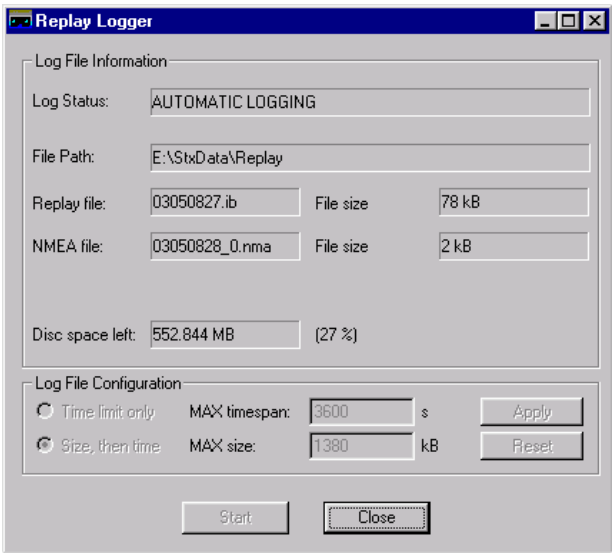


Figure 71 The Replay Logger window

6.25 Copy system configuration

In the DARPS, system information specific for each vessel is stored in the setup file and in Registry. Information like baud rate settings, GPS receiver settings, differential corrections types and more, is stored. This information is very useful during troubleshooting. A new functionality which copies this information is available from the **TMS** display. If selecting **File|Copy Configuration** from the **TMS** display, the **Copy Configuration** program is started.

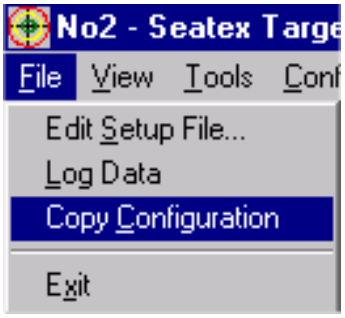


Figure 72 How to access the Copy Configuration window

The following system information may be copied:

- Setup file
- Registry settings
- Port settings
- Target list

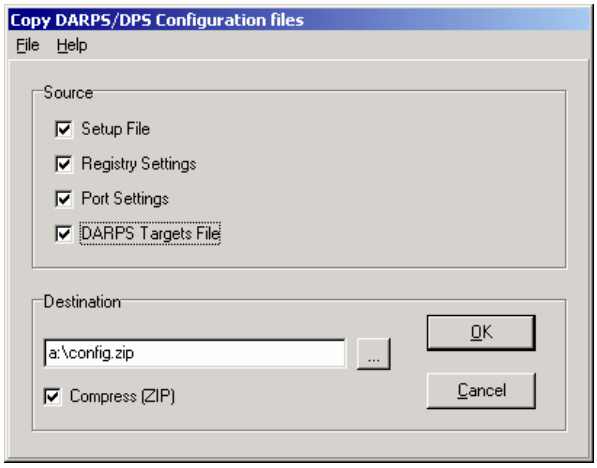


Figure 73 The Copy Configuration dialogue

After the files have been copied, they are available on a floppy as a zip-file.

6.26 Help

Under the **Help** menu in the **TMS** display, the *User* and *Installation manuals* are found on electronic form. The Release Note for the current version of DARPS 132 is also found here.

If selecting **About Tms for NT…** system information as GPS receiver type, GPS receiver firmware and DARPS 132 version number is made available, see Figure 75.

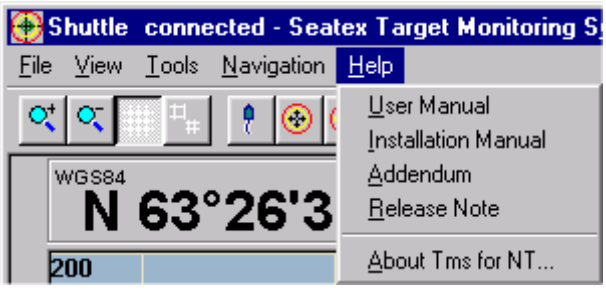


Figure 74 The Help menu

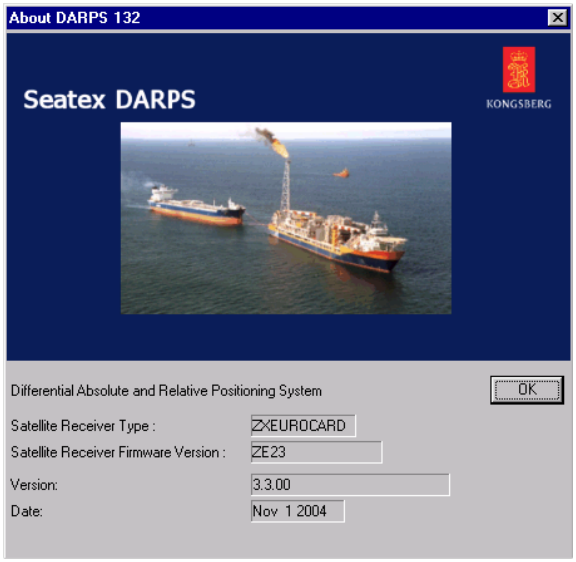


Figure 75 The About window

6.26.1 DBViewer

Under the **Tools** menu in the **TMS** display, the **DBViewer** is available. The DBViewer is a database viewer developed for troubleshooting of the DPS system. The databases contain a wide range of information such as GPS almanac, GPS ephemerises, raw GPS measurements, attitude, detailed position quality information and information about reference stations.

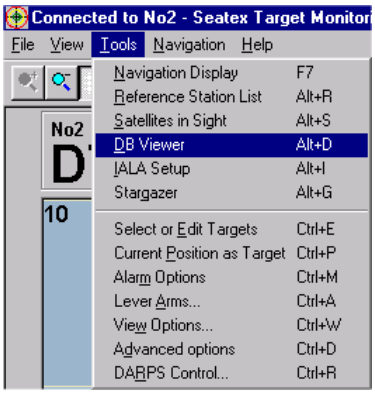


Figure 76 The DBViewer menu

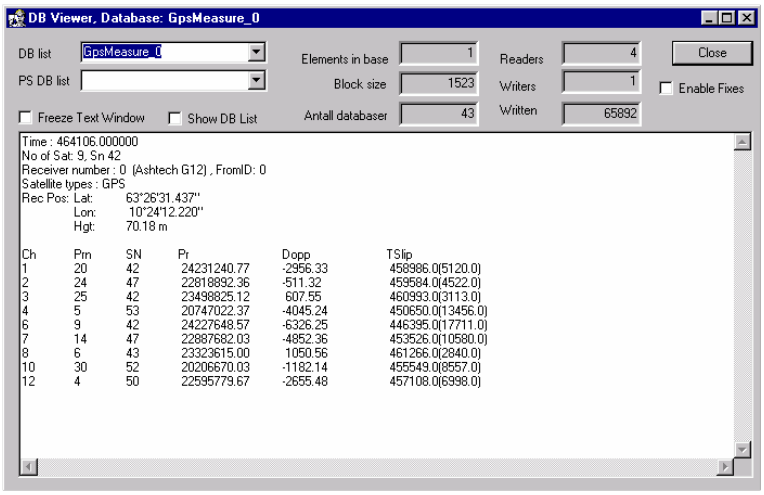


Figure 77 The DBViewer window

6.27 Stop procedure

The controlled way to turn off the DARPS 132 is to press CTRL-ALT-DEL simultaneously and select **Shut Down** in the appearing menu. Turn off power when the message "it is now safe to turn off your computer", appears.

CAUTION

Do not turn off power during the Windows NT shutdown sequence

7 MAINTENANCE

7.1 General

The DARPS 132 system consists of both software and hardware. The software part can be reinstalled or upgraded to the latest version in the field by running the software installation procedure. Service of the DARPS 132 hardware and the Transceiver Module in the field, can consist of:

- Exchange of damaged GPS antenna cables.
- Exchange of failed GPS antenna.
- Exchange of failed DARPS 132 unit.
- Exchange of damaged UHF antenna cables.
- Exchange of failed UHF antenna.
- Exchange of failed Transceiver Module.

The DARPS 132 requires a skilled technician to maintain most of the hardware service.

7.2 Periodic maintenance

7.2.1 Software upgrades

Seatex will regularly offer software upgrades with improvements and new functionality.

7.2.2 Cleaning of air inlet

The air inlet at the rear of the DARPS 132 unit needs to be cleaned regularly to avoid overheating of the unit. The period between each cleaning is dependent on the air quality at the installation site, however we recommend that the filter should be cleaned at least every six months.

7.3 Repairs and modifications

Repair of the DARPS 132 consists of exchange of damaged antenna cables, exchange of GPS antenna and replacement of the DARPS 132 unit. A skilled electrician can do all this.

7.3.1 Exchange of GPS antenna cable

1. Follow the stop procedure described in section 0 and turn off the power on the DARPS 132 unit.
2. Dismount the damaged antenna cable. The new antenna cable must be as straight as possible. Do not crush or crimp the cable, as this will affect the electrical properties of the cable.
3. See [1] for connector installation.
4. Connect the antenna cable to the GPS antenna.
5. The connection between the GPS antenna and the antenna cable should be sealed against water penetration, preferably by using waterproof self-vulcanising tape.
6. Connect the antenna cable to the DARPS 132 unit and turn power on.

CAUTION

If the antenna cable is attached to the unit, do not attach the antenna cable to the antenna with the DARPS 132 unit powered on. If the antenna cable is short-circuited with power on, the GPS receiver within the unit can be damaged.

7.3.2 Exchange of GPS antenna

1. Follow the Stop Procedure described in section 0 and turn off the power on the DARPS 132 unit.
2. Dismount the failed GPS antenna.
3. Mount the new antenna on the antenna rod.
4. Connect the antenna cable to the antenna.
5. The connection between the GPS antenna and the cable should be sealed against water penetration, preferably by using waterproof self-vulcanising tape.
6. Connect the antenna cable to the DARPS 132 unit and turn power on.

CAUTION

If the antenna cable is attached to the unit, do not attach the antenna cable to the new antenna with the DARPS 132 unit powered on. If the antenna cable is short-circuited with power on, the GPS receiver within the unit can be damaged.

7.3.3 Exchange of UHF antenna cable

1. Follow the Stop Procedure described in section 0 and turn off the power on the DARPS 132 unit and the Transceiver Module.
2. Dismount the damaged antenna cable. The new antenna cable must be as straight as possible. Do not crush or crimp the cable, as this will affect the electrical properties of the cable.

3. See [1] for connector installation.
4. Connect the antenna cable to the UHF antenna.
5. The connection between the UHF antenna and the antenna cable should be sealed against water penetration, preferably by using waterproof self-vulcanising tape.
6. Connect the antenna cable to the Transceiver Module and turn power on.

7.3.4 Exchange of UHF antenna

1. Follow the Stop Procedure described in section 0 and turn off the power on the DARPS 132 unit and the Transceiver Module.
2. Dismount the failed UHF antenna.
3. Mount the new antenna on the antenna rod.
4. Connect the antenna cable to the antenna.
5. The connection between the UHF antenna and the cable should be sealed against water penetration, preferably by using waterproof self-vulcanising tape.
6. Connect the antenna cable to the Transceiver Module and turn power on.

7.3.5 Repair of the DARPS 132 unit and the Transceiver Module

The DARPS 132 unit and the Transceiver Module are not designed for first line maintenance. All repairs and modifications of the units, except for installation of new software versions and setup of the system, have to be done by Seatex qualified personnel. Failed units have to be shipped back to Seatex for repair.

7.3.6 Installation of a spare DARPS 132 unit

Use the following procedure to install the received spare unit if such a unit is available while your unit is being repaired:

1. Follow the Stop Procedure described in section 0 and turn off the power on the DARPS 132 unit.
2. Disconnect the DARPS 132 unit to be repaired from its cables and the rack, and replace it with the spare unit.
3. Connect all cables as they were on the original unit.
4. Power up the unit.

If the hard disk on the DARPS 132 unit has failed, it is not possible to access the setup file. The spare unit has to be set up as described in the *Installation Manual*, [1].

7.3.7 Installation of a spare Transceiver Module

Use the following procedure to install the received spare module if such a unit is available while your unit is being repaired:

1. Follow the Stop Procedure described in section 0 and turn off the power on the DARPS 132 unit and the Transceiver Module.
2. Disconnect the Transceiver Module to be repaired from its cables and the rack, and replace it with the spare unit.
3. Connect all cables as they were on the original unit.
4. Power up the units.

8 TROUBLESHOOTING

8.1 General

This part of the document is written for personnel with operator experience when a situation arises where assistance from service personnel may be required. The aim of this section is to identify the problem so that the appropriate action can be taken.

The error conditions in the system are usually observed by looking at the colour codes of the different fields in the display pages. In the following pages a description of the different status and alarm situations is given.

8.2 No satellites tracked by receiver

Figure 78, Figure 79 and Figure 81 show the three most common display pages when the GPS receiver tracks no satellites. This can happen in the following situations:

1. When operating close to offshore installations part of the horizon might be shadowed (by e.g. a platform) resulting in blocking of the GPS signals.
2. Faulty antenna cable or connectors
3. Faulty GPS antenna
4. SW or GPS receiver hang-up or defects in the GPS receiver
5. Faulty communication setup parameters for the GPS receiver in the setup file, see *Installation Manual* [1].

Recommended action for SW or GPS receiver hang-up:

1. Shut down the DARPS 132 as described in section 0 and turn the power off.
2. Turn on the unit again after a couple of minutes and see if the problem is solved. It will usually take up to five minutes before the position is stable after a reboot. In the boot up sequence a reset of the GPS receiver is done and that may solve the problem.
3. If the situation is unchanged check the GPS antenna and the coax cable/connectors. This is described in the *Installation Manual* [1].

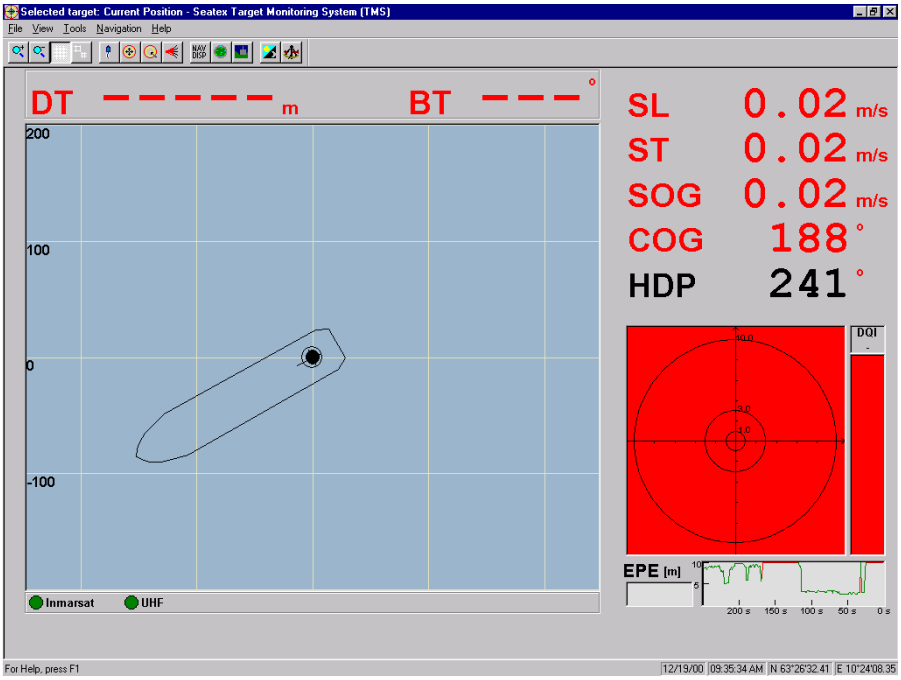


Figure 78 TMS display. No satellite fix available

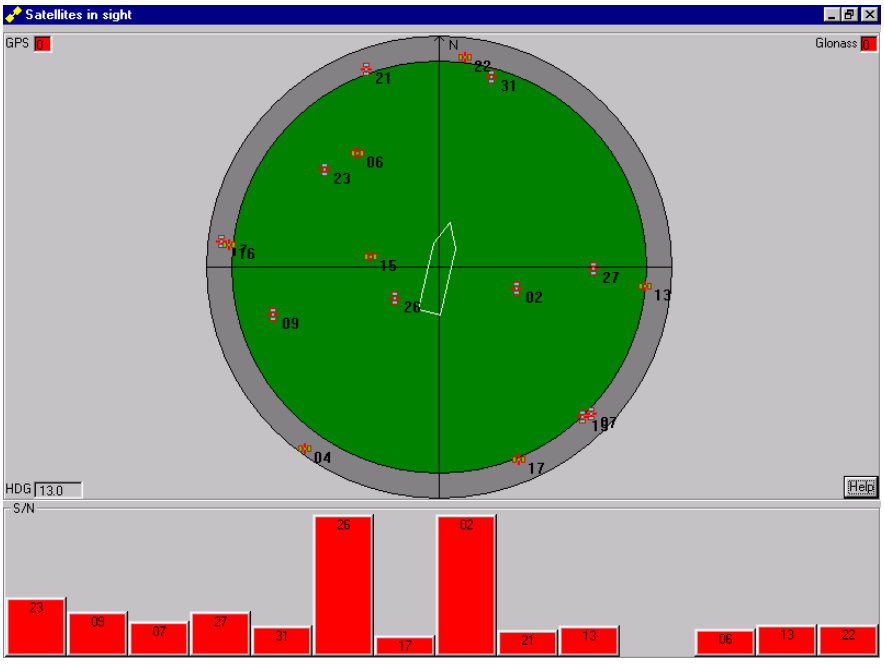


Figure 79 Satellites in Sight display. No satellites available

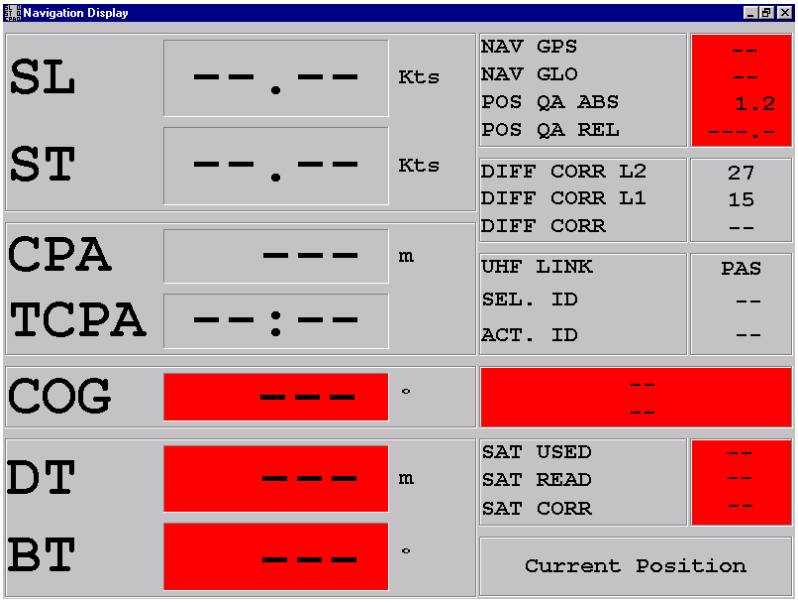


Figure 80 Navigation display with no satellites tracked by the receiver

8.3 Few satellites tracked by receiver

A problem with few satellites is very often due to shadowing of the GPS antenna or poor antenna connectors or cable. An example of the error ellipse and status is shown in Figure 81. There are few satellites in the north-east direction of the sky (seen by the direction and size of the error ellipse). This situation is often experienced on vessels working close to offshore platforms or other shadowing objects. If the problem is assumed to be due to water penetration in the antenna cable or connectors, measure the cable and antenna in accordance with the *Installation Manual* [1].

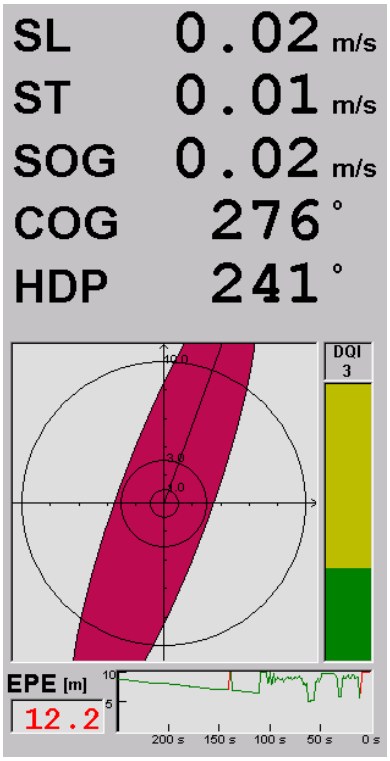


Figure 81 Error ellipse with few satellites tracked by receiver

8.4 Loss of differential corrections

Loss of differential correction is seen in the status indicators for the links in the bottom right part of the **TMS** display (see Figure 82 and Figure 83). If there are several differential correction links interfaced to the DARPS 132, a problem with one of the links may not degrade the position solution. If all the links are missing, the position will be severely degraded due to the non-differential position solution.

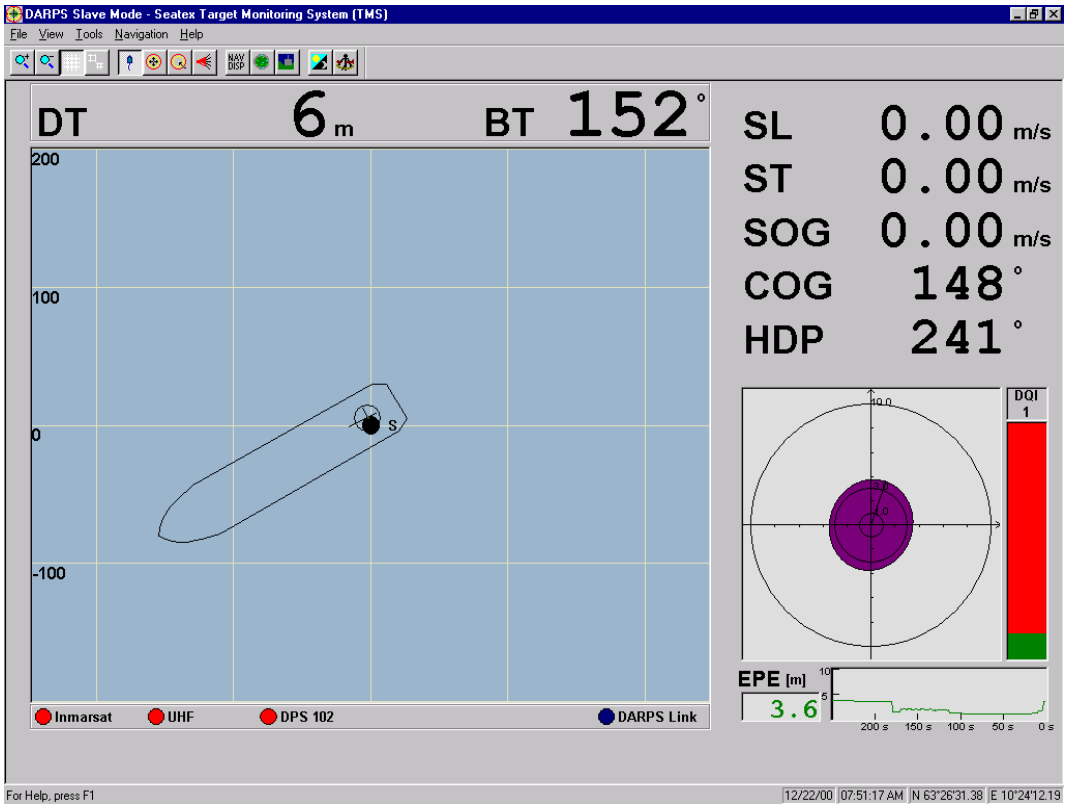


Figure 82 TMS status all differential links missing

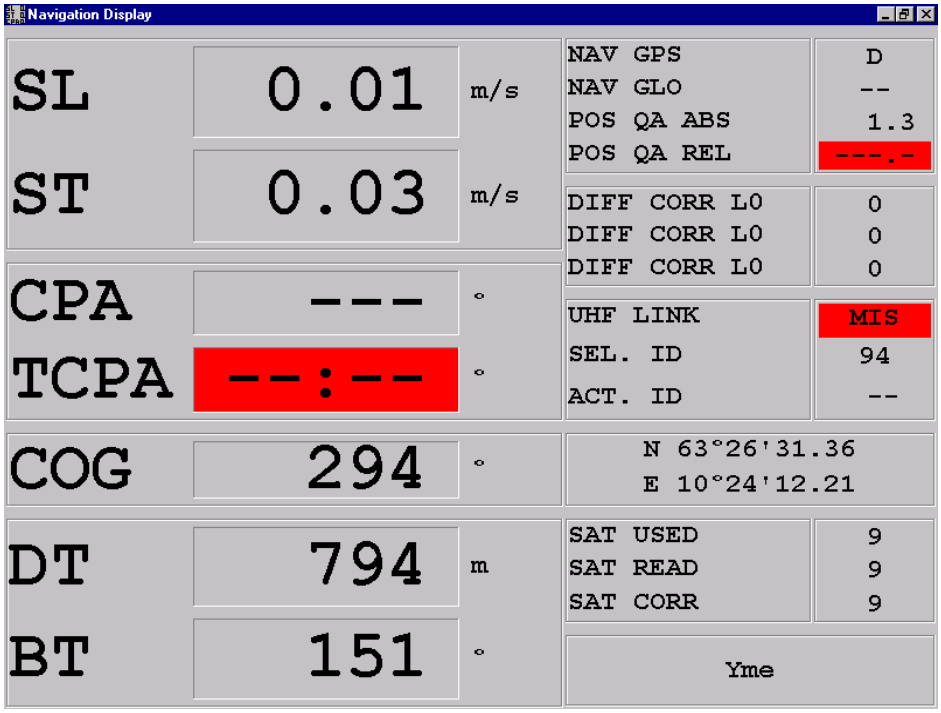


Figure 83 Navigation display with no differential links and no DARPS links

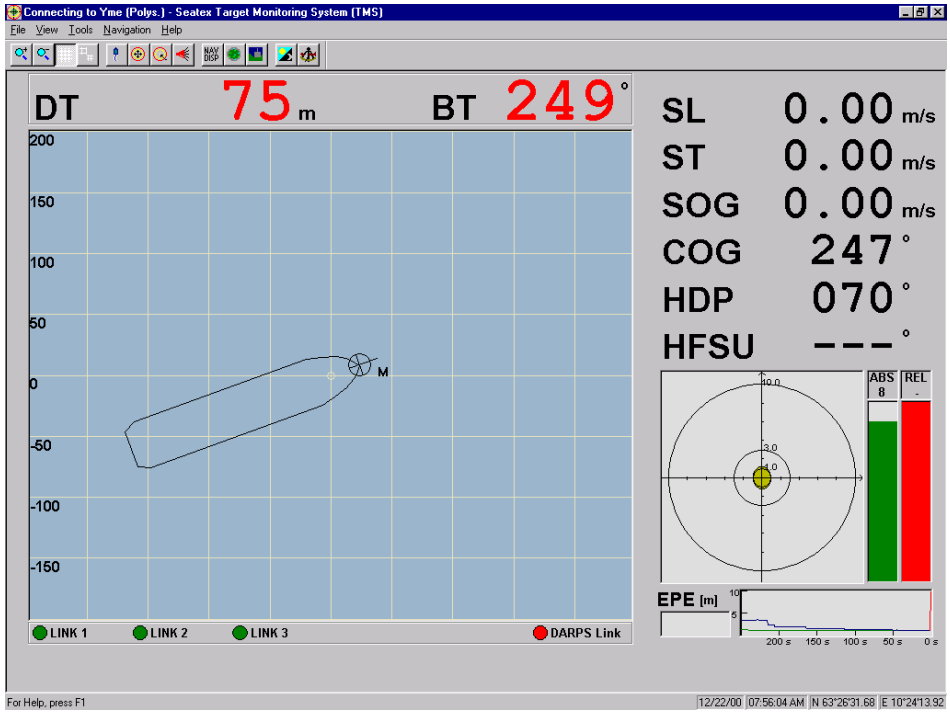


Figure 84 TMS display with no DARPS links

The most common differential correction systems interfaced to the DARPS 132 are the Fugro Seastar Spot and Fugro Seastar DP (Inmarsat) correction service. The Fugro differential corrections are received through satellite links.

Satellite Differential Correction Systems

Differential corrections to the DARPS 132 are very often applied by using a Fugro demodulator which receives data from either a Spot satellite or an Inmarsat satellite. The Fugro Operator's Manual describes the operation of the demodulator. The status of the demodulator and the reception of correction data can be monitored through the display window. When the display window says "RECV" followed by signal bars, the unit has established contact with the satellite. The signal strength can be monitored through the signal bars and from the Seastar menu **Correct Readings** and **Signal quality**.

Figure 85 The Fugro Seastar demodulator front view

If the DARPS 132 is connected to an Inmarsat correction link, the following should be checked if the reception is poor:

- Turn power on the demodulator OFF and then ON again, by using the switch at the rear of the demodulator.
- Check the cabling between the Inmarsat terminal and the demodulator.
- Check that the Inmarsat terminal is tracking the correct satellite for the area.
- Check the serial port cable between the demodulator and the DARPS 132.

Figure 86 The Fugro Seastar demodulator rear view

8.5 IALA Beacon signal missing

An IALA Beacon receiver is optional in the DARPS 132 system. If ordered, the receiver is integrated in the DARPS 132 unit.

8.5.1 Unstable signal

The status of the IALA differential link changes from green to red if the differential corrections are lost or missing. If the signal is unstable, frequently changing from red to green, do the following:

1. Check if the vessel is near an IALA station and is supposed to receive IALA signals.
2. Check if the antenna and the antenna cable are connected properly.
3. The IALA antenna should be protected from direct illumination from radar beams and other transmitting antennas. If the antenna is close to transmitting antennas, move the IALA antenna.
4. Check if the DARPS 132 system is grounded as recommended.

Note The DARPS 132 cabinet must be connected to a grounded outlet.

5. If still unstable signal, contact Seatex.

8.5.2 No IALA signal

If the IALA signal is missing do the following:

1. Check if the vessel is near an IALA station and is supposed to receive IALA signals.
2. Check if the antenna and the antenna cable are connected properly.
3. The IALA antenna should be protected from direct illumination from radar beams and other transmitting antennas. If the antenna is close to transmitting antennas, move the IALA antenna.
4. Check if the DARPS 132 system is grounded as recommended.

Note The DARPS 132 cabinet must be connected to a grounded outlet.

If the vessel is close to an IALA station and the signal is still missing follow the procedure below.

Preparations

1. Open the Setup file from the **Control** toolbar.
2. Change the following setting:
   - **!**DIFFCORR_LINK_1 com3 4800 n 8 1 nh

   This change will make it possible to perform troubleshooting to the IALA Beacon receiver.

3. **Save** the change and **Exit** the Setup file.
4. When question to reboot the system due to the changing, press **Yes**.

Troubleshooting

1. After the reboot, check the IALA settings by opening the IALA setup program from the **Control** toolbar.

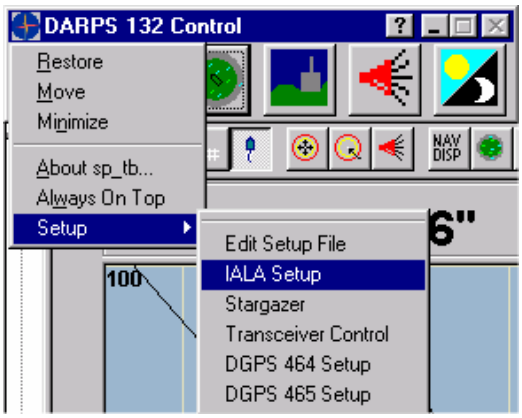


Figure 87 IALA Setup from Control toolbar

2. Check that the **Receiver Communication Setup** is as Figure 88. Press **OK**.

3. Check that there is contact with the IALA Beacon receiver by selecting **File|Receiver Info** in the **Beacon Receiver Command** window. If contact a dialogue box with the IALA Beacon receiver serial number and software version will appear, see Figure 89. If no contact, close the **Beacon Receiver Command** window and start again. It may be difficult to make contact with the receiver. If no contact after several times, contact Seatex.

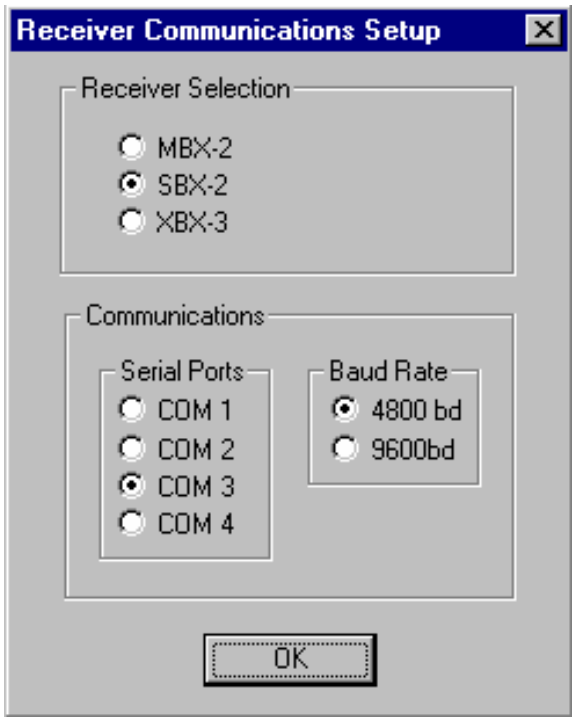


Figure 88 Receiver Communication Setup

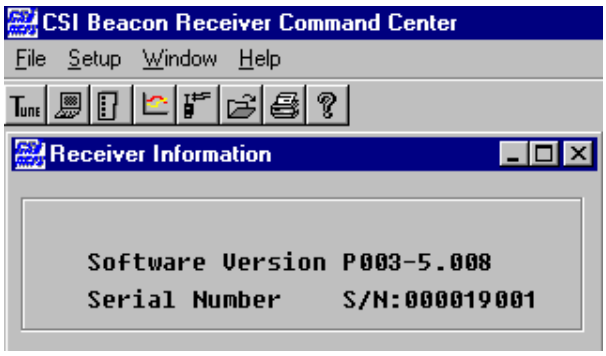


Figure 89 IALA Beacon Receiver Information

4. To check if the IALA Beacon receiver is locked on a station, i. e. is receiving data, select **File|Performance Plots**. Select the parameters as in Figure 90.

5. The parameters shall have the following values:
   - SNR > 10 dB
   - PRF ≈ 100
   - Lock = Yes

If Lock = No, the IALA Beacon receiver is not locked on a station. If Lock =Yes and there is still no signal when returning to DARPS 132 mode, check the DARPS 132 Setup file. The baud rate or comport setup may be wrong.

If the SNR value is less than 10, there is a bad signal. Typical SNR value is between 15 and 30 dB. If the PRF value is less than 100, not all data are decoded.

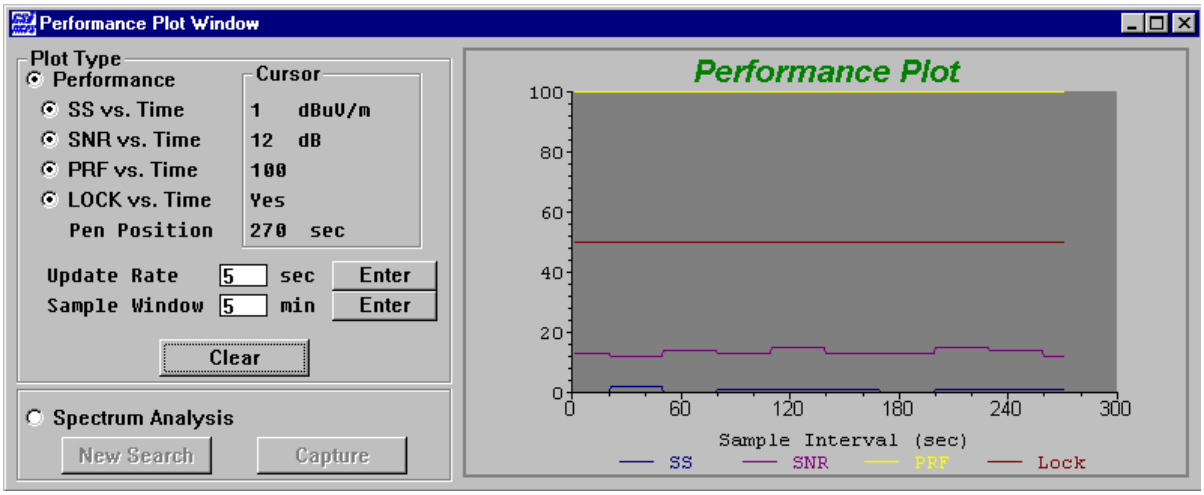


Figure 90 The Performance Plot window

Finishing

1. After editing and troubleshooting the IALA Beacon receiver, open the Setup file from the **Control** toolbar.
2. Change the following setting:

- DIFFCORR_LINK_1 com3 4800 n 8 1 nh

3. **Save** the change and **Exit** the Setup file.
4. When question to reboot the system due to the changing, press **Yes**.
5. When the system is running, check visually that Link 1 receives corrections.

If no signal and all the above is checked and tested, contact Seatex.

8.6 Loss of gyro signal

When the gyro is missing, the status part of the **TMS** display will look similar to the example in the figure to the right where the SL, ST and HDP numbers are red. The vessel will be displayed with the last valid heading.

If the gyro signal is missing, check the following:

1. Is the serial line connected properly?
2. Is the gyro and gyro repeater working correctly?
3. If the above items are OK, check the gyro setup in bottom of the setup file DARPS.CFG, see the *Installation Manual* [1].

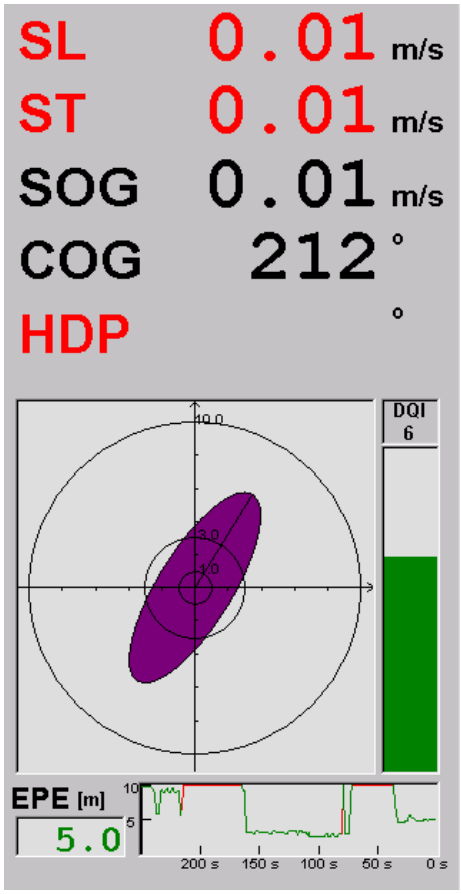


Figure 91 TMS status when gyro is missing

8.7 DARPS connecting problems

8.7.1 Wrong sender address for DARPS telegrams

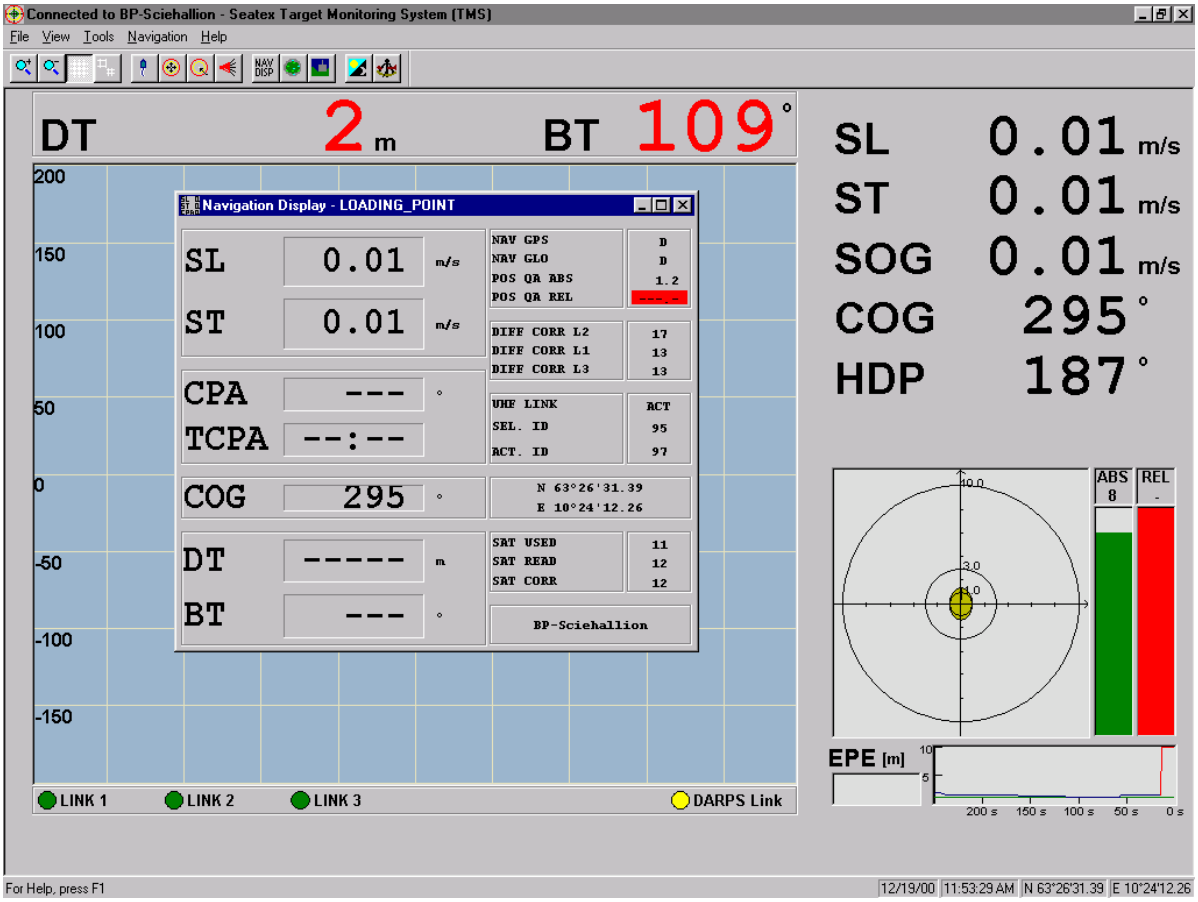


Figure 92 Data from wrong transponder received

When the Relative Link Indicator in the **TMS** display is yellow, it is quite likely that data from another transponder than expected, are received.

Check the SEL. ID number and the ACT. ID number in the **Navigation** display. If they are different, check the address and the UHF switch position the slave is set to answer with in the **DARPS Settings** dialogue box. When the address and/or the UHF switch position is changed, the master vessel will start to transmit new information.

8.7.2 The system returns to DPS mode

If the system returns to DPS mode when operating in DARPS mode and the vessels are in connect mode, check if the DP is transmitting correct information and if it is transmitted regularly. The DP shall transmit the $PSALB telegram at least every other minute.

8.7.3 Navigation display status indicators

Below is a description of status indications on the master vessel's Navigation display during a loading operation.

The master system polls but receives answer from wrong target:

- ACT ID: shows the ID to the slave vessel that is answering, yellow background.
- HFSU: no computation, red background.
- DT & BT: computes distance and bearing against the slave position, which is found in the Target List, red background.
- POS QA Rel: no computation, red background.

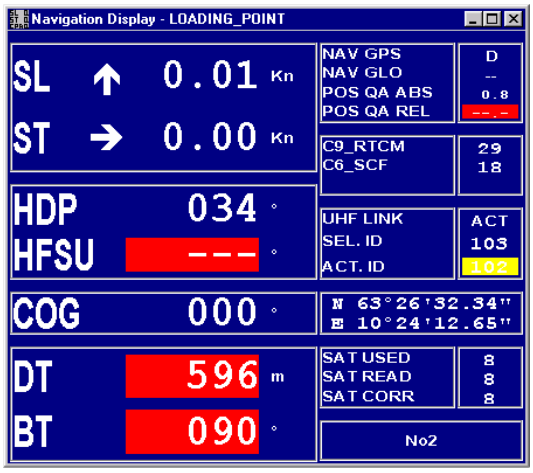


Figure 93 Answer from wrong target

No relative telegram is output.

The master vessel does not receive gyro from the slave vessel:

- HFSU: no computation, red background.
- DT & BT: computes distance and bearing from own selected point (arm) to the antenna point on the slave vessel, red background.

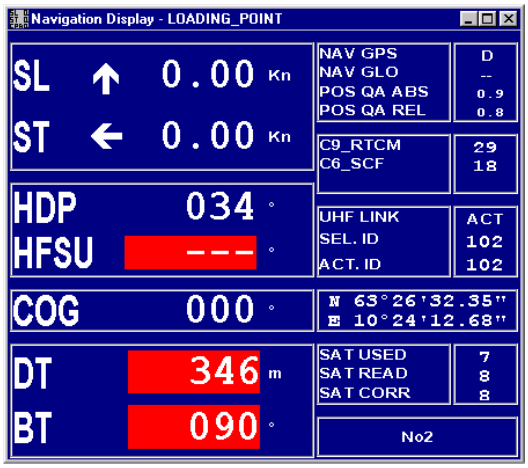


Figure 94 No gyro from slave vessel

The relative telegrams are output, but with status indicators which shows that heading on the slave vessel is missing, see [1] for specifications on the telegrams.

The master vessel loses own heading:

- SL & ST: uses last valid values, red background after 20 seconds.
- HDP: uses last valid values, red background after 20 seconds.
- DT & BT: uses last valid heading to compute distance and bearing, red background after 20 seconds.

The relative telegrams are output, but with status indicators which shows that heading on the master vessel is missing, see [1] for specifications on the telegrams.

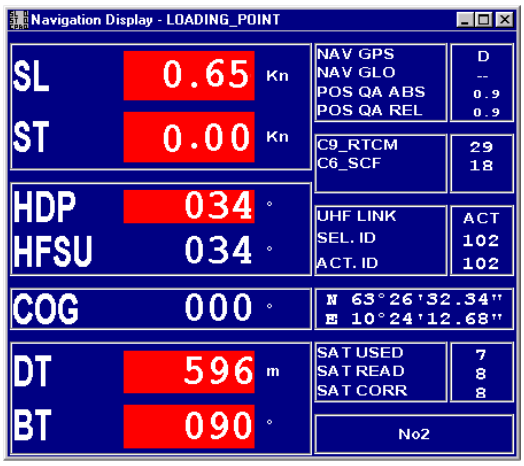


Figure 95 Master vessel loses own heading

The master vessel loses all data from the slave vessel during a loading operation:

- HFSU: uses last valid value, red background after 20 seconds.
- DT & BT: uses last valid values to compute distance and bearing, red background after 8 seconds.
- POS QA Rel: no computation, red background.
- UHF Link: is set to MIS, red background.
- ACT ID: looses target ID, blue background.

No relative telegrams are output.

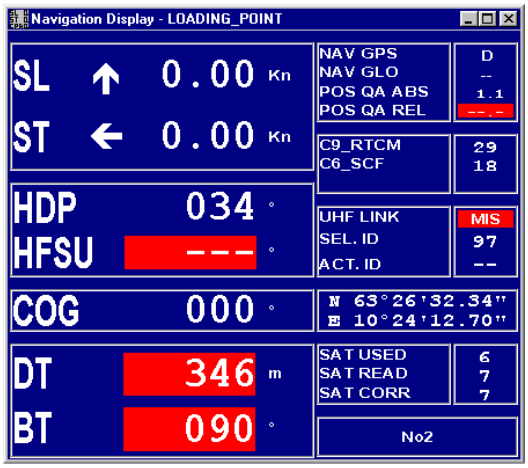


Figure 96 Master vessel loses all data from slave vessel

The master vessel loses the offset vector from the slave vessel during a loading operation:

- DT & BT: no influence on the computation of the distance and bearing, computes as normal from own selected point (arm) to offloading point on slave vessel.

The relative telegrams are output, but with status indicators which shows that heading on the master vessel is missing, see [1] for specifications on the telegrams.

However, if the master vessel does not receive the offset vector overall, DT & BT is computed from own antenna point to antenna point on the slave vessel. The DT & BT field will have red background.

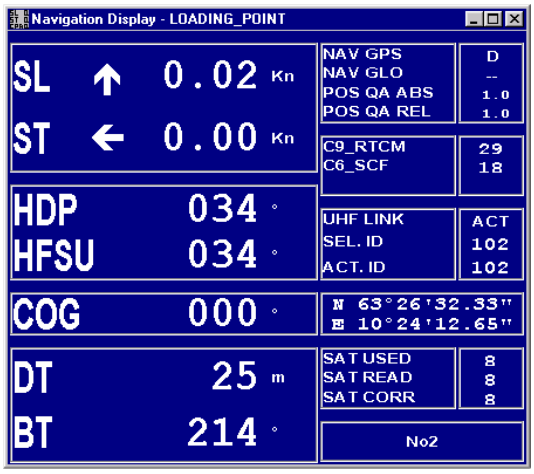


Figure 97 Master vessel loses slave offset vector during loading

Master loses gyro from the slave:

- HFSU: displays last valid heading, red background after 20 seconds.
- DT & BT: uses last valid heading from the slave to compute distance and bearing, red background after 20 seconds.

The relative telegrams are output as OK in 20 seconds. After 20 seconds, with the status indicators which shows that heading on the slave vessel is missing, see [1] for specifications on the telegrams.

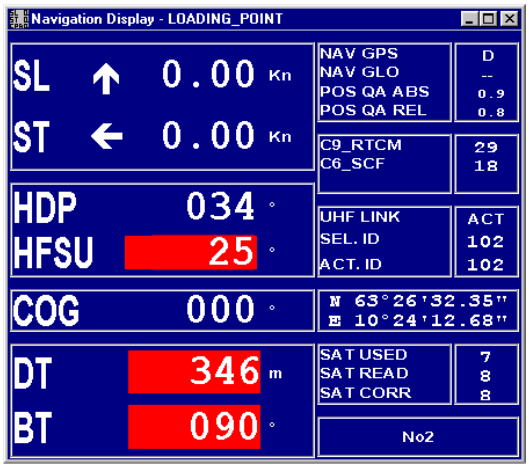


Figure 98 Master loses gyro from slave vessel

8.8 Installation of new target list

The TMS detects if the target list file, **targets.ini**, is unavailable and presents a dialogue for selecting a new target list from a set of target list files.

This feature may also be used when the operator wants to change or update the target list, as described in the following procedure:

1. If new target list files have been received, copy these files to the DARPS configuration directory, normally **C:\DARPS\ETC**. The target list files are named **targets_**<*name*>**.ini**.
2. Delete the current **targets.ini** file.
3. When the **targets.ini** file is unavailable, the following dialogue will be presented.

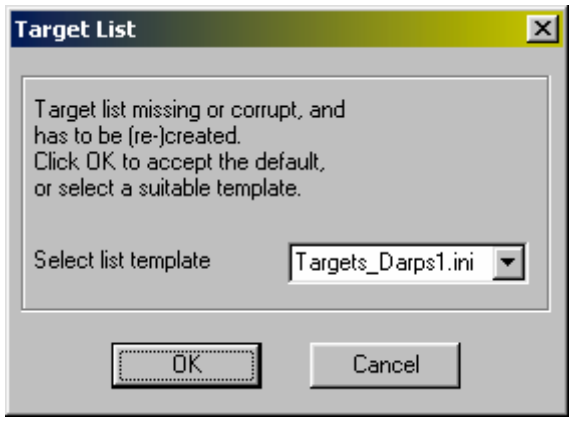


Figure 99 Installation of new target list

4. If the suggested target list file is not the desired one, select the desired target list file from the drop-down list.
5. Click **OK** to accept the selection. The selected target list file will now be copied to a new **targets.ini**, which is automatically loaded into the system.
6. Please note that this dialogue will continue to pop up if the user clicks the **Cancel** button because **targets.ini** is required for DARPS operation.

8.9 External output problems

Check the serial lines and cable connectors for mechanical damage if the external equipment receives no data from the DARPS 132. Check also that the connectors are connected to the correct output ports both on the DARPS 132 equipment and on the external equipment.

If the cable and connectors are OK, check that the external output configuration of the DARPS 132 system is set up correctly. This is described in the *Installation Manual* [1].

A printout of the default DARPS 132 setup file is shown in the *Installation Manual* [1]. An example of a port setting from the setup file is shown below:

```
DPIO_1 com8 9600 n 8 1 nh
OUTPUTMODE_1 0                  ! 0:event-driven 1:timer-driven
OUTPUTINTV_1 1000               ! output interval between datagrams in milli-seconds
POSOUT_DBGFMT_1  0              ! debug info in position output
NMEA_OUTPUT_1          GPGGA    ! sequence GNS(GGA),GST,DPGGA,VTG,ZDA
```

Com8 is set up to transmit a (DPIO) DPGGA message every second, with baud rate 9600, no parity, 8 data bits, 1 stop bit.

8.10 Operating system problems

The DARPS 132 runs on a Window NT 4.0 operation system. Some problems that may occur are listed below.

8.10.1 Hang-up of the operating system

Hang-up of the operating system is usually solved by rebooting the DARPS 132 by pressing the CTRL-ALT-DEL buttons simultaneously and selecting **Shut Down** from the menu, or by turning the power of the DARPS 132 unit off and then on again. If the unit experiences frequent hang-ups, call Seatex for a thorough examination of the system.

8.10.2 Hard disk problems

If the hard disk is faulty, Seatex should be contacted to reinstall the system. It is not recommended to do the reinstallation unless there is a trained operator available.

8.11 Installation of DARPS 132 software

1. Insert the first installation floppy or the CD and run SETUP.EXE.
2. Select the appropriate software DARPS 132.
3. Follow the instructions.
4. Reboot after completing the installation.

8.12 Installation of TDMA firmware

To download new firmware in the TDMA Transceiver Module, a PC with DOS and the downloading utility program sc3load.exe together with a 25 to 9-pin DSub 1:1 cable is needed.

1. Connect com1 on the PC to port 3 at the rear of the TDMA Transceiver Module with the 25 to 9-pin DSub cable.
2. Start the downloading utility program sc3load.exe from a DOS prompt by typing: sc3load sc3xxx.0 (sc3xxx.0 is the name of the new software file and xxx is the version number. E.g. version 1.56 will be named sc3156.0).
3. Turn power on the unit.
4. Press "Y" if the sc3load program asks if you want to download new firmware. The program will now start to download the firmware.
5. If sc3load.exe will not download the new file, do step 2 again and try to power cycle the TDMA Transceiver Module after starting sc3load.exe.

8.12.1 Configuration after firmware downloading

To configure a TDMA Transceiver Module a handheld terminal or a PC with the WinHHT program together with a 9-pin DSub 0-modem cable is needed.

1. Connect the handheld terminal to port 1 at the rear of the TDMA Transceiver Module. If using a PC, connect com1 at the PC to port 1 at the rear of the TDMA Transceiver Module by using the 9-pin DSub cable.
2. Turn power on the unit.
3. When asked for password, type "AABB". Now a page with firmware version number, id and slot number appears. Check that correct firmware is installed and that the ID of the unit is correct.
4. Press "*" to change the unit's ID.
5. Press "=" to set up the unit as a VCU.
6. Press "+" to set the unit's frequency table. See table below for the different TDMA Transceiver Modules frequency table. Press ENTER to leave the pages.

TDMA Module	Min.freq. [kHz]	Max.freq. [kHz]	Spacing [kHz]
TDMA860	868012	871200	12.5
TDMA450	450000	453187	12.5
TDMA455	451950	455137	12.5

Table 6 TDMA Transceiver Modules frequency table

For further configuration of the unit, see page 115.

Blank page

9 DRAWINGS

For outline drawings of the mechanical dimensions of the different DARPS 132 parts, see the *Installation Manual* [1].

Blank page

10 PARTS LIST

The different parts in the DARPS 132 system are listed below.

DARPS 132

Part No	Description
G202-30	**DARPS 132 w/cabinet, Shuttle Tanker, including;** G071-40 Vessel bridge wing display (speed along and transversal ship), (2 ea.)
G202-31	**DARPS 132 w/cabinet, FPSO, including;**

Standard supplied equipment

Part No	Each of the two models above comprises the following additional parts:
G202-29	DARPS 132 Processing Unit, (1 ea.)
G060-06	GPS L1/L2 antenna, (1 ea.)
G060-03	GPS antenna mounting rod, (1 ea.)
G060-13	DGPS IALA radio beacon antenna, (1 ea.)
G071-21	Cabinet, 6U, (1 ea.)
G071-27	Keyboard with rollerball, 19" rack mounted, (1 ea.)
G071-29	Adapter cable for GPS antenna cable, 1.5m, (3 ea.)
G060-30	VGA monitor, office type 15" including G071-28, (1 ea.)
G071-30	Keyboard and monitor switch, (1 ea.)
G071-28	Power cable, 1.5m, (2 ea.)
G060-50	UHF data and programming cable, (1 ea.)
G200-69	DARPS 132 User Manual, (1 ea.)
G200-70	DARPS 132 Installation Manual, (1 ea.)
G200-71	DARPS 132 Site Manual, (1 ea.)

Optional supplied equipment

Part No	Description
G063-03	UHF TDMA transceiver module, 450 MHz
G063-04	UHF TDMA transceiver module, 860 MHz (with diplexer)
G063-05	UHF transceiver module, 450 MHz
G063-08	UHF transceiver module, 450 MHz, 9600 baud
G063-10	UHF TDMA transceiver module, 860 MHz (without diplexer)
G063-11	UHF TDMA transceiver module, 455 MHz
G063-13	TDMA combiner, transceiver module, 450 MHz
G063-14	TDMA combiner, transceiver module, 455 MHz

Part No	Description
G060-08	UHF antenna, 440-470 MHz
G060-48	UHF antenna, 860 MHz
G060-49	UHF antenna, combined 450/860 MHz

Part No	Description
G071-40	Vessel bridge wing display (speed along and transversal ship)
G070-01	GPS antenna cable (1/2" superflex flame retardant, max 100m), price per m
G071-08	Connector low loss GPS antenna cable, 1 ea.
G070-02	GPS antenna cable, RG214, price per meter
G071-07	Connector RG214 GPS antenna cable, 1 ea.
G071-22	Cabinet, 9U
G-071-23	Cabinet, 12U

Recommended spare parts

Part No	Description
G060-13	DGPS IALA radio beacon antenna
G060-06	GPS L1/L2 antenna
G070-01	GPS antenna cable, ½" superflex flame retardant
G071-08	Connector low loss GPS antenna cable, 1 ea.
G070-02	GPS antenna cable, RG-214
G071-07	Connector RG-214 GPS antenna cable, 1 ea.

IALA DGPS

Part No	Description
G073-01	**DGPS IALA Beacon Receiver, including;**
G073-02	DGPS IALA beacon receiver, external module, including;
G060-13	DGPS IALA radio beacon antenna
G060-16	IALA beacon receiver power supply, 220V
G060-17	IALA beacon receiver data cable
G060-18	IALA beacon receiver interconnection cable

Optional supplied equipment

Part No	Description
G070-02	GPS antenna cable, RG-214, price per meter
G071-07	Connector RG-214 GPS antenna cable, 1 ea.
G070-01	GPS low loss antenna cable, 1/2" , price per m
G071-08	Connector low loss GPS antenna cable, 1 ea.

Fugro Inmarsat

Part No	Description
G211-02	**Fugro DGPS demodulator, Inmarsat B & M, including;**
G071-65	Fugro Inmarsat Demodulator
G071-12	Demodulator mounting bracket
G071-16	Fugro cable #3, 1m
G071-17	Fugro cable #6, 1m
G071-19	Fugro data cable, 1.5m
G071-13	Demodulator power supply (110/230 VAC / 12 VDC)

Fugro Spotbeam

Part No	Description
G211-04	**Fugro Spotbeam demodulator, including;**
G071-64	Fugro Spotbeam Demodulator
G071-11	Fugro Spotbeam antenna, narrowband
G071-12	Demodulator mounting bracket
G071-14	Fugro cable #1, 1m
G071-15	Fugro cable #2, 1m
G071-19	Fugro data cable, 1.5m
G071-13	Demodulator power supply (110/230 VAC / 12 VDC)

Optional supplied equipment

Part No	Description
G060-14	Fugro in-line amplifier, Inmarsat - AD 200 - 9
G060-15	Fugro in-line amplifier, Spotbeam - AD 200 - 8
G071-09	Narda coupler for Inmarsat B & M demodulators
G071-13	Demodulator power supply (110/230 VAC / 12 VDC)
G071-20	Fugro FTU/3000 (needed for Inmarsat A)
G071-35	Fugro spotbeam antenna, wideband (AMS)
G070-02	GPS antenna cable, RG214, price per meter
G071-07	Connector RG214 GPS antenna cable, 1 ea.
G070-01	GPS antenna cable (1/2" superflex flame retardant, max 100m), price per m
G071-08	Connector low loss GPS antenna cable, 1 ea.

Blank page

Appendix A - WinHHT

WinHHT is a terminal emulator program. It acts like a terminal and can be used via the DARPS unit.

Connect a 9-pin DSub cable with a null modem between port 1 at the rear of the TDMA Transceiver Module and an available RS-232 port on the DARPS unit. Use com 1 to 18. Start the WinHHT program from the DARPS 132 Control toolbar, as shown in the figure below.

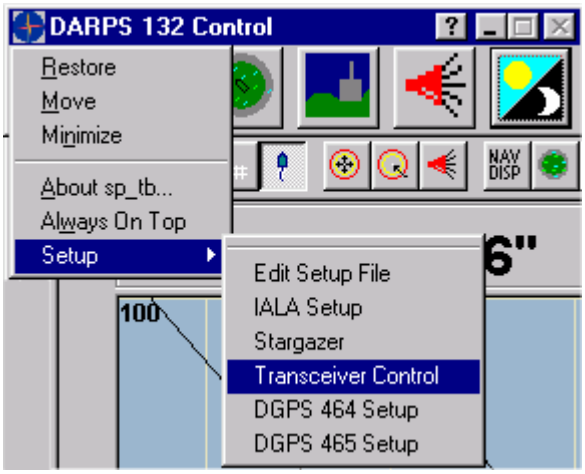


Figure 100 WinHHT from Control Toolbar

Select the **Settings** button to select correct com port and baud rate on the DARPS unit. A new window will appear and available com ports on the DARPS unit are listed. Select the correct port and press **OK**.

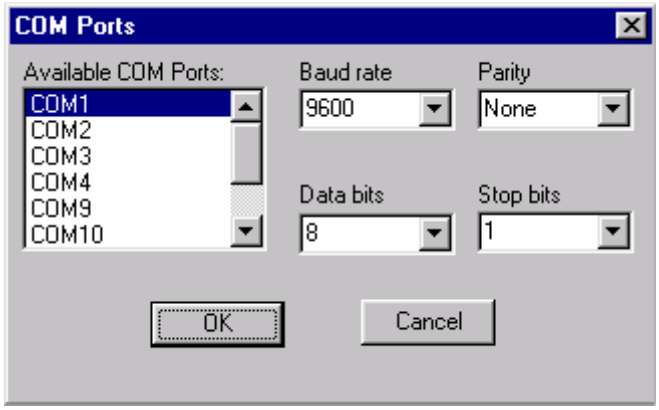


Figure 101 Com ports settings

When asked for password, type **SEATEX**. Now the opening page will appear, as shown in Figure 102. This page will display the TDMA unit's firmware version number, unit ID number and slot number. After a couple of seconds or when a letter is being pressed, the page will change to a new page as in Figure 103.

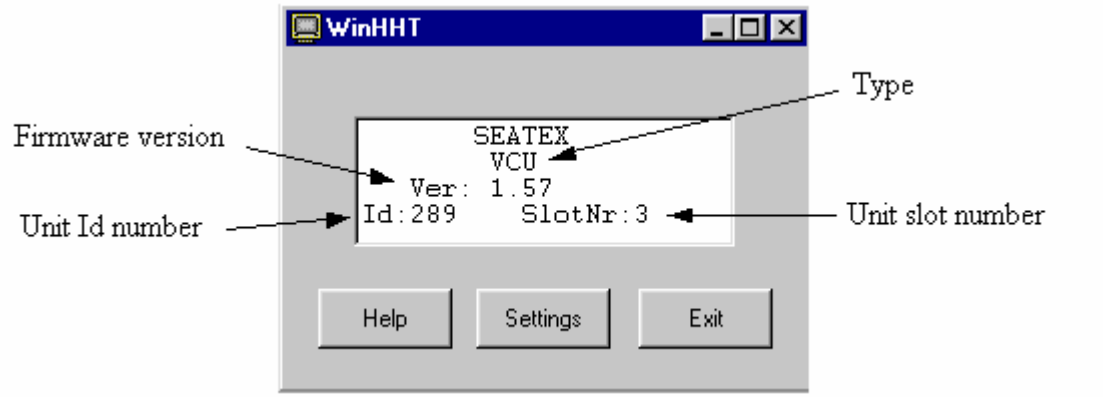


Figure 102 WinHHT opening page

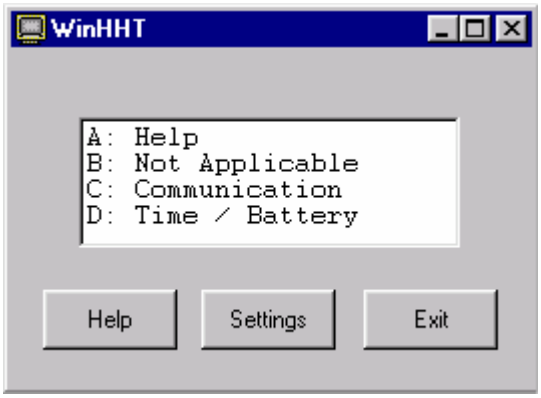


Figure 103 WinHHT page list

Different functions are available via the WinHHT program. Pressing the **Help** button displays an overview of the functions and which character to press to access them.

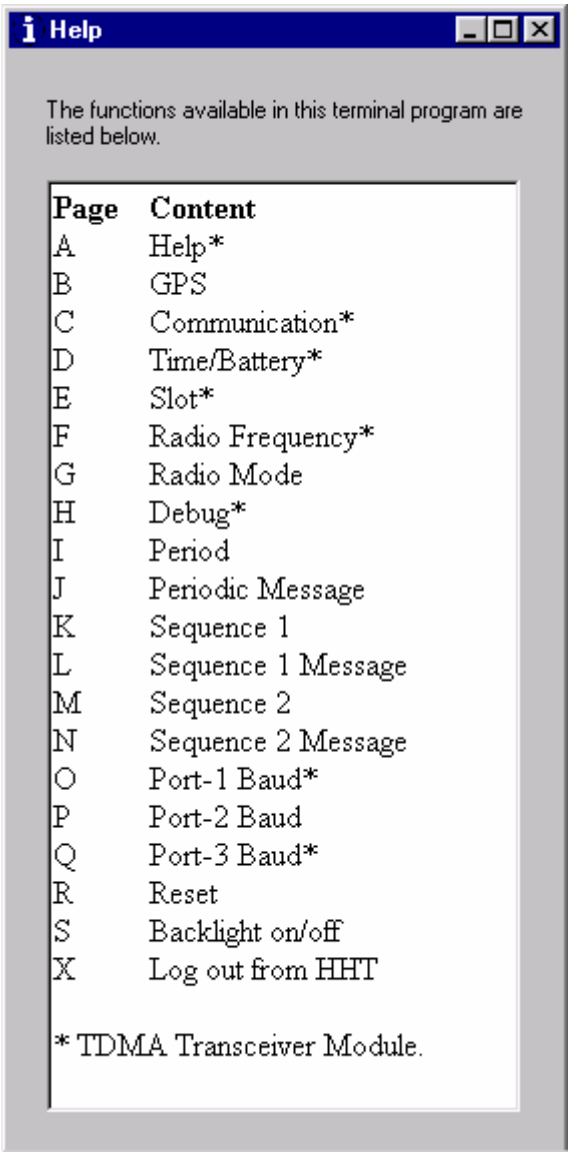
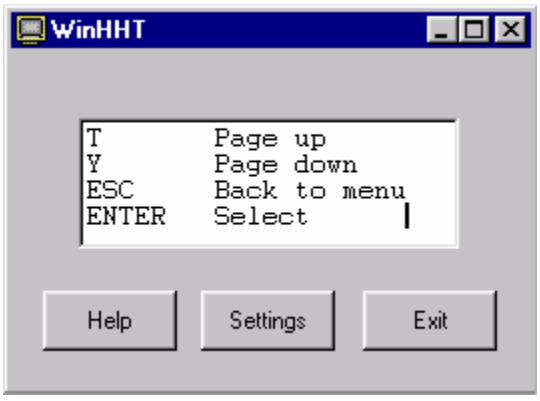


Figure 104 List of available functions in WinHHT

A: Help

This is a help display page.



In addition to the help keys displayed on the page, the following is important when using WinHHT:

- Make sure the cursor is placed inside the text window before starting to input parameters.
- If you have made a mistake you can press ESC any time.
- A new configuration value will not be used until you press ENTER. "Store Config!" will be displayed. All configuration parameters are then stored in non-volatile memory in the TDMA Transceiver Module.

C: Communication

When the TDMA module is transmitting and/or receiving messages, page C displays the time since last transmitted or received message. The following text could be displayed on page C:

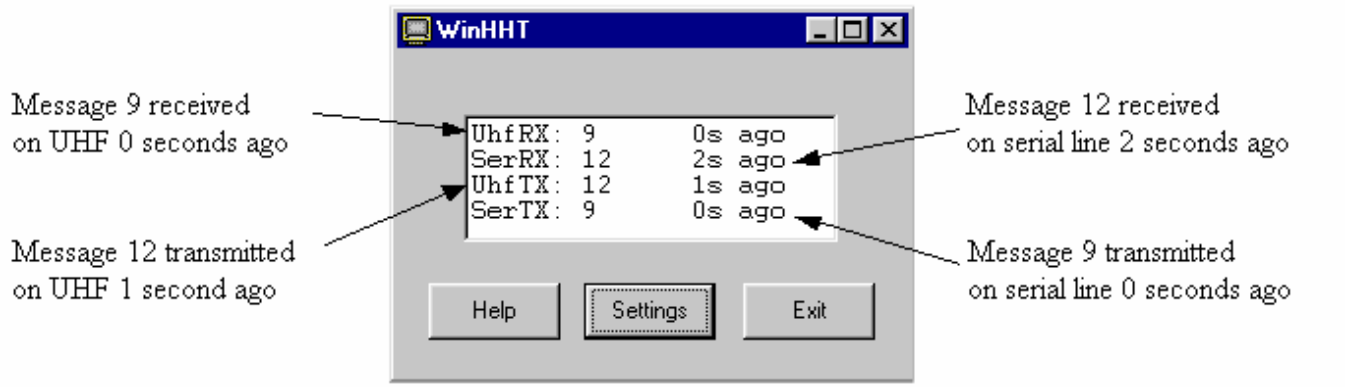


Figure 105 Page C in the WinHHT program

Several messages are transmitted and received. Below is a list of the message types, which are transmitted or received:

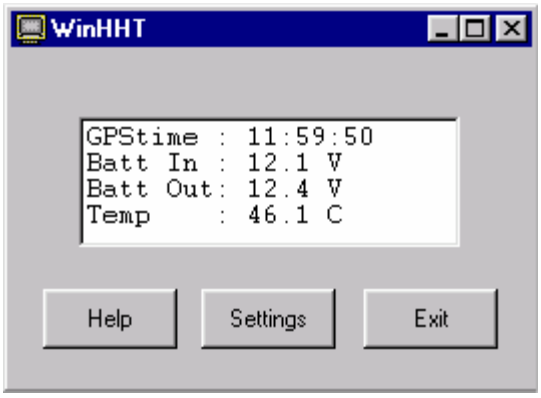
Number	Type	Comment
4	Configuration	Configuration of frequency and slot number.
9	Short raw data	Data such as number of satellites, time and pseudo-range data are transmitted.
12	DARPS data	Data such as heading, roll and pitch, vessel info, offset and antenna vector are transmitted.
13	DARPS configuration	Radio mode configuration.
14	DARPS static data	Data such as vessel info, offset and antenna vector are transmitted
37	DARPS data and configuration	Data such as heading, roll and pitch and offset vector. Message sent from master to slave.
52	Buffer full	This message is sent when the TDMA serial input buffer is near full.
53	Time	This message is used together with the PPS to synchronise the TDMA to GPS-time with high accuracy. The message should be transmitted once each 5-15 second.
55	Setup information /acknowledge	This message is sent as an acknowledge message from the TDMA when it receive a message.

Note Message types 9, 12, 53 and 55 are transmitted or received more often than the other messages. Due to slow update of the terminal program and fast transmission and receiving, not all message numbers are displayed.

D: Time/Battery

Page D displays time since last booting.

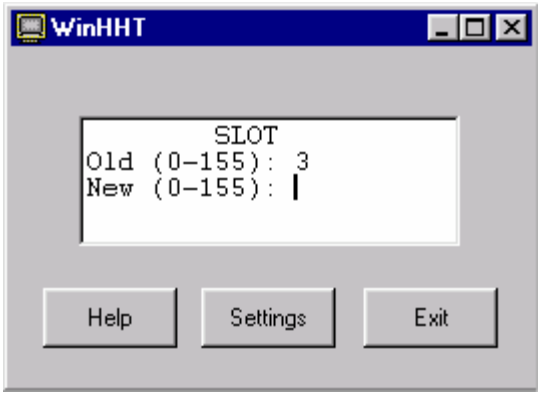
When the processor is synchronised with GPS time, "GPS Time" will be displayed instead of "Invalid Time".



E: Slot

Choose page E to change slot numbers from the HHT. Select the wanted slot number and press ENTER to store the configuration.

Default value: Not defined. Any number can be set from factory.



Note Select a unique slot number for each TBU. Slot numbers between 0 and 25 can be used when the update rate is 0.5 Hz, while the numbers between 0 and 12 can be used when the update rate is 1 Hz.

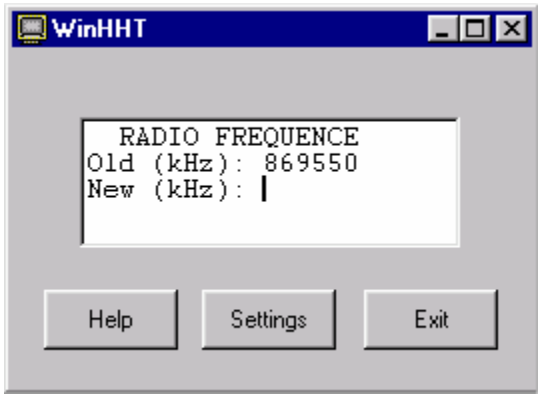
If two units are accidentally assigned to the same timeslot, at the same frequency, data will be lost. If one unit has a much stronger signal, e.g. has shorter range, it may be received correctly but will mask the data from the weaker unit. If the signal strengths are similar, data from both units will be corrupted.

1 sec													2 sec											
slots to use													slots to use											
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Figure 106 Slot description

F: Radio frequency

Choose page F from the menu and set the frequency in kHz. Press ENTER to store the configuration. The frequency can be set from 868012 kHz to 871200 kHz in 12.5 kHz steps.



Default value: 869500

H: Debug

This page is for debug purposes only. The following debug functions are available:

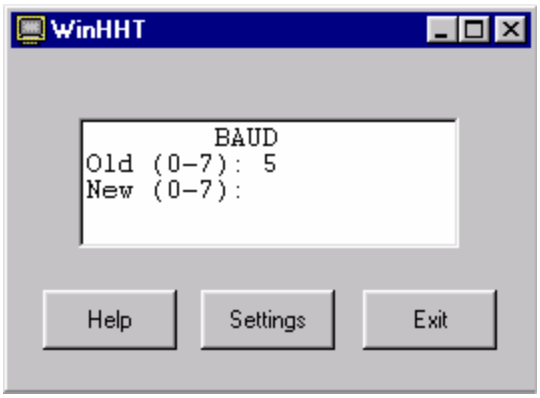
0 = No debug.
1 = Debug printouts can be seen on WinHHT.
2 = Debug printouts are sent to COM1.
4 = UHF TX debug. The radio will transmit the character X continuously. This function can be used to check the radio frequency and power.
8 = COM2 debug. All character input from WinHHT is sent to COM2 TX. All characters received on COM2 RX are presented on WinHHT.
16 = Turn relay 1 on.
32 = Turn relay 2 on.
64 = PPS debug. A "!" is printed each time a PPS interrupt occurs.
128 =Communication debug printouts.

Note Combinations of the above can/must be used. For example: To see the PPS printouts on WinHHT: Select debug function 65 (64+1).

Press ESC to terminate the debug mode. All debug flags will then be reset.

Default value: 0

O, P, Q: Port-1-3 baud



The baud rate for the serial ports can be selected according to the following table:

0 = 300 baud
1 = 600 baud
2 = 1200 baud
3 = 2400 baud
4 = 4800 baud
5 = 9600 baud
6 = 19200 baud
7 = 38400 baud

Default value: Port dependent (see notes below).

Note Port 1 at the rear of the TDMA Transceiver Module corresponds to Page O. Port 1 must be set up with a baud rate of 5 (9600). The WinHHT program must be connected to Port 1.

Note Port 3 at the rear of the TDMA Transceiver Module corresponds to Page Q. Port 3 must be set up with a baud rate 5 (9600). Port 3 must be connected to the DARPS unit.

Note Port 2 is not used.

Blank page

Appendix B – Handheld terminal

The Termiflex ST 2000 works as a simple ASCII terminal, capable of simultaneously transmitting and receiving ASCII characters via an RS-232 serial line. Once power is connected, the terminal undergoes a series of self-tests to verify proper unit operation. No input is required during the self-test (approx. three seconds duration).

Figure 107 Handheld terminal

Normally, the HHT will be configured by Seatex before delivery.

The terminal setup mode is entered by pressing the lower left and lower right keys (**Z** and **ENTER**) while the unit undergoes the power up self-test. While in setup mode, incoming data are ignored.

When The Main Menu is entered, the text "MAIN MENU" will be shown on the top display line and the soft key labels "COM DSP KBD EXIT" will be shown on the bottom line. Switch between the different options be pressing **NXT** or **PRV**. All parameters must be set up as listed in Table 7.

Communication (COM) Setup:	
Baud rate	9600
Parity	NONE
Data, Stop bits	8,1
Display serial errors ?	YES
Aud serial errors ?	NO
Support XON/XOFF ?	NO

Display (DSP) Setup:	
Disp ctl chars ?	NO
Disp esc chars ?	NO
Cursor visible ?	YES
Auto line wrap ?	YES
New line on cr ?	NO
Display self-test ?	YES
Backlight on ?	YES
Backlight strength ?	OPTIONAL

Keyboard (KBD) Setup:	
Local echo ?	NO
Key repeat	SLOW
Audible keys ?	YES
Simplified KB ?	NO
Program function key F1?	< MAIN >
Exit the Main Menu by pressing	< EXIT>.
Save Changes ?	YES
Leave the Setup by pressing	<EXIT>

Table 7 Handheld Terminal Configuration Parameters

The handheld terminal is connected to port 1 at the rear of the TDMA Transceiver Module.

The handheld terminal works as the WinHHT program.

Index

M

N

O

P

Q

R

S

T

U

W

X

Z

Reader's comments

Please help us to improve the quality of our documentation by returning your comments on this manual.

Your information on any inaccuracies or omissions (with page reference):

Please see next page

Your suggestions for improvements:

Name: ……..…..…..
Title/function: ……..…....……
Company: ……..
Address: ……..…
……..…....….
……..…....….
Telephone: ……..…....….
Facsimile: ……...…...
E-mail: ……..…....
Date: ……....…….

Manual reference:……..……..
Revision: ……....…
.

Thank you for your contribution!

Please send this form to: Secretary of Research and Development
Kongsberg Seatex AS
Pirsenteret, N-7462 Trondheim, Norway

Telephone: +47 73 54 55 00
Facsimile: +47 73 51 50 20
E-mail: km.seatex@kongsberg.com