000.JDP-10000-OME

NAVIS NavDP 4000

Dynamic Positioning & Independent Joystick Control System

Operation Manual

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Contents

Abbreviations

ACK Acknowledge

AP Autopilot

AWC Automatic Wind Compensation

BOD Bearing Origin Destination

BTW Bearing To Waypoint

CB Communication Box

COG Course Over Ground

COR Center of Rotation

CP Control Panel

CPP Controllable Pitch Propeller

CPU Central Processing Unit

DGPS Differential Global Positioning System

DP Dynamic Positioning

DTW Distance To Waypoint

EBL Electronic Bearing Line

ECDIS Electronic Chart Display and Information System

FAA Federal Aviation Administration

FPP Fixed Pitch Propeller

GPS Global Positioning System

GUI Graphic User Interface

HDG Heading

HDOP Horizontal Dilution Of Precision

HM Heading Monitor

HPR Hydroacoustic Position Reference

HS Track High Speed Track

HSC Heading Control System

I/O Input/Output

IJ Independent Joystick

JB Junction Box

JDP Joystick/Dynamic Positioning

LCD Liquid Crystal Display

LED Light-emitting Diode

LS Track Low Speed Track

MAN Manual

MCP Main Control Panel

NWU Network Unit

PCB Printed Circuit Board

PCP Portable Control Panel

PLC Programmable Logic Controller

PMF Power Monitoring Function

PMS Power Monitoring System

PRS Position Reference System

PSU Power Switch Unit

PWR-DU Power Distribution Unit

RMS Root Mean Square

ROV Remotely Operated Vehicle

RPM Revolutions Per Minute

SI-DU Serial Interface Distribution Unit

SOG Speed Over Ground

SP-U Surge Protection Unit

STBD Starboard

TAL Thrust Allocation Logic

UPS Uninterruptible Power Supply Unit

VDR Voyage Data Recorder

VRS Vertical Reference Sensor

WP Waypoint

XTE X-Track Error

Chapter 1

System Principles and Functionality

1.1 Introduction

This document describes the **NAVIS NavDP 4000** system. **NAVIS NavDP 4000** is a DP control system providing an all-weather vessel motion control in different ways. **NAVIS NavDP 4000** is the family of systems.

More usual types are listed below.

Stand-alone single DP control system (DP-0)	
NAVIS NavDP 4011	DP Control Station
Single DP system with integrated joystick system (DP-1)	
NAVIS NavDP 4011	DP Control Station
NAVIS NavDP 4001	IJ Control Station
Dual-redundant DP system with integrated joystick system (DP-2)	
NAVIS NavDP 4022	DP Control Station
NAVIS NavDP 4002	IJ Control Station

More detailed information see in Chapter 2, page 15.

With the system the Operator controls the vessel:

– moving;
– heading;
– position.

The calculations are done with allowance for the forces applied to a vessel like wind, current and waves.

NAVIS NavDP 4000 gets data both sensor and manual inputs. The manual input (position and heading settings) is available in any mode.

To provide the specified moving the set of control signals (rpm, pitch or azimuth angles, etc.) for every thruster is generated. The calculation is based on the received data.

NAVIS NavDP 4000 controls the vessel in three coordinate axes — surge, sway and yaw.

The coordinate values can be set in the following ways:

– manually — the operator set all coordinate values;
– automatically — all coordinate values are controlled automatically;
– automanually — some of coordinates are set manually while the others are controlled automatically.

Manual control is provided with joystick and rotary knob.

Information is displayed on the LCD with a touchscreen.

The touchscreen is used to set the information to display, to select a control mode and to enter data (setpoints, root data, limitations, etc).

NAVIS NavDP 4000 applications are run under Windows 7 PRO.

1.2 System Principles

This section gives an overview of the **NAVIS NavDP 4000** principles illustrated in Figure 1.1.

The coordinate system is the Figure 1.2

Where:

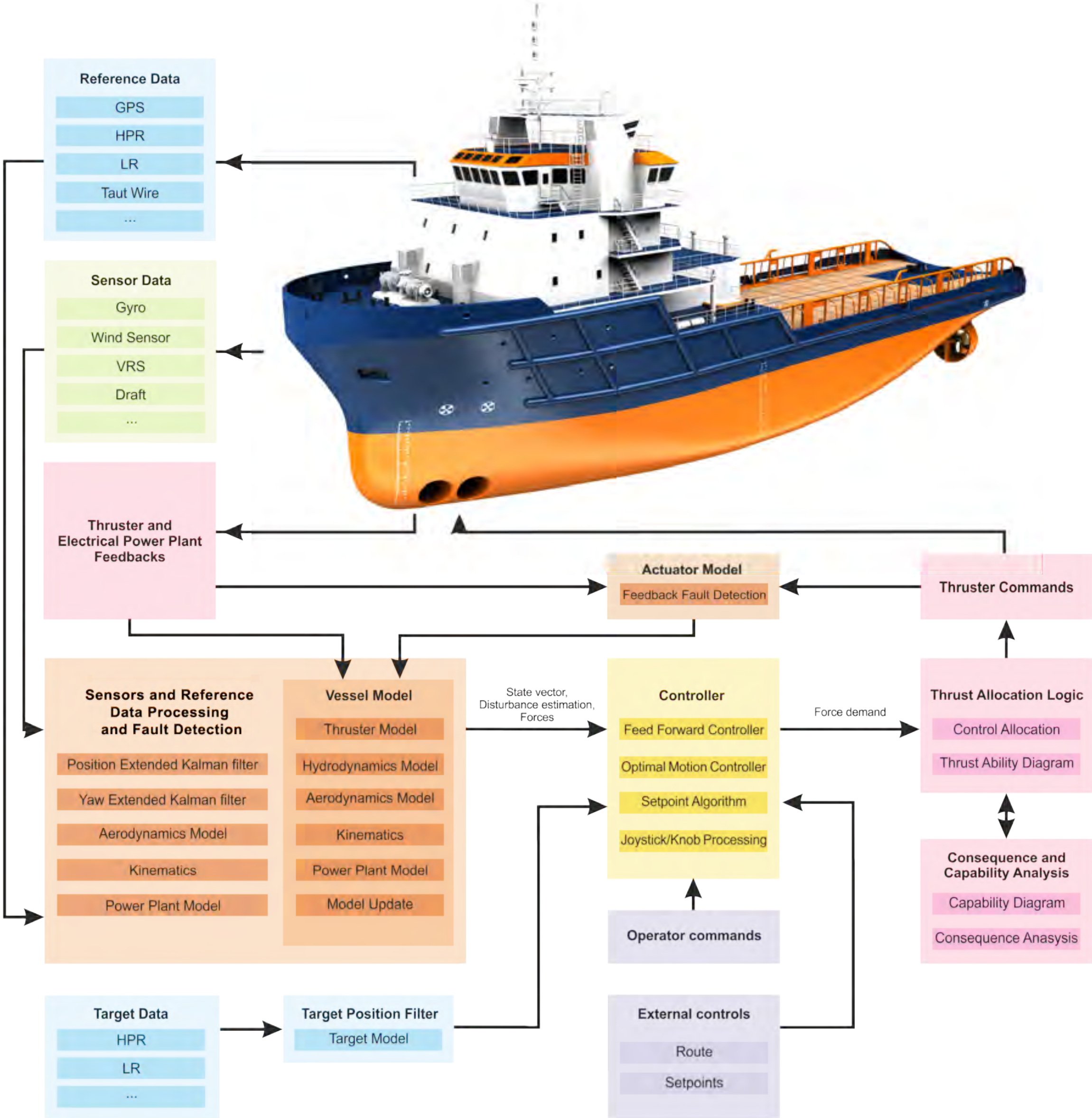


Figure 1.1: **NAVIS NavDP 4000** principles

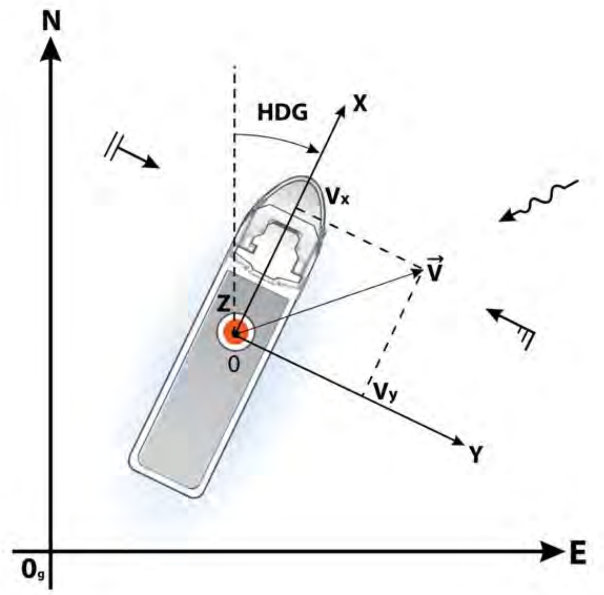


Figure 1.2: **NAVIS NavDP 4000** Coordinate systems

N north
E east
X the bow direction axis placed at midship line and parallelly to the still-water surface
Y the starboard direction axis placed at midship line and parallelly to the still-water surface
Z the vertical axis as perpendicular to the the still-water surface
HDG heading
V the vessel course and speed vector
Vx, Vy proper projections of velocity

The diagram contains also the current, wind and waves directions references.

1.2.1 Vessel Model

The base of the **NAVIS NavDP 4000** system is a mathematical model describing the vessel's moving as a function of the forces applied to. The vessel model is applied to get a noise free estimation of the vessel position, heading and speed. A lot of parameters such as vessel mass, draft, hull form, propulsion type and arrangement, superstructure and location etc are used in the model.

1.2.2 Wind Model

A wind model is used to calculate the wind forces and moment as a function of the wind speed and direction. The model is based on the aerodynamic vessel description, and includes a set of coefficients for various angles of attack. So, the wind speed and direction values mentioned above, as well as the vessel heading, are used to calculate the wind induced forces in the surge and sway axes and the moment. Information about the wind induced forces and moment is then used to implement a feedforward loop into the overall control signal.

1.2.3 Thruster Model

A thruster model is based on thruster hydrodynamic characteristics. This model uses the feedback signals from the thrusters calculating thruster forces.

1.2.4 Vessel Model Update

The vessel model doesn't provide an accurate description of the vessel dynamics. The wind and thruster forces, as well as the hull hydrodynamics are simulated only approximately. As to the current speed and direction, they are not measured but calculated. Finally, the DP control system doesn't cancel out a high-frequency wave induced forces, because these forces are greater than the thruster ones. Therefore, to use the position and heading determined values by controller the data is filtered to exclude a wave induced component.

To update the model extended Kalman filter is used. The method provides the effective noise filtering of the position and heading data. The vessel model update algorithm applies the measured data from reference systems and sensors and the data predicted by the model to calculate a position and heading difference, which is applied to the model update.

The Kalman filter technique provides an optimal estimation of ship moving parameters and those of current. Moreover, it provides so calling "dead reckoning" positioning (only for a short period of time) if there are no further model updates.

1.2.5 Operator Commands

The DP operator switches the system to the mode and input commands providing a required maneuver.

A rotary knob is used to generate the required moment.

A joystick is used either to generate a control force vector both the surge and sway directions or to set required vessel speed (both the surge and sway directions). The thrusters provide the control force and speed.

To input data(position and heading setpoints, route parameters etc.) a touchscreen is applied.

1.2.6 Set Point Algorithm

The **NAVIS NavDP 4000** system provides the vessel moving according to the operators' commands and selected mode. The Set Point Algorithm transforms operator commands to detailed instructions to Optimal Controller. For instance, the track following mode includes several tasks, such as:

- track specification
- obtaining s pecified track
- following a track leg
- following a new leg etc

Each task is described as a particular control problem, and is solved using a particular algorithm.

1.2.7 Optimal Controller

The Optimal Controller provides a vessel position and heading, as well as the vessel speed.The parameter values are input by operator.

The controller produces a force required to move a vessel to a specified position or to steer course. The force is proportional to an error of the vessel model position values.

The controller produces the force required to provide the given speed. The force is proportional to an error of the vessel model speed value.

When solving this problem, the Optimal Controller accounts for the manual control forces (if any) and the feed forward control loops (wind compensation)forces.

To cancel out unmodelled and unmeasured forces (current and mathematical model errors)an integral feedback loop is used.

The thrusters provides resulting control forces along the both axis and the turning moment.

1.2.8 Sensors and Position References Systems Data Processing

The DP control system receives information from sensors and ref-systems.

DGPS furnish the DP control system the vessel position information, while gyrocompass conveys the vessel heading data.

VRS transfers roll and pitch values.

Wind sensor measures the wind speed and direction.

The information from sensors is continuously processed for the purpose of detecting possible data errors. An operator can assign sensors to be used, and estimate validity of obtained data.

1.3 Basics of System Operation

An operator sets control mode and inputs data via Control Panel and LCD touchscreen.

With entered data Control Computer calculates position and heading setpoints, route parameters, force and turning moment values demanding to provide the specified moving etc. Also, Control Computer receives feedback signals from actuators and data from sensors and reference systems.

Signals from sensors and reference systems are processed with the purpose of fault detection, and then are used to calculate scope of vessel coordinates and speed.

After being provided by different sensors, the estimates are weighted to obtain the best.

The estimated and preset data are compared in the Optimal Controller, which calculates the force demand in the surge and sway axes, as well as the turning moment demand. These demands are transformed into actual control commands for actuators, with the actual power and individual thruster rpm/angle/etc limits taken into account.

The commands for thrusters, represented in terms of rpm and rudder angles, are transformed into current and/or voltage signals via special calibration tables, obtained earlier on the stage of calibration.

The demanded values of current and/or voltage control signals are transferred to PLC, and then PLC produces the required current and voltage on its outputs. The actuators receive the signals from PLC and yield desired rpm and angles.

All the information about the control system operation and the vessel position and moving, including raw sensor data and smoothed estimates, desired and actual thruster rpm/angles, position and heading offsets, enabled thruster configuration, etc is displayed.

In case of a system fault or a situation which may affect the system performance, an alarm message is produced and appears on the screen, and can also be printed in real time, if the Alarm Printer is connected.

Chapter 2

System Hardware Configuration

As mentioned above, **NAVIS NavDP 4000** is the family of systems.
The **NAVIS NavDP 4000** system types in accordance with IMO classification system are listed below.

Stand-alone single DP control system (DP-0)	
NAVIS NavDP 4011	DP Control Station
Single DP system with integrated joystick system (DP-1)	
NAVIS NavDP 4011	DP Control Station
NAVIS NavDP 4001	IJ Control Station
Dual-redundant DP system with integrated joystick system (DP-2)	
NAVIS NavDP 4022	DP Control Station
NAVIS NavDP 4002	IJ Control Station

Class DP-0 System Configuration

The Figure 2.1 represents the **NAVIS NavDP 4000** standard hardware configuration of IMO Class DP-0 System. The system contains the following sensors:

– Gyro
– DGPS
– Wind
– VRS

The sensors are connected to the Control Unit via Operator station junction box (JB) while the Thruster system is connected directly to the Control Unit.

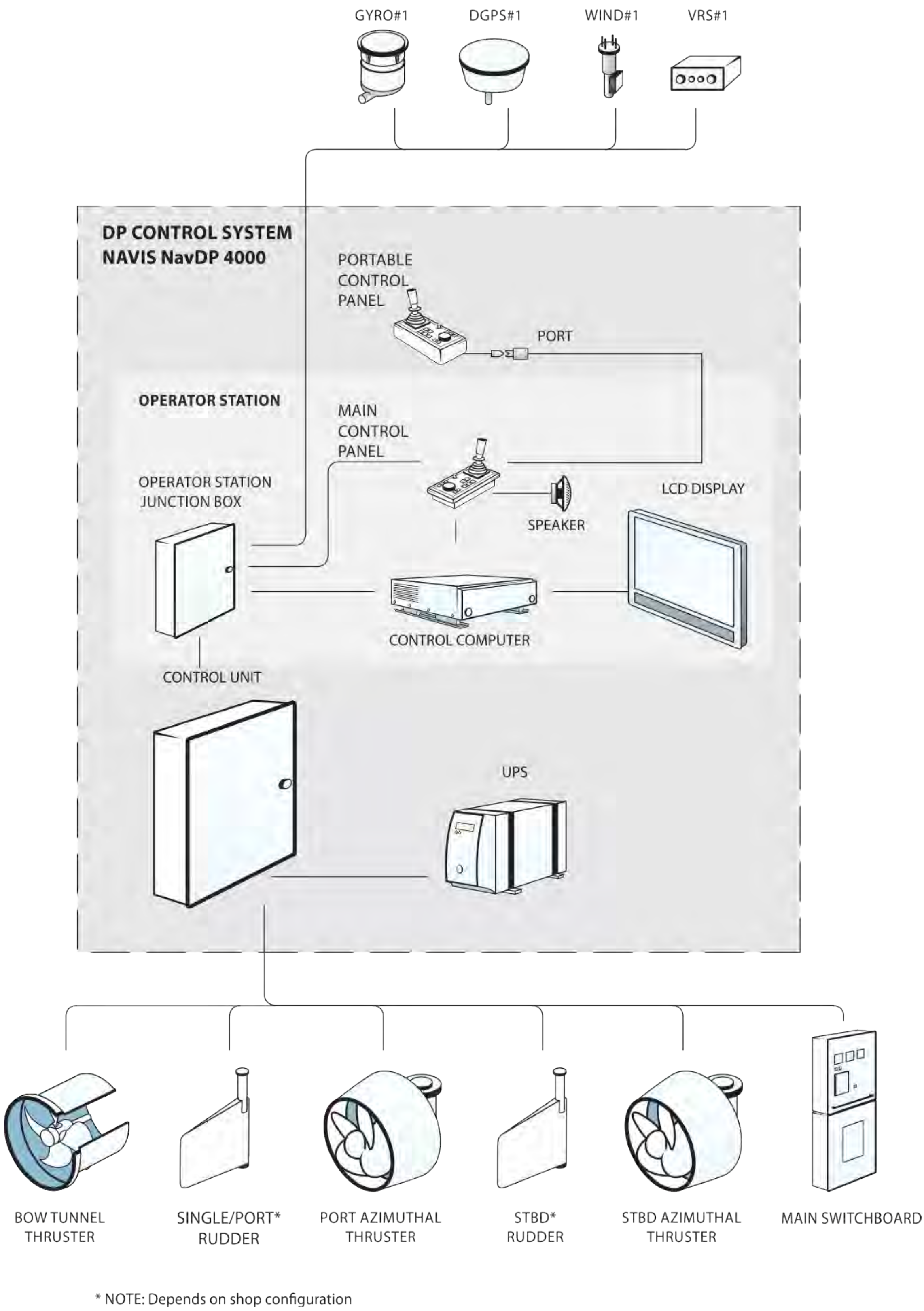


Figure 2.1: Typical **NAVIS NavDP 4000** for DP-0 Class Ship Hardware Configuration

Class DP-1 System Configuration

The **NAVIS NavDP 4000** typical hardware configuration for IMO Class DP-1 System is presented in Figure 2.2. The configuration contains two control systems — IJ and DP and the following sensors:

- Gyro — 2
- DGPS — 2
- Wind — 2
- VRS — 2
- HPR — 1
- LR — 1

All sensors are connected to the DP Control Unit via the DP Operator station junction box. Some of them (e.g. Gyro, DGPS, Wind) are also connected to the I Control Unit via the IJ operator station junction box. The Thruster system is connected to the both Control units.

Control transfer between the **NAVIS NavDP 4011** and **NAVIS NavDP 4001** is performed manually by means of the Mode Selector which is supplied together with **NAVIS NavDP 4000**.

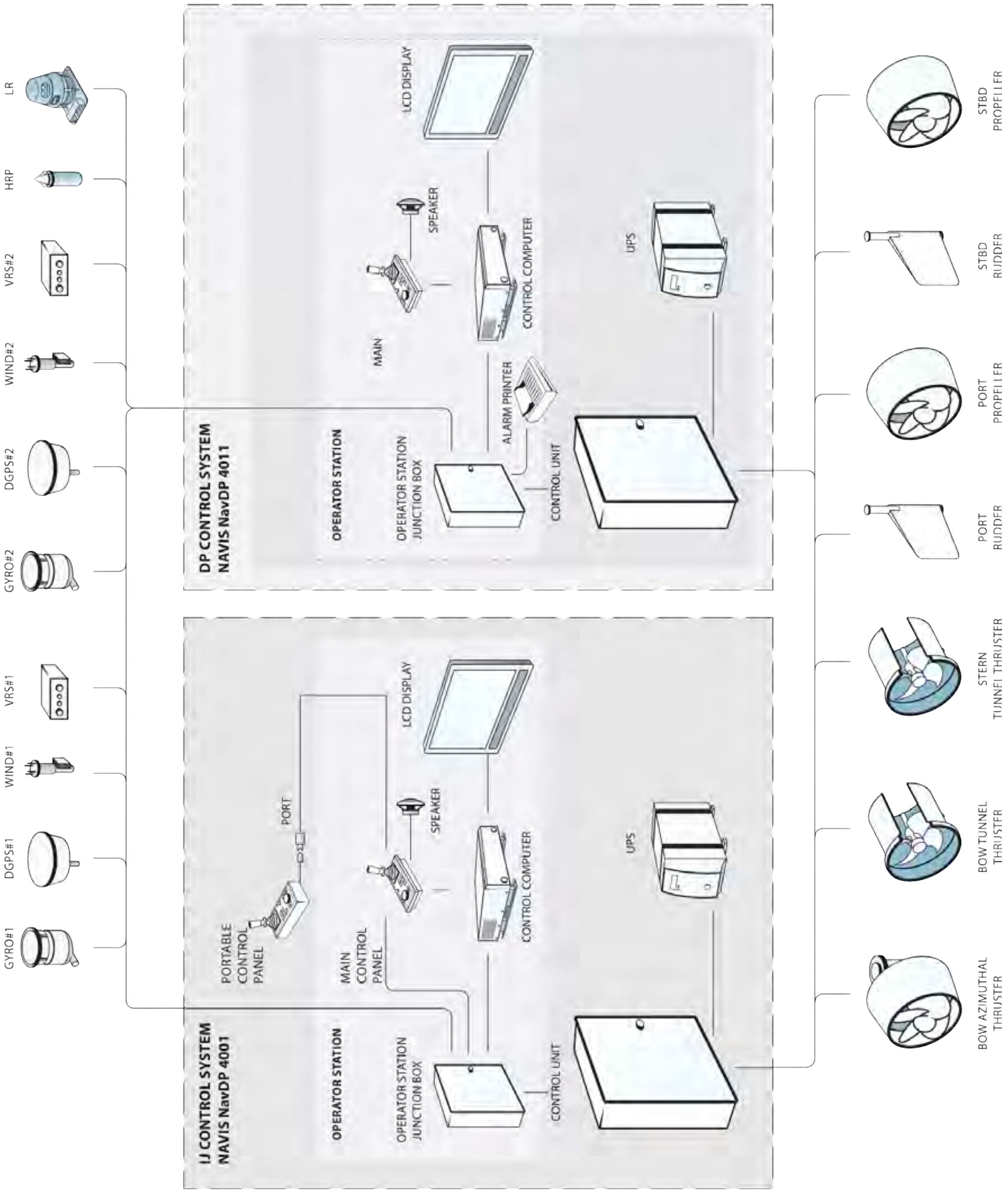


Figure 2.2: Typical **NAVIS NavDP 4000** for DP-1 Class Ship Hardware Configuration

Class DP-2 System Configuration

The **NAVIS NavDP 4000** of IMO Class DP-2 is a redundant DP control system that contains the **NAVIS NavDP 4002** IJ control station and two DP control stations **NAVIS NavDP 4022**: main (DP-A) and backup (DP-B).

The **NAVIS NavDP 4022** is designed to operate the distributed I/O system via the redundant data communication link (redundant DP network). This communication link provides communication between the main and backup control units. The system contains the following sensors:

- Gyro — 3
- DGPS — 2
- Wind — 3
- VRS — 3
- HPR — 1
- LR — 1

All sensors are connected both to the main and to the backup junction boxes. Some of them (e.g. Gyro, DGPS, Wind) are also connected to the IJ junction box.

The **NAVIS NavDP 4022** is designed so that no single failure of any unit should result in case of loss of the remaining equipment's ability to maintain a vessel position.

The **NAVIS NavDP 4000** typical hardware configuration for IMO Class DP-2 System is presented in Figure 2.3.

Each thruster is connected to the control unit via the own I/O unit.

The **NAVIS NavDP 4002** system uses an individual bus to communicate with the I/O units. The main and backup systems use the shared one.

Each of the control systems (IJ, DP-A and DP-B) can be switched on and off independently of each other. Control transfer between the **NAVIS NavDP 4022** and **NAVIS NavDP 4002** is performed manually by means of the Mode Selector.

Control transfer between DP-A and DP-B control systems can be performed manually by the operator (using control panel — see Section 2.6, page 37), or automatically in case of failure.

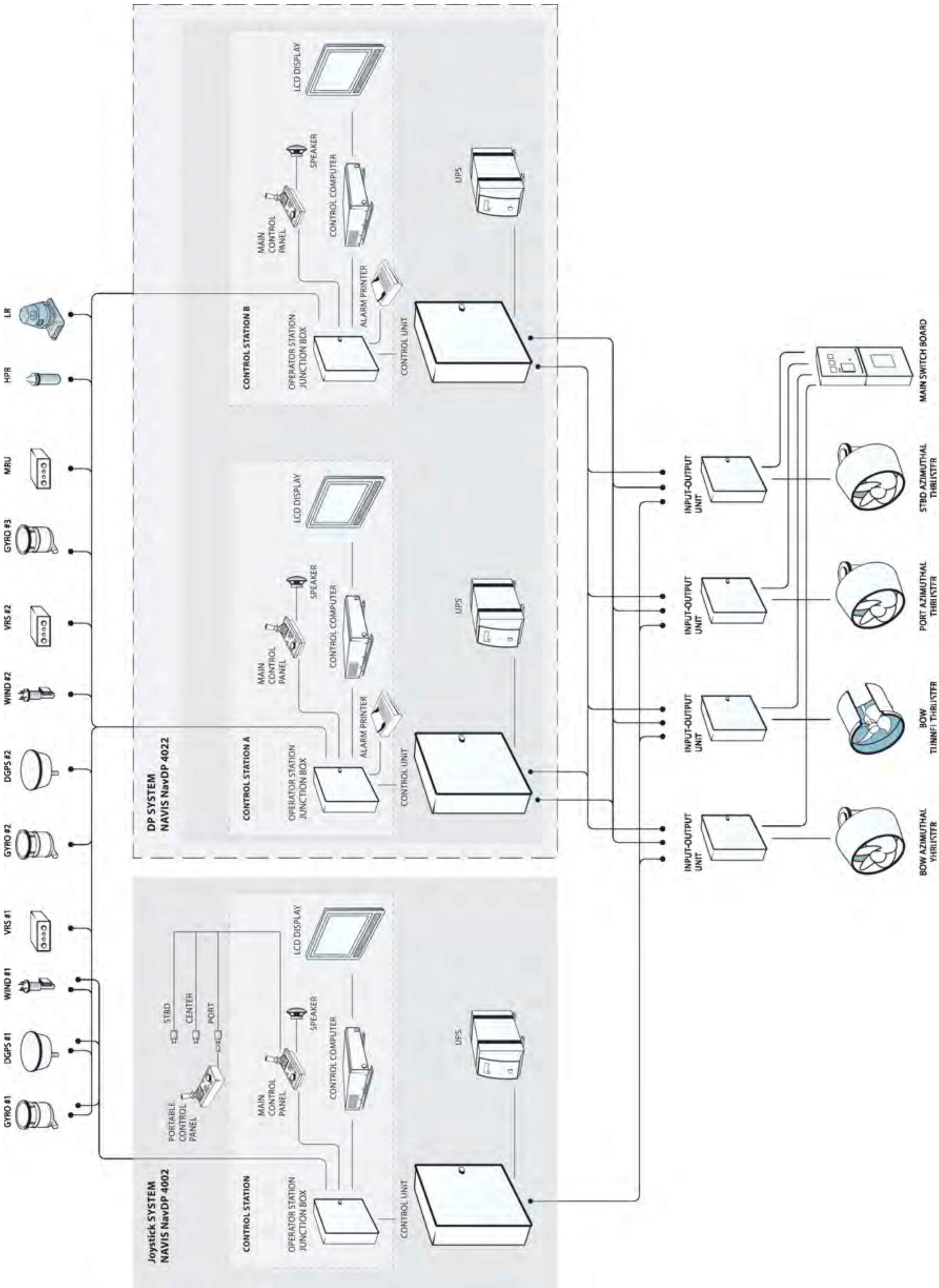


Figure 2.3: Typical **NAVIS NavDP 4000** for DP-2 Class Ship Hardware Configuration

The following table contains configurations of the different class systems.

DP System Class	DP-0: **NAVIS NavDP 4011**	DP-1: **NAVIS NavDP 4011/ NAVIS NavDP 4001**	DP-2: **NAVIS NavDP 4022/ NAVIS NavDP 4002**
Control Unit	+	DP, IJ	DPA, DPB, IJ
Alarm Printer	option	DP (option)	DPA, DPB, IJ (option)
Uninterruptible Power Supply Unit (UPS)	+	DP, IJ	DPA, DPB, IJ
Local Input-Ouput Units	-	-	+
Operator Station			
Control Computer	+	DP, IJ	DPA, DPB, IJ
LCD with Touchscreen	+	DP, IJ	DPA, DPB, IJ
Junction Box	+	DP, IJ	DPA, DPB, IJ
Main Control Panel (MCP)	+	DP, IJ	DPA, DPB, IJ
Portable Control Panel (PCP)	option	option	option
Alarm Speaker	+	DP, IJ	DPA, DPB, IJ
Interfaces			
Thrusters	+	separate interfaces with the IJ and DP	separate interfaces with the IJ and DP
Sensors, position reference systems	+	+	+

2.1 Operational Modes and Mode Selector

This section provides an overview of operational modes in which **NAVIS NavDP 4000** operates.
The Mode Selector is used to select the station from which the thrusters are controlled(depends on configuration).

2.1.1 Bridge (or Manual) Mode

The Mode Selector is set to **OFF** (**Bridge**, or **Manual**) position. All the thrusters are controlled with the aid of levers, wheels, etc., located at the bridge Operator Console.
In this mode **NAVIS NavDP 4000** does not control the vessel.

2.1.2 DP Mode (DP Control System)

This mode provides the heading control(Auto/manual/by track/by target) and position control(auto/manual/by track/by target/semi-auto/speed vector). The list of available heading and position control modes depends on system configuration.
See Section 9.2, page 161 and 9.3, page 165 for details.
The IJ control system has two modes - IJ and Autopilot(AP)

2.1.3 IJ mode (IJ Control System)

When operating in this mode, the IJ control system is normally considered to be a back-up system for DP operation; therefore, it shall normally be used in case of the DP control system failed.
Auto/manual heading control modes, manual position control modes are available in this mode.

2.1.4 Autopilot mode

Auto heading/high speed track control modes are available in this mode.
See Section 10.7, page 201 for details.

Mode Selectors for NAVIS NavDP 4011

In case of simple configuration of **NAVIS NavDP 4011** the Mode Selector has two positions:

DP — Control is transferred to the **NAVIS NavDP 4000**.

OFF, Manual or Bridge — **NAVIS NavDP 4000** is not controlling the vessel.

2.1.5 Mode Selectors for NAVIS NavDP 4011 or NAVIS NavDP 4022

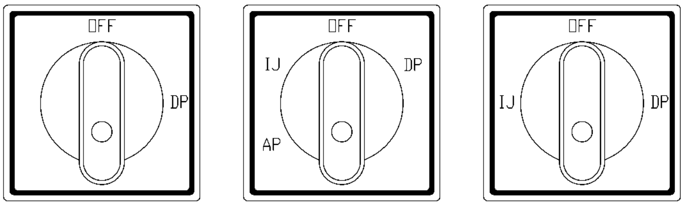


Figure 2.4: Mode selector “OFF–DP”, “OFF–DP–AP–IJ”, “OFF–DP–IJ”

For the **NAVIS NavDP 4000** system with built-in Autopilot mode the Mode Selector has four positions:

OFF, Manual or Bridge — Control is performed by any system other than **NAVIS NavDP 4000**.

AP — Control is transferred to the IJ control system, and this system is to operate in AP mode

IJ — Control is transferred to the IJ control system, and this system is to operate in IJ mode

DP — Control is transferred to the DP control system. For DP-2 class systems (DP-A and DP-B operator stations): control is given to that one which has been set active (master) for the last time when the vessel was controlled by DP control system. Each position is marked on the control panels or pushbuttons.

For the **NAVIS NavDP 4000** system without built-in Autopilot mode the Mode Selector has three positions:

DP — Control is transferred to the DP control system.

IJ — Control is transferred to the IJ control system.

OFF, Manual or Bridge — **NAVIS NavDP 4000** is not controlling the vessel.

2.2 Operator Stations

Operator Station (OS) comprises the following components, usually console mounted (an example of console is shown in Figure 2.5):

- LCD with touchscreen. The touchscreen monitor is used for selecting control modes, enabling and disabling sensors and position reference systems, entering data, and displaying all the information concerning the system operation and the vessel behavior.
- Control Computer
- The Main Control Panel (MCP) is used for controlling the vessel manually by means of the joystick and rotary knob, alarm acknowledging, control transfer, and controlling the vessel is a number of simplest operational modes.
- Portable control panel (PCP) is used for controlling the vessel manually by means of the joystick and rotary knob, alarm acknowledging, control transfer, and controlling the vessel is a number of simplest operational modes.
- Alarm Speaker. Alarm speaker is used for audible alarms.
- Junction Box.

Figure 2.5: An example of DP Consoles

The Operator Station performs the following functions:

- Operator-DP interaction control via touchscreen LCD, control panel with joystick, knob and LED indicators
- Generation of sound alarms and voice announcements
- Interaction with Control Unit
- Other functions

Master and Slave stations

When controlling the vessel with the **NAVIS NavDP 4022**, the operator controls with DP-A or DP-B control system whichever is the Master. The other system is the Slave. All data is duplicated so there is no data loss in case of control transfer from one OS to another (say, from DP-A to DP-B).

Entire information is available at the every OS in view mode. But only the Master OS allows the operator to input data, select control mode and control the vessel.

2.3 Main and Portable Control Panels (MCP, PCP)

The MCP is used for:

- Input of control signals from pushbuttons, knob and joystick (if any);
- Setting main DP system operation modes;
- Setting DP system parameters;
- LED Indication;
- Volume control of sound and voice alarms;
- Displaying DP system info on built-in color LCD (for a model with LCD);
- Control transfer between Control Panels.

WARNING!	Control panels and associated Joysticks should be oriented in longitudinal or transverse direction to vessel's centerline. Angular orientation is prohibited as potentially dangerous for vessel control.

WARNING!	Both main and portable control panels should be properly fixed by using mounting bracket kit. Unfixed panel using is prohibited as potentially dangerous for vessel control.

The PCP is normally used for vessel movement control from the places differs from DP control center, for example bridge wings of front console.

Portable control panel general view is shown in Figure 2.6.

Figure 2.6: Portable Control Panel (PCP)

2.4 Control Panel MCP4000 with LCD Screen

The following components of the Control Panel are mounted on an aluminum base plate:

– Rotary Knob/button;
– 6” color LCD;
– PCB with integrated indicators and electronic components.

The arrangement of controls, push buttons and indicators on the control panel is shown in Figure 2.7.

The special protective transparent film with button and indicator inscriptions printed on is glued on the aluminum base plate. All panel controls and indicators are highlighted.

The Alarm Speaker is used for voice announcement of all messages appearing in the system Alarm Window. Alarm Speaker is embedded into the system console and connected with the Control Panel by separate cable.

For LCD GUI details see Section 5.12, page 90.

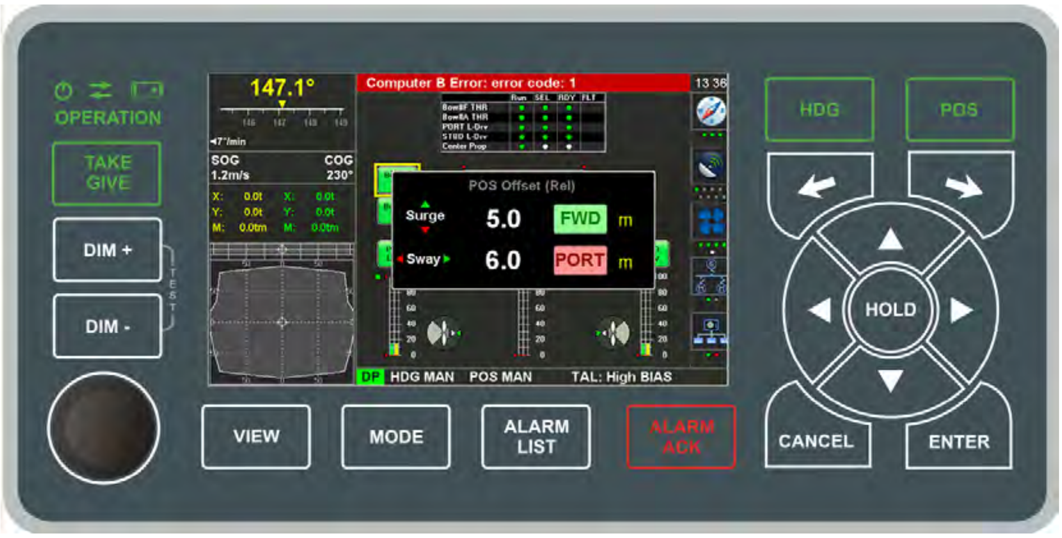


Figure 2.7: Control Panel Controls, Buttons and Indicators (MCP and PCP)

Disconnected Panel

In case the panel has no signal from the system, the status is “Disconnected”. In this state all push buttons have white backlights, but the color of the indicators corresponds their status (see the sections below).

In this state to call the Configuration menu (see 5.12.6, page 99) press at one time on the DIM+/DIM- buttons.

NOTE!	In case there is no Lamp Test item in the list, the lamp test is performed by the long (at least 5 sec) pressing on the DIM+/DIM- buttons.

Monitorless Configuration

In case the system configuration does not include a touchscreen display the operations are performed via the control panel. Description of the functionality see below.

All popup windows appear on the panel display.

2.4.1 POWER

 indicates if the system is powered. In case the system is powered, the button is green.

2.4.2 OPERATION

indicates if the system is active. The green lightning means that the vessel is under the system control.

2.4.3 Communication Icon


indicates the state of the control panel connection with a control computer via Ethernet link. Green indicator means connection is OK while red one means connection fault.

2.4.4 BATTERY


indicates an internal battery status. The red lightning of indicator means that the battery is nearly dead.

2.4.5 TAKE/GIVE

The TAKE/GIVE button is used for transferring control between:

- DP A and DP B systems (for DP-2 systems);
- control panels of the control system (if two or more control panels are in use).

The active panel button is green highlighted.
The system operates in one of the control transferring modes:

- Take;
- GiveTake.

The mode settings are performed when the system is configured and not allowed to change using the software GUI.

Take Mode

Control can be taken to any control panel by holding the **TAKE/GIVE** button.

GiveTake Mode

This configuration means that the system should be switched to the transfer state. Press the **TAKE/GIVE** button on the active panel.

NOTE!	When the **TAKE/GIVE** button is pressed on the inactive panel, a continuous audio signal is generated signing the wrong action.

After the system is switched to the control transferring state, the current active panel beeps, and the inactive panels buttons **TAKE/GIVE** start blinking.

For taking the control, it is necessary to press the **TAKE/GIVE** button on the active control panel and hold it for the a preset period (60 seconds by default). In case there is no action during this period, the system returns to the previous state, and it is under control of the current active panel. The other method of returning control to the active panel is pressing the **TAKE/GIVE** button on the active panel within the given period.

NOTE!	In case of emergency outage of a main control panel, the system is switched to the control transferring state automatically. In case of emergency outage of a portable control panel, the control is transferred to the main control panel automatically.

2.4.6 DIM +, DIM -

Pushbuttons (see Figure 2.8) are used to control the brightness of the control panel's backlight.

In case of "Connected" state pressing on the both pushbuttons at once and holding them at least 5 seconds calls the Configuration menu(see 5.12.6, page 99).

NOTE! In addition, in some configurations the short pressing on the both buttons calls the Configuration menu on the main system screen. In this case the rotary knob functionality is standard.

In case of "Disconnected" state the menu is called via the short pressing on the buttons.

Figure 2.8: The Brightness Buttons

2.4.7 HDG

The HDG pushbutton can be used in the DP, IJ and Autopilot modes to select Auto Heading (AutoHDG) control mode.

There are two ways to switch to the AutoHDG mode:

– Double pressing the HDG push button

– Pressing the HDG push button then pressing the Hold pushbutton

In this case the current heading is get as the preset one.

The pushbutton backlight changes to green.

To set the heading different from the current one press the HDG pushbutton once (in any control mode). The HDG setting dialog appears on the panel LCD.

There are two way to change the value:

– With the knob match buttons (see Figure 2.10): press and hold the pushbutton or press the pushbutton several times to get the necessary value. Then press the Enter pushbutton.

– with rotary knob (see Figure 2.12) — turn the rotary knob to get necessary value, then press the Enter pushbutton.

NOTE! The HDG settings dialog is called in any control mode by the single pressing the HDG pushbutton.

To switch off the AutoHDG mode press the HDG pushbutton twice.

2.4.8 POS

The POS pushbutton is available in the DP mode only it's meant for selecting the Auto Position (AutoPOS) control mode.

There two way of switching on the AutoPOS mode:

– press the POS pushbutton twice;

– press the PS pushbutton then press the HOLD pushbutton.

In this case the current vessel position is get as the preset one.
The pushbutton backlight changes to green.
To set the offset values press the POS pushbutton once (in any control mode).
The Offset dialog appears on the panel LCD.
There are two way to change the value:

– with the Joystick match pushbuttons (see Figure 2.9): press and hold the pushbutton or press the pushbutton several times until the required value is set. Then press the Enter pushbutton.

– with the rotary knob (see Figure 2.12) — turn the knob until the required value of the Sway or Surge parameters is set. Then press the Enter pusbutton. Press the knob's pushbutton to switch between the Surge and Sway fields.

> **NOTE!** The Offset settings dialog is called in any control mode by single pressing the POS pushbutton.

To switch off the AutoPOS mode press the POS pushbutton twice.

2.4.9 The Control Elements Group

The group is located at the right of the LCD screen and contains the following control elements (see Figure 2.9:

HOLD — 2.4.10, page 29

Arrow buttons — 2.4.11, page 29

Joystick match buttons — 2.4.11, page 29

Cancel — 2.4.15, page 30

Enter — 2.4.14, page 30

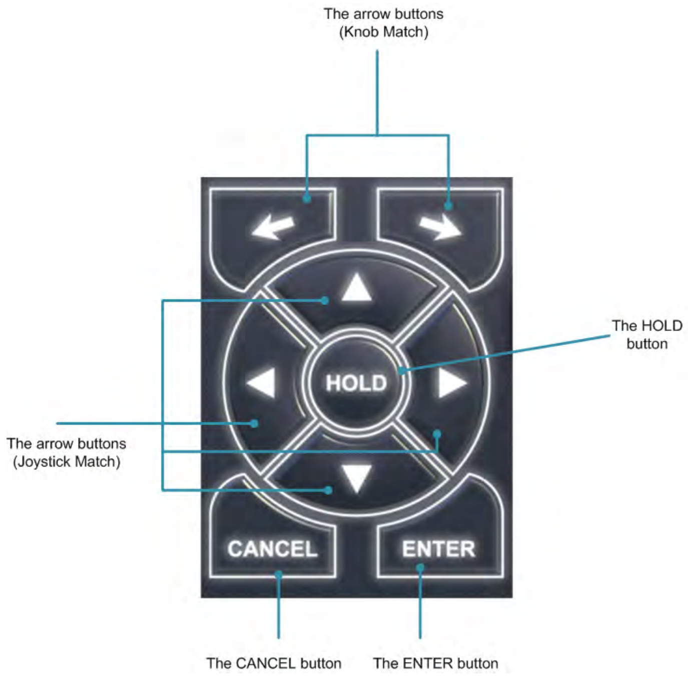


Figure 2.9: The Control Elements Group

2.4.10 HOLD

The HOLD button is used to take actual position and/or heading as preset ones for automatic keeping.

2.4.11 Arrow Buttons

Arrow buttons (see Figure 2.9) are meant for

- joystick match indication
- position and heading offset
- menu navigation

Joystick Match and Rotary Knob Match (for the Configuration with Joystick)

If the system operates in Auto position control mode, the vector of thee total thrust produced by thrusters is continuously displayed on the screen.

If the vessel position control is switched to the manual mode the vector of the total thrust is controlled by the operator with the help of joystick.

The joystick tilt can be different from the one corresponding to the current vessel position so before the system is switched to the manual control mode, the operator should synchronize the joystick position with the current thrust vector. The Joystick Match indicator hints directions to tilt the joystick.

It helps to avoid an undesirable jump in the thruster control.

The Joystick Match indicator shows in which direction the joystick is to be tilted. This must be done to avoid undesirable jump in the thruster control and provide bumpless control transfer.

The same concerns the rotary knob in case the vessel heading control is switched from the automatic to manual mode. The rotary knob match indicators see at the Figure 2.10.

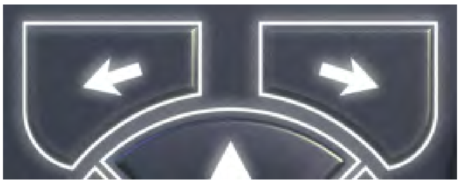


Figure 2.10: The Knob Match Indicators

NOTE! If joystick behavior isn't consistent with your expectations, calibrate the joystick with the Configuration menu, submenu Service menu, section Joystick Calibration.

Position/Heading Offset

Operating in AutoPOS and/or AutoHDG mode use the arrrow buttons to get offsets to specified directions (see Figure 2.11).

2.4.12 Rotary Knob

Rotary knob (see Figure 2.12) is meant for:

- position and heading offset;
- menu navigation;
- set parameters in Configuration Menu;
- controls navigation.

Rotary knob has a pushbutton at the top.

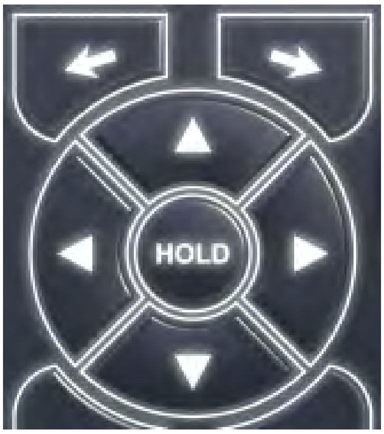


Figure 2.11: Arrow Buttons

Figure 2.12: Rotary Knob

Heading Control

The vessel heading is controlled with a rotary knob.

When Manual Heading control mode is selected, the knob is used for generating the control moment in the yaw axis, which is proportional to the angle of the knob rotation.

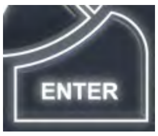
2.4.13 ALARM ACK

The ALARM ACK button is used to acknowledge incoming alarm messages that are displayed in the Alarm Window (and on the Last Alarm/Message line) (see Fig 2.13). In case of the unacknowledged alarms the button is red-blinked.

When holding the button the Silence mode is on (in case at least one alarm to acknowledge is in list).

In the Silence mode the button is red non-blinking if unaknowledged alarms are in list.

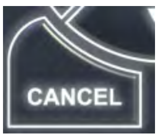
2.4.14 ENTER



The ENTER pushbutton is used to acknowledge operations via the control panel. The ENTER softkey on the LCD serves the same function.

This button approves only the actions performed via the control panel, the main DP display (Visual) operations are unavailable for the control panel's Enter pushbutton.

2.4.15 CANCEL



The CANCEL button performs cancellation function, e.g. in case of wrong input.

Keep in mind that the only control panel operations can be cancelled.

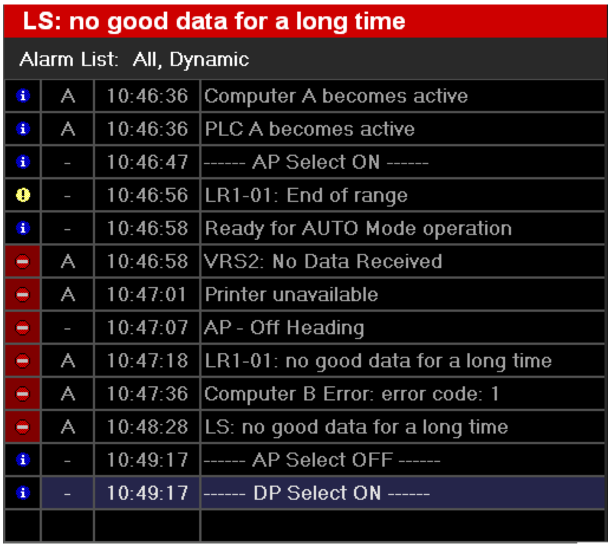


Figure 2.13: Alarm List View

2.4.16 VIEW

The VIEW pushbutton switches cyclically available views (windows) on the display:

- Parameters view;
- Thrusters view;
- Electrical Power Plant view (if available);
- Sensors view;
- Ref-systems view;
- Autopilot view (if available).

Press on the pushbutton to switch to the next window.
Press on the pushbutton twice to display the list of windows (see Figure 2.14)

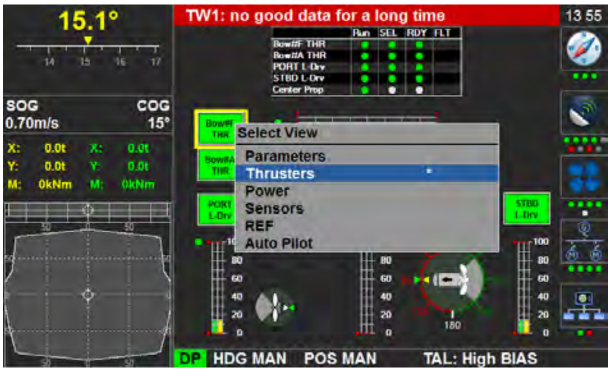


Figure 2.14: List of Windows

To switch between the items use the knob rotation, to select an item push the knob's pushbutton.

2.4.17 MODE

The MODE pushbutton is to view control modes view on the display (see Figure 2.15). Press MODE again to hide control modes view.

Double-click MODE pushbutton to view context parameters.

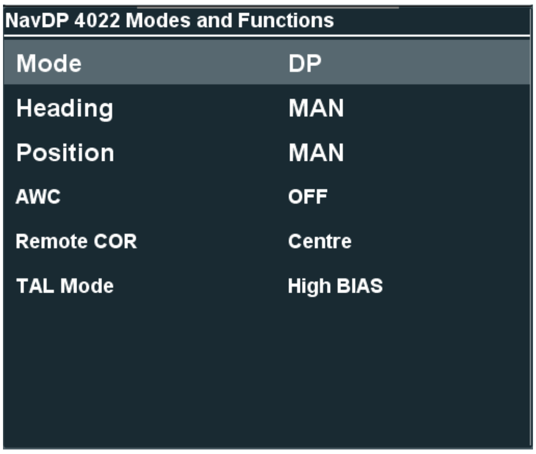


Figure 2.15: Modes and Functions

2.4.18 ALARM LIST

The ALARM LIST pushbutton is to view Alarm List (see Figure 2.13) on the display. Press ALARM LIST to hide Alarm List view.

To display the entire text of long alarm message press the **Enter** pushbutton or the knob's pushbutton when the message is selected. The pop up window with details appears (see Figure 2.16).

To hide the Details window press one of the pushbuttons one more time.

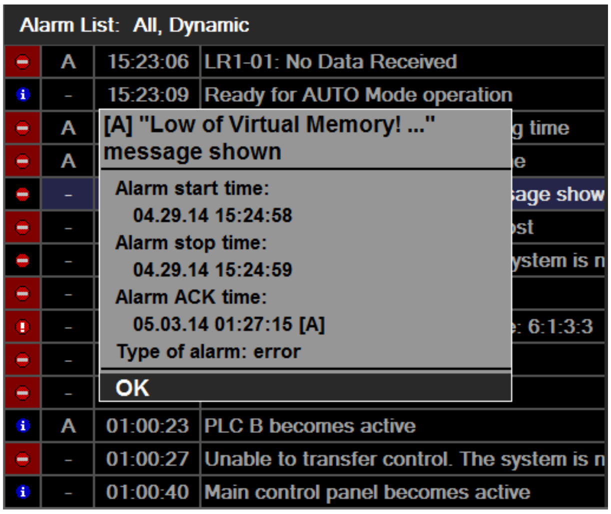


Figure 2.16: Alarm Details

2.5 Control Panel MCP4000-3

The following components of the Control Panel are mounted on an aluminum base plate:

– Rotary Knob;

– PCB with integrated indicators and electronic components.

The arrangement of controls, push buttons and indicators on the control panel is shown in Figure 2.17.

The special transparent film is glued on the aluminum base plate to protect the controls. Buttons' and indicators' names are printed on the film. Every control is highlighted.

The Alarm Speaker voices every message appearing in the list of the system Alarm Window. Alarm Speaker is embedded into the system console and connected with the Control Panel by separate cable.

Figure 2.17: Control Panel Controls, Buttons and Indicators (MCP and PCP)

Disconnected panel

In case the panel has no signal from the system the status is "Disconnected". In this state all push buttons have white backlights, but the color of the indicators corresponds their status (see the sections below).

2.5.1 Power

Indicates if the system is powered.

2.5.2 OPERATION

Indicates if the system is active. Highlighting means that the vessel is under the system control.

2.5.3 TAKE/GIVE

The TAKE/GIVE button is used for transferring control between:

- DP A and DP B systems (for DP-2 systems) ;
- control panels of the control system(if two or more control panels are in use).

The active panel button is green highlighted.
The system operates in one of the control transferring modes:

- Take
- GiveTake

The mode settings are performed when the system is configured and not allowed to change using the software GUI.

Take Mode

Control can be taken to any control panel holding the **TAKE/GIVE** button.

GiveTake Mode

This configuration means that the system should be switched to the transfer state. Press the **TAKE/GIVE** button on the active panel.

> **NOTE!** When the **TAKE/GIVE** button is pressed on the inactive panel, a continuous audio signal is generated signing the wrong action.

After the system is switched to the control transferring state, the current active panel beeps, and the inactive panel buttons **TAKE/GIVE** start blinking.

For taking the control, it is necessary to press the **TAKE/GIVE** button on the active control panel and hold it for the a preset period (60 seconds by default). In case there is no action during this period, the system returns to the previous state, and it is under control of the current active panel. The other method of returning control to the active panel is pressing the **TAKE/GIVE** button on the active panels within the given period.

> **NOTE!** In case of emergency outage of a main control panel, the system is switched to the control transferring state automatically. In case of emergency outage of a portable control panel, the control is transferred to the main control panel automatically.

2.5.4 Communication

 indicates the control panel connection with a control computer via RS-422 link. Green indicator means the connection is OK while red one means the connection fault.

2.5.5 Alarm Ack

The Alarm Ack button is meant for acknowledge incoming alarm messages that are displayed in the Alarm Window (and on the Last Alarm/Message line).

2.5.6 Enter

The Enter pushbutton is meant for acknowledge a touchscreen softkey requests. The pushbutton responds to double click to prevent an accident operation.

2.5.7 Rotary Knob (Setting Heading)

The vessel heading is controlled with a rotary knob with center detent. When operating in the Manual Heading control mode the knob is used for generating the control moment in the yaw axis, which is proportional to the angle of the knob rotation.

2.5.8 Test

Brightness Control

There are two pushbuttons on the Control Panel, which are used for brightness control of the component backlights (see Figure 2.18).

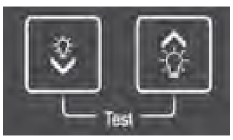


Figure 2.18: The Brightness Pushbuttons

Quick Settings Menu

The Quick settings menu is open by pressing the two brightness pushbuttons simultaneously.
The following settings are available (see Figure 2.31):

- Audio volume.
  Press **Set** softkey. In the opened dialog window change the volume by using arrow softkeys (see Figure 2.32);
- Palette. Day/Night palettes are available;
- Test alarm;
- Lamp test;
- Print screen (if Screen printer is available).

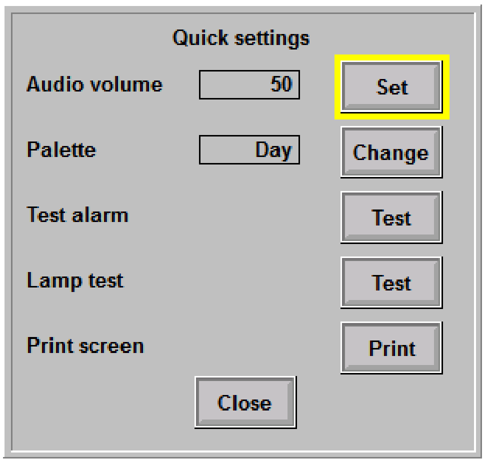


Figure 2.19: Quick Settings Menu

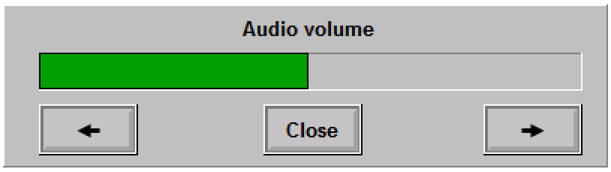


Figure 2.20: Audio Volume Setting

2.5.9 Arrow Buttons

The arrow buttons (see Figure 2.21) are meant for:

- the knob match indication
- position and heading offset

2.5.10 HDG

The HDG pushbutton can be used in the DP, IJ and Autopilot modes to select Auto Heading (AutoHDG) control mode. There are two ways to switch to the AutoHDG mode:

- Double pressing the HDG push button
- Pressing the HDG push button then pressing the Hold pushbutton

In this case the current heading is get as the preset one.
The pushbutton backlight changes to green.
To set the heading different from the current one press the HDG pushbutton once (in any control mode). The HDG setting dialog appears on the screen.
There are two way to change the value:

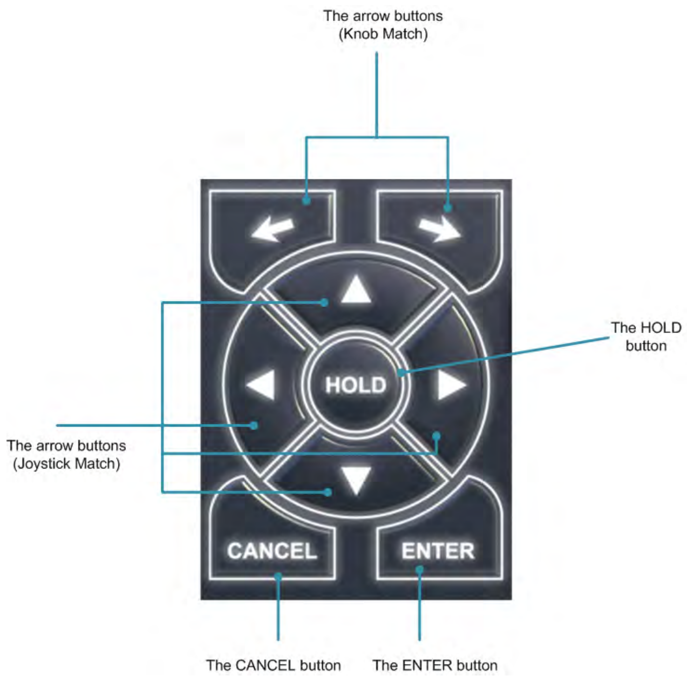


Figure 2.21: The Group of Controls

- With the Knob match buttons (see Figure 2.22): press and hold the pushbutton or press the pushbutton several times to get the necessary value. Then press the Enter pushbutton.
- with rotary knob (see Figure 2.23) — turn the knob to get necessary value, then press the Enter pushbutton.

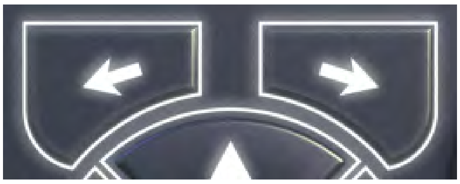


Figure 2.22: Knob Match

Figure 2.23: Rotary Knob

> **NOTE!** The HDG settings dialog is called in any control mode by the single pressing the HDG pushbutton.

To switch off the AutoHDG mode press the HDG pushbutton twice.

2.5.11 POS

The POS pushbutton is availavle in the DP mode only it's meant for selecting the Auto Position (AutoPOS) control mode.

There two way of switching on the AutoPOS mode:

– press the POS pushbutton twice;

– press the PS pushbutton then press the HOLD pushbutton.

In this case the current vessel position is get as the preset one.
The pushbutton backlight changes to green.
To set the offset values press the POS pushbutton once(in any control mode).
The Offset dialog appears on the screen. Keep in mind that it is impossible to switch to another tab of this dialog. The only Offset settings are available from the control panel.
There are two way to change the value:

– with the Joystick match pushbuttons (see Figure 2.21): press and hold the pushbutton or press the pushbutton several times until the required value is set. Then press the Enter pushbutton. Keep in mind that the direction of the pusbutton arrows is the same as in the Offset settings dialog i.e. the arrow pushbutton performance depends on the control panel orientation.

– with the rotary knob (see Figure 2.23) — turn the knob until the required value of the Sway or Surge parameters is set. Then press the Enter pusbutton. Press the knob's pushbutton to switch between the Surge and Sway fields.

NOTE! The Offset settings dialog is called in any control mode by single pressing the POS pushbutton.

To switch off the AutoPOS mode press the POS pushbutton twice.

2.5.12 HOLD

The HOLD button is used to take actual position and/or heading as preset ones for automatic keeping.

2.6 Control Panel MCP2000

The following components of the Control Panel are mounted on an aluminum base plate:

– 2-axis analog Joystick

– Rotary Knob

– PCB with integrated indicators and electronic components

The arrangement of controls, push buttons and indicators on the control panel is shown in Figure 2.24.
The special protective transparent film with button and indicator inscriptions printed on is glued on the aluminium base plate. All panel controls and indicators are highlighted.
The Alarm Speaker is used for voice announcement of all messages appearing in the system Alarm Window. Alarm Speaker is embedded into the system console and connected with the Control Panel by separate cable.

Disconnected panel

In case the panel has no signal from the system the status is "Disconnected". In this state all push buttons have white backlights, but the color of the indicators corresponds their status(see the sections below).

2.6.1 Power

— indicates if the system is powered.

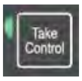
2.6.2 System Active

— indicates if the system is active. Highlighting means that the vessel is under the system control.

Figure 2.24: Control Panel Controls, Buttons and Indicators (MCP and PCP)

Figure 2.25: Portable Control Panel

2.6.3 Take Control

 — the pushbutton is meant for the control transfer between

- DP-A and DP-B control systems (for DP class 2) ;
- control panels in a control system (if two or more control panels are used).

A green LED indicator near the Take Control pushbutton indicates whether a control panel is active or not.

The system operates in one of the control transferring modes:

- Take;
- GiveTake.

The mode settings are performed when the system is configured and not allowed to change using the software GUI.

Take Mode

Control can be taken to any control panel holding the **Take control** button.

GiveTake Mode

This configuration means that the system should be switched to the transfer state. Press the **Take control** button on the active panel.

After the system is switched to the control transferring state, the **Take control** buttons indicators on inactive panels start blinking.

For taking control, it is necessary to press the **Take control** button on the active control panel and hold it for the a preset period (60 seconds by default). In case there is no action during this period, the system returns to the previous state, and it is under control of the current active panel. The other method of returning control to the active panel is pressing the **Take control** button on the active panel within the given period.

NOTE!	In case of emergency outage of a main control panel, the system is switched to the control transferring state automatically. In case of emergency outage of a portable control panel, the control is transferred to the main control panel automatically.

2.6.4 Serial Link Indicator

indicates the state of the control panel connection with a control computer via a serial link (RS-422). Green indicator means connection is OK while red one means connection fault.

2.6.5 Battery Indicator

indicates an internal battery status. Red indicator means the battery is nearly dead.

2.6.6 Knob Match and Joystick Match

If the system operates in Auto position control mode, the vector of thee total thrust produced by thrusters is continuously displayed on the screen.

If the vessel position control is switched to the manual mode the vector of the total thrust is controlled by the operator with the help of joystick.

The joystick tilt can be different from the one corresponding to the current vessel position so after the system is switched to the manual control mode, the operator should synchronize the joystick position with the current thrust vector. The Joystick Match indicator (see Figure 2.26) hints directions to tilt the joystick.

It helps to avoid an undesirable jump in the thruster control.

The similar process is to synchronize the rotary knob position with the proper indicator (see Figure 2.27) in case the vessel heading control is switched from the automatic to manual mode.

Figure 2.26: The Joystick Match Indicator

Figure 2.27: The Knob Match Indicator

2.6.7 Volume

— the Audio Volume Knob is used for volume control of voice alarms on the external loud speaker.

2.6.8 Alarm Ack

— the Alarm Ack button is used to acknowledge incoming alarm messages as displayed in the Alarm Window (and on the Last Alarm/Message line).

The Alarm Ack button blinks in case unaknowledged alarms are in list.

2.6.9 Enter

— the Enter pushbutton is used to acknowledge a touchscreen softkey requests. The pushbutton responds to double click to prevent an accident operation.

The Enter softkey on the LCD serves the same function.

2.6.10 Rotary knob (Heading)

The vessel heading is controlled with a rotary knob with center detent. When Manual Heading control mode is selected, the knob is used for generating the control moment in the yaw axis, which is proportional to the angle of the knob rotation.

2.6.11 Joystick (Position)

In the Manual Position Control Mode, the joystick is used to make the thrusters generate forces in the surge and sway axes, which are proportional to the angle of the joystick tilting in each direction.

In the Manual Speed Vector Control Mode the joystick is used to control the thrusters so that they move the vessel in the direction and with such surge and sway speed components as the joystick tilt specifies.

2.6.12 Test

There are two pushbuttons on the Control Panel, which are used for brightness control of the components backlights (see Figure 2.28).

The Quick settings menu (see Figure 2.29) is open by pressing the two pushbuttons simultaneously. The dialog allow an operator to test alarms, test lamps as well as change the palette and print the screen (if available).

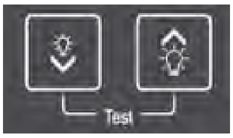


Figure 2.28: The Pushbuttons

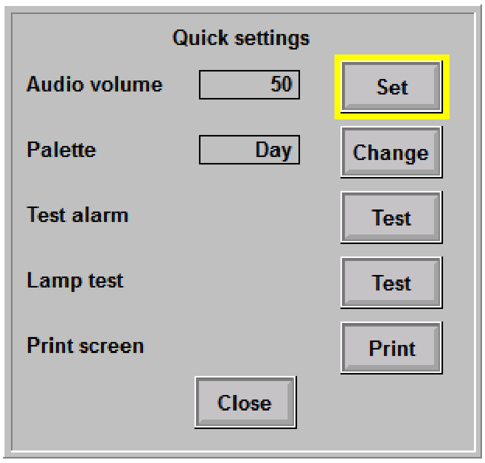


Figure 2.29: Quick Settings Menu

2.6.13 Hold HDG

— the Hold HDG pushbutton is available in the DP, IJ and Autopilot modes and it's meant for selecting the Auto Heading control mode.

The button responds to double click to prevent an accident operation.

Upon double click an actual heading is taken as a preset heading to be kept automatically.

Repeated double click returns the system to the Manual Heading control mode. To take manual heading control, it is necessary to synchronize the rotary knob with an actual yaw control moment according to knob match indication.

A green LED Indicator near Hold HDG pushbutton indicates the Auto Heading mode is active.

2.6.14 Hold POS

— the Hold POS pushbutton is available in the DP mode only and it's meant for selecting the Auto Position control mode.

The button responds to double click to prevent an accident operation.

Upon double click an actual position is taken as a preset position to be kept automatically.

Repeated double click returns the system to the Manual Position control mode. To take manual position control, it is necessary to synchronize the joystick with an actual thrust vector according to the joystick match indication.

A green LED Indicator near Hold POS pushbutton indicates the Auto Position mode is active.

2.6.15 Silence

— the button is to mute an audible alarm.

2.7 Control Panel MCP-B

MCP-B is a control device equipped with rotary knob and buttons located on the front panel. Its front panel is covered with polycarbonate.

The arrangement of controls, push buttons and indicators on the control panel is shown in Figure 2.30.

Figure 2.30: Control Panel MCP-B

2.7.1 Power

Indicates if the system is powered.

2.7.2 Communication Icon

Communication Icon indicates the state of the control panel connection with a control computer. Green indicator means connection is OK while red one means connection fault.

2.7.3 Rotary Knob

Rotary knob contains the following control elements:

- pushbutton at the top;
- match buttons on the sides at the top, bottom, left, right;
- rotary handle;

Rotary knob is meant for:

- position and heading offset;
- menu navigation;
- set parameters in Quick settings menu;
- controls navigation.

2.7.4 In Control

The In Control button is used for transferring control between:

- DP A and DP B systems (for DP-2 systems) ;
- control panels of the control system(if two or more control panels are in use).

The active panel indicator is green highlighted.

2.7.5 DIM Mode

Pushbutton is used to control the brightness of the control panel's backlight.
To change brightness long press the button then rotate the knob.

2.7.6 CANCEL

The CANCEL button performs cancellation function, e.g. in case of wrong input.
Keep in mind that the only control panel operations can be cancelled.

2.7.7 Alarm ACK

The Alarm Ack button is meant for acknowledge incoming alarm messages that are displayed in the Alarm Window (and on the Last Alarm/Message line).

2.7.8 AutoHDG

The AutoHDG pushbutton can be used to select Auto Heading (AutoHDG) control mode.
There are two ways to switch to the AutoHDG mode:

– Double pressing the AutoHDG pushbutton

– Pressing the AutoHDG push button then pressing the Hold pushbutton

In this case the current heading is get as the preset one.
The pushbutton backlight changes to green.
To set the heading different from the current one press the AutoHDG pushbutton once (in any control mode). The HDG setting dialog appears (see. 5.22).
To change the value turn the rotary knob to get necessary value, then press the knob.

NOTE!	The HDG settings dialog is called in any control mode by the single pressing the AutoHDG pushbutton.

To switch off the AutoHDG mode press the AutoHDG pushbutton twice.

2.7.9 AutoPOS

The AutoPOS pushbutton is available in the DP mode only it's meant for selecting the Auto Position (AutoPOS) control mode. The AutoPOS pushbutton can be used to select Auto Position (AutoPOS) control mode.
There two way of switching on the AutoPOS mode:

– press the AutoPOS pushbutton twice;

– press the AutoPOS pushbutton then press the HOLD pushbutton.

In this case the current vessel position is get as the preset one.
The pushbutton backlight changes to green.
To set the offset values press the AutoPOS pushbutton once (in any control mode).
There are two way to change the value:

– with the knob match pushbuttons: press and hold the pushbutton or press the pushbutton several times until the required value is set.

– with the rotary knob — turn the knob until the required value of the Sway or Surge parameters is set. Press the knob's pushbutton to switch between the Surge and Sway fields. Then press the knob.

> **NOTE!** The Offset settings dialog (see. 5.19) is called in any control mode by single pressing the AutoPOS pushbutton or the knob match pushbuttons.

To switch off the AutoPOS mode press the AutoPOS pushbutton twice.

2.7.9.1 Menu

The Quick settings menu is open by pressing the button Menu.
The following settings are available (see Figure 2.31):

- Audio volume.
  Press knob. In the opened dialog window change the volume by rotating knob (see Figure 2.32);
- Palette. Day/Night palettes are available;
- Test alarm;
- Lamp test;
- Print screen (if Screen printer is available).

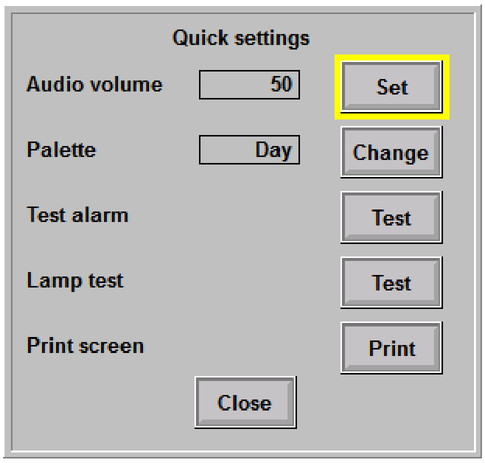


Figure 2.31: Quick Settings Menu

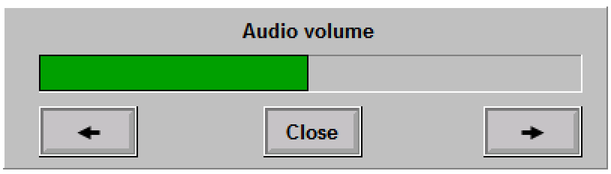


Figure 2.32: Audio Volume Setting

2.7.9.2 Fn

Individually customizable function button.

2.8 Joystick and Rotary Knob

The 2-axis joystick provides:

- setting the thrust in the vessel's coordinates (operating in the Manual Position Control mode);
- setting the speed value and vector in different coordinates (operating in the Manual Speed Vector mode).

The rotary knob is used for setting the turn moment (in the manual heading control mode).

Thrust and turn moment settings

Thrust and turn moment are denoted by vector **F** (see figure 2.33).

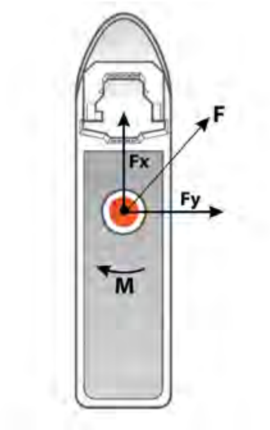


Figure 2.33: **NAVIS NavDP 4000** Forces and moments designation rules

Before operating the joystick, the Joystick Gain value should be checked (Figure 2.34). The Joystick Gain determines the ratio of joystick tilt angle to the force value, as well as of the knob rotation angle to the turn moment value. Normal, high or progressive gain are available to select.

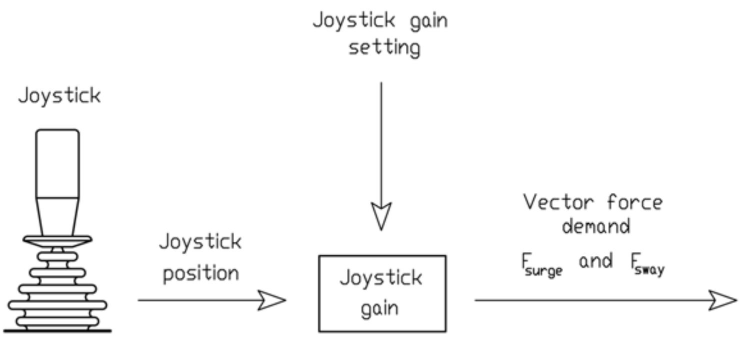


Figure 2.34: Joystick gain diagram

The maximum achievable thrust and moment (Figure 2.35) have been calculated during the process of calibration.

Vessel Speed Settings

The speed is denoted by vector **V** (see Figure 2.36).

Manual speed vector mode is described in the section 9.3.5, page 168. The speed demands on joystick position relative to the vessel, whatever position the control panel is set to.

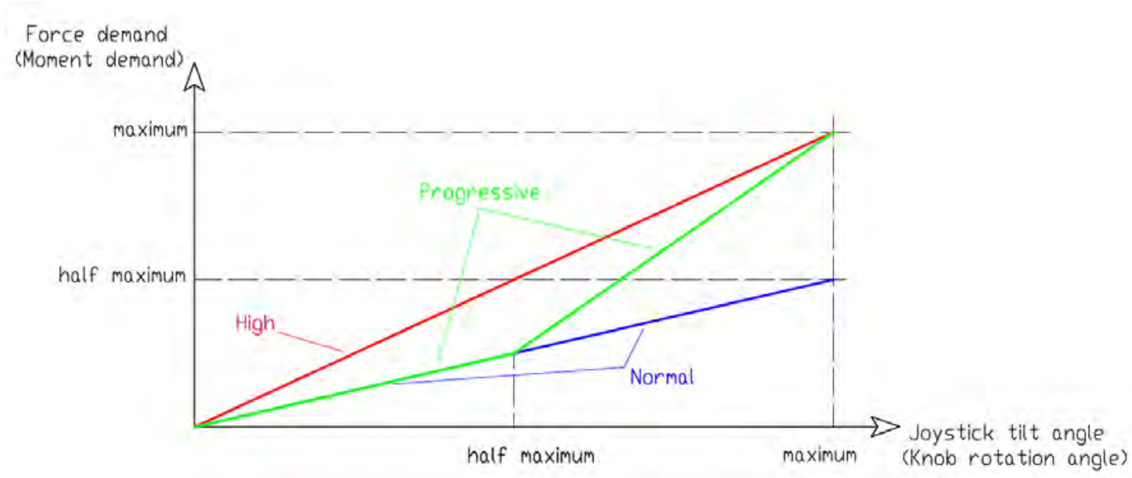


Figure 2.35: Joystick limits and gain types

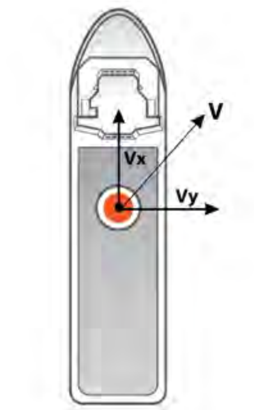


Figure 2.36: **NAVIS NavDP 4000** speed designation rules

2.9 Printers

2.9.1 Alarm Printer

There are two possible printers installed as alarm printer: a 9-pin dot matrix printer Epson LX-300+II (see Figure 2.37) and Epson LX-350 (see Figure 2.38).

Figure 2.37: Epson LX-300

Figure 2.38: Epson LX-350

The alarm printer is connected to the control computer via serial COM Port RS-232.
The printer status is displayed with round indicators in the System monitor window (Figure 2.39).

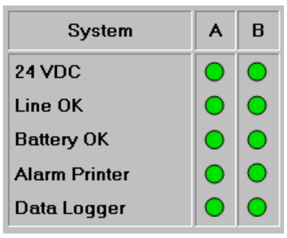


Figure 2.39: Status indicators

green — the printer is available;

red — the printer is not available.

WARNING! Before starting, please, read the Printer User Manual.

Figure 2.40: The network alarm printer of size A4

2.9.2 Network Alarm Printer

A page network printer is meant for alarm printing on paper of size A4 (see figure 2.40).

The alarms are printed as the pages are filled in or in definite intervals, which are set in the System Settings page of the PARAM window (see Figure 2.41).

Figure 2.41: Interval Setting for Alarm Printing

The printer status is displayed with round indicators in the System Monitor window (see Figure 2.39).

green — the printer is available;

red — the printer is not available.

Forced alarm printing is possible on this printer.

For forced printing press the **Print** softkey in the Alarm window or the Alarm Monitor window. The following dialog box appears (see Figure 2.42).

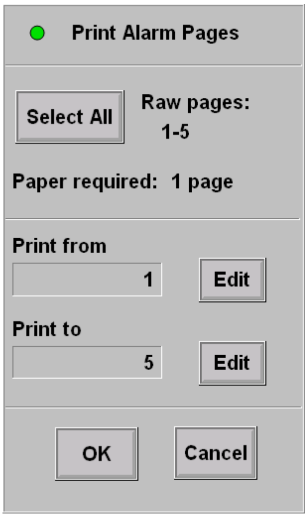


Figure 2.42: Alarm Printing Settings

Raw pages — a range of pages available for printing;

Paper required — a paper quantity required for printing the selected pages;

Print from — a head page;

Print to — a last page;

Select All — allows choosing all the pages available to be printed;

OK — press to close the dialog box and print the pages selected;

Cancel — press to close the dialog box without page printing.

2.9.3 Color Printer

A color network printer is meant for screen printing on the paper of size A4.

The HP Laserjet PRO color M451 is used (see Figure 2.43). The printer User Manual is the part of the documentation package.

Figure 2.43: HP Laserjet PRO Color M451 Printer

The printer status is displayed with round indicators in the System Monitor window (similar to the alarm printer status, see Figure 2.39).

green — the printer is available;

red — the printer is not available.

Print screen

For MCP2000 and MCP4000-3 families press the **Test** buttons on the control panel **together** to print a screen contents (see Figure 2.18). The Quick Settings Menu appears (see figure 2.44). Press the **Print** button to print the screen.

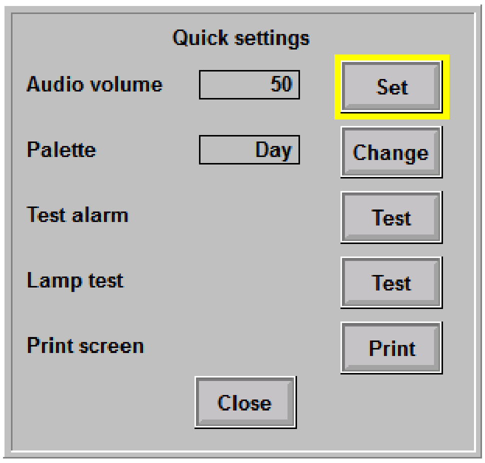


Figure 2.44: Quick Settings Menu

For the MCP4000 with LCD select the Print DP Screen item in the Configuration menu (see Section 5.12.6, page 99 for details). Bear in mind that this option depends on the system configuration.

Chapter 3

Switching On/Off and Troubleshooting

Follow the procedures described below to switch **NAVIS NavDP 4000** on.

– Power the system ON — see Section 3.1, page 50. I/O Units and control computers will be started up.

– When the **DPShell** screen is displayed go to Section G, page 302.
  If you don't go to the next procedure the **Starter** screen will appear after a little while.

– When the **Starter** screen appears, select an appropriate item in the menu (Real Mode). For more detailed information about the **Starter menu** see Section 3.2, page 51.

The taking control procedures are described in Section 3.4, page 55. Keep in mind that the system should be switched on.
For switching the system off (emergency or ordinary) refer to Section 3.6, page 55.

WARNING!	It is strongly prohibited to deenergize the system without observing the rules! In case the system deenergizing is necessary please follow the switch-off instruction (Section 3.6, page 55).

3.1 Power On

3.1.1 Power On — DP-0 Class System

To switch a control system ON, press the **POWER** pushbutton installed in the corresponding Control Unit. Before pressing this pushbutton, make sure about the position of the Mode Selector.
To switch the DP system ON, first set the Mode Selector to the **(OFF)Manual** position. See Figure 2.4.

3.1.2 Power On — DP1 Class System

Each of the IJ and DP control systems can be switched ON and OFF independently of each other. To switch a control system ON, press the **POWER** pushbutton installed in the corresponding Control Unit. Before pressing this pushbutton, make sure about the position of the Mode Selector.
If you are going to switch the IJ system ON, first set the Mode Selector in the **OFF (Manual)** or **DP** position.
To switch the DP system ON, first set the Mode Selector to the **OFF(Manual)** or **IJ** position.
See Figure 2.4.

3.1.3 Power On — DP2 Class System

Each of the IJ, DP-A and DP-B control systems can be switched ON and OFF independently of each other.
To switch a control system ON, press the **POWER** pushbutton installed in the corresponding Control Unit. Before pressing this pushbutton, make sure about the position of the Mode Selector.
To switch any of the DP-A and DP-B systems ON, first set the Mode Selector to the (OFF)Manual or IJ position.
To switch the IJ system ON, first set the Mode Selector in the **OFF (Manual)** or **DP** position.
See Figure 2.4.

3.2 Starter Menu

In normal operation, all the control systems (DP and IJ) must be switched on.

After the control system is switched on (DP and IJ), and “Start DP” option will be selected, loading DP window appears (see Figure 3.1).

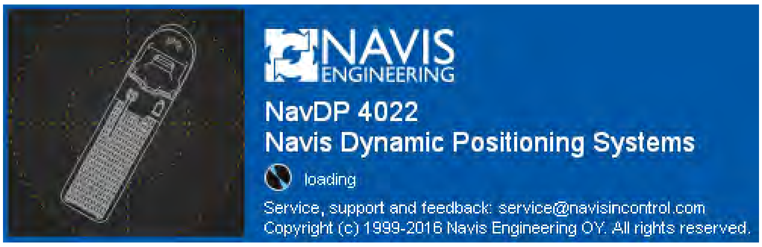


Figure 3.1: DP Loading Window

And in few seconds the Main Screen appears on the monitor (Figure 3.2):

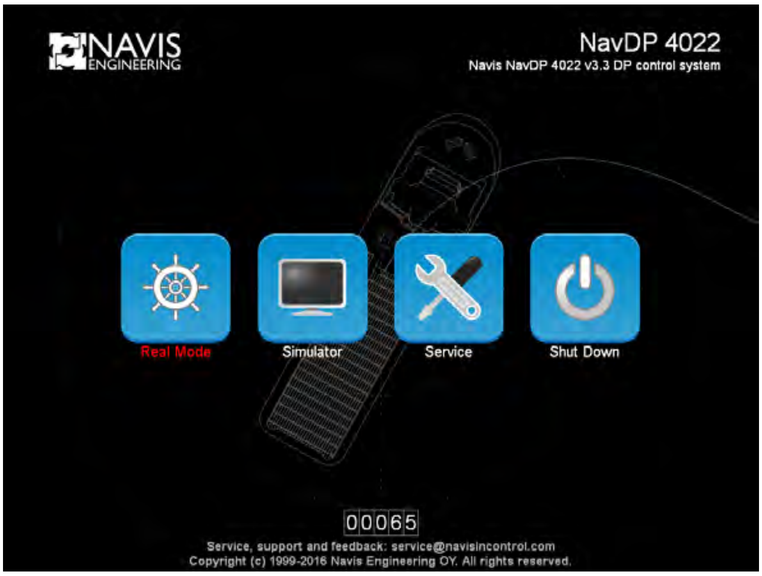


Figure 3.2: Starter Main menu

You then use a menu and select from:

– Real Mode

– Simulator Mode

– Services

– Shut Down

Select **Shut Down**, if you are going to switch the control system off.
In case there is no any work station the system will shut down.
In case the system has several work stations the following submenu will be displayed:

– Figure 3.3 in case the work station is assosiated with the control computer
– Figure 3.4 in case of the separate work station

The submenu items means:

Computer (in case an assosiated work station) — the control computer, all depended work stations and proper PLC will be switched off;

Workstation (in case of separate work station) — only the work station will be switched off;

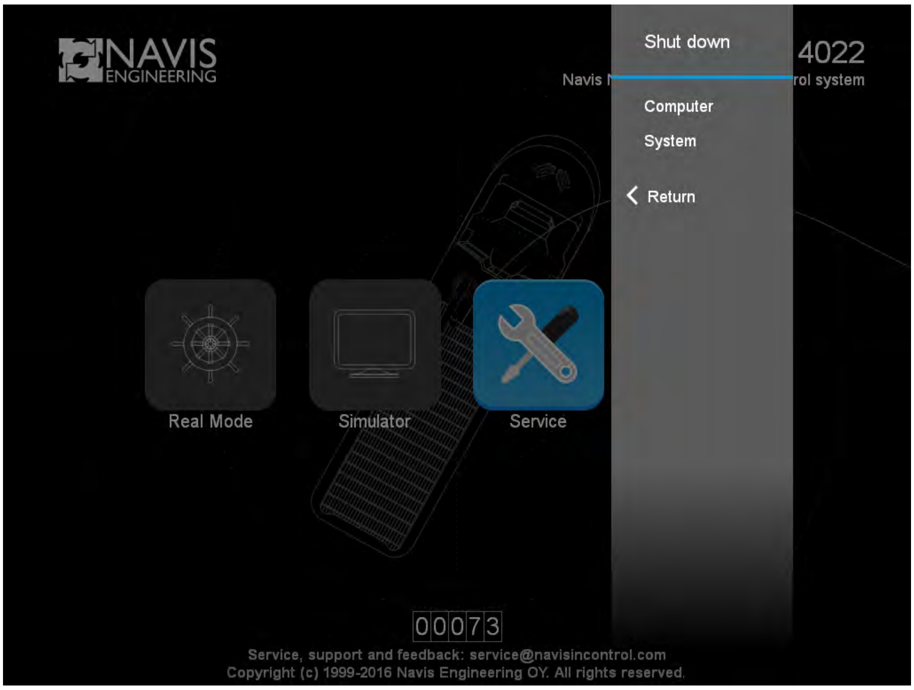


Figure 3.3: The Shut Down menu of an associated work station

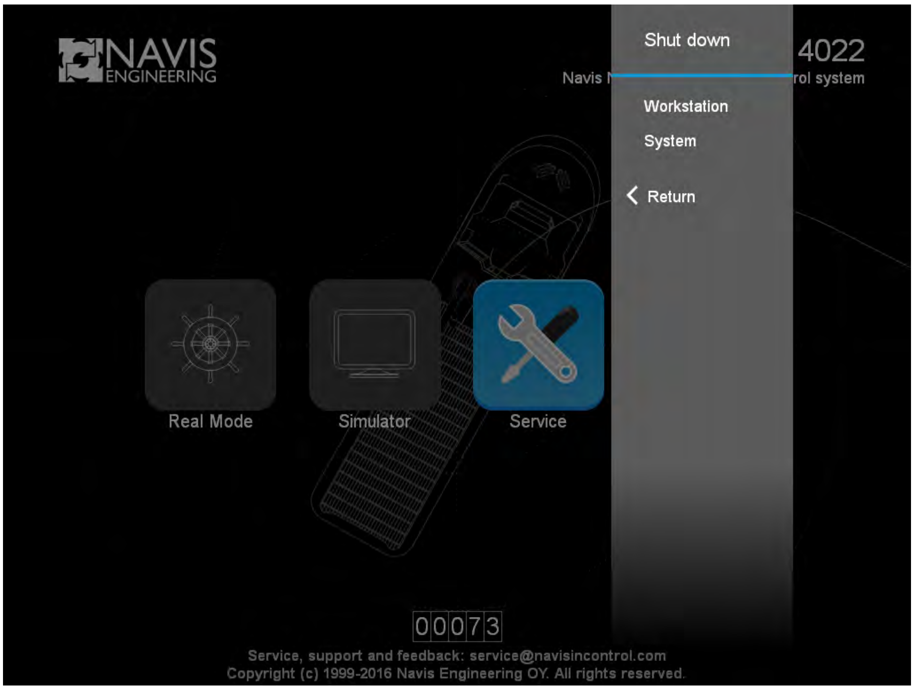


Figure 3.4: The Shut Down menu of an separate work station

System — the control system will be switched off;

Return — return to the Starter.

Simulator Mode

Select **Simulator Mode** to start the operation in the **Simulator Mode** (see Section 11, page 245 for details).

Service Mode

See Section I, page 341 for details on **Services** menu.
The following submodes are available:

Monitor The Monitor utility starts. This utility displays information about data flow between CC and PLC. The submode is intended for the system calibration while DST is in process. It is password protected.

PLC Faults

Alarm Viewer Alarm listing.

COM Ports COM port data viwer.

Info Display version and other information about the system

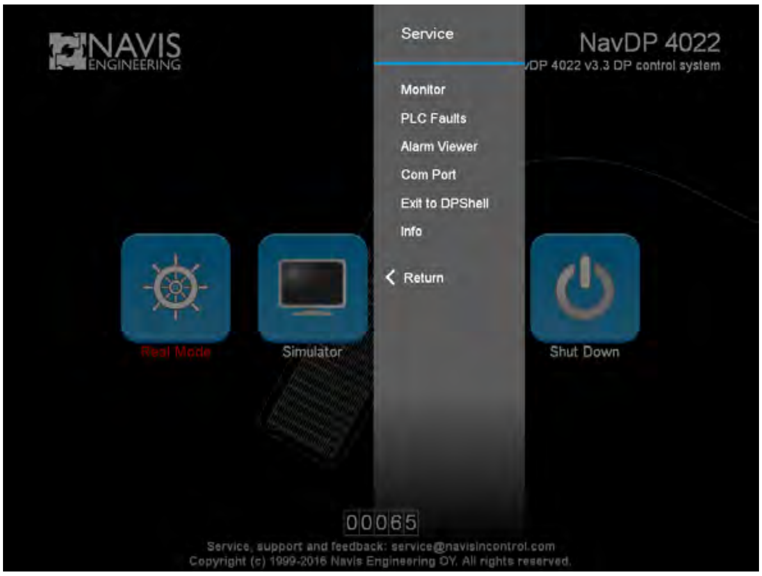


Figure 3.5: Service menu listing

If you select **Real Mode**, the control system gets ready to take control over the thrusters, and immediately checking the interfaces with the sensors, position reference systems and thrusters. The Operator Interface Screen appears on the monitor.

Note that, although the control system is switched on, it does not have control over the thrusters unless the Mode Selector is set to due position (see Section 2.1.4, page 22) for taking control: IJ position for the IJ control system, and DP position for the DP control system.

Software Versions

To display a version of the system software select the **Info** item in the **Service** menu. Following view will appear (Figure 3.6). To display a detailed information about version of the system software select the **Details** item. Following view will appear (Figure 3.7).

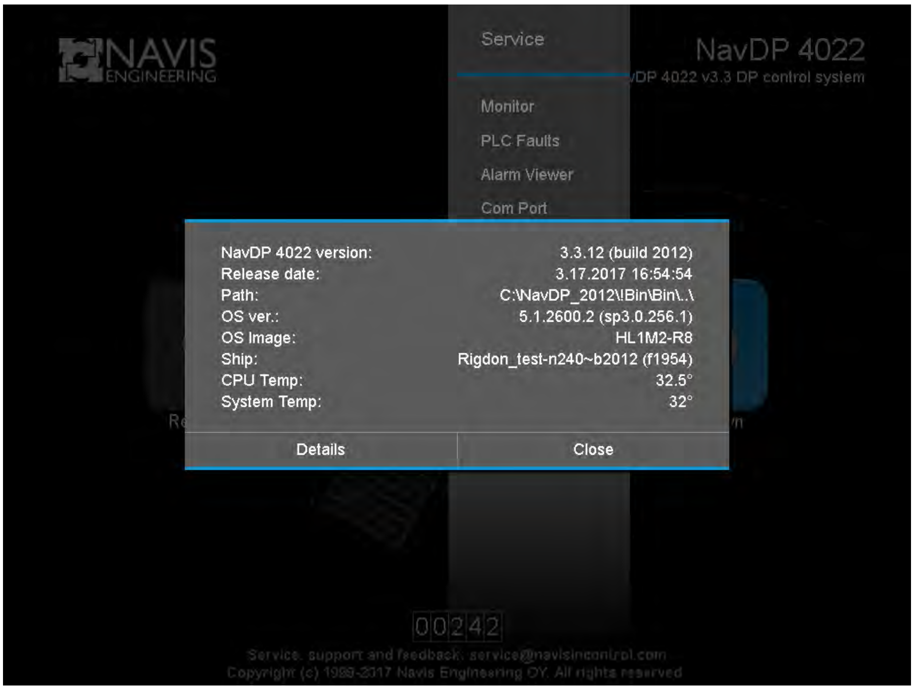


Figure 3.6: Starter menu: Versions subwindow

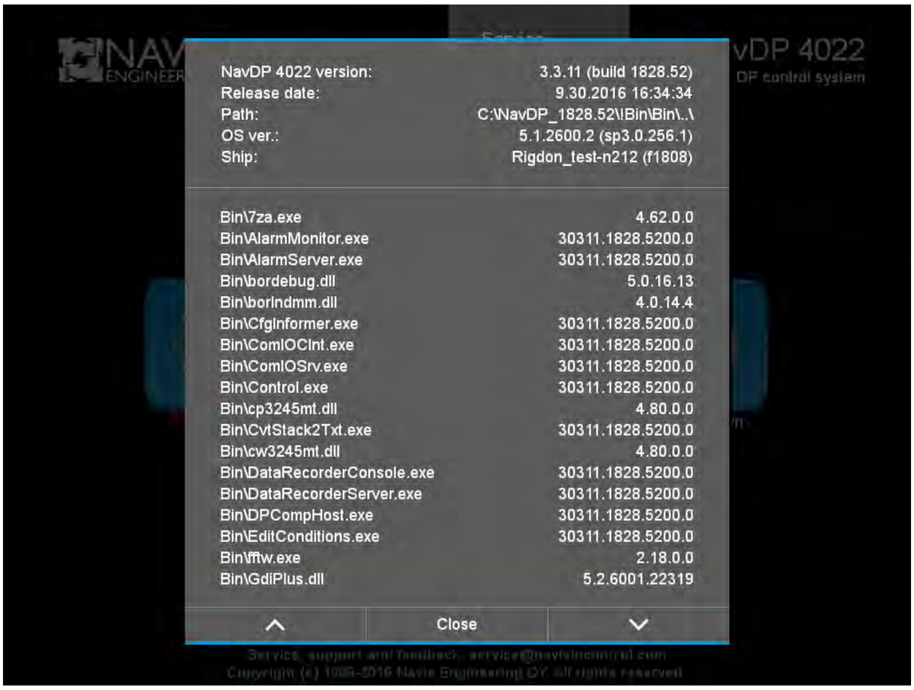


Figure 3.7: Starter menu: Versions subwindow (details)

3.3 Save a Screenshot as a File

For saving a screenshot doubleclick (or press on the touchscreen) on the CPU master indicator. The system generates the following message "The following screenshots have been generated in folder XXX", where XXX is the full file address.

The default file format is bmp, the default file location is the "ShipName/Out/" folder.

3.4 Taking Control

Never set the Mode Selector to **IJ** or **DP** position unless the proper control system is switched on. In normal operation all the control systems are to be switched on. If the control system is switched on, but the Mode Selector is set to another position, the softkeys at the bottom of the screen are grey and disabled. Only the **ENTER**, **Select window**, **Silence** and **ACK** softkeys are lit up and enabled. You can use the enabled softkeys to select windows and parameter pages, changing parameters, viewing information (including the signals and data being received from the thrusters, sensors and reference systems) and acknowledging messages; however, you cannot control the vessel.

To transfer control to the IJ system, set the Mode Selector to **IJ** position. The softkeys assigned to this control system become active.

To transfer control to the DP control system, set the Mode Selector to **DP** position. The softkeys assigned to this control system become active.

3.4.1 Master/Slave Stations

For DP2 Class Systems, one of the DP-A and DP-B control systems is **the master**, while the other is **the slave**. The vessel can only be controlled from the master system. You can transfer control to the slave system. To do that, press and hold for two seconds the **Take Control** button on the Main Control Panel of the slave system.

If the Portable Control Panel is connected to the control system, you can transfer control in the same way.

3.5 Failure Modes

3.5.1 For DP1 Class Systems

In case of the DP control system fails, set the Mode Selector to IJ position and start control over the vessel from the IJ control system. Note that only a few operational modes are available from this system, therefore, the IJ control system would chiefly be used for safely terminating the current operation.

3.5.2 For DP2 Class Systems

In case of either DP-A or DP-B control system fails, control is automatically transferred to the other control system.

If the Mode Selector is set to the **Manual**, **AP** or **IJ** position, however, only one of the DP-A or DP-B control systems is switched on (or capable of working), you can further set the Mode Selector to the DP position, and control will be given to an operable control system (DP-A or DP-B, dependently on which of them is operable).

If during operation you loose the DP control system in total (that is much more severe fault compared to a single failure), you can set the Mode Selector to **IJ** position, so as to complete the current operation safely from the IJ control system.

3.5.3 Multi-WS system

The system generates a priority list of workstations like WS1 WS2 ... WSn. In case the master workstation disconnection the control is transferred automatically to the first active station in the list.

3.6 Switching Off

There are two ways of switching a control system off and shut down its control computer correctly. However, whatever way you prefer, first set the Mode Selector in the **OFF** position. Then use one of the ways described below.

3.6.1 Basic way

The Mode Selector is assumed to be in the **OFF** position.

Press the POWER pushbutton installed in the corresponding Control Unit and hold it for 2 seconds until it starts blinking. Then the control system will be completely switched off in 3 minutes until the power pushbutton stops blinking.

3.6.2 Supplementary Way

The Mode Selector is assumed to be in the **OFF** position.

Exit the current operational mode using the Exit softkey on the Operator Interface Screen (in the upper left corner).

Select **Shut Down** option on the Main Screen.

Computer for control computer switching off
System for the DP system closing

Press the “<” symbol at the menu title to back to the main screen.

> **NOTE!** The switching off process for multi-WS configuration is described in the Section 3.2, page 51

You can also resort to the emergency way, however, in an emergency situation only.

3.6.3 Emergency method

This method is intended for the system shutdown regardless the **Mode Selector** position.

Press the **Power** pushbutton installed in the corresponding Control Unit and hold it for 10 seconds. Then the control system will be switched off in 3 minutes.

While the control system is shutting down, “Power” indicator at control panel is blinking and the following inscription is being displayed on the LCD:

SYSTEM IS AUTOMATICALLY SHUTTING DOWN
POWER OFF REQUEST RECEIVED

Chapter 4

System Messages and Alarms

4.1 Alarm Message Types and Priority

There are five categories of messages, as shown below:

Critical error (highest priority) A fault has occurred and affected much the system performance, so that normal operation is not possible.

Error (high priority) A fault has occurred and affected the system performance. The fault must be fixed as soon as possible.

Warning messages (medium priority) An event has happened, which may affect the system performance or cause a system failure unless no precautions would be taken during a reasonable period of time.

Information messages (low priority) Messages give some information to be taken into account, however, no system failure has occured, so there is no need for urgent precautions to take.

System messages Such a message is rather for a service engineer than a system operator, so it is displayed in the Alarm Monitor Window only (it is not displayed in the Alarm Window).

Messages may be "new" — not acknowledged, and "actual" (alarm condition is presented) or "not actual". Some events cannot be actual (like information messages — for example, "Gyro filter started").

NOTE! Full list of Alarms generated by the DP **NAVIS NavDP 4000** system — see Section B, page 251.

4.2 Audible and Voice alarms

All generated alarms except the system messages are attended both by voice messages and beep noise.
Depending on a category of the appeared message the beep can sound before or after a voice message.
When appearing the information and/or warning messages the beep preceeds a voice message.
When generating the error and/or critical messages the beep sounds both before and after a voice message.
It should be noted that the beep sounds after a voice message until the alarm is acknowledged.

4.3 Alarm/Message Line

The last unacknowledged message is displayed on the Alarm/Message Line at the top of the screen (see Figure 4.1).

Figure 4.1: Alarm/Message Line

In the Alarm Window unacknowledged messages are indicated by blinking symbols background or or or . See section 4.8, page 60 for details.

NAVIS ENGINEERING is used for displaying a dialog window (see Figure 4.2).
The window contains the following information:

– version of the system;
– e-mail for service, support and feedback.

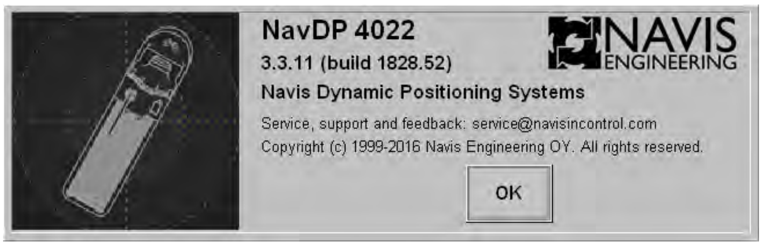


Figure 4.2: Service Dialog Window

Press “OK” softkey to close the window.

4.4 ACK Softkey

Use the **ACK** softkey in SYS Panel to acknowledge new (unacknowledged) alarms.
ACK softkey is blinking in case of one or more unacknowledged alarm in the list.

4.5 Silence Softkey

Use the **Silence** softkey in SYS Panel to silence all unacknowledged alarms.
The softkey has the following color code:

red — the mode is ON;

dark-red — the mode is OFF.

The mode is available to switch on in case of one or more unacknowledged alarm in the list.

4.6 Alarm Window

Alarm window is shown in Figure 4.3. Use this window to read and acknowledge messages.
Press **ACK** softkey to acknowledge a selected message.
Press **All ACK** softkey to acknowledge all the messages displayed in the window.
Use arrow softkeys to select a message. The selected message is displayed against blue background.
Press **All** softkey to display all the messages.
Press **Active** softkey to display only active messages.
Press **Static view** softkey to place every incoming message at the end of the list and that will be shown on the screen as the selected message.
Press **Dynamic view** softkey to place every incoming message at the end of the list without being set as the selected message.
Press **Details** softkey to display the detailed information about the alarm including the following (see Figure 4.4):

– the message text;
– the alarm type;
– the alarm source (CCA and/or CCB control station);
– the time of alarm initiated (Start time) ;
– the time of alarm ended (Stop time);
– the time of acknoweledgement (Ack time);
– the control station on which the alarm have been acknowleged (CCA or CCB).

The Alarm Window messages have the following format

Message category	Message status	Time of message initiated	Message text

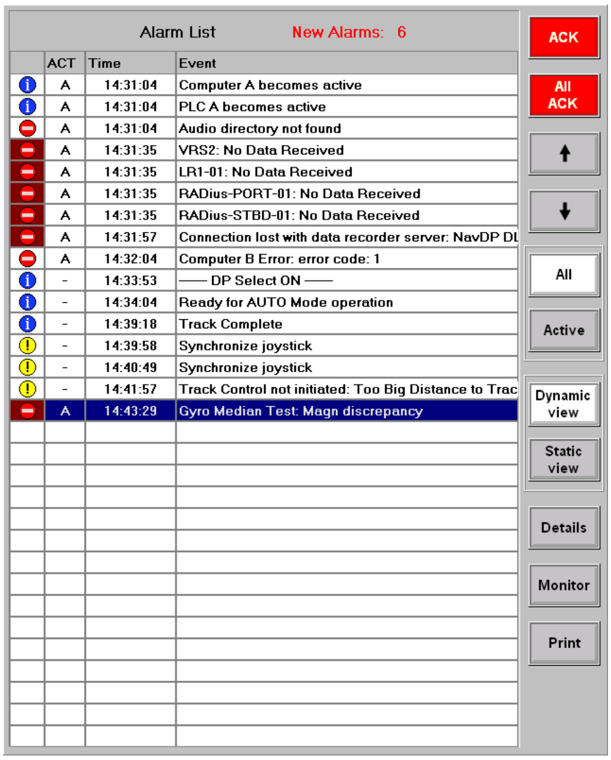


Figure 4.3: Alarm List Window

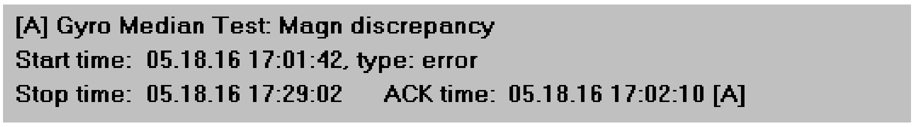


Figure 4.4: Alarm Details

4.7 Alarm Monitor Window

Press **Monitor** softkey to display the Alarm Monitor Window (Figure 4.5).

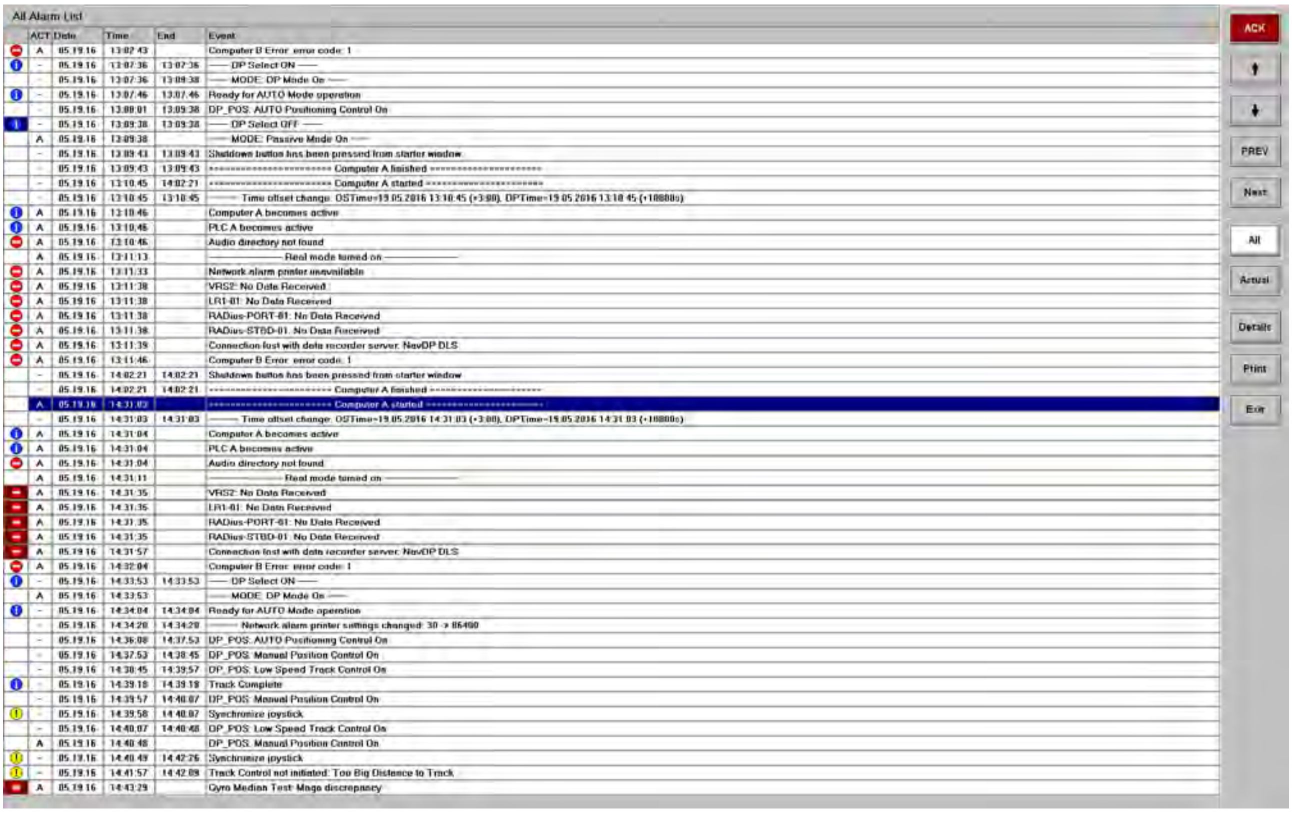


Figure 4.5: Alarm Monitor Window

This window is similar to the Alarm Window, but it gives more information about the messages.
Press **Prev**, **Next** and arrow softkeys to list up and down.
Press **Exit** softkey to leave the Alarm Monitor Window.
In the Alarm Monitor Window, a message is presented in the following format

The message indicator	Act — the message status, if the alarm is active or not and the system the alarm belongs to (see the sections below)	Date — the date of message initiated	Time — the time of message initiated	End — the time of alarm acknowledging	Event — the message text

4.8 Message Markers

Critical error, error, warning and information messages are displayed in both the Alarm Window and Alarm Monitor Window.

Depending on their priorities, the messages are marked as follows:

 for critical error;

 for error;

 for warning messages;

 for informational messages.

4.9 Message Statuses

Message Status informs you about the system where the alarm is active:
For DP-2 Class Systems:

A — the alarm is active on CCA;

B — the alarm is active on CCB;

AB — the alarm is active both on CCA and CCB;

dash — the alarm is not active.

For DP-0 or DP-1 class systems:

A — the alarm is active;

dash — the alarm is not active.

Unacknowledged messages always appear on the screen, even if neither the Alarm Window nor Alarm Monitor Window is loaded.

4.10 Alarm Messages Printing

Press **Print** softkey in the "Alarm window" or the "Alarm Monitor window" for alarm printing.

> **NOTE!** **Print** softkey is available only in case the network alarm printer is connected to the system (see Section 2.9.2, page 48).

The Printing settings are on the PARAM⇒System window.
The period is set in the Alarm Page Printing field by chosing one of hte following values: 10 min, 30 min, 1 h, 2 h, 3 h, 4 h, 6 h, 12 h, 24 h.
In case **Off** value is set, the alarm page is printed after it has been totally filled.
After the period has been set press the **Apply** softkey.
Example of alarm print page:

```
* 1
  Status     Event date/time   Alarm time      Alarm text
-----------------------------------------------------------------------------
               === Session 19.05.2016 11:31:04 ===
N  I  U A  05.19.16  14:31:04  14:31:04  Computer A becomes active
N  I  U A  05.19.16  14:31:04  14:31:04  PLC A becomes active
N  A  U A  05.19.16  14:31:04  14:31:04  VRS2: No Data Received
 A I  * A  05.19.16  14:31:25  14:31:04  Computer A becomes active
 A I  * A  05.19.16  14:31:25  14:31:04  PLC A becomes active
```

Column 1 — indicates if the alarm is new.

Possible values are:

N — alarm is new;

Empty — alarm is not new (change in some previous alarm).

Column 2 — type of the changes in alarm.

Possible values are:

M — alarm is modified in some way;

A — alarm was acknowledged;

S — alarm is stopped (becomes inactive);

X — alarm was acknowledged and stopped in the same time;

Empty — no changes.

Column 3 — alarm type.

Possible values are:

I — info;

W — warning;

A — alarm;

CR — critical error.

Column 4 — is the alarm acknowledged or not.

Possible values are:

U — the alarm is acknowledged;

***** — the alarm is not acknowledged.

Column 5 — control station ID.

Possible values are:

A — the alarm is active on CCA;

B — the alarm is active on CCB;

AB — the alarm is active both on CCA and CCB;

dash — the alarm is not active.

Column 6 — alarm date in format mm.dd.yy.

Column 7 — time of last change in alarm (acknoledgement, becoming inactive, etc.).

Column 8 — alarm start time.

Column 9 — alarm message.

Chapter 5

Operator Interface

5.1 Operator Screen Layout

The operator interface screen layout for standard resolution (1024x768, 1280x1024, etc.) is shown in Figure 5.1.

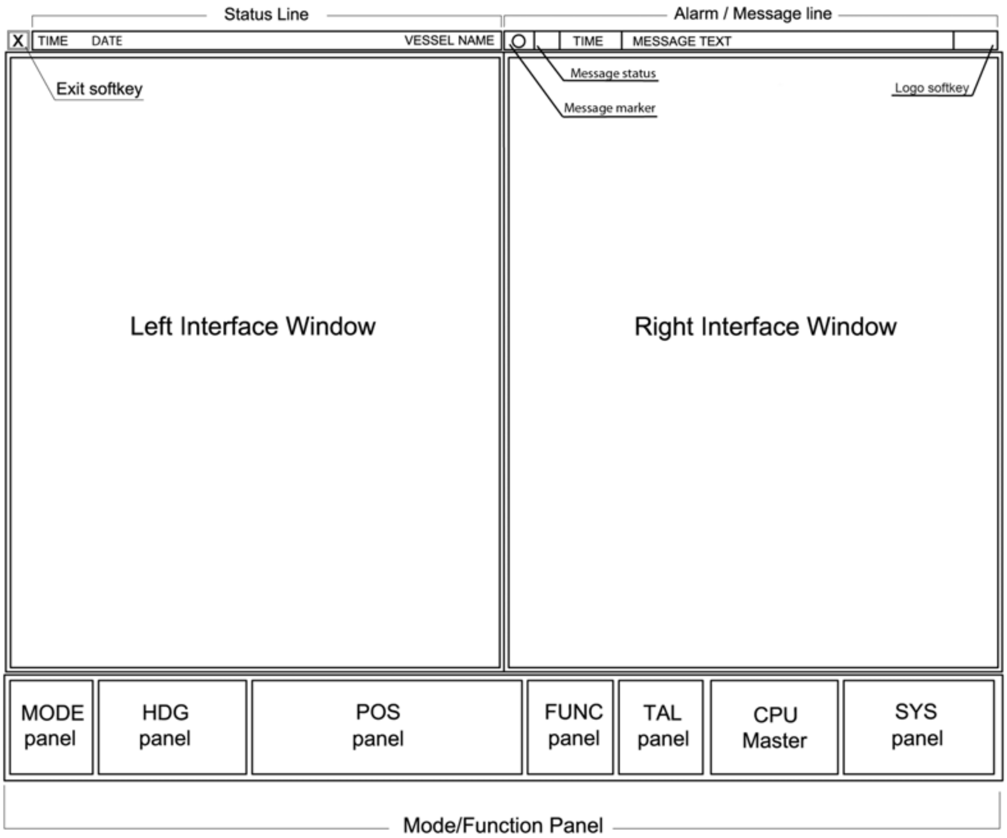


Figure 5.1: Operator Screen Layout

The operator interface screen example is shown in Figure 5.2.

The following layouts are applicable for the wide screens (with resolution: 1680x1050, 1920x1200, etc.):

Screen with two standard windows and additional left console (see Figure 5.3).

The additional left console contains the same areas as the left console of MCP with LCD screen does: Heading console, Position console and Thrust Ability Diagram (see Section 5.12.4, page 96).

The example of wide screen with additional left console is shown in Figure 5.4.

Wide screen with three windows (see Figure 5.5).

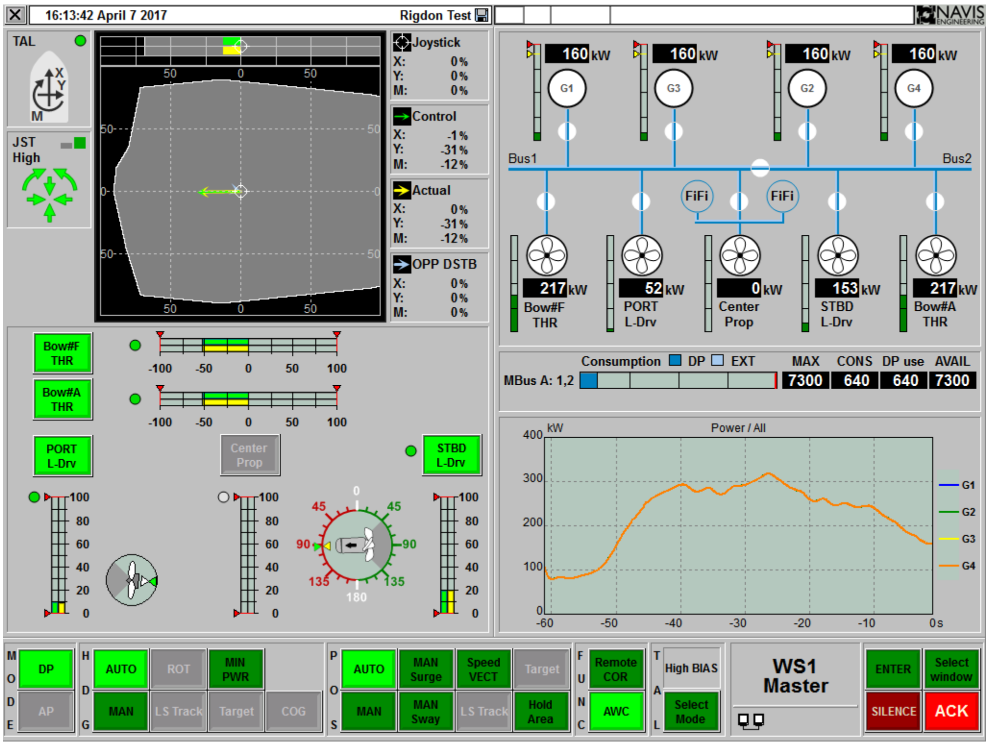


Figure 5.2: Example of the Operator Interface Screen

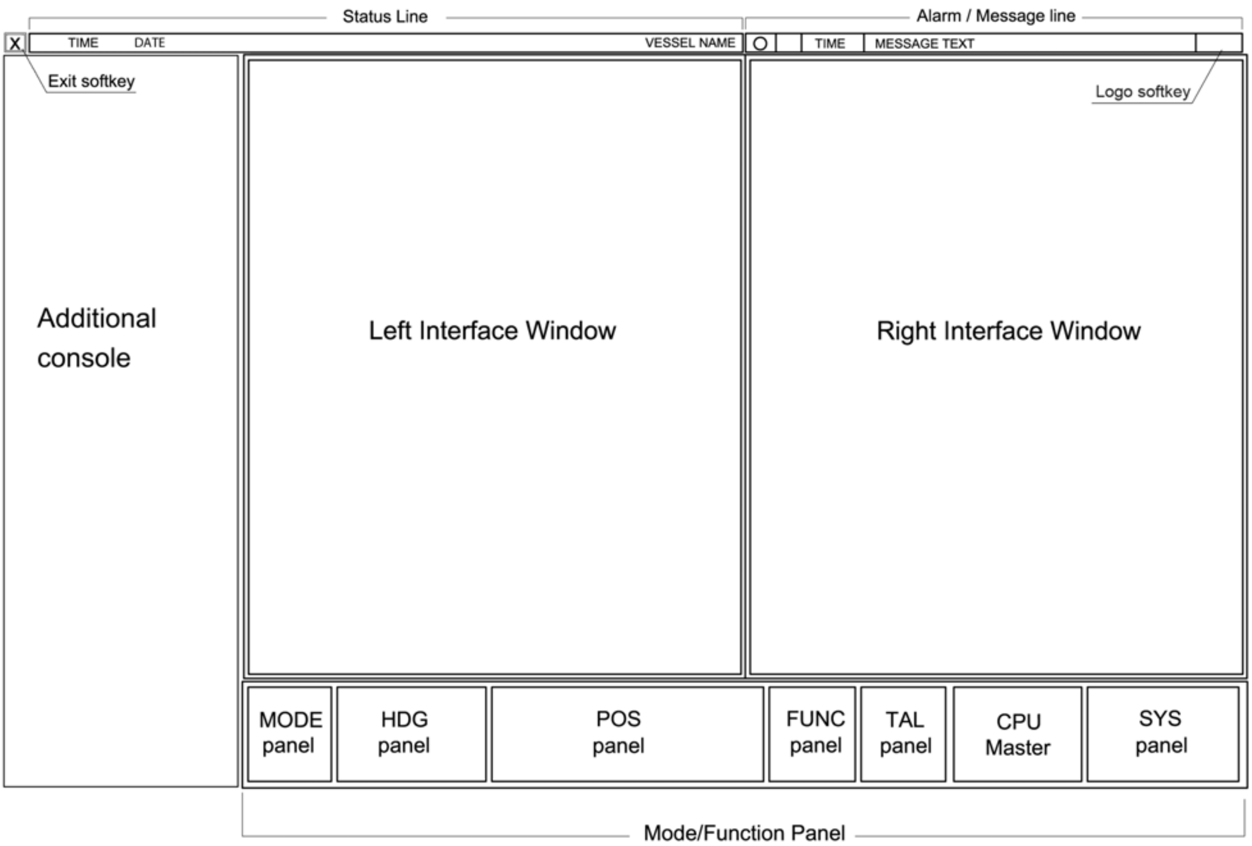


Figure 5.3: The Wide Screen Layout with Additional Left Console

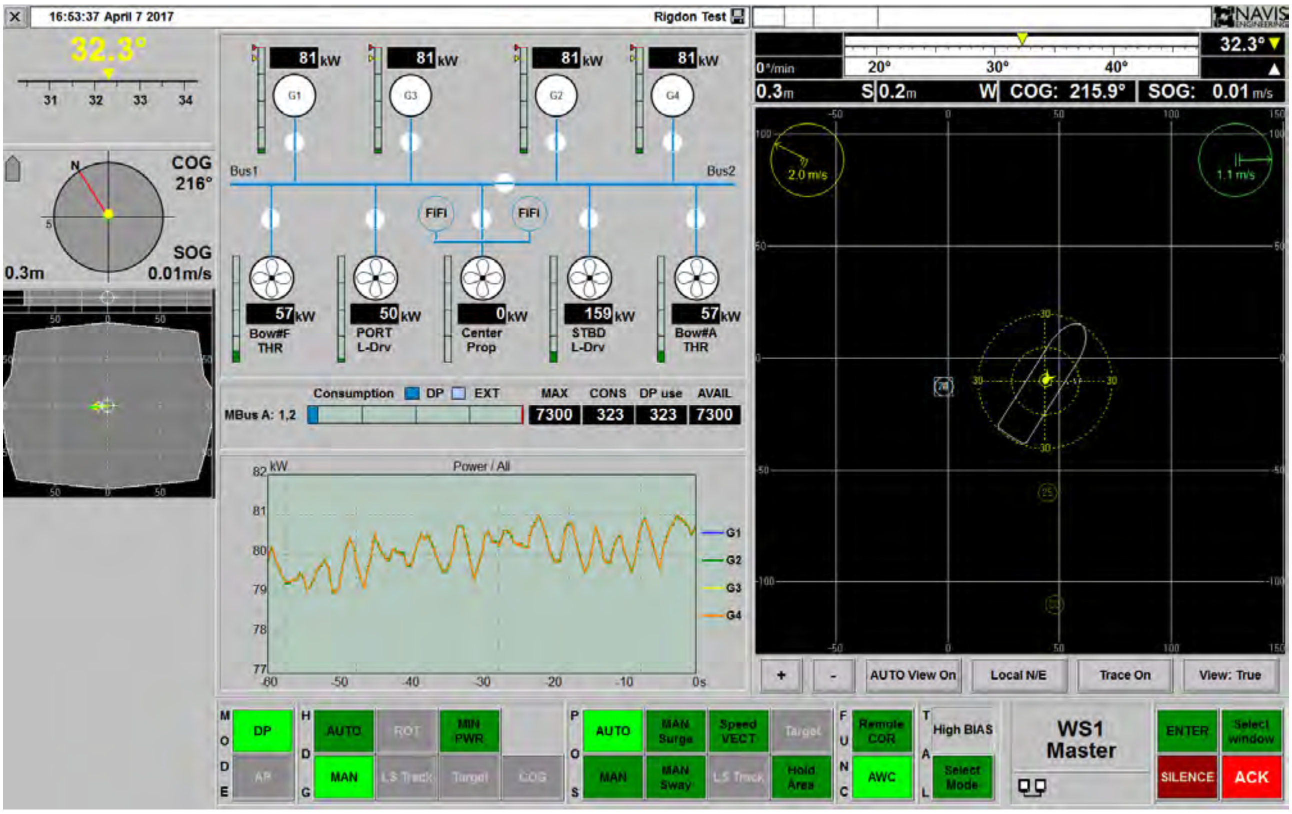


Figure 5.4: Example of the Wide Screen with Additional Left Console

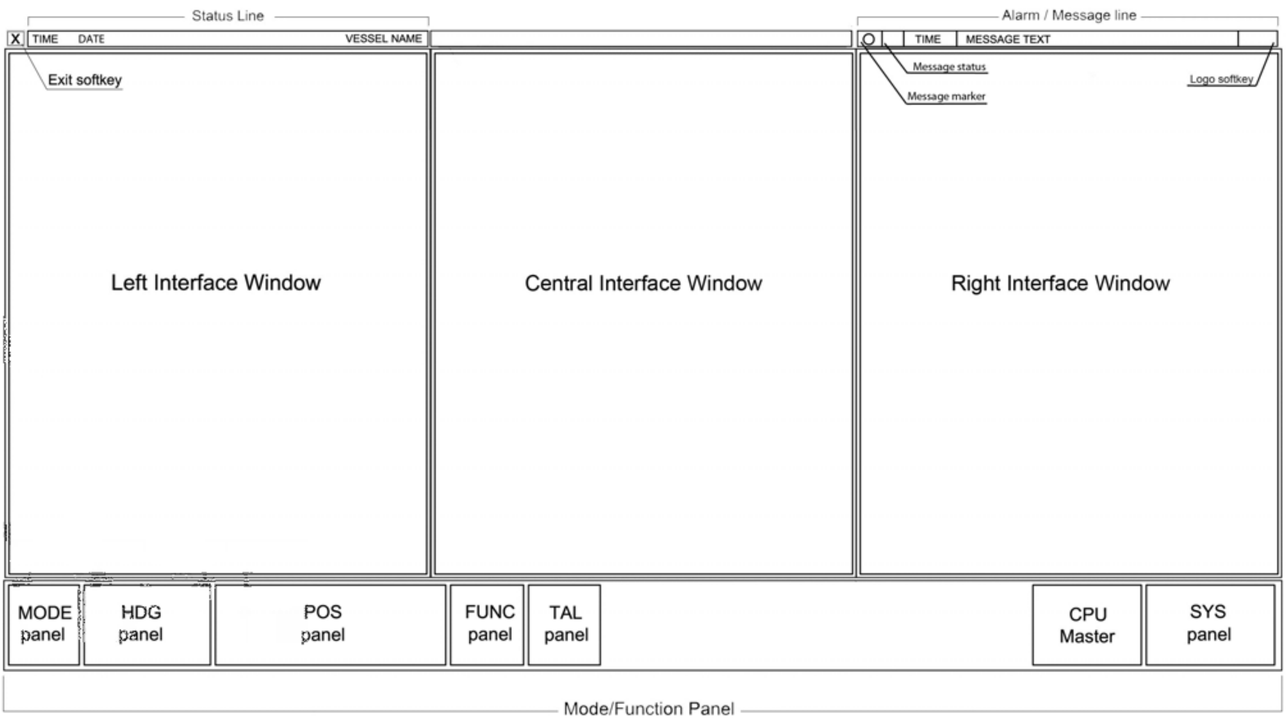


Figure 5.5: The Wide Screen Layout with Three Windows

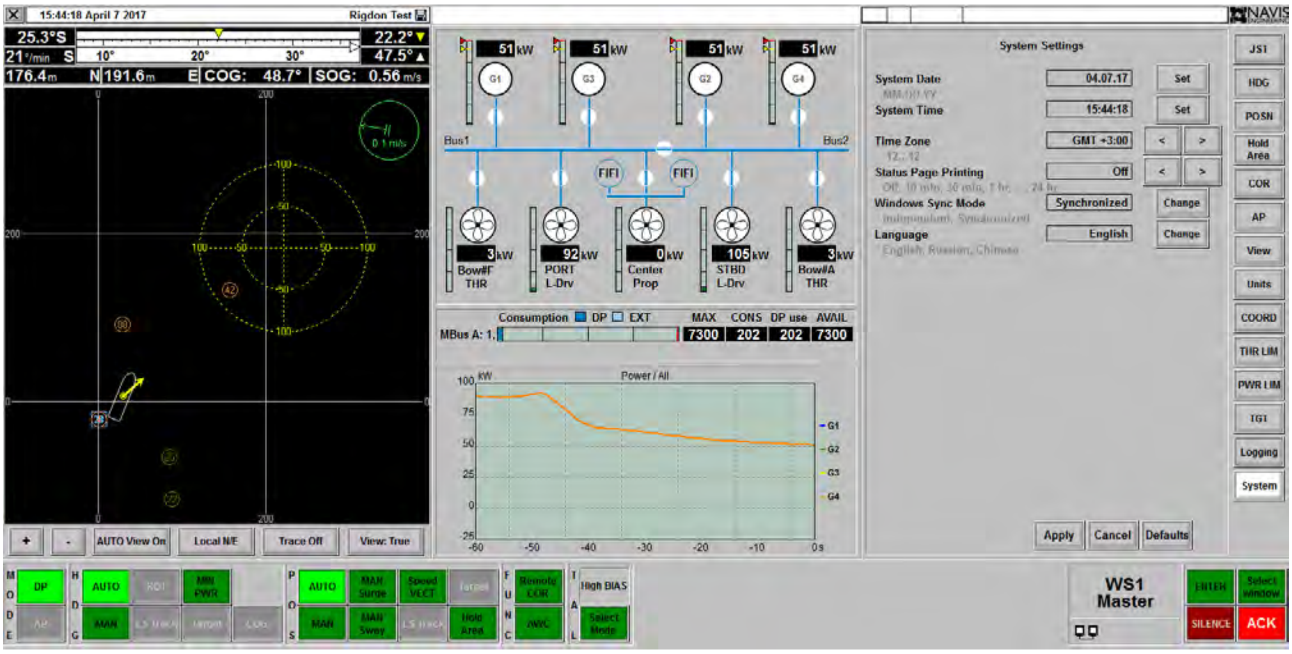


Figure 5.6: Example of the Wide Screen with Three Windows

The example of wide screen with three windows is shown in Figure 5.6.
There are special cases when the standard layout has an additional service line under the bottom Mode/Function panel.

5.1.1 Status Line

Status Line displays the operational mode, vessel name, date and time.

 — Exit softkey.
Don't press the exit softkey operating in the DP mode for DP station, and operating in the IJ mode for IJ station. See Section 3.6, page 55 for details.

5.1.2 Alarm/Message Line

The Alarm/Message Line displays the last not acknowledged alarm message:

See Section 4, page 57 for details.

5.1.3 Mode/Function Panel

Mode/Function Panel is shown in figure 5.7.

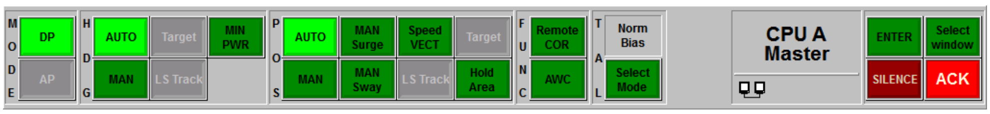


Figure 5.7: Mode/Function Panel

This Panel includes:

MODE panel — to select a control mode (DP, IJ, AP).

HDG panel — to select a heading control mode. See Section 9.2, page 161 for details.

POS panel — to select a position control mode. See Section 9.3, page 165 for details.

FUN panel — to select a function. See Section 10, page 171 for details.

TAL panel — to select a TAL mode. See Section 6.3, page 115 for details.

SYS panel — to select window, confirm selected mode/function, acknowledge alarms and silence.

5.2 DP Windows (Views)

Each of the Operator Selected Page is used for displaying one of information windows; each of them is used for parameters setting and serves a particular purpose. Press the **Select window** softkey, and the Select Window appears on the screen (see figure 5.8).

This window contains sofkeys to be pressed if a particular window must be displayed.

The Window List below shows the purpose of each window.

Softkey	Window	Comment
Alarm	Alarm Window	section 4, page 57
PARAM	Parameter Window	section 5.9, page 85
Map	Position and Heading Display	section 5.4, page 70
AUTO THR	Auto Thruster Window	section 6, page 101
MAN THR	Manual Thruster Window	section 6, page 101
Power	Power Monitoring Window	section 6.4.4, page 119
Sensors	Sensor Window	section 7, page 126
REF	Reference System Window	section 8, page 139
Target	Target Window	section 10.5, page 180
Track	Track Window	section 10.6.3, page 190
CAP Analysis	Capability Analysis Window, Drift Analysis Window	section 10.8, page 207, section 10.9, page 218
CONS Analysis	Consequence Analysis Window	section 10.10, page 227
Help	Help Window	section 5.3, page 69
Trend View	Trend View Window	section 5.8, page 81
System Monitor	System Monitor Window	section 10.12, page 232
AP	Autopilot Window	section 10.7, page 201

The window content depends on the configuration and options of a system.

The screen always contains two different information windows.

Softkeys with the open windows' titles are white highlighted.

5.2.1 Quick Switcher Panel

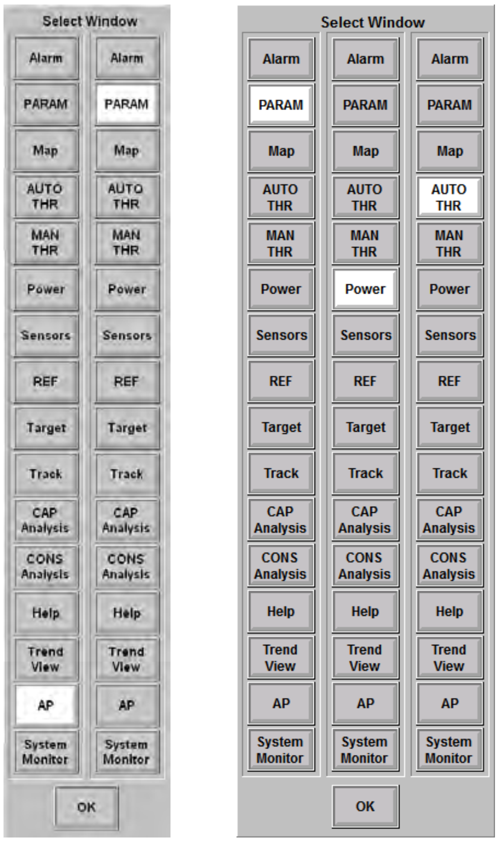
Some of information windows are available from the Quick Switcher panel (see Figure 5.10):

– Alarm;
– Map;
– AUTO THR;
– Power;
– Help.

Hold your touch at the top of the screen in area of either status line or alarm/message line until the Quick Switcher panel will appear (see Figure 5.9).

The Quick Switcher panel contains sofkeys to be pressed if a particular window must be displayed. The panel content depends on the configuration and options of a system.

Softkey with the open window's title is white highlighted.



(a) For the screen with two windows

(b) For the screen with three windows

Figure 5.8: Select Window Examples

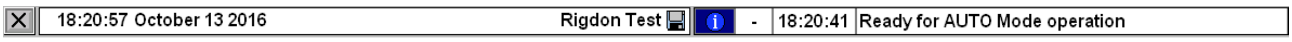


Figure 5.9: Status and Alarm/Message Lines

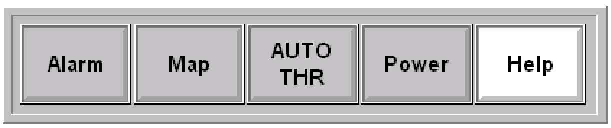


Figure 5.10: Quick Switcher Panel

5.3 Help Window

The Help window is available by **Select Window⇒Help**.

The Help window contains sections of the Operation Manual for **NAVIS NavDP 4000** system.

 — Softkey is used to open home page of the Help window.

Home page contains a list of all Manual sections as hyperlinks (see Figure 5.11).

 and  — Softkeys are used for navigation between the previously browsed pages.

 and  — Softkeys are used for listing up and down.

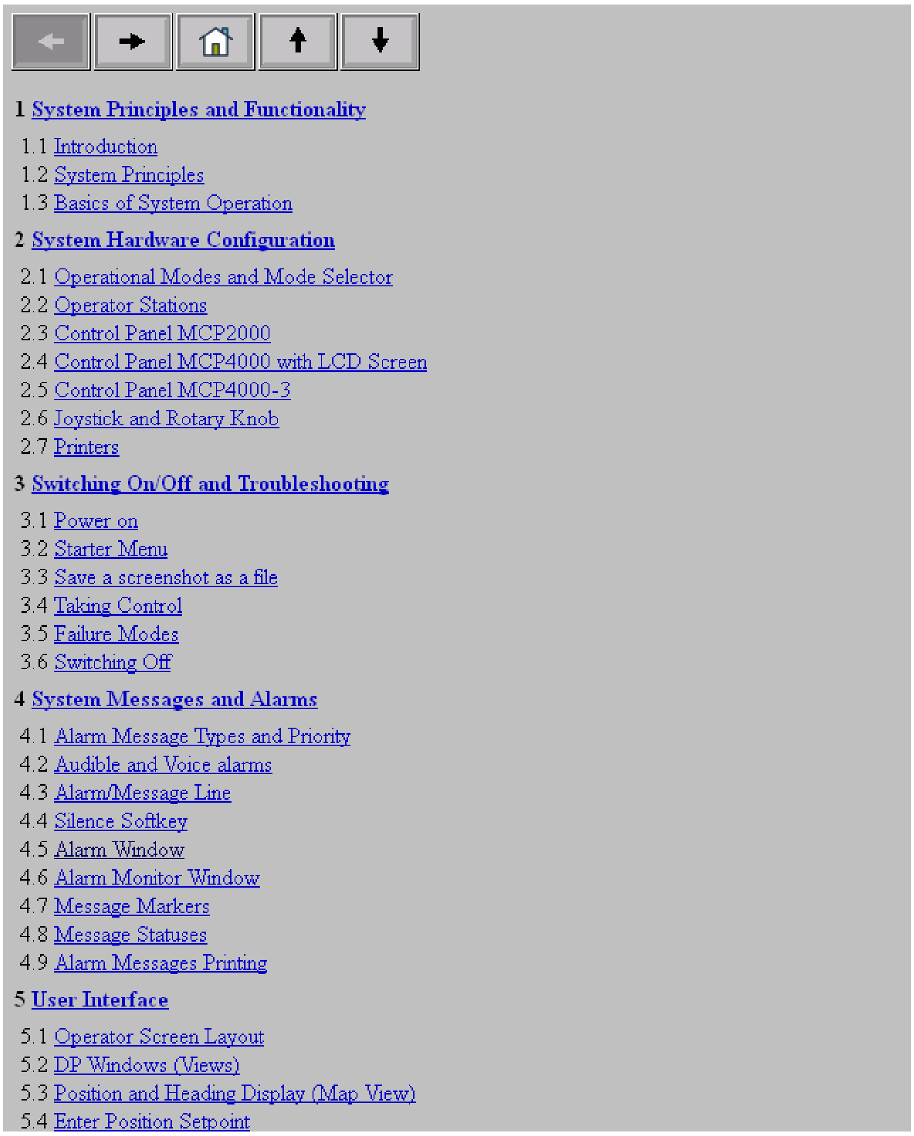


Figure 5.11: Help Window. Home Page

> **NOTE!** If you want to view help for operation with a particular system window:
>
> – open this window;
> – open the Help window on the second side of the screen (at the left/right).
>
> In this case a section containing information for operation with the opened window will be displayed (see Figure 5.12).

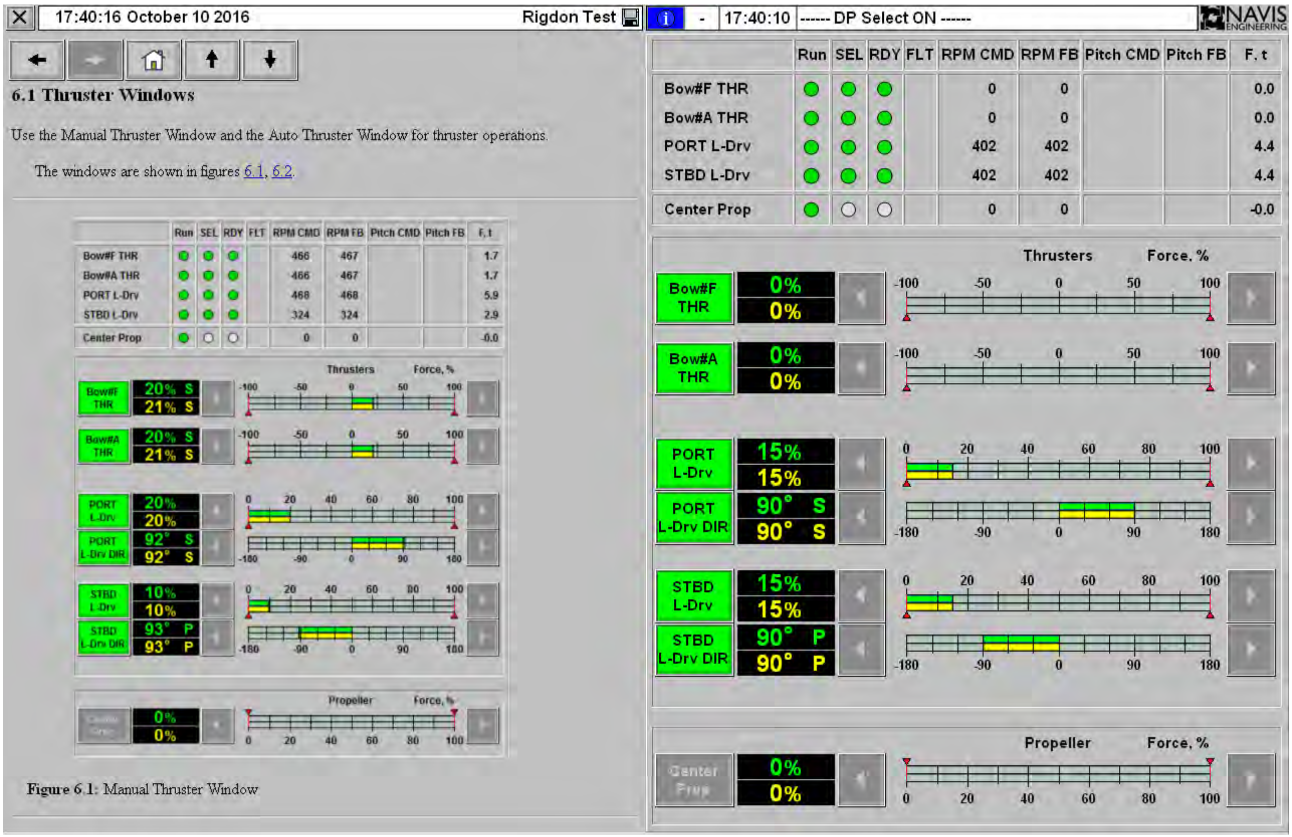


Figure 5.12: Help Window (Manual Thruster Section) — Manual Thruster Window

5.4 Position and Heading Display (Map View)

The Map window (Figure 5.13) contains the vessel's position and heading information. The information representation depends on an active mode.

5.4.1 Vessel heading displaying

Actual Heading Actual heading is shown:

- numerically
- graphically by yellow marker

Numerical indicator and markers are displayed in all control modes.

Heading Setpoint Heading setpoint is shown:

- numerically

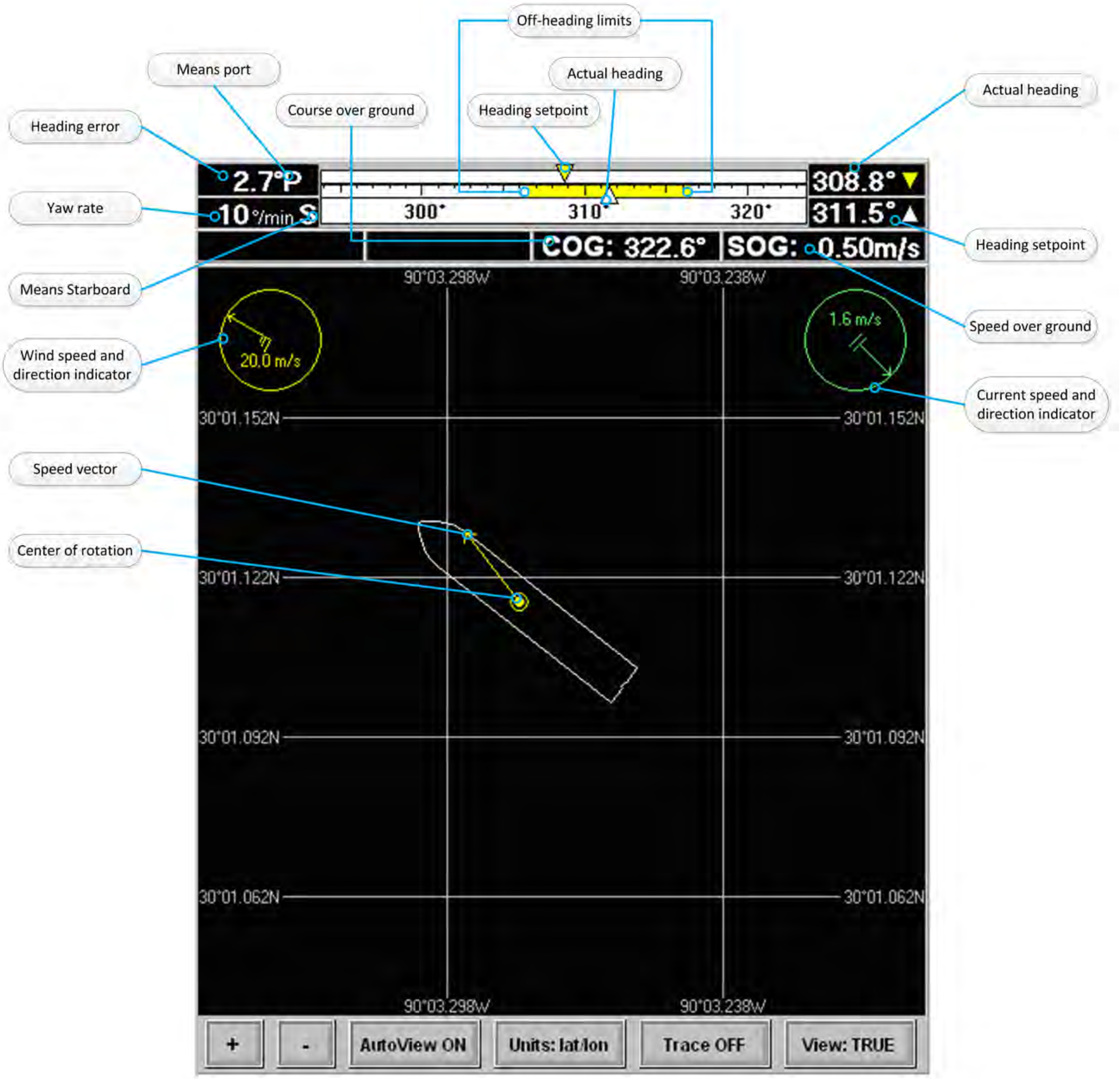


Figure 5.13: Display example

– graphically by white marker

Numerical indicator and markers are displayed in following modes only:

– DP Mode (Auto Heading, LS Track and Target),
– AP Mode (Auto Heading /HS Track).

Off-Heading Limit The range of the allowable heading deviation from the heading setpoint is displayed with yellow line on the scale.

A range value is set by operator in **HGD** page of the **Param** window (see Section 5.9, page 85).

Off-Heading Limit Excess Off-Heading Limit indicator becomes red-colored in case a value of heading error exceeds a value of Off-Heading Limit.

The indication disappears as the deviation is less than a half of Off-Heading Limit.

This indication is provided only in Auto Heading mode.

> **NOTE!** The indication is provided if a heading setpoint has been achieved.

Heading Error Heading error indicator displays the deviation from the heading setpoint. 'S' means starboard, 'P' - portside.

Yaw Rate Yaw rate indicator displays a value of yaw rate and its direction. 'S' means starboard, 'P' - portside.

5.4.2 Vessel position displaying

Position Error, Auto Position Mode Indicators display the deviation of a vessel from Set Position.

The left Position Error indicator displays the deviation in the surge/north axis.

The right Position Error indicator displays the deviation in the sway/east axis.

Data is displayed depending on a Map view selected in View page of Param window(5.9, page 85):

– **View: REL** the deviation is displayed in vessel coordinates.

For left indicator: 'F' means forward, 'A' - aft.
For right indicator: 'P' means portside, 'S' - starboard.

– **View: TRUE** the deviation is displayed in geographical coordinates.

For left indicator: 'N' means north, 'S' - south.
For right indicator: 'E' means east, 'W' - west.
The indication of Position limit excess is provided by the system:

In case the vessel exceeds Position limit the Position Error indicators become red-colored. The Position limit is set by operator in **Pos** page of **Param** window (see Section 5.9, page 85).

> **NOTE!** This indication appears if the vessel reached Set Position and then exceeded the Position limit.

Position Error, LS Track Mode Indicators display the deviation of a vessel from current track leg.

The left Position Error indicator displays a value of XTE: 'R' means right, 'L' — left.

The right Position Error indicator displays a value of DTW. (See Section 9.2.6, page 164).

The indicator displays the Course over ground (COG) in degrees.

The indicator displays the Speed over ground (SOG). The Speed over ground is shown in units selected by the operator in **Units** Page of **Param** window (see Section 5.9, page 85).

5.4.3 Map View

The following information is displayed on the Map (see figure 5.13):

Wind speed and direction indicator Wind speed is displayed with yellow numeric indicator.

Wind direction is displayed with yellow arrow.

Wind speed and direction are shown in a yellow circle.

Current speed and direction indicator Current speed is displayed with green numeric indicator.

Current direction is displayed with green arrow.

Current speed and direction are shown in a green circle.

Wind speed and current speed are measured in units selected by the operator in **Units** page of **Param** window (see Section 5.9, page 85).

Vessel contour Vessel contour is displayed with Speed vector and Center of rotation (COR).

The vessel contour is located on the Map according to the actual position and directed towards the actual heading.

The Speed vector direction corresponds to the course over ground (COG).

The Speed vector length equals the distance the vessel should pass moving with current speed within 1 minute.

The COR position is set by the operator in DP modes (See Section 10.1, page 171).

Position setpoint symbol If the vessel position is controlled automatically the position setpoint is shown with yellow symbol on the display:

- small circle if a relative view is selected
- dotted circles if a true view is selected

5.4.4 View Controls

Map View Scale Press "+" and "-" softkeys to change the scale of view (Zoom In/Zoom Out).

When zooming out and ship contour is too small in proportion to map scale, ship contour size is fixed.

When zooming in and ship contour is out of window, the COR point and small shaded ship-shape symbol is shown to represent the ship orientation.

> **NOTE!** Too large zoom when you can't see real ship contour and only shaded ship-shape symbol is shown is dangerous and non-informative scale.

Auto View selection Use the appropriate softkey to select the AutoView ON or AutoView OFF mode. The current mode is displayed on the softkey:

Auto View ON The vessel contour is always shown on the screen. In this case the coordinate grid shifts when the vessel contour approaches the visible limits of the Map.

Auto View OFF This mode allows the vessel contour to leave the Map when approaching its visible limits.

Coordinate system selection Use the appropriate softkey to select a coordinate system to be displayed.

The current coordinate system is indicated on the softkey:

Geo the geographic coordinate system is displayed

Local N/E the Cartesian coordinate system is displayed

UTM The UTM coordinate system. To show/hide this option, change "Use UTM" parameter in Coord page of Param window.

Trace selection Use the appropriate softkey to select Trace ON or Trace OFF mode.

The current mode is displayed on the softkey:

Trace ON The vessel trace is displayed with white points on the screen (the trace of the center of rotation).

Trace OFF The vessel trace is not shown on the screen.

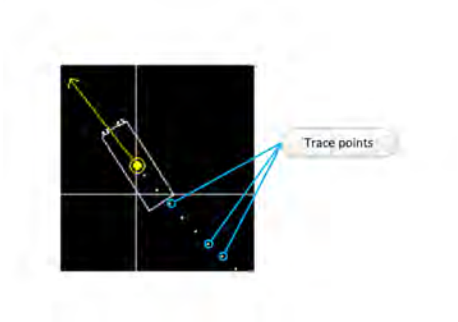


Figure 5.14: Trace Points Example

The vessel trace is shown on the screen according to Step and History settings for the vessel trace. These settings are made by the operator in **View** page of **Param** window (see Section 5.9, page 85).

View selection Use the appropriate softkey to select the Map representation:

- in absolute coordinates
- in relative coordinates

The current mode is displayed on the softkey:

View: TRUE The map is shown in the earth fixed coordinates.

View:REL The map is shown in the vessel fixed coordinates.

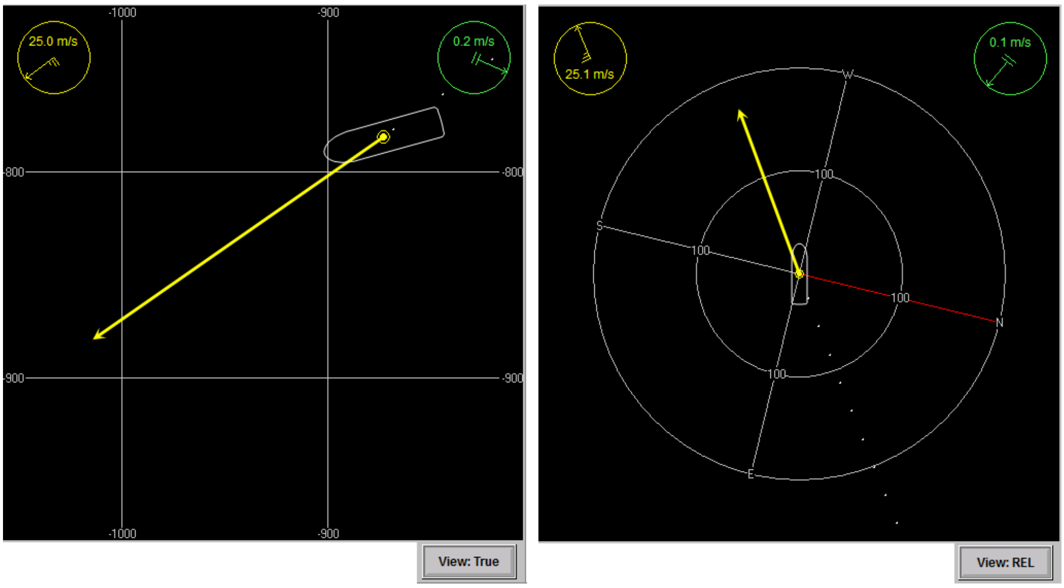


Figure 5.15: View: true and relative

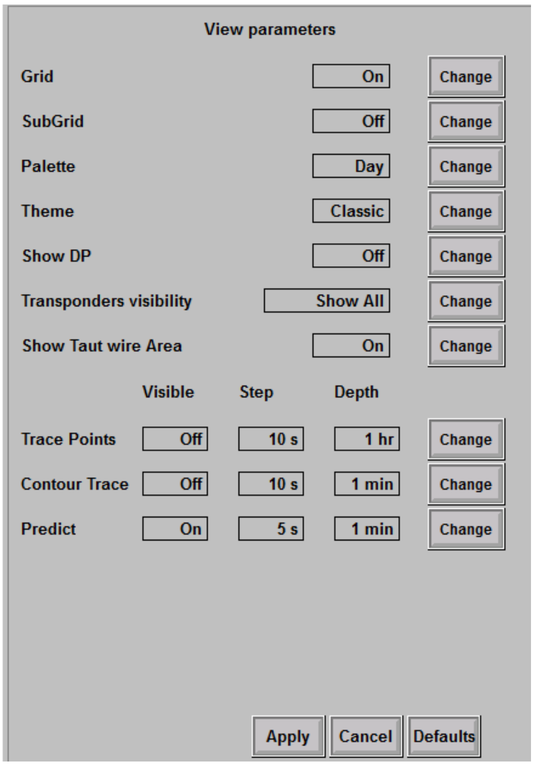


Figure 5.16: The prediction parameters settings

Motion Prediction Some configuration have the Motion prediction function available.

The prediction settings are in the Param window, tab View (see fig. 5.16)

In case the Motion prediction is on the yellow vessel outline is displayed at the position calculated for given time (the time settings are: 30 sec, 1 min, 2 min, 3 min, 4 min, 5 min). the intermediate positions are displayed as dotted yellow outlines (10 contours for the selected period)(see fig. 5.17).

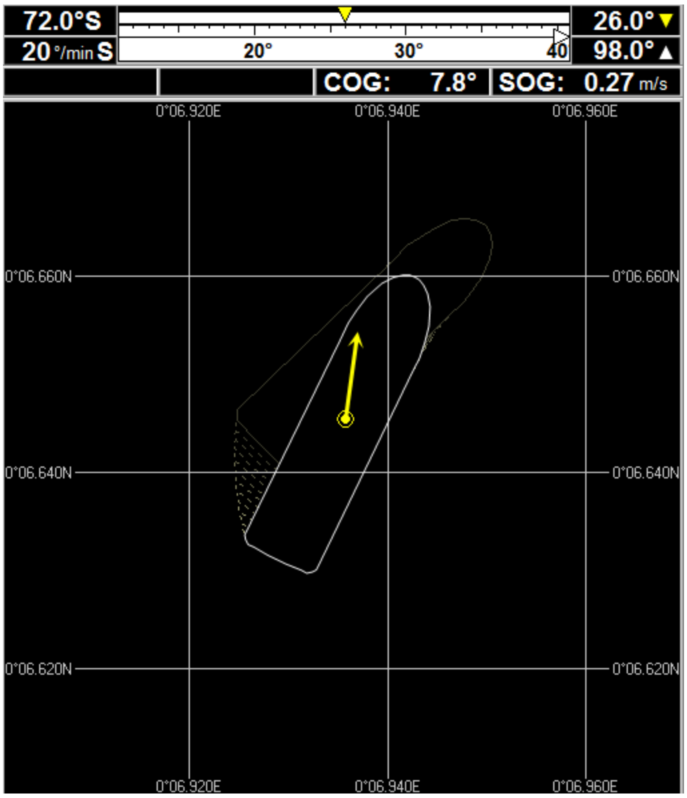


Figure 5.17: The motion prediction display for the 5 minutes

5.5 Enter Position Setpoint

Press the **AUTO** softkey on the **POS** panel to get the dialog (see Figure 5.18). Then set a new value for the position setpoint in the proper entry field.

The coordinates displayed in the LAT and LON bars (the latitude and longitude) depend on the current control mode.

In case of the manual position control, the current coordinates are displayed.

In case of the auto control, the latest position setpoint is displayed.

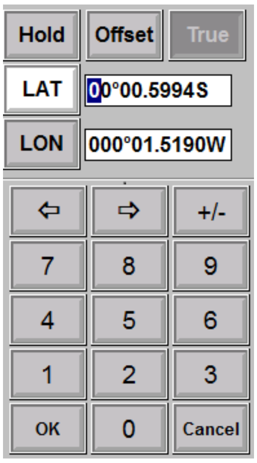
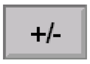


Figure 5.18: Input Position Setpoint dialog

Set new coordinates using the LAT and LON bars, or enter the offset value.

The offset value can be entered in three ways (see Figure 5.19):

– via geographic coordinates;
– via through the vessel based rectangular coordinates;
– via the vessel based polar coordinates;

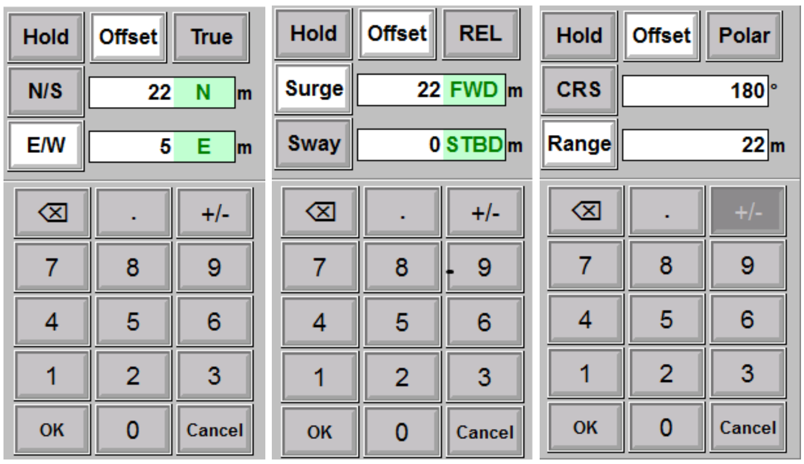


Use the softkey to change the direction:

N — north;
S — south;
W — west;
E — east;
FWD — fore;
AFT — aft;
STBD — starboard;
PORT — port.

Use arrow softkeys to move the blue cursor in the text box.

NOTE! Relative offsets direction are color-marked. An afterbody and port with red, bows and starboard — with green.



(a) True offset (b) Relative offset (c) Polar offset

Figure 5.19: Input Position Offset dialog

In case operator entered the Offset value and then selected another coordinate system, the **NAVIS NavDP 4000** system automatically converts data in the new coordinate system. The current offset value can overflow the reserved digits. In this case the entry field will be red and the # symbols will be displayed (see figure 5.20).

Select the first coordinate system and enter a new offset value for the correct data displaying.

See Section 8.1, page 139 for details about entering position in different coordinate systems.

The position offset values can be set with control panels (CP4000 family). See Sections 2.4.8, page 27 and 2.5.11, page 36 for details.

5.5.1 Position new setpoint indication on Map

When **Map** window is visible, new position setpoint is shown on map view – see figure5.21.

WARNING! A new position setpoint is shown on Map as brown vessel contour with new heading and position.

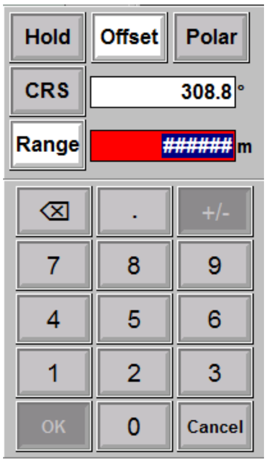


Figure 5.20: The field overflow

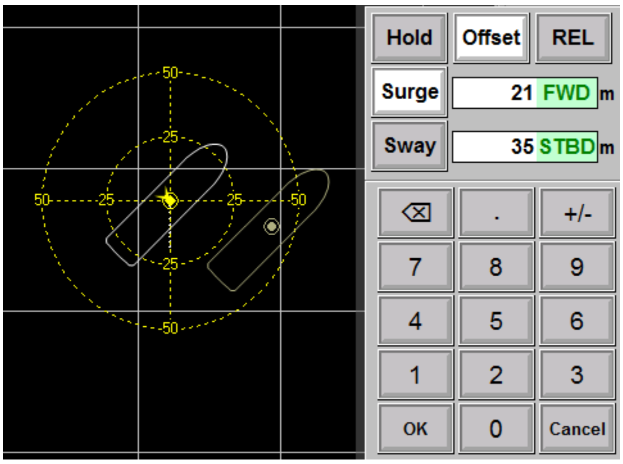
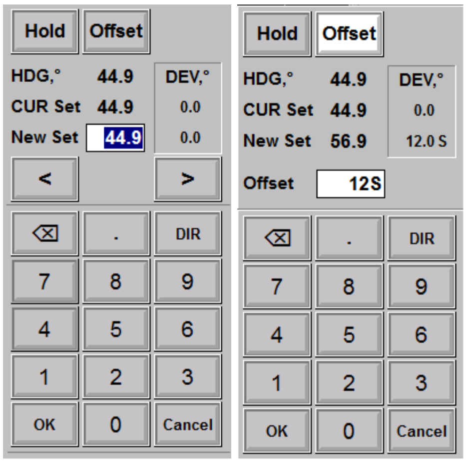


Figure 5.21: Position new setpoint indication on Map

5.6 Enter Heading Setpoint

Press the **AUTO** softkey on the **HDG** panel and set a new value for the heading setpoint in the appeared dialog box (see figure 5.22(a)).



(a) Enter heading setpoint (b) Enter heading offset

Figure 5.22: Input Heading dialog

Hold softkey Press this softkey to put Actual heading into the Editing Field.

Offset softkey New Heading Setpoint input as offset of Actual heading value.

5.6.1 Preset heading input

In preset heading mode **Offset** softkey is not active. The following information is displayed in the window:

HDG — actual heading;

CUR Set — current heading setpoint;

New Set (white input field) — new heading setpoint;

DEV from CUR Set — the actual continiously updated deviation of the vessel from the heading setpoint (difference between the actual heading and this one setpoint). **P** symbol means that the rotation direction is to the left from the actual heading to the set one, **S** — to the right respectively;

DEV from NEW Set — the actual continiously updated deviation of the vessel from the new heading setpoint. **P** symbol means that the rotation direction is to the left from the actual heading to the set one, **S** — to the right respectively. For more information about this sign see the note below.

To set a new value, different from the latest one, you can enter this value in the **NEW Set** field and then press **Ok** softkey, or use [<]/[>]softkeys to increase/decrease new value.
To change the **direction of rotation** use **DIR** softkey.

NOTE! For large deviations sign "P" or "S" is always highlighted with white bar.

The input is available with control panels (CP4000 family). See Sections 2.4.7, page 27, 2.5.10, page 35 for details.

5.6.2 Offset heading input

You can also set the Offset value (**Offset** softkey is active) — see figure 5.22(b).

In this case the **NEW Set** heading changes automatically according to the **Offset** entered. Use the **DIR** softkey to change the direction of rotation: Port of Starboard.

The turn direction depends on value of the 'Always Use Shortest Turn' parameter. See the 5.6.3 for details.

It is recommended to check the New Deviation Direction when entering an offset value. When operator press **Hold** button, dialog is switched to preset heading input mode (**Offset** button is off).

5.6.3 Heading new setpoint indication on Map

When **Map** window is visible, new heading setpoint and turn direction is shown on the map view.

The turn direction depends on value of the 'Always Use Shortest Turn' parameter. The 270 °turn track for the parameter's different values is represented on the figures 5.23 and 5.24.

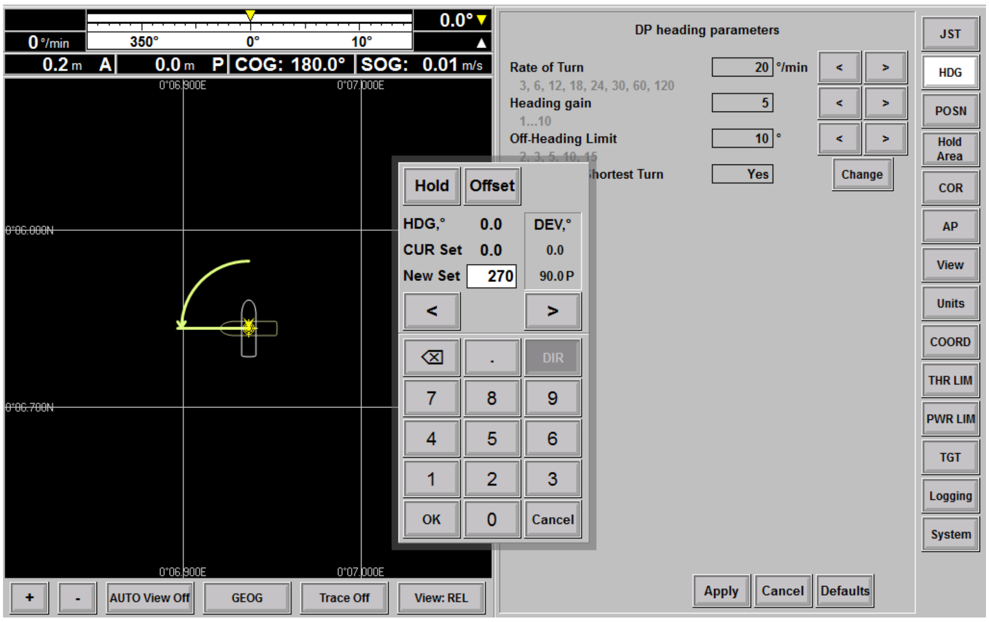


Figure 5.23: The turn track in case Always Use Shortest Turn=Yes

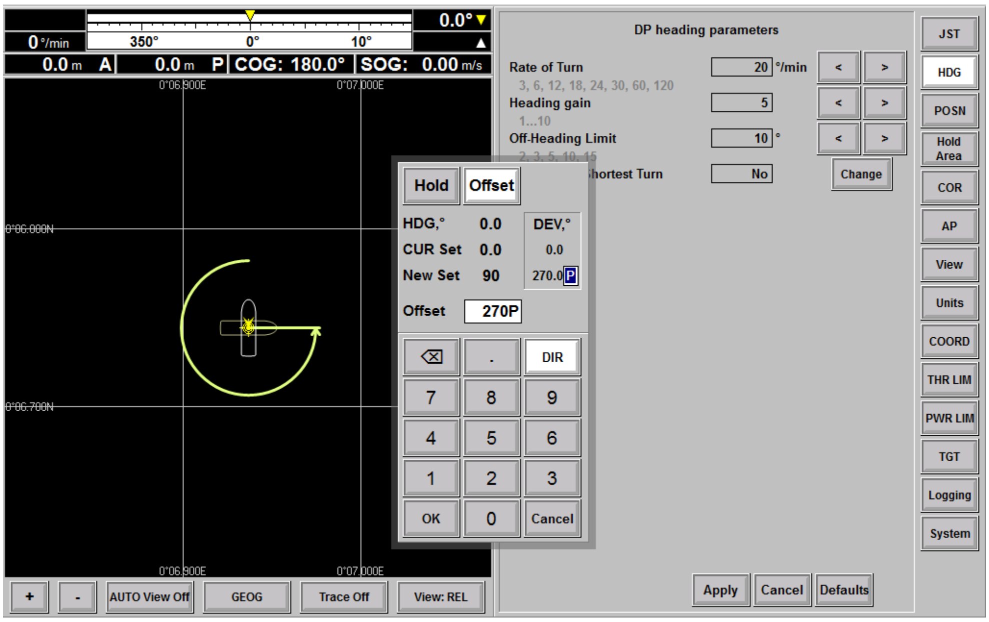


Figure 5.24: The turn track in case Always Use Shortest Turn=No

5.7 Enter Crab Angle

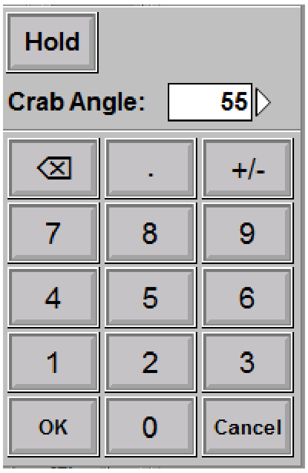


Figure 5.25: Input Crab Angle dialog

Press the **LS Track** softkey in the **HDG** panel and set a new value for a crab angle in the appeared dialog box (see figure 5.25).

For LS Track mode activation see the Section 10.6, page 189.

5.8 Trend View Window

The Trend view window is available by **Select Window⇒Trend**. The window contains three different blocks that graphiclly display trends of three independent parameters selected by operator. A trend period is defined by operator too and it is the only one for the all trends. Each block has several modes. The first one is Graphical. It displays a dynamic or a static diagram of parameter.

At the diagram the horizontal axis is the time one. The vertical (Y) axis is the axis of parameter values.

The title of the diagram contains the parameter class and name. The diagram legend is at the right side.

Example

The Figure 5.26 displays the following trend for the 5 min interval:

– Generator Powers of class Power;

– Gyro Heading of class Sensors;

– Wind Speed of class Sensors.

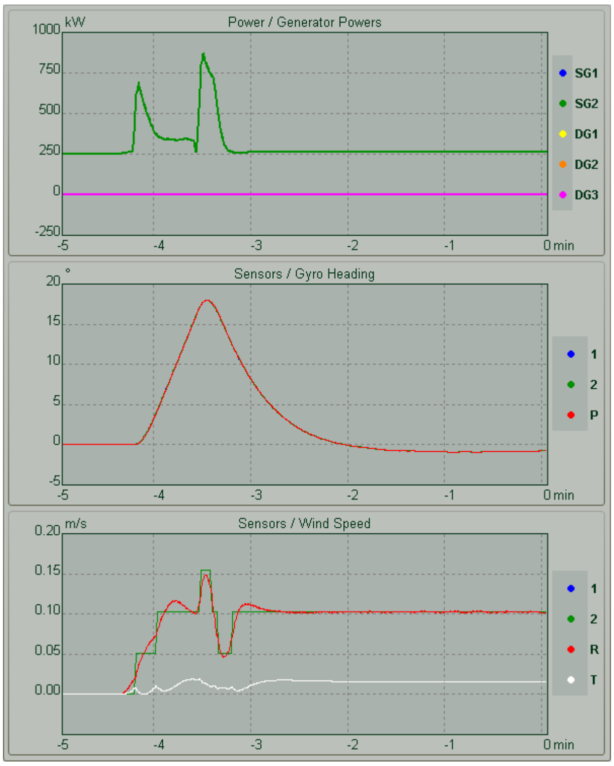


Figure 5.26: Trend View Window

5.8.1 Trend View Settings

The trend setting mode is available by clicking on the diagram background area (see Figure 5.27). The settings console contains three blocks:

Data Type — to chose the data type;

Y axis — values setting;

Time axis — time interval setting.

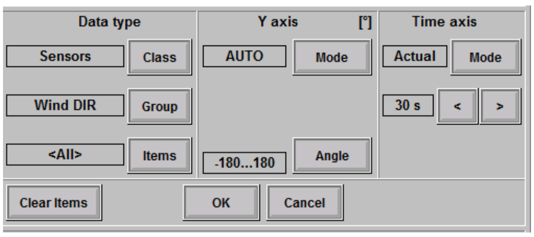


Figure 5.27: Settings console

5.8.1.1 Data Type

The data is hierarchy structured and it looks like:

– Class

  – Group

∗ Item

Thus to choose the item operator should decide on a class, then decide on a goup, then decide on an item.

The class name of the trend is displayed in the field beside the **Class** button.

The group name of the trend is displayed in the field beside the **Group** button.

The list of selected items is displayed in the field beside the **Item** button.

In case all items have been selected the field contains the note <All>. To delete items from the list use the **Clear Items** button. This action doesn't make any changes to Class and Group.

Clicking on the **Class** button switches the settings console to the class selection one (see Figure 5.28). The button of the current class is white indicated.

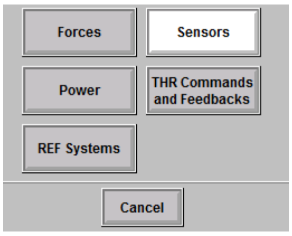


Figure 5.28: Class selection console

It is possible to choose another class or click on the **Cancel** button to switch back to the settings console. In case the different class has been selected the class selection console switches to the settings one with the selected class name displayed near the **Class** button (see Figure 5.29).

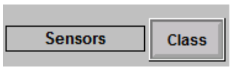


Figure 5.29: The current class name displayed on the settings console.

The same algorithm is for the group selection.

Items are selected from their console and the number of items can be different — from null till all of them (see Figure 5.30). It should be noted that different groups have different numbers of items.

The items console contains:

– item name buttons;

– item legend;

– OK and Cancel buttons.

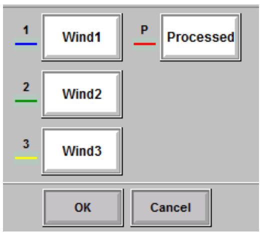


Figure 5.30: Item consol

Selected buttons are white indicated, the nonselected ones stay gray. To deselect an item click on the selected item name button. The button switches to gray.

After the choice has been done it's necessary to push **OK** to apply the item list and to switch to the settings console.

Obviously, the only one class and group can be selected. At the same time the number of items can be any but no more than the number of items of the group.

The full list of items see in Appendix ((K, page 345).

5.8.1.2 Y axis

The console contains information about units and limit values of the selected parameter. There are three methods to set limit values:

Auto the range of values is calculated automatically to fit entire values into the image;

Manual the range is fixed by operator; the operator is allowed to set the limits of Y axis values with the Min and Max buttons; the buttons appear on the console just after the mode has been selected; the current values are displayed on the right side of the proper button (see Figure 5.31);

Full Range in this case the range is calculated automatically within minimum and maximum permissible values.

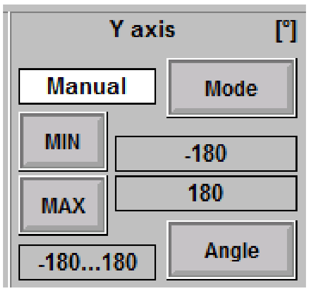


Figure 5.31: Y axis block

The method is selected by clicking the **Mode** button. It is possible to set a coordinate system for the parameters that have a degree units. –180 ° – 180 ° and 0 ° – 360 ° are accessible by clicking the **Angle** button.

5.8.1.3 Time axis

There are two modes to display a trend: Actual and History.

> **NOTE!** All time settings are general for all trends. It means that whenever changes occur, all trends apply them.

The initial(end-limit) time point is at the right bottom of diagram.

In case of Actual mode the end-limit value is the current time and the time interval gets back as negative values.

The units(hr, min,s)are displayed at the initial point.

The History mode allows selecting the end-limit point (the **End** button). In this case the static diagram is displayed for the selected interval with the end-limit point. The units are displayed at the first interval value.

To switch to the graphic mode click **OK**. If the changes shouldn't be applied click **Cancel**.

In case of the History mode the diagram can be moved along the time axis by clicking on the arrow buttons that appear at the bottom right and bottom left after clicking on the proper background spots (see Figure 5.32).

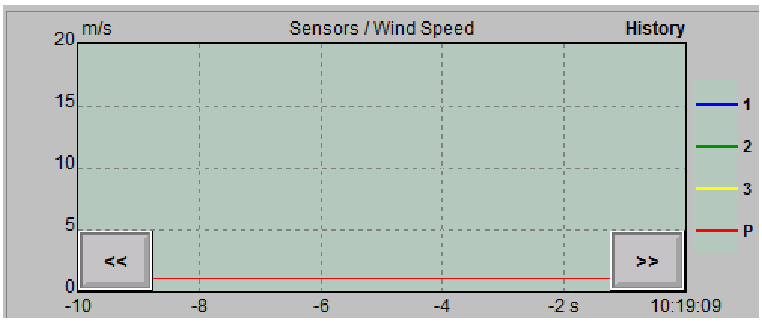


Figure 5.32: History mode

5.9 System Parameters

Every control mode and a way of an information displaying requires the appropriate parameters values defined.
The PARAM window contains pages with parameters which are not required to be frequently changed.
Some of the parameters are common for different control modes.
Before the operating starts it's necessary to make sure that all required parameters have correct settings.
The infrequently changed parameters are described in 5.9.1.
The other parameters are assigned to the windows and softkeys, so that they are accessible where they are needed or as soon as a particular action is to be performed. Such parameters are described in proper sections.

5.9.1 Parameter Pages

To open the window click **Select Window** ⇒ **Param**
One of the parameter pages appears. The page name is displayed at the top of the page.
The following parameter pages are available:

JST	Joystick Mode Parameters
HDG	DP Heading Parameters
POSN	Position Parameters
COR	COR Point Edit
AP	Autopilot Parameters
View	View Parameters
Units	Measure Units
COORD	Coordinate Systems Parameters
THR LIM	Thrust Limits
PWR LIM	DP Power Limits
TGT	Target Parameters
Logging	Logging Parameters
System	System Settings

A number and contents of pages depend on a system configuration.
In addition to this you can set some parameters using Track, REF, Sensors, AP windows.

5.9.2 Graphic Display Customization

A new function of **NAVIS NavDP 4000** in 1024 version is a posibility of choosing a graphic theme for the graphical display. The following themes are available:

Light — the default theme (see Figure 5.33);

Classic — the old style theme (see Figure 5.34);

Dark — the dark theme (see Figure 5.35).

To change the theme go to (**Select Window** ⇒ **PARAM** ⇒ **View**). Then chose the theme by clicking on the Change button in the Theme row. After the theme has been chosen click Apply to apply the changes. The theme is changed immediately.
There are two palettes available in the View window. These are Day and Night palettes.

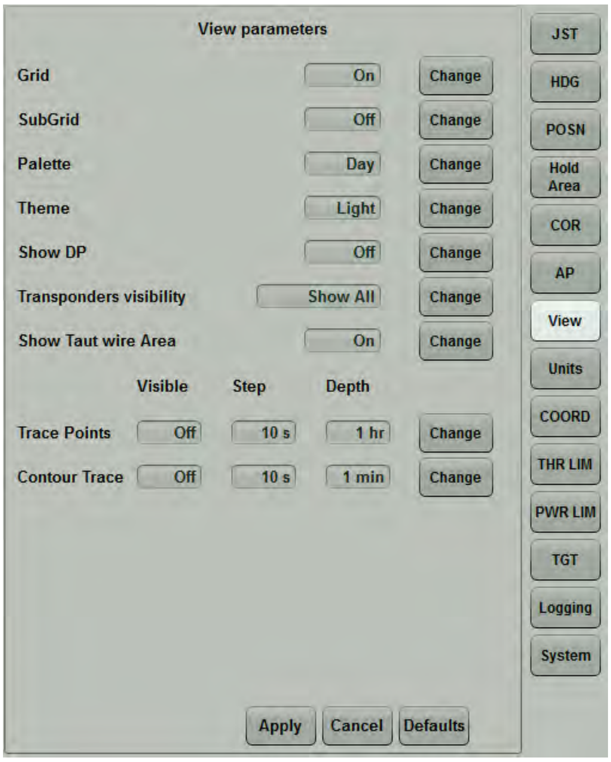


Figure 5.33: Light Theme

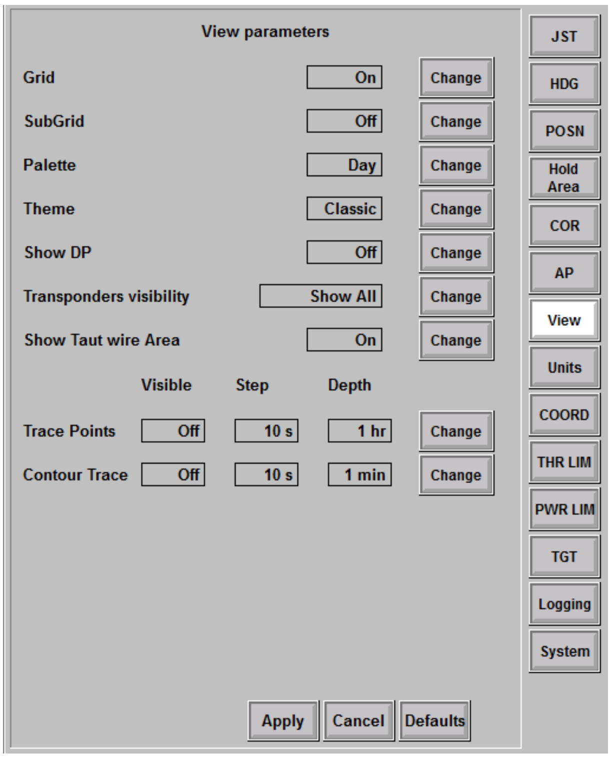


Figure 5.34: Classic Theme

Figure 5.35: Dark Theme

5.9.3 Entering Parameter Values

While entering the parameters in the parameter pages, you use one of three possible ways.

Case 1

A parameter has a predefined set of values, and you must select the one. Tipically, all possible values are shown in faded color.

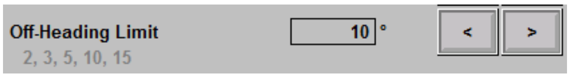
For instance,

means that the joystick gain has been set to **Normal**. When pressing the **Change** softkey, several options are scrolled. They are **Normal**, **High** and **Progressive**.

As soon as you have selected the necessary value, press the **Apply** softkey, or press the **Cancel** softkey to cancel. The actual value is displayed against the dark background, others are displayed against the white background.

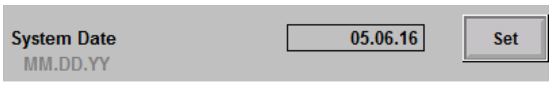
Case 2

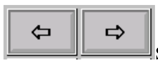
In Case 1 the values are listed cyclically. In this case they are listed to the left or right from the actual value with arrow buttons, for instance



Case 3

The necessary value is entered via a touch-control keyboard. For instance,



Press the **Set** softkey, keyboard-like dialog will appear. Using  softkeys, move the blue cursor and print digits on its place. Then press the **Ok** softkey to confirm, or the **Cancel** softkey to cancel.

In all the cases, press the **Defaults** softkey in order to set default values.

5.10 Syncronized/Independent Mode

NOTE!	The default mode is Synchronized.

There is a group of parameters and operation in DP-2 systems that can be changed and performed both on Master and Slave station. Depending on mode the parameter settings and operations are performed independently (the Independent mode) or synchronized on both stations (the Synchronized mode).

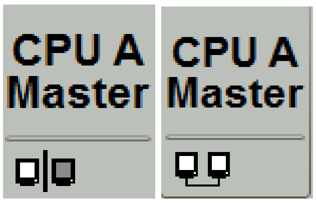
See Appendix A, page 250 for the entire list of parameters and operations.

NOTE!	The mode switching is avalable on the Master station only.

The current mode is indicated on the icon placed in the 'Main CPU indicator' section (see figure 5.36) and on the System tab of the Param window (see Fig.5.37)

The Setting Mode Switching

There are two way to switch the setting mode.



(a) Independent (b) Synchronized

Figure 5.36: The current mode indicator

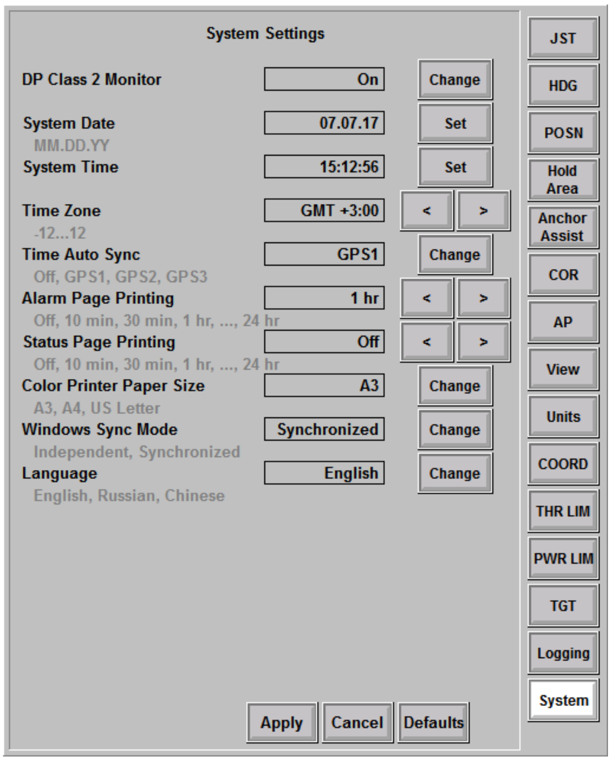


Figure 5.37: The setting mode on the System tab

Switching via the Param Window

Press the **Change** softkey for parameter Windows Sync Mode on the Param →System tab (see figure 5.37). After the value has been changed press the **Apply** softkey to switch the mode or **Cancel** softkey to hold on the current one.

Switching the Mode via Icon

The mode switching is available without using the Param window. Press the icon indicating the current mode(see figure 5.36). The switching dialog appears (Fig. 5.38).

Press**Yes** to switch the mode or **No** to hold on the current one.

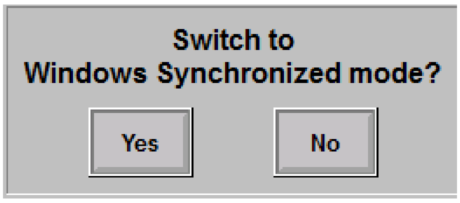


Figure 5.38: The switching dialog

5.11 Time Auto Synchronization Mode

The mode allows the operator to synchronize system time by using ZDA message data from GPS. For more detailed information about GPS messages see Appendix D.2, page 284.

The mode parameters are set in the **System** page of the **PARAM** window (see Figure 5.39).

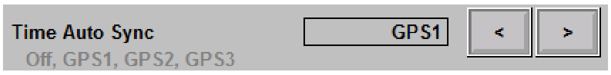


Figure 5.39: Time Auto Synchronization Settings on the System Page

GPS# — select GPS sensor for time auto synchronization;

Off — choose to turn the mode off.

When the Time Auto Sync mode is on, the following time corrections are performed:

1. Periodic system time correction.

   System time will be corrected when the following conditions are fulfilled:

   – offset between the system and CPU time exceeded set threshold.
     The threshold value and synchronization period (usually once a day) are set during the **NAVIS NavDP 4000** system installation and cannot be changed by the operator;
   – selected GPS operates normally (data from the sensor are used by the system).
     In case the sensor is not used or failed, the following alarm is generated: "Selected GPS for Time Auto Synchronize was turned off".
   – the system receives ZDA messages from the selected GPS sensor.
     In case ZDA messages have not been received, the following alarm is generated: "No ZDA data received".

2. CPU time correction right after the system start-up.

   CPU time will be corrected if the offset between the system and CPU time exceeded set threshold.

5.12 Control Panel MCP4000 with 6" Color LCD, the LCD GUI

The LCD is used to display the system operation windows (see Figure 5.40).

The figures 5.41 shows the layout of the screen operational areas. The alarm list is displayed on the center console (see Figure 2.13). To switch between views use the "VIEW" pushbutton (see 2.4.16, page 31).

NOTE!	In case the panel is not active the Alarm Message Line blinks.

5.12.1 Main View

The center of the screen has the following views to display:

– Alarm List View;
– Parameters View;
– Auto Pilot View;

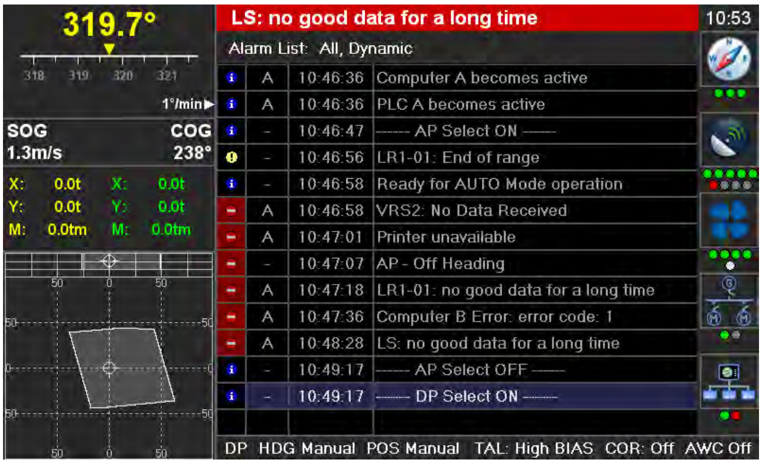


Figure 5.40: LCD Panel

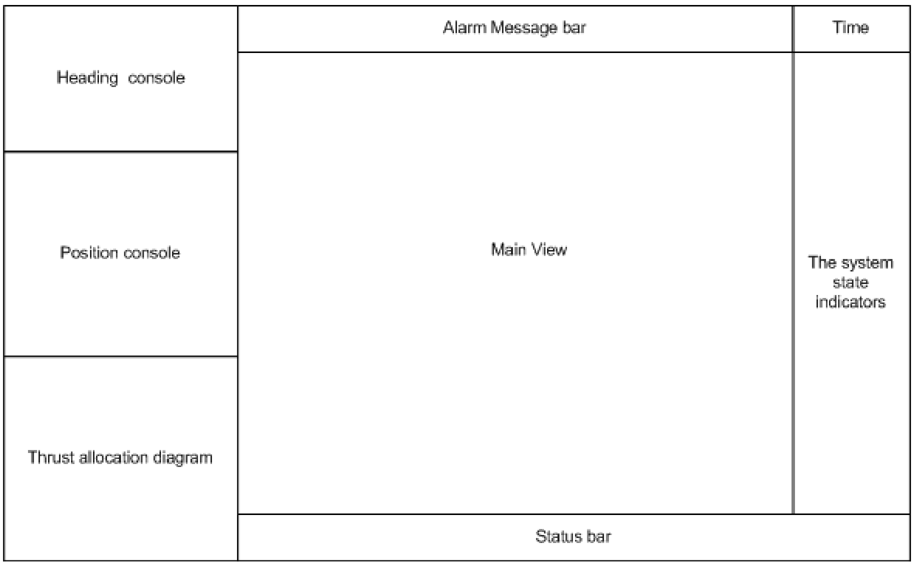


Figure 5.41: The Screen Operational Areas Layout

– Sensors View;
– Thruster View;
– REF View;
– Power View (if available);
– System views.

The Main View also is used to display the control position dialog window.

5.12.1.1 Alarm List View

To switch to the Alarm List View press the “ALARM LIST” pushbutton (see 2.4.18, page 32). The view contains the entire list of the DP alarm messages.

Additionally the last message is displayed in the top alarm bar.

5.12.1.2 Auto Pilot View

Operating in the autopilot mode (AP) main view contains the following information (see Figure 5.42):

– The current heading;
– The heading set;
– The current angular velocity;
– The current speed (SOG);
– The heading set offset.

Figure 5.42: AP Mode

> **NOTE!** The AP View is the view title and doesn’t mean the AP mode

In DP mode the displayed information depends on settings. In case of the AutoHDG mode the heading and the current speed are displayed (see Figure 5.43).

Figure 5.43: DP, AutoHDG mode

5.12.1.3 Sensors View

The view contains a list of sensors and serves to set parameters of the selected sensor (see Figure 5.44).
Sensor buttons are color coded. The color indicates the state of the sensor.
To jump between the sensors buttons use the encoder.
The selected buttons is yellow-frame indicated.

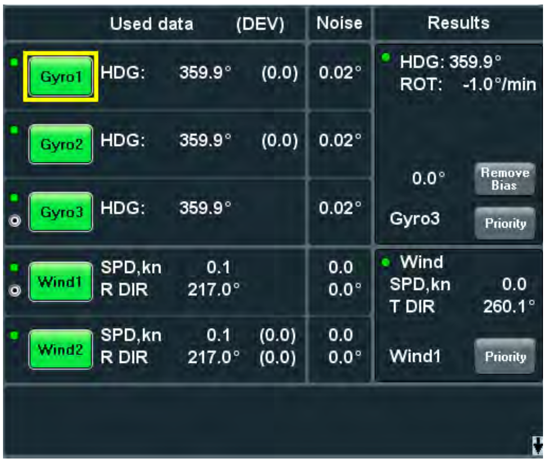


Figure 5.44: Sensors View

5.12.1.4 Thrusters View

The view contains the list of the thrusters (see Figure 5.45).
Thruster buttons are color coded. The color indicates the state of the sensor.
To jump between the sensor buttons use the encoder.
The selected button is indicated with yellow frame.

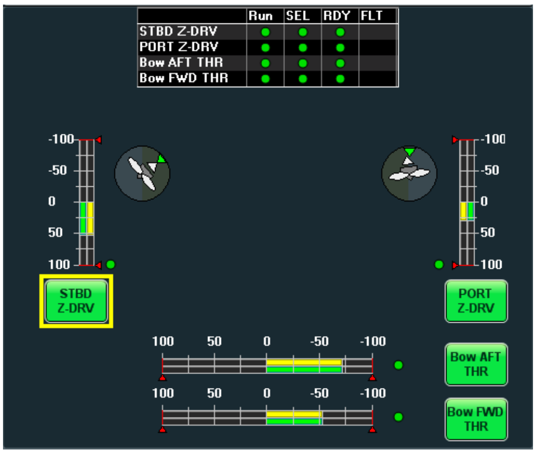


Figure 5.45: Thruster View

5.12.1.5 REF View

The view contains the list of Reference systems (see Figure 5.46).
The buttons are color coded. The color indicates the state of the Ref system.
To jump between the system buttons use the encoder.
The selected button is indicated with yellow-frame.

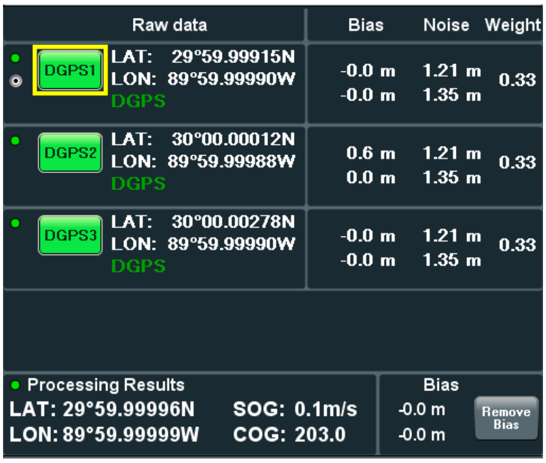


Figure 5.46: REF View

5.12.1.6 Power View

The view displays the vessel power system scheme, the power distribution and general power consumption (see Figure 5.47).

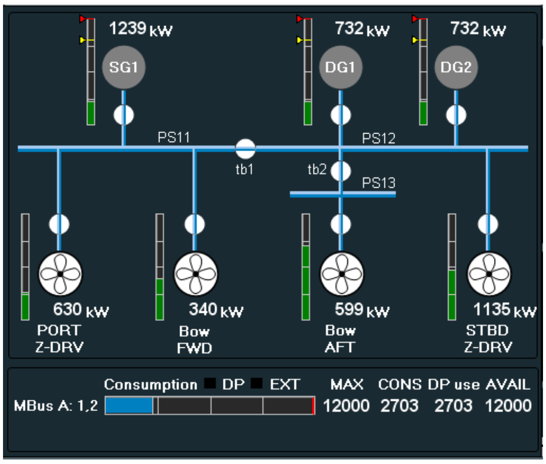


Figure 5.47: Power View

5.12.2 Parameters View

The view contains the parameters list of the system (see Figure 5.48).

5.12.3 Right Panel

The right panel contains a list of the system state indicators:

 — compasses (gyro, magnetic);

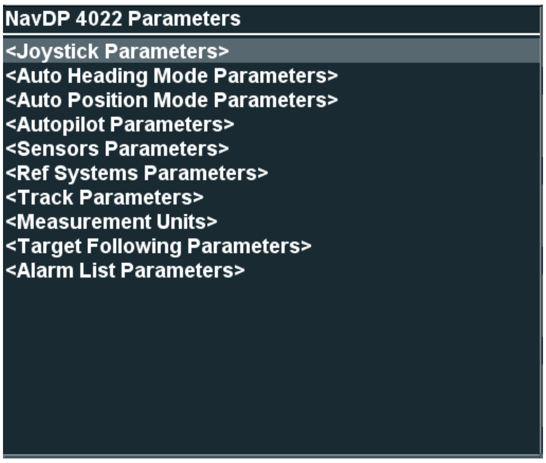


Figure 5.48: Parameters List

 — reference systems (GPS, HPR, TW, LR);

 — thrusters and propellers;

 — generators;

 — PLC connections.

Figure 5.49: Example of the Reference Systems State Indication

The indicators are color coded (see Figure 5.49 as an example):

– For sensors and reference systems

green — sensor (system) is in use, data is valid;
white — sensor (system) is in use in the monitoring mode;
gray — sensor (system) is not in use;
red — sensor (system) is in use, data is not valid.

– For thrusters and propellers

green — thruster (propeller) is running in normal mode;
white — thruster (propeller) is running in normal mode, but is not controlled by DP;
red — thruster (propeller) is running but not available (there is the Fault signal).

– For generators

green — generator is connected (the breaker is closed);
gray — generator is not connected (the breaker is open).

– For PLC connection

green — PLC is connected;

red — PLC is not connected.

The system time is located at the top right corner.

5.12.4 Left Panel

The left panel contains three consoles. The information displayed in a console depends on the current mode and settings.

5.12.4.1 Heading Console

The top left corner contains the vessel heading information (see Figure 5.50).
Depending on operating mode the following data are displayed:

- DP mode, manual heading and manual position:
  - Current heading
  - Current angular velocity
- DP mode, auto heading and/or auto position, or AP mode:
  - Current heading
  - Heading set
  - Current angular velocity
  - An offset angle and direction

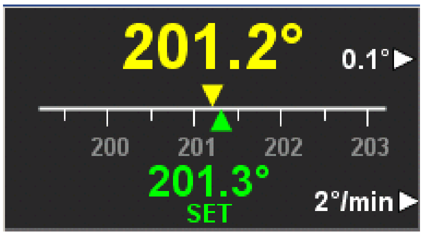


Figure 5.50: Heading Console

5.12.4.2 Position Console

The SOG and COG values a displayed in the console. Additionaly operating in DP mode:

- In the AutoPos mode the console contains the graphic view (in relative coordinates) of the vessel position relative to the set value (see Figure 5.52):
  - the real offset;
  - The allowable circle for the the set point with the Position Limit as the radius value and preset point as the center;
  - The vessel sign displayed about the set position and with drift direction;
  - The North sign.
- In case of other modes:
  - Coordinates as a text (see Figure 5.51).

In the Hold Area mode the radius value is equal the Holding Area Radius and the Warning Radius is displayed as dashed circle (see Figure 5.53)
Operating in the AP mode the console contains the following data:

- SOG
- COG
- Heading sensor
- POsition sensor

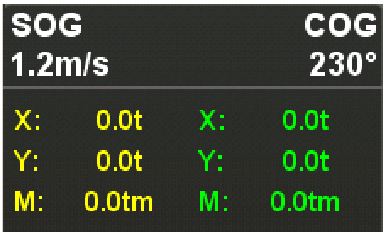


Figure 5.51: Position Console

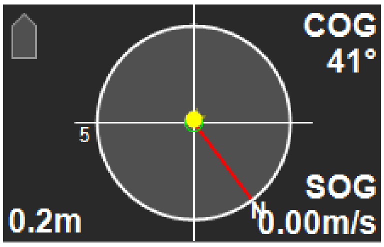


Figure 5.52: Position Console in the POS Mode

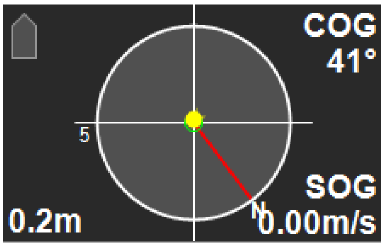


Figure 5.53: Position Console in the Hold Area Mode

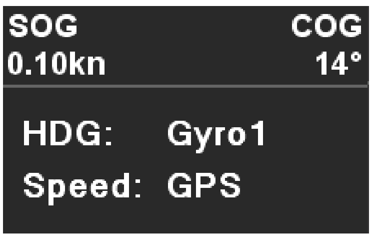


Figure 5.54: Position Console in the AP Mode)

5.12.4.3 Thrust Ability Diagram

Operating in the DP mode the bottom left console contains the Thrust Ability Diagram view (see Figure 5.55).

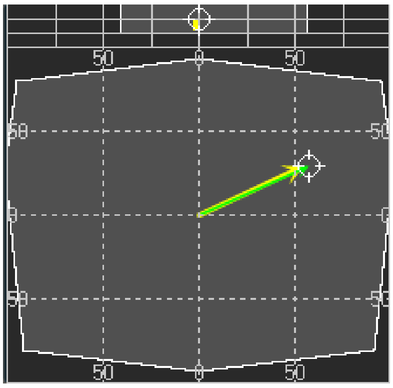


Figure 5.55: Thrust Ability Diagram (DP Mode)

Operating in the AP mode instead of the plot the rudders and propellers data are displayed (see Figure 5.56).

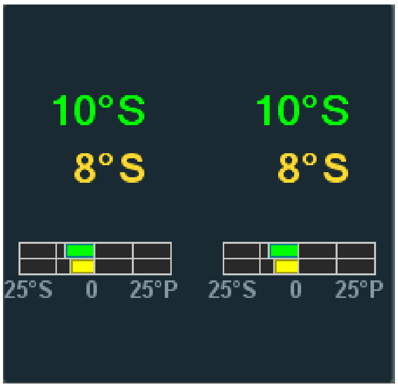


Figure 5.56: The Rudders and Propellers Data (AP mode)

5.12.5 Status Bar

The status bar is not displayed if the Mode Selector is in the Off position.
In other cases the status bar indicates the following data:

- Control mode(DP, AP, IJ);
- Heading mode (AUTO, MAN, Target, LS Track, Min Power, Dodge);
- Position mode (AUTO, MAN, Hold Area, Target, LS Track, MAN Surge, MAN Sway, Speed Vect);
- AWC status (displayed if only status is ON);
- Remote COR (displayed if only the COR is different from the center);
- TAL Mode (Synch Mode, High BIAS, Low BIAS, No BIAS).

Some examples of the status bar are represented on the Figures 5.57, 5.58.

Figure 5.57: Status Bar in the AP Mode

Figure 5.58: Status Bar in the DP Mode

5.12.6 Configuration Menu

Configuration menu is meant for accessing additional parameters of MCP. To activate the menu press and hold DIM+ and DIM- buttons at the same time. Use the encoder rotation to switch between the menu items and press the encoder to select the item.

There are following options in Configuration menu:

RETURN back to the previous window

Set volume sets volume of audible alarm

Set night palette switch to the night palette

Alarm test the alarm messages test

Print DP screen print the current screen

Lamp test activates the test of console lighting

System Information information about MCP version and hardware status.

Connections - choose connection from available in a list.

Service... switch to the Service menu

NOTE! The item list depends on the system configuration

The Service menu:

RETURN back to the previous window

Set panel role... the panel role setting (MCP, PCP,....)

Calibrate joystick joystick calibration function

Device test switch to the test list

Service mode activate the Service mode dialog

Restart panel activate the panel restart dialog

Reboot panel activate the panel reboot dialog

Shutdown panel activate the panel shutdown dialog

The Device test submenu:

RETURN - back to the previous window

Keyboard&encoder test

SD card test

EL-foil test

Joystick test

Battery test

Speaker test

Beeper test

Digital inputs test

Power management test

Show report - display the device overall report

The Service menu and its submenu are intended for engineers. The detailed information is in the Service Manual.

5.12.7 Modes and Functions

See Section 2.4.17, page 31

5.12.8 Values Setting in the AutoPos and HDG Modes

Operating in the AutoPos mode the the operator can set the surge and sway values using the encoder and the arrow push buttons.

The setting dialog (see Figure 5.59) is activated by pushing the the POS button or any arrow button. The control is provided by arrow buttons.

To delegate control to the encoder press the encoder when the dialog is active. After control is delegated encoder rotation is used to change the values. To select the value or to switch between the values press the encoder.

The HDG dialog is activated in similar way pushing the HDG button or a Knob Match indicator. The control is provided by the Knob Match indicators.

As for the POS dialog the control is delegated to the encoder by pressing the encoder when the dialog is active. Rotate the encoder to set a new HDG value and press the encoder to approve the value.

Figure 5.59: Setting with the Encoder

To set values with the arrows push buttons press any arrow button. The arrow indicators near the “Surge” and “Sway” items switch from gray to colored (see Figure 5.60).

Figure 5.60: Setting with the Arrows Buttons

5.12.9 CP Orientation

There are four orientations allowed for CP: forward, aft, port and starboard. This is adjusted in DP System during installation and commissioning.

Chapter 6

Thrusters

6.1 Thruster Windows

Use the Manual Thruster Window and the Auto Thruster Window for thruster operations.
The windows are shown in figures 6.1, 6.2.

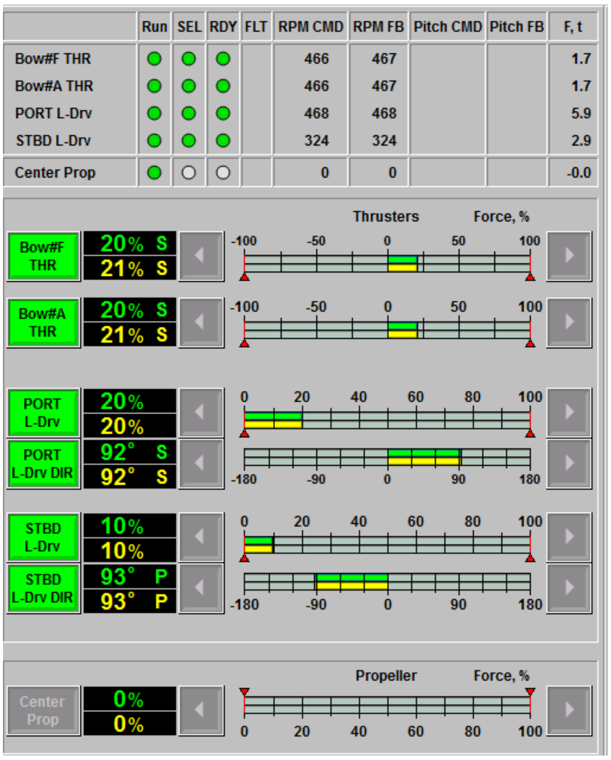
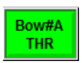


Figure 6.1: Manual Thruster Window

The Thrust Ability Diagram is displayed at the top of the Auto Thruster Window.
The Thrusters View is displayed at the bottom of the Auto Thruster Window.
The Thrusters State Table is displayed at the top of the Manual Thruster Window.
The Manual Thrusters Controls are displayed at the bottom of the Manual Thruster Window.

6.1.1 Thruster Softkeys

The softkeys are provided both in AutoThr and in ManThr windows.



The softkeys serve for selecting a particular mode the corresponding thruster should perform.

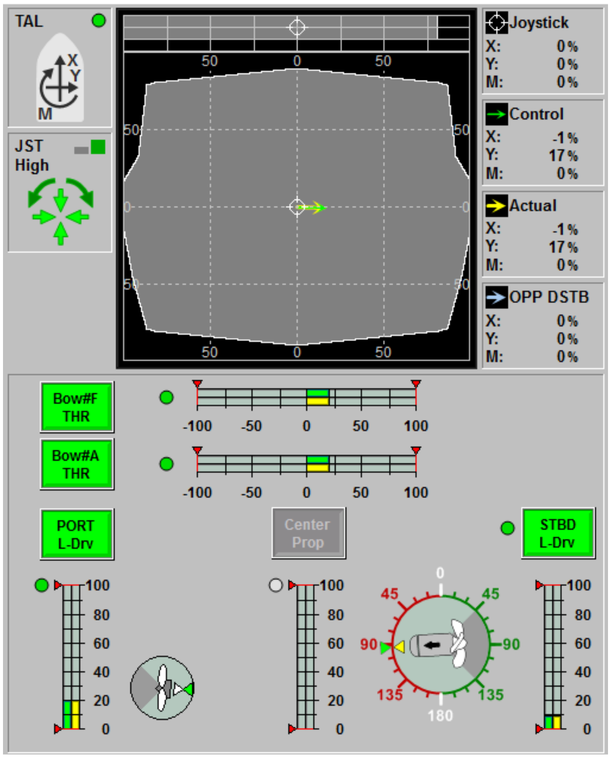


Figure 6.2: Auto Thruster Window

A thruster softkey are color coded. The colors are grey, dark green, light green, red, depending on the thruster state and available operations.

See Section 6.2.1, page 111 for thruster status details.

6.1.2 Thrust Ability Diagram (Auto Thruster Window)

If the vessel's heading or position or both are controlled manually, the Thrust Ability Diagram displays the following information:

- the desired values for forces vector $\mathbf{F}_{demand}$ and moment $\mathbf{M}_{demand}$;
- the actual values for forces vector $\mathbf{F}_{actual}$ and moment $\mathbf{M}_{actual}$;
- the estimated disturbance force vector $\mathbf{F}_{disturb}$ and moment $\mathbf{M}_{disturb}$;
- possible combinations of the forces vector $\mathbf{F}$ and moment $\mathbf{M}$

The Thrust Ability Diagram works in terms of forces vector $\mathbf{F}$ and moment $\mathbf{M}$, and is based on the Thruster Allocation Function usage (see Section 6.3, page 115).

The Thrust Ability Diagram contains some common data shared with Capability Analysis Function and the Consequence Analysis Function but, obviously, doesn't replace them.

The Thrust Ability Diagram is displayed at the top of the Auto Thruster Window.

NOTE!	The Thrust Ability Diagram view corresponds to the joystick orientation. The orientation (axis direction) is displayed at the top left corner.

Thrust Ability Diagram. Moment

The top bar is related to the moment $\mathbf{M}$.

Joystick Symbol corresponds to the moment demand from knob $\mathbf{M}_{demand}$.

Control The green bar corresponds to the control moment $\mathbf{M}_{control}$.

Actual The yellow bar corresponds to the actual moment $\mathbf{M}_{actual}$.

Disturbance The blue bar corresponds to the moment required to compensate an external disturbance moment $\mathbf{M}_{disturb}$.

The value of $\mathbf{M}_{demand}$ depends on rotary knob position – it is proportional to knob position.
The grey bar shows all possible (achievable) values for **M** for the present conditions.

6.1.2.1 Thrust Ability Diagram. Forces

The bottom bar is related to the force **F**.

Joystick The symbol corresponds to the to the demand force $\mathbf{F}_{demand}$.

Control The green vector corresponds to the control force $\mathbf{F}_{control}$.

Actual The yellow vector corresponds to the actual force $\mathbf{F}_{actual}$.

Disturbance The blue vector corresponds to the force required to compensate an external disturbance force $\mathbf{F}_{disturb}$.

The value of $\mathbf{F}_{demand}$ depends on joystick position
Maximum values of demand X- and Y-forces are the system parameters, they are tuned during the system calibration.
The grey area shows all possible values for **F** provided that the demand for **M** would not be changed. The scales are in % to maximum.

At "Speed VECTOR" mode (see Section 9.3.5, page 168) the corresponds to the joystick position, specified speed is proportional to the joystick position.
Maximum value of vessel speed is the system parameter, it is tuned during the system calibration.
If the system operates in the automatic control position mode ([POS]) the $\mathbf{F}_{demand}$ is automatically calculated according to the control algorithm.

6.1.2.2 Thrust Ability Diagram. Possible Forces/Moments Area

The grey bar for moment **M** and grey area for thrust **F** are of maximum size if:

- maximum power (from diesels or generators) is provided to the thrusters;
- all the thrusters are included in the Auto Thruster Group;
- all the limits in the Thruster Page and Power Page are set to maximum (100%).

If you set 50% limit to a thruster producing the turning moment and transverse thrust (for instance, a tunnel thruster), the diagram changes but without any change in the longitudinal force.
The graphical view of the thrust acceptable values is the grey region. In case the $\mathbf{F}_{demand}$ value is greater than the acceptable one the system set the **F** value equal to the maximum one.

The joystick symbol exactly means the actual demand for **F** only if the joystick symbol remains inside the grey area.
The actual value $\mathbf{F}_{actual}$ is displayed as a white vector.
Any change of the actual value $\mathbf{F}_{actual}$ makes to change the moment acceptable values range representing by a grey bar.
The knob sets the moment **M** according to the rotation angle. As mentioned above the acceptable values range is graphically represented by a dinamic grey bar. In case a **M** value assigned with the knob rotation is greater than the acceptable one the system sets the actual value equal to the maximum one.

Therefore, the knob symbol exactly means the command value for **M** only if the knob symbol remains inside the grey bar.
The actual value of **M** is displayed as a white bar.
If the knob symbol approaches the boundary, the grey area for **F** approaches the joystick symbol. However, if the knob symbol crosses the boundary, the grey bar for **M** expands in order to have the knob symbol inside. In that case the actual command value for **M** remains proportional to the knob position, but at the cost of insufficient value of **F**. That is because the vessel's heading is given a priority.

> **NOTE!** Some configurations provides no heading priority in the AutoHdg-ManPos modes

6.1.2.3 Thrust Ability Diagram. Automatic Modes

When the position is controlled automatically, the Thrust Ability Diagram continuously informs the of the margin in **F** and **M**.

If the vessel's heading or/and position is being controlled automatically, the corresponding symbols do not match to actual values of **F** and **M**. However, the actual values are always displayed, so the operator has information if the achievable thrust is close to the limit.

The wind force is also displayed in the diagram as a blue vector.

Then the operator has information whether the thrusters could provide enough thrust to compensate the wind.

6.1.2.4 Thrust Allocation Status

The TAL status round Indicator placed above the bar diagram is color-coded:

Green color indicates the thrust allocation is in operation;

Red color indicates that either Control Forces or Control Moment is missing.

The color of X/Y/M symbols is black if the thrust allocation of this axis is in operation. The red color means that the thrust allocation of the corresponding axis is missing.

6.1.2.5 Thrust Ability Diagram. Digital Indicators

There are digital indicators and legend at the right side of thrust ability diagram.

Control force $\mathbf{F}_{control}$ and moment $\mathbf{M}_{control}$.
: The green vector and bar mean the actual force and moment respectively.

: Digital indicators show the components of X,Y and M in % to required force maximal values and force values in tons.

Actual force $\mathbf{F}_{actual}$ and moment $\mathbf{M}_{actual}$.
: The yellow vector and bar mean the actual force and moment respectively.

: Digital indicators show the components of X,Y and M in % to required force maximal values and force values in tons.

: Estimation of an actual forces is calculated using thruster feedbacks.

: Signs rule is according with the Figure 2.33.

OPP DSTB force $\mathbf{F}_{disturb}$ and moment $\mathbf{F}_{disturb}$.
: The blue vector means the force, which is required to compensate disturbance force, while the blue bar means the moment, required to compensate disturbance moment.

Joystick Digital indicators show the joystick and knob position in %
: In **Speed VECTOR** mode the required speed is shown (see figure 6.3).

> **NOTE!** In the "Speed VECTOR" mode (see Section 9.3.5, page 168), the X and Y values are the required Vx and Vy (in percents to maximum value), and the marker corresponds to the joystick position too.

At changing-over from one mode to another one position of joystick and/or knob symbol can differ from the actual values of force and/or moment.

There is the Correction of the Joystck/Knob position Diagram at the left of the Thrust Ability Diagram (see figure 6.4). The diagram's arrows are coded for direction and color.

The arrows direction:

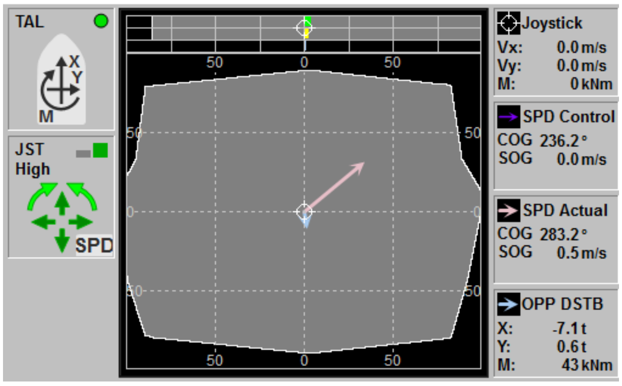


Figure 6.3: The required speed values in **Speed VECTOR** mode

in - the axis is in automatic control mode

out - the axis is in manual control mode

The arrows color code:

Green - the axis is in automatic control mode

Dark-green - the axis is in manual control mode

Light-gray - the axis is out of control or is not synchronized (the arrow direction is opposite to syncronization)

Red - the axis is not synchronized (the arrow direction is the same as syncronization)

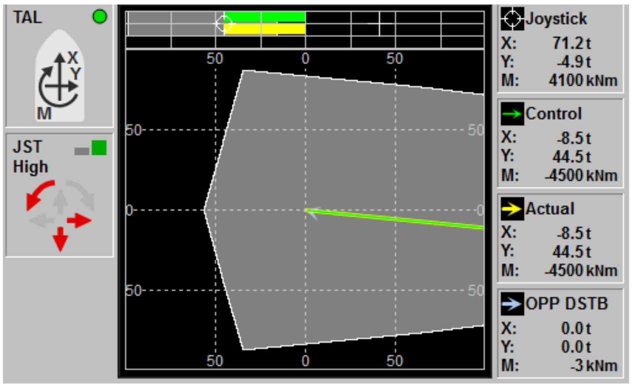


Figure 6.4: Thrust Ability Diagram. Red arrows: need to synchronize

The system keeps the actual value of force till the synchronization and moment and doesn't react to any tilt of joystick and rotation of knob unless they are synchronized.

6.1.3 Thrusters State Table (Manual Thruster Window)

The Manual Thruster Window (see figure 6.1) contains the columns:

Run — Run signal round indicator;

Sel — Select signal round indicator;

Rdy — Ready signal round indicator;

Flt — Fault signal round indicator;

Mode — Mode text indicator;

RPM cmd — RPM command digit indicator;

RPM fb — RPM feedback digit indicator;

Pitch cmd — Pitch command digit indicator;

Pitch fb — Pitch Feedback digit indicator;

F — Force digit indicator.

6.1.3.1 RUN Indicator

The Run indicator can be green or red.
The red color means that the RUN signal from a thruster is missing.
The green color means that RUN signal is present.

6.1.3.2 SELECT Indicator

The Sel indicator can be green, red or white.
The green color shows that **NAVIS NavDP 4000** is maintaining SELECT signal.
The red color shows that SELECT signal has been produced, but no READY signal has come in response.
The white color shows that, under current conditions, SELECT signal is to be released.

6.1.3.3 READY Indicator

The Ready indicator can be green, red or white.
The green color shows that a thruster system is maintaining READY signal in response to the corresponding SELECT signal being maintained by **NAVIS NavDP 4000**.
The red color shows that a thruster control system has not produced READY signal, although **NAVIS NavDP 4000** has already sent SELECT signal.
The white color shows that, under current conditions, READY signal is not produced.

6.1.3.4 Fault Indicator

The fault indicator can be red; otherwise it is not shown at all.
The indicator shows whether the situation is normal or faulty.
See failure section 6.2.4.3, page 114 for details

6.1.3.5 Mode Indicator

Mode indicator is text indicator for special modes (for example, FiFi mode)

6.1.3.6 RPM and Pitch Indicators

The feedback indicators display information received from the thruster control systems (feedback signals).
The command indicators display the command values to the thruster control systems.
If a thruster has two control inputs, as azimuth thruster (thrust itself and thrust direction), it has two pair of indicators.
The thrust indicator is located from the right of the feedback indicator, and shows the actual thrust of each thruster. If for a particular thruster the feedback field is empty (no digits displayed), it means that this information is not provided for **NAVIS NavDP 4000**. If the feedback field looks like ------, it means that no information comes.

6.1.3.7 Force Indicator

Actual force (calculated by **NAVIS NavDP 4000**).
The power units (tons, kN) are set in “Units” page of “PARAM” window.

6.1.4 Manual Thruster Controls (Manual Thruster Window)

- the bar graph and the numerical display shows the required (green) and actual (yellow) values.
- thruster softkey — see Section 6.1.1, page 101
- Arrow softkeys  and 

See Section 6.2.4, page 112 for details.

6.1.4.1 Rudder

The Manual Thruster Window contains the bar graph (Figure 6.5)and the numerical display(Figure 6.6 show the required (green) and actual (yellow) angle values.

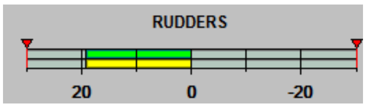


Figure 6.5: Rudder Bar Graph

Figure 6.6: Rudder Numerical Display

6.1.4.2 Propeller

The Manual Thruster Window contains the bar graph (Figure 6.7)and the numerical display (Figure 6.8) shows the demand (green) and actual(yellow) values for the thrust. The thrust is given in % to maximum. The following notation is used: **AS** means astern, **AH** means ahead.

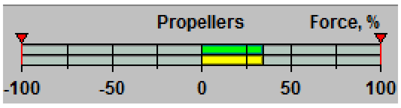


Figure 6.7: Propeller Bar Graph

Figure 6.8: Propeller Numerical Display

6.1.4.3 Azimuth Thruster

The Manual Thruster window includes two bar graphs (thrust and azimuth, Figure 6.9)as well as two numerical displays that show the demand (green) and actual (yellow) values for the thrust and azimuth (Figure 6.10).

The thrust itself is given in % to maximum, the thrust direction (azimuth) is given in degrees.

The following notation is used: **S** means starboard, **P** means portside.

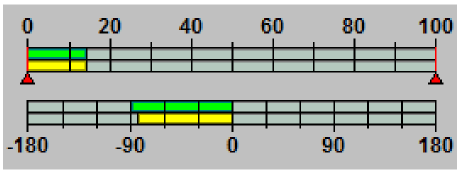


Figure 6.9: Azimuth Thruster Bar Graphs

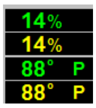


Figure 6.10: Azimuth Thruster Numerical Displays

6.1.4.4 Tunnel Thruster

The Manual Thruster Window contains the bar graph (Figure 6.11) and the numerical display (Figure 6.12) that show the required (green) and actual (yellow) values for the thrust.

The thrust is given in % to maximum.

The following notation is used: **S** means starboard, **P** means portside.

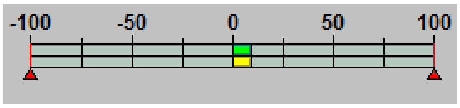


Figure 6.11: Tunnel Thruster Bar Graphs

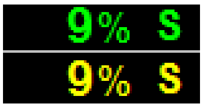


Figure 6.12: Tunnel Thruster Numerical Displays

6.1.4.5 Waterjet

A waterjet generates propulsive thrust from the reaction created when water is forced in a rearward direction.

Steering is achieved by changing the direction of the water stream as it leaves the jet unit. Pointing the jet stream one way forces the stern of the boat in the opposite direction which puts the vessel into a turn.

Reverse is achieved by lowering an astern deflector (E) into the jetstream after it leaves the nozzle. This reverses the direction of the force generated by the jet stream, forward and down, to keep the boat stationary or propel it in the astern direction.

The Manual Thruster Window contains two bar graphs (thrust and direction – see figure 6.13) and two numerical displays (Figure 6.14), showing the demand (green) and actual (yellow) values for thrust and direction.

The following notation is used: **S** means starboard, **P** means portside.

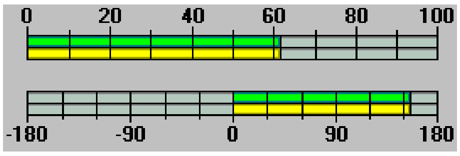


Figure 6.13: Waterjet Bar Graphs

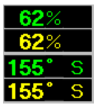


Figure 6.14: Waterjet Numerical Displays

6.1.5 Thruster View (Auto Thruster Window)

For each thruster, **NAVIS NavDP 4000** displays a thruster view accordingly to the thruster type.

The thrusters' layout on the Thruster View is similar to the thrusters' arrangement on the vessel.

NOTE!	Thruster view is shown accordingly to the orientation of the Operator Station

Thruster View contains for each thruster:

– the bar graph which shows the demand (green) and actual (yellow) values (command and feedback).

– thruster softkey (see Section 6.1.1, page 101)

– thruster state indicator (see Section 6.2.1, page 111)

6.1.5.1 Rudder

The actuator symbol (Figure 6.15), located in the Auto Thruster Window, shows the actual rudder angle.

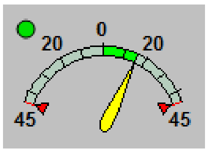


Figure 6.15: Actuator symbol

which shows the demand (green) and actual (yellow) angle values.

6.1.5.2 Propeller

For this thruster, **NAVIS NavDP 4000** controls the thrust itself.

The bar graph (Figure 6.16), located in the Auto Thruster Window, shows the actual thrust (yellow), as well as the thrust demand (green).

Pointer shows the thrust limit which has been set in the Thrust Page for this thruster.

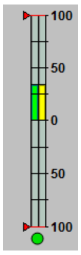


Figure 6.16: Propeller bar graph

The thrust is given in % to maximum.

6.1.5.3 Azimuth Thruster

For this thruster, **NAVIS NavDP 4000** controls the thrust direction (azimuth) as well as the thrust itself. The thruster symbol (Figur 6.17), located in the Auto Thruster Window, shows the desired and actual thrust direction.

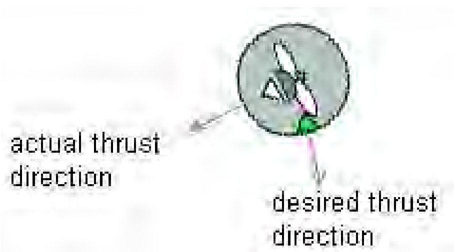


Figure 6.17: Thrust direction

The bar graph (Figure 6.18)shows the actual thrust (yellow) as well as the thrust demand (green).Pointer shows the thrust limit which has been set in the Thrust Page for this thruster.

Some configurations have the following azimuth thruster symbols: Figure 6.19, Figure 6.20.
The thrust is given in % to maximum, angle is given in degrees.
Prohibited sectors are shown as gray sectors, see Section 6.3.1, page 118 for details.

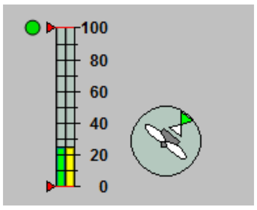


Figure 6.18: Azimuth thruster bargraph

Figure 6.19: Azimuth Thruster: forward

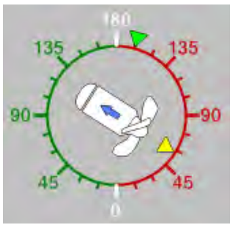


Figure 6.20: Azimuth Thruster: reverse

6.1.5.4 Tunnel Thruster

For this thruster, **NAVIS NavDP 4000** controls the thrust itself.

The bar graph (Figure 6.21), located in the Auto Thruster Window, shows the actual thrust (yellow), as well as the thrust required (green).

Pointer shows the thrust limit which has been set in the Thrust Page for this thruster.

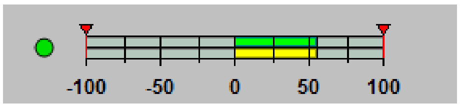


Figure 6.21: Tunnel thruster bargraph

and shows the required (green) and actual (yellow) values for the thrust. The thrust is given in % to maximum.

6.1.5.5 Waterjet

The actuator symbol, located in the Auto Thruster Window, shows the desired (green) and actual (yellow) thrust vector – see figure 6.22.

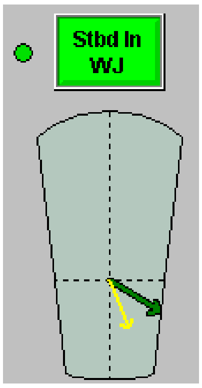


Figure 6.22: Waterjet thrust indicator

6.2 Thruster Operation

6.2.1 Thruster status

Each thruster can be:

– not available for DP operation.

The corresponding thruster softkey is grey or red.

– available for DP operation from Manual Thruster Window. The corresponding thruster softkey is dark green.

All such thrusters are the elements of the Manual Thruster Group, and each thruster is controlled separately from the others.

– available for DP operation from Auto Thruster Window.

The corresponding thruster softkey is light green. All such thrusters are the elements of the Auto Thruster Group, and the thrust demand to each thruster is assigned by the Thruster Allocation Function.

A round status indicator is displayed for each thruster that monitors whether the thruster can be taken to auto control status or not. This indicator is color-coded:

Green color means that the thruster can be taken to auto control status or have been already set in this status.

Red color means that the thruster cannot be taken to auto control status because the control is failed.

White color means that the thruster cannot be taken to auto control status because it is not available for this control mode.

6.2.2 Thrust Demand

The Thruster Allocation Logic distributes the thrust demand (force and moment) between automatically controlled actuators.

Dealing with a thruster, **NAVIS NavDP 4000** operates in term of its thrust, in whatever way the thrust is produced. **NAVIS NavDP 4000** receives feedback signals (rpm, pitch, azimuth angle, rudder angle etc.) and calculates the actual thrust.

The value of the actual thrust is then indicated in % to maximum. Those propulsion parameters which produce the thrust (i.e. rpm, pitch, azimuth angle, rudder angle etc.), are also indicated in numerical form. When controlling a thruster, **NAVIS NavDP 4000** calculates the **thrust demand**. The thrust demand is then transformed to desired propulsion parameters (i.e. desired rpm, pitch, azimuth angle, rudder angle etc.), and these parameters come from **NAVIS NavDP 4000** at the input of the thruster control system.

Independently of the number of the thrusters and their types and locations, their effect on the vessel can be described by the vector force **F** and the rotational moment **M**.

If the vessel's position is controlled manually, with the joystick, the demand for **F** is calculated accordingly to the joystick position. If the vessel's position is controlled automatically, the demand for **F** is calculated by means of a particular control algorithm, dependently on the control mode activated.

If the vessel's heading is controlled manually, with the rotary knob, the demand for **M** is calculated accordingly to the knob angle. If the vessel's heading is controlled automatically, the demand for **M** is calculated by means of a particular control algorithm, dependently on the control mode activated.

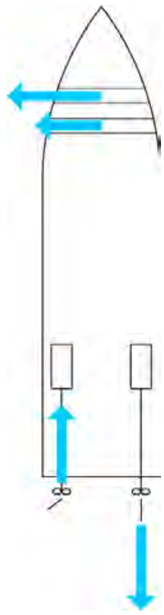


Figure 6.23: Thrust Allocation

The demand for **F** and **M** must then be shared by the thrusters from the Auto Thruster Group, which is performed by the Thruster Allocation Function. This function assigns the thrust demand to each thruster from the Auto Thruster Group.

The figure 6.23 demonstrates that there are many ways in which a combination of **F** and **M** can be shared by the thrusters. The Thruster Allocation Function always does it in an optimal manner, with many limitations taken into account.

6.2.3 Thruster Control

In normal operation, a thruster can be controlled whether manually or automatically. We say the thrusters controlled manually (respectively, automatically) to constitute the **Manual** (respectively, **Auto**) **Thruster Group**.

When the thruster is included into the Manual Thruster Group, its thrust demand is set independently from other thrusters and no command comes to it except the command that can be input manually from Manual Thruster window. The thruster does not participate in joystick/knob control as well as automatic control.

In this case, the thruster softkey is dark green.  and  softkeys can be used in Manual Thruster window to control the thruster. These softkeys are light green. When pressing these softkeys, the thrust demand (the green line) can be changed.

The thruster control system controls the thruster so as to provide the actual thrust equal to the demand (the yellow line). For an azimuth thruster, you can set the thrust direction (azimuth) to be controlled manually, while the thrust itself is included in the Auto Thruster Group.

If you are going to include an automatically controlled thruster (with softkey green) in the Manual Thruster Group press the thruster softkey and then press ENTER to acknowledge. To remove a thruster from the Manual Thruster Group (and thus include in Auto Thruster Group), do the same.

6.2.4 Interface with the Thrusters

6.2.4.1 Interface Signals

NAVIS NavDP 4000 interfaces to each thruster by means of the signals listed below.

Run (Available for DP) Signal from thruster to **NAVIS NavDP 4000** and means that

- the thruster motor is running without any fault;
- thruster control can be transferred to the **NAVIS NavDP 4000** at any time upon the **NAVIS NavDP 4000** request.

Select Signal from **NAVIS NavDP 4000** to a thruster and means that the **NAVIS NavDP 4000** is going to take control over the thruster.

Ready Signal from a thruster to **NAVIS NavDP 4000** in response to SELECT, and means that from this time the thruster is controlled by **NAVIS NavDP 4000**.

Feedback Feedback signal from a thruster, in terms of voltage or current, which allow the **NAVIS NavDP 4000** system to estimate actual thrust produced by the thruster.

For example – rpm feedback, pitch feedback for CPP, angle feedback for azimuth thruster or rudder.

Linear, sin/cos or 3-phase angle feedback signal can be realized for azimuth thrusters.

Command Analog command signal from **NAVIS NavDP 4000** to a thruster, in terms of voltage or current, which is proportional to the desired thrust (“Thrust command”) or rpm (“rpm command”) or pitch (“Pitch command”) for CPP or angle (“Angle command”) for rudders and aziumth thrusters.

Command signal may be tansefered as proportional analog signal or discrete signal from **NAVIS NavDP 4000** to a thruster, for example steering gear NFU commands (see below).

Linear, sin/cos, 3-phase angle command signal, bang/bang or proportional rate control signal can be provided for azimuth thrusters.

Combined control can be realized for CPP propellers/thrusters: two separate commands — rpm and pitch.

Direction discrete command Discrete signals — clutch ahead/astern command signals for propellers, port/starboard command signals for tunnel thrusters.

Direction discrete feedback Discrete signals — clutch ahead/astern feedback signals for propellers, port/starboard feedback signals for tunnel thrusters.

Thruster CB Status — Discrete feedback signal from a thruster (open/close), for PMS function

Thruster Power — Analog (voltage or current) feedback signal from a thruster, for PMS function

NOTE! The system configuration can include additional conditions to generate the “available for DP” signal

6.2.4.2 Normal Operation

If the Mode Selector is set to MANUAL position, the thruster’s state is indicated as

Run	Select	Ready	Fault
Green	White	White	

The thruster control softkey is grey (deactivated). After the Mode Selector is set in IJ or DP position, **NAVIS NavDP 4000** checks for each thruster whether the corresponding RUN signal is present. If yes, **NAVIS NavDP 4000** sends SELECT signal to each thruster and because in normal operation RUN signal is present for each thruster and starts waiting for READY signal in response. The Sel indicator turns green. After receiving READY signal, the Rdy indicator turns green too. Therefore, the thruster’s state becomes as below

Run	Select	Ready	Fault
Green	Green	Green	

The thruster control softkey turns dark green, which means that the thruster is not included into the Auto Thruster Group, and can only be controlled manually by means of  and  softkeys. Furthermore, the thruster can be included in the Auto Thruster Group.

If the Mode Selector is set to MANUAL position, **NAVIS NavDP 4000** releases SELECT signal, and the thruster’s state becomes

Run	Select	Ready	Fault
Green	White	White	

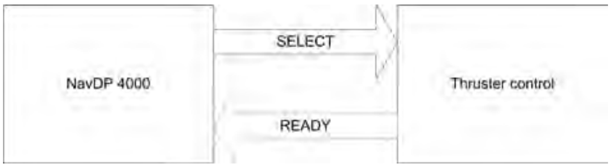


Figure 6.24: Signals exchange

The above described is normal operation.

While the thruster is under DP control, **NAVIS NavDP 4000** maintains SELECT signal, and the thruster system maintains READY signal in response. If **NAVIS NavDP 4000** releases SELECT signal then the thruster system releases READY signal in response. See Figure 6.24.

The thruster system can release READY signal without SELECT signal released, which means that the thruster is out of the DP control.

When the thruster system releases RUN signal it means that the thruster is not available for DP operation. In this case, SELECT and READY signals are to be released.

Without RUN signal, **NAVIS NavDP 4000** does not know whether the thruster is available for DP. It is very similar to the requirement of monitoring if data from sensors and position reference systems is available for DP, regardless of whether **NAVIS NavDP 4000** active or not.

6.2.4.3 Failure Mode — RUN Signal Lost

If a thruster does not send RUN signal then, independently of the position of the Mode Selector, the thruster's state is indicated as

Run	Select	Ready	Fault
Red	White	White	Red

This situation is faulty, which is signalized by the Flt indicator colored red. In this situation the thruster is not available for DP, and the thruster control softkey is grey in whatever position the Mode Selector is set.

Since the thruster can later be available for DP, you must properly put it into operation. There are two common situations.

a) The Mode Selector is set to MANUAL position. After RUN signal has recovered, the thruster's state is indicated as

Run	Select	Ready	Fault
Green	White	White	

and the thruster control softkey remains grey. The next steps are described in section "Normal Operation"

b) The Mode Selector is set to IJ or DP position (NAVIS NavDP 4000 is active). After RUN signal has recovered, the thruster's state is indicated as

Run	Select	Ready	Fault
Green	White	White	Red

and the thruster control softkey gets red, which means that the thruster has just recovered from a failure mode. Press the thruster softkey. It starts blinking. Press the softkey once again to cancel, or press ENTER softkey to acknowledge.

The operation is available for a thruster group. Press and hold any of the red-colored thruster softkeys until the dialog box shown in Figure 6.25 appears.

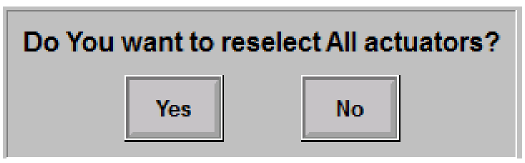


Figure 6.25: Dialog box

After pressing ENTER, (or Yes) **NAVIS NavDP 4000** immediately sends SELECT signal to the thruster, (or thruster group) and starts waiting for READY signal in response. This situation is shown below

Run	Select	Ready	Fault
Green	Green	Red	Red

If READY signal comes before the waiting period expires, the round indicators will look as

Run	Select	Ready	Fault
Green	Green	Green	

and the thruster control softkey turns dark green. You can then press this softkey once again (and press ENTER softkey to acknowledge) to include the thruster in the Auto Thruster Group.

6.2.4.4 Failure Mode — READY Signal Lost

a) READY signal fails during normal operation
In normal operation, the thruster's state is indicated as

Run	Select	Ready	Fault
Green	Green	Green	

If READY signal is lost, **NAVIS NavDP 4000** waits for a short period while indicating the thruster's state as

Run	Select	Ready	Fault
Green	Green	Red	

If there is no READY signal during the waiting period, the thruster's state becomes as below

Run	Select	Ready	Fault
Green	White	White	Red

b) READY signal fails while recovering the thruster from a failure mode
If the thruster has just recovered RUN signal, its state is indicated as

Run	Select	Ready	Fault
Green	White	White	Red

The thruster softkey is red. To put the thruster into operation press the thruster softkey and then press ENTER softkey. The new thruster's state is

Run	Select	Ready	Fault
Green	Green	Red	Red

If the waiting period of time expires but there still is no READY signal, the thruster's state changes to the previous one, i.e.

Run	Select	Ready	Fault
Green	White	White	Red

6.3 Thruster Allocation Function

The Thruster Allocation Function (Thrust Allocation Logic, TAL) has the demand for **F** and **M** as the input value, and then calculates the thrust demand to each thruster included in the Auto Thruster Group. This allows you to perform the same maneuver with different thruster configurations, provided that the maximum possible thrust covers all the needs. Indeed, if one of the thrusters from the Auto Thruster Group has been lost during DP operation or removed from the Auto Thruster Group, its thrust will be distributed among the remaining thrusters, so that the demand for **F**and **M**will be satisfied.

The Thruster Allocation Function is a sophisticated optimization algorithm, it also takes into account all the power limits to generators and thrusters which you have set in the Thruster and Power Pages. This function also takes into account the positions of the circuit breakers and the tie breakers.

The Thruster Allocation Function is tuned to provide the best performance for specific vessel arrangement at any environment.

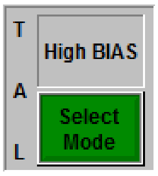


Figure 6.26: TAL area

6.3.1 TAL Modes

Usually, several Allocation Modes are available to set up by DP operator. If "TAL Mode" option is available, the Mode/Function panel includes the indicator of the current Thrust Allocation Mode, and the softkey used for selecting other Allocation Modes (see Figure 6.26)

Pressing the Select Mode softkey, the bar appears on the screen to provide a choice of desired Allocation Mode(see Figure 6.27)

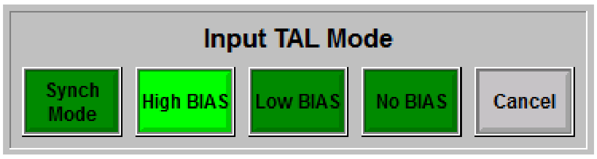


Figure 6.27: TAL mode dialog

TAL is available in the DP mode only (see Figure 6.28).

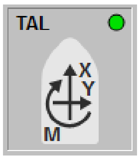


Figure 6.28: Indicator of the TAL status

The TAL indicator is green if TAL is available and the preset values of forces and moments are in the Thrust Allocation Diagram. In case the values are out of the diagram the indicator is red.

The TAL indicator is light-gray in case of the AP mode.

Set of allocation modes available depends on actuators set.

Typical modes are:

Port Ahead TAL Mode for twin-propeller (FPP) ship. Port propeller works ahead.

Stbd Ahead TAL Mode for twin-propeller (FPP) ship. Starboard propeller works ahead.

Low Bias Low degree of thruster bias. About thruster biasing see below

High Bias High degree of thruster bias. About thruster biasing see below

No Bias No thruster biasing

Free Rotation Mode for ships with aziumuth thusters – low penalty for azimuth rotation

Sync Group of thrusters work synchronized, or almost synchronized – due to high penalty for difference (for example, groups of two azimuths for 4-azimuth ship) or only one-axis (sync X-axis)

Auto DP System selects mode automatically

Thruster Biasing — allows thruster(s) to counteract other(s) so that resulting effect of biasing is zero.

Thruster biasing does not reduce vessel capability since the counteraction will be reduced when the total demand force increase. Being set up to Bias, thrusters consumes more power however provide faster response to demand force change and better DP performance.

Thruster Biasing is useful in the following situations:

– When azimuth thruster cannot give zero thrust. Other thrusters can be used to compensate minimum force.

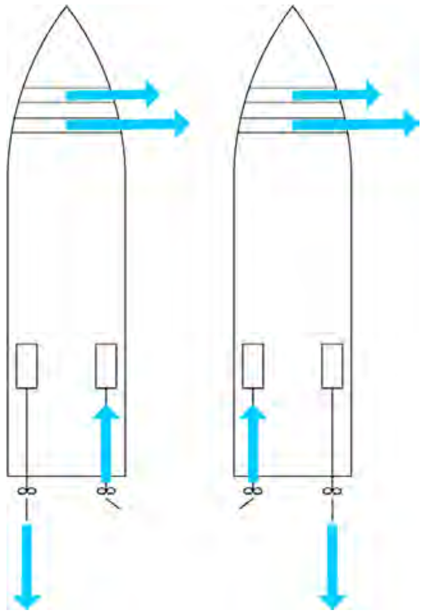


Figure 6.29: Thrust Allocation Modes: Starboard Ahead and Port Ahead

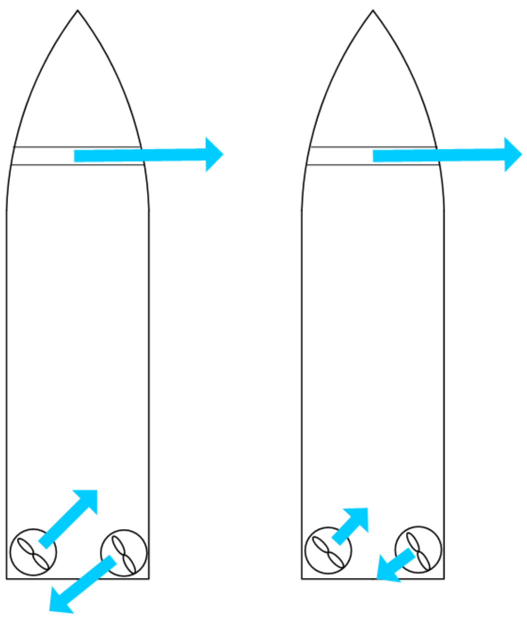


Figure 6.30: Thrust Allocation Modes: High and Low Bias

– When weather is bad or environment changes direction slowly.

– When fast DP maneuvers are required.

– When accurate station keeping is the highest priority for intermediate environment.

Prohibited Azimuth Sector — prohibit thrust direction for particular azimuth thruster to avoid thruster-to-thruster and hull-to-thruster interaction, see Figure 6.31.

Figure 6.31: Prohibited Azimuth Sector

See Section 6.1.2, page 102 for Thrust Ability diagram.

6.4 Power Monitoring and Blackout Prevention

The PMS Function acts in addition to the vessel's Power Management system. The function is active in all operational modes.

The PMS function can be turned on/off from **PARAM** window, **PWR LIM** tab (see Figure 6.32).

Figure 6.32: PMS Function Turning On/Off

In case PMS monitor function is turned off by the operator, the red-colored text **"PMS Function Off"** is displayed on the **Master CPU** panel (see Figure 6.33).

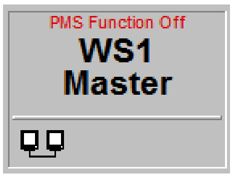


Figure 6.33: PMS Function Off on the Master CPU Panel

NOTE! **NAVIS NavDP 4000** cannot control the generator load and power sharing. The only way to influence the generator load is the thruster load control.

Therefore, **NAVIS NavDP 4000** assigns the thrust demand to each thruster so that:

– to provide good performance in a particular operational mode;
– to avoid generator's overload and provide **blackout prevention**.

6.4.1 Power Monitoring

The goals mentioned above may conflict, therefore **NAVIS NavDP 4000** tries to achieve a trade-off between them. The following data is considered:

– current power output of each generator;
– current power input of external consumers;

– maximal power limits (in %, represented as scales) for each generator (this parameter is set in the Pow Lim parameter page);
– maximal power limits (in %, represented as scales) for each thruster (this parameter is set in the Thr Lim parameter page);
– position of each circuit breaker and the tie breaker;
– current value of power input from each thruster.

Based on this information, the PMF continuously monitors the power system and produces recommendation to the Controller and the Thrust Allocation function, so that the upper limits for the generators and thrusters would not be exceeded. The generator upper power limits set in the Pow Lim parameter page are normally smaller compared to the limits of the vessel's Power Monitoring system (PMS), so that the vessel's PMS interferes when the **NAVIS NavDP 4000** cannot keep the generator's load within predetermined limits.

6.4.2 Generator/Engine Overload Protection and Blackout Prevention

Automatic reducing thrusters' pitch/rpm is used for generators/bus bars overload protection.

Automatic reducing of propellers' pitch/RPM is used for main engine overload protection.

Generator Overload Protection and Engine Overload Protection functions can be turned on/off from **PARAM** window, **PWR LIM** tab (see Figure 6.34).

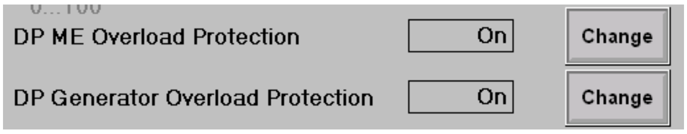


Figure 6.34: Overload Protection Settings

In case generator/engine overload protection is turned off, in the Power window main engine (ME) and/or bus name and the numerical value of the corresponding fields AVAIL are highlighted in yellow (see figure 6.35).

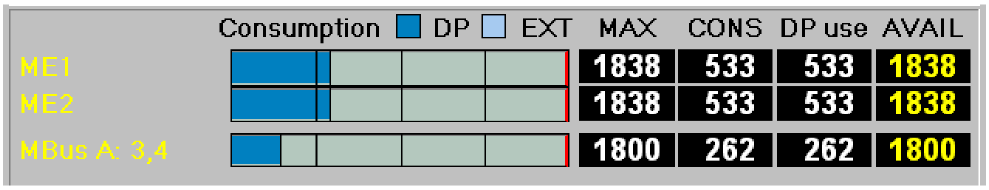


Figure 6.35: Diesel Protection off and Blackout Prevention off

At some problems in power signals of Generator, its Overload Protection Function will be automatically turned off.

6.4.3 Power Alarms

Generates an alarm when power limits are exceeded.

NAVIS NavDP 4000 interfaces each generator by means of the signals listed below.

Generator Breaker Status — discrete feedback signal;

Generator Power – analog (voltage or current) feedback signal for PMS function.

Besides that, for all tie breakers the **Tie Breakers Status** signal is used.

For each Main Engine, the **Main engine Power** feedback signal is used.

6.4.4 Power View

The Power View provides you with all the information about the thruster and generator load, the positions of the circuit breakers and tie-breakers. It is displayed in Power window. Use the Select window softkey on SYS panel to open the Power window.

An example of power window is shown in Figure 6.36.

The Power View window is divided into 3 areas:

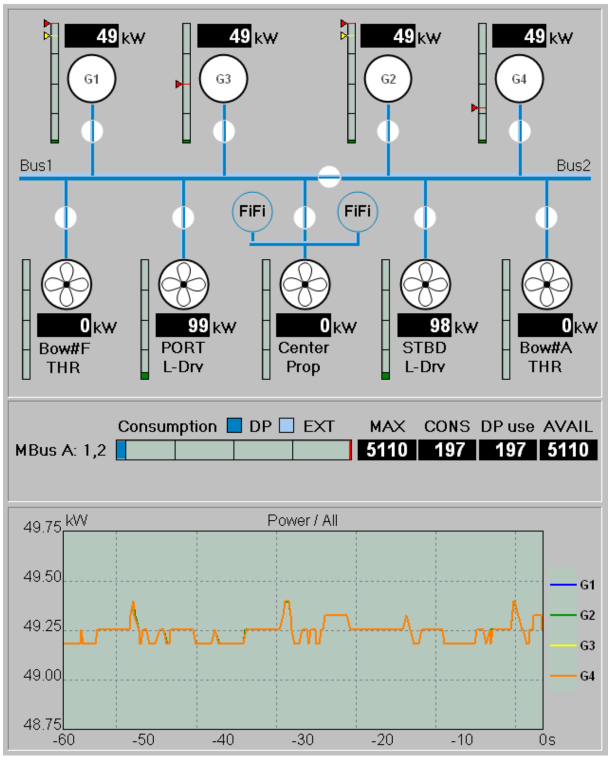


Figure 6.36: Power Window Example

- Power mimic diagram
- Power consumption display
- Power trend view

Power mimic diagram

On the Power mimic diagram in the top of the Power View the following information is shown:

- how generators and thrusters are connected to buses;
- power produced by each generator;
- power consumed by each thruster;
- status of each circuit breaker and tie breaker;
- how extra load (if any) such as Fi-Fi pumps or hydraulic drives is applied to diesel engines.

Examples of power mimic diagrams are shown in Figure 6.37.

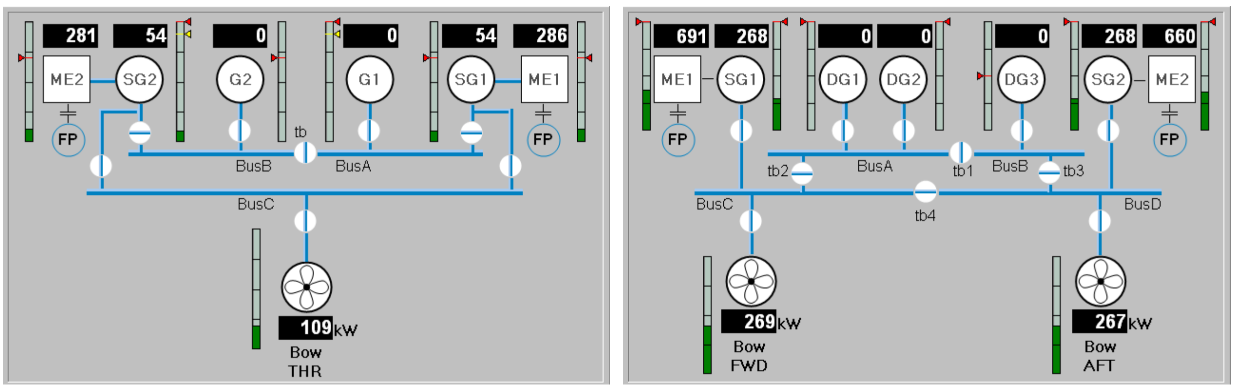


Figure 6.37: Power Mimic Diagram Examples

Generator is driven by a diesel engine

If a generator is driven by a diesel engine, and there is no extra load on the diesel engine, the information about the generator is displayed as shown in Figure 6.38

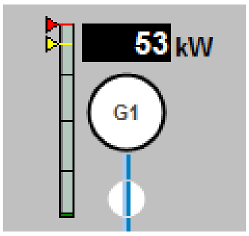


Figure 6.38: Generator on scheme

which includes:

– round indicator with the generator short name. It's color coded. White color means that the generator is connected to a bus, otherwise the color is grey.

– circuit breaker indicator. If the generator is connected to a bus the circuit breaker is displayed closed; otherwise it is displayed open.

– generator power numeric indicator

– generator power bar indicator that shows the current produced power as a percentage of the maximum available power.

– limit on the power demand (limit on the command signal) from the DP control system. This limit is set in Power-Limits page of Param window.

Pointer shows the power limit which has been set in the Param window.

If the diesel engine can run a FiFi pump, it is displayed as shown in Figure 6.39.

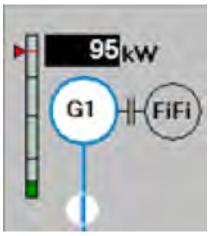


Figure 6.39: FiFi pump on scheme

– Fi-Fi pump indicator is white-colored if the Fi-Fi pump is connected otherwise it is grey-colored.

– the generator round indicator becomes yellow-colored, if a Fi-Fi pump connected causes the power limitation on the generator from the DP control system (i.e. the DP control system automatically reduces the maximum available power for this generator).

– the other generator indicators are yellow as well if this power limitation is applied to all the generators connected to the same bus (even if some of them are not driving Fi-Fi pumps) and the message “Limited by FiFi” is displayed below the bus symbol (Figure 6.40).

Figure 6.40: Message “Limited by FiFi”

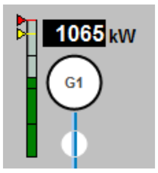


Figure 6.41: Shaft generator on scheme

Shaft Generator

The information about a shaft generator is displayed as shown in Figure 6.41
which includes:

- round indicator with the shaft generator short name. It's color coded. White color means that the generator is connected to a bus, otherwise the color is grey.
- circuit breaker indicator. If the shaft generator is connected to a bus the circuit breaker is displayed closed; otherwise it is displayed open.
- shaft generator power numeric indicator.
- shaft generator power bar indicator that shows the current produced power as a percentage of the maximum available power.
- limit on the power demand (limit on the command signal) from the DP control system. This limit is set in Power-Limits page of Param window and shown with pointer .

Main Engine

The information about the power consumed by the main engine is displayed as shown in Figure 6.42

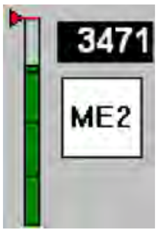


Figure 6.42: Main engine on scheme

which includes:

- square indicator with the main engine short name.
- main engine power numeric indicator.
- main engine power bar indicator that shows the current produced power as a percentage of the maximum available power.
- limit on the power demand (limit on the command signal) from the DP control system. This limit is set in Power-Limits page of Param window and shown with pointer .

If the main engine can run a FiFi pump, it is indicated as shown in Figure 6.43

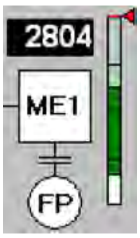


Figure 6.43: FiFi pump on scheme

- fire pump indicator is white-colored if the Fire pump is connected otherwise it is grey-colored.
- power consumed by the fire pump is indicated by white color on the power bar indicator.

6.4.4.1 Thruster

The information about the power consumed by the thruster is displayed as shown in Figure 6.44

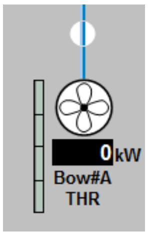


Figure 6.44: Thruster on scheme

which includes:

- round indicator which is color coded. White color means that the thruster is connected to a bus, otherwise the color is grey.
- circuit breaker indicator. If the thruster is connected to a bus the circuit breaker is displayed closed; otherwise it is displayed open.
- thruster power numeric indicator. The power unit is set in Units page of Param window.

6.4.4.2 The System Indication of ‘PMS Limitation’ Signals

The PMS limitation signal is delivered from external equipment which can control the thruster, and has higher priority compared to **NAVIS NavDP 4000**. This equipment may be for instance the vessel’s power management system. If this signal has come, the thruster command signal is limited by the external equipment, so that it may be the feedback signal differs much from the command signal set by **NAVIS NavDP 4000**. This situation is not interpreted as a failure.

The following elements indicates when the signal is obtained:

- bus becomes red-colored on the power mimic diagram and the inscription ‘PMS Limitation’ is indicated above the bus (Figure 6.45)
- the power limited thruster indicator becomes yellow (Figure 6.46)
- power limited thruster symbols become yellow on the Power mimic diagram (Figure 6.47)

When the signal is lost this indicator disappears and the bus becomes blue-colored.

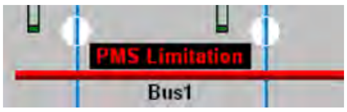


Figure 6.45: PMS Limitation

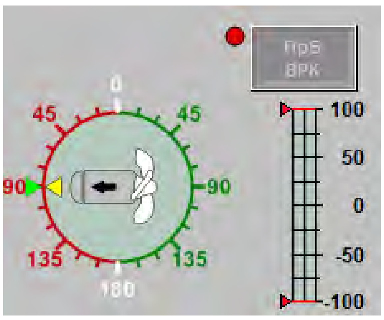


Figure 6.46: A power limited thruster indication example

The indication of “PMS Limitation” signal is provided depending on the system configuration.

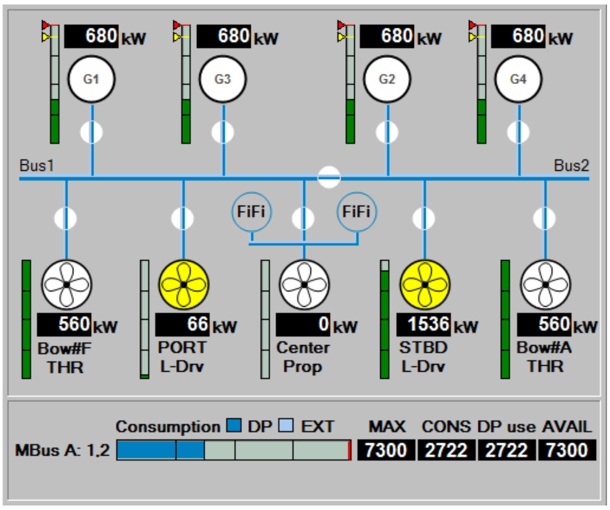


Figure 6.47: An example of power limites thrusters in the Power mimic diagram

6.4.4.3 Power consumption display

Power consumption display in the middle part of the Power View where the information about power consumption on main buses and main engines is shown.

Note that the maximum available power and power available for DP are calculated for the generators connected to the bus, and for the generator power limits which have been set in the PowerLimits parameter page. If the tie-breaker is closed, the two buses are considered as one bus.

The name of one or several buses (depending on the tie breaker position) and main engines is indicated in the left part as shown above. If the name of the bus (or buses) is red it means that Blackout prevention function is activated for the bus (or buses), black – not activated.

Total power consumption is displayed as a percentage of the maximum available power on a bar graph:

- Dark blue bar shows the power used for DP operations;
- Light blue bar shows the power consumed by the external power consumers.

Numerical indicators show the power values for:

Max	maximum available power
Cons	consumed power (by all the consumers)
DP use	power used for DP operations
Avail	power available for DP operations

NOTE! Power units are set in the Measure units page of the Param window.

6.4.5 Indication of Blackout Prevention Function

When a generator is overloaded, the Generator power bar indicator becomes red-colored. It means that Blackout Prevention Function is activated. The name of the bus to which a generator is connected becomes red-colored. The alarm ‘BusN Blackout Prevention: Gm’ is generated in the system, where N means a bus name, m is a number of the generator overloaded. When a main engine is overloaded the alarm ‘Port (Stbd) Main Engine Overload Protection’ is generated in the system. Main Engine power bar indicator becomes red-colored.

6.4.6 Power trend view

Power trend view is at the bottom of the Power View where you can monitor the Power Graph (Figure 6.48). On the Power Graph a curve for each generator, shaft-generator and main engine selected within a specified time span.

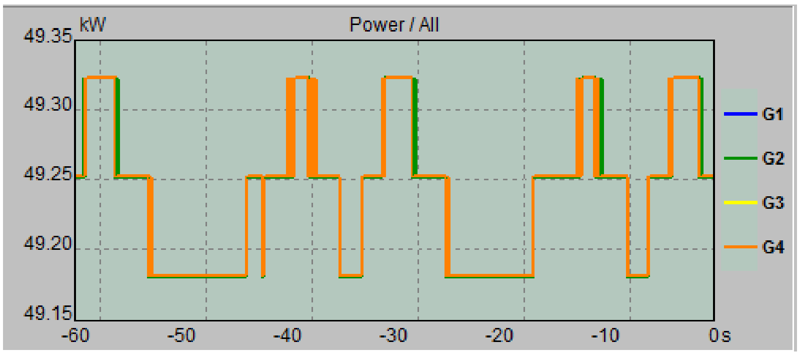


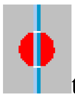
Figure 6.48: Power trend view

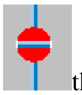
Each power curve is color-coded. In case of equal load of two or more generators one curve can overlap the other(s). See Section 5.8, page 81 for more detailed information about trends configuring.

6.4.7 Failure modes

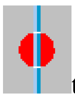
NAVIS NavDP 4000 compares the information about the position of a generator or thruster circuit breaker with the actual power consumed by the generator or thruster.

There may be two situations where the generator circuit breaker status signal and the generator power signal are mutually contradictory:

– the circuit breaker is open while the generator power is remarkably more than zero. In this case the system considers the generator working, the breaker state as closed and displays red indicator;

– the circuit breaker is closed while the break of the power signal is detected. In this case the system considers the breaker as open one and displays the red indicator.

For a thruster breaker:

– the breaker status is indicated as OPEN while the consumed power is indicated as not zero(i.e. the generator isn't supplying power to the bus). In this case the system does not remove the thruster from the Auto Thruster Group.

The tie breaker failure modes depends on vessel configuration.

Chapter 7

Sensors

7.1 Sensors Data Processing

The **NAVIS NavDP 4000** system processes raw sensors data using complex Kalman-based filtration.

Data processing algorithms allow determining the faults like jumps, drift, high noise etc, and also allow the short prediction when no data is received at all.

The results of processing is the output of filter of “main” sensor (priority sensor). For the continuity of processing results in some situations, the bias factor is added.

7.1.1 Sensors Priority

Sensor Priority can be changed manually (by operator) or automatically when priority sensor is fault or turned off.

7.1.2 Sensors Fault Detection and Redundancy

- Median-like test for three sensors (gyros and VRS sensors). Two alarm levels are used: alarm only (with changing the priority sensor) and reject sensor.
- “Discrepancy” test for two sensors (alarm only).
- Prediction test (alarm when raw data and fiter output discrepancy detected).
- Jump detection based of multi-hypothesis Kalman-like filter (with changing the priority sensor if necessary). This test is useful for GPS-compasses.

7.1.3 Data Processing Results

The following processed data is calculated: heading and yaw rate for compasses, wind speed and wind direction for wind sensor, pitch and roll angles for VRS.

7.2 Sensor Interface and Operations

Initiate the **Sensors** window (fig. 7.1) for the information about the sensors used by **NAVIS NavDP 4000**.

The window is divided into three parts:

- navigation bar (see section 7.2.1);
- table containing the specified sensor group data (see section 7.3);
- graph/sensors parameters .

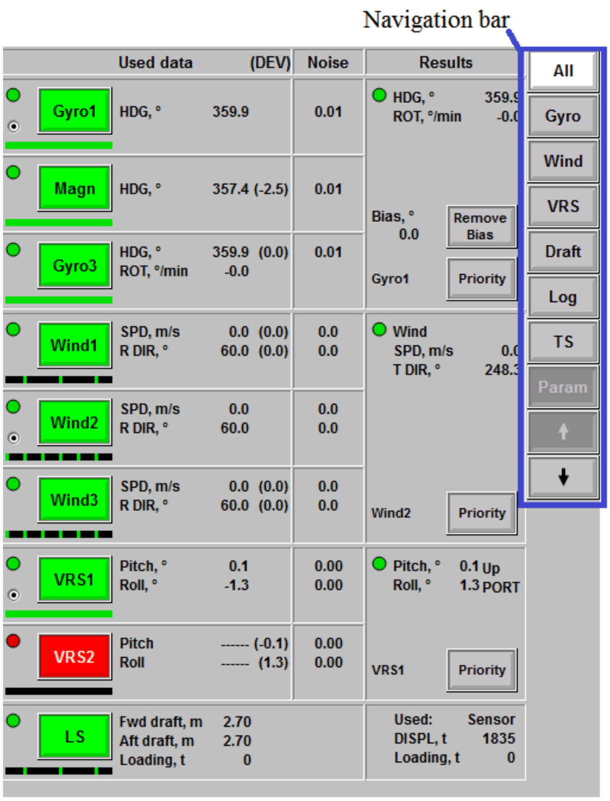


Figure 7.1: Sensors window

7.2.1 Navigation Bar

Navigation bar contains a group of the softkeys to control the view of the Sensor window:

– Softkeys for selection of the sensors to be displayed on the window

All — press to monitor all the sensors;

Gyro — press to display Gyro Sensors details, graph and parameters;

Wind — press to display Wind Sensor details, graph and parameters;

VRS — press to display VRS details, graph and parameters;

Draft — press to display Loading (Draft) Sensor details, graph and parameters.

The softkey of the sensor group selected for displaying is white-colored. The others are grey-colored.

– Arrow softkeys Use the arrow softkeys to scroll a list of sensors, if required in case many sensors of different groups are used.

The softkeys are light grey if they are available.

The softkeys are dark grey if they are not available.

– Graph/Param softkey

Graph/Param softkey — press to switch between Sensors Graph and Sensors Parameters for the sensor group selected.

If the **ALL** softkey is activated and all sensors are shown this softkey is dark grey and not available.

7.2.2 Parameters protection

To protect parameters from unauthorized value changes the system requests a password just after the **Apply** softkey has been pressed. To input the password use the virtual keyboard (see figure 7.2).

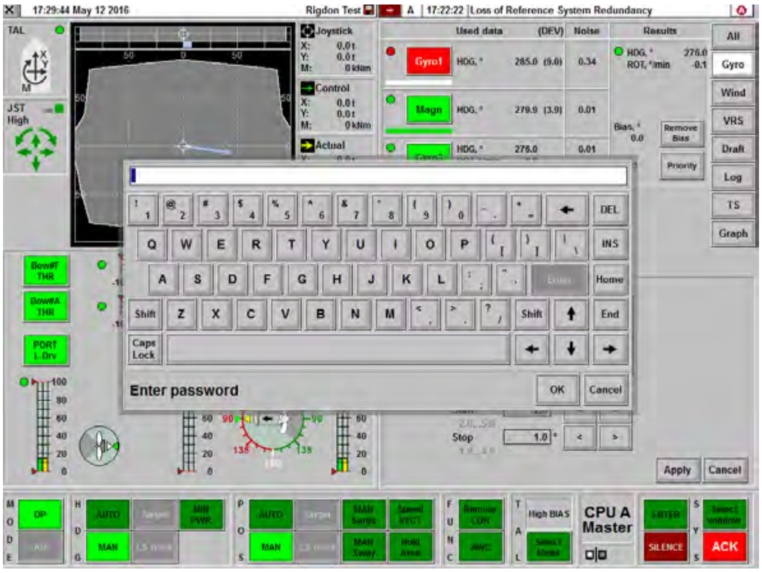


Figure 7.2: The password request for sensor parameters

> **NOTE!** For control panel CP4000 with LCD the protection is implemented as disabled Apply menu item. In this case it is imposseible to change the values.

7.2.3 Sensor Softkey and Indicators

There is a sensor softkey for each of the sensors. Using this softkey the operator defines a state of a sensor and operates it.

In addition, each sensor is shown with different indicators that display the status of the data transmitted by the sensor and their filter. These indicators are: Data indicator, Data filter indicator and Preferred sensor indicator.(Figure 7.3)

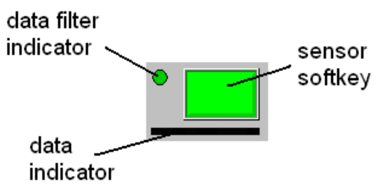


Figure 7.3: Sensor softkey with indicators

7.2.4 Sensor Softkey

A sensor's name is the title of the proper sensor softkey.

Use the sensor softkey to operate a sensor.

Press a sensor softkey to get the following dialog box for the specified sensor (see Figure 7.4). The softkey of the current usage state is white-colored.

Not Use — select this item if the sensor does not work properly or is not installed yet;

Monitor — select this item if you want to turn off the sensor temporarily;

Select — press to select the sensor;

Cancel — press to exit the dialog box without any changes.

The color of the sensor softkey shows the state of the sensor as described below:

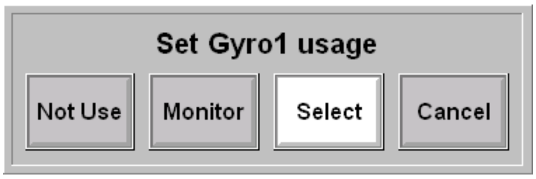


Figure 7.4: Gyro Usage Dialog

Light green — normal operation. Data from the sensor are being used by **NAVIS NavDP 4000**;

Dark green — data from the sensor are coming to **NAVIS NavDP 4000**, however, they are not used;

Red — the sensor is not being used because of a fault. It can for instance be if the filter has been receiving incorrect data for a long time, or there was no data at all, so that **NAVIS NavDP 4000** removed the sensor from operation.

To try the sensor to operation back press the sensor softkey;

Grey — the sensor is not connected to **NAVIS NavDP 4000**.

7.2.5 Data Filter Indicator

The indicator can be of different colors:

Green — the filter is working. Normal operation. Data from the sensor are coming and being processed by the filter;

Grey — the filter is not working;

Red — the data received by the filter are incorrect for a long time, or there was no data from the sensor for a long time, or the filter has just started operation, and it takes a few seconds before the process has converged.

7.2.6 Data Indicator

The data indicator is represented as a black bar. When a piece of information comes to **NAVIS NavDP 4000**, it is indicated as a narrow stroke. The stroke moves along the bar, from the left to the right. The distance between two adjacent strokes corresponds to the time interval between two pieces of information. If the distance is very small, the strokes merge into one line.

The color of a single stroke provides you with the information about the corresponding piece of data.

Green — the data received from the sensor have a correct structure, they satisfy the accuracy criteria, and therefore, they are used by the **NAVIS NavDP 4000**;

White — sensor is in “Monitor” or “Not used” state, or the data received from the sensor have a correct structure, however, they do not satisfy the accuracy criteria, and therefore, they are not used by **NAVIS NavDP 4000**;

Red — the data received from the sensor have incorrect structure; therefore they are not used by **NAVIS NavDP 4000**.

7.2.7 Preffered Sensor Indicator

The  symbol indicates the main sensor. If there is only one sensor in a sensor group it is not indicated with this symbol and becomes main.

7.2.8 Sensors Raw and Used Data Table

Sensor data are given in the table. In the first column you can see the following information:

1. Raw/used data. Press the table name for switching over. Used data is data with additive correction.
2. Deviations from the main sensor in comparison with raw/used data. The main (single) sensor has a zero deviation that is not displayed.

If the raw data of any compass or VRS differ from the raw data of other sensors of the same type by about the same value you should enter the correction. See Section “Gyro Sensor Details” (page 131) and Section “VRS Details” (page 133).

In the second column the **noise estimation** is shown.

Noise is estimated using Kalman-based filter, RMS value of noise for each sensor is shown.

7.2.9 Data Processing Results

The **Results** column in the table of the Sensors window contains the following:

- the sensor data processing results
- the status of processing (Processing status indicator)
- the Priority softkey for selection of a main sensor

The sensors of the same type are jointed in groups such as Gyro, Wind, VRS and LS groups. The **NAVIS NavDP 4000** uses the combined result of the sensors of a separate group.

The sensor data processing results are expressed in numerical values of the data transmitted by the sensors of the particular sensor group.

The status of processing is displayed with round indicators (named Processing status indicators) located in the right part of the Sensors window. These indicators show whether the data are correct or not. There must be at least one sensor in the group, and it must work properly in order to have the correct data. The color of the indicator is color-coded depending on the quality of the transmitted data:

Green — the filter operates properly;

Red — no valid data are received by the sensors. The alarm message "Heading dead reckoning" is generated and the indicator becomes red;

Grey — the filter is stopped:

- All the sensors are in "Monitor" or "Not used" state. The alarm message "Heading dead reckoning" is generated and the indicator is red-colored. Then the alarm message "Filter not ready" appears in two minutes and the indicator becomes grey. The filter does not operate.
- When the system starts up and no valid data are received by the sensors, the filter is not able to start up. The alarm message "Filter not ready" is generated as a result and the indicator becomes grey.

7.2.10 Priority Setting

When the system starts up, the sensor with the lowest noise is appointed as the main sensor.

Priority softkey – press this softkey. A dialog box appears and displays the sensors transmitting the correct data and used by the system. The softkey of the main sensor is light green. Other softkeys are dark green. Select a sensor to make it main and press an appropriate dark green sensor softkey. Press **Cancel** softkey to leave the dialog box without any changes (see figure 7.5).

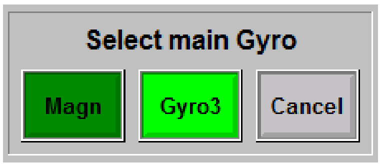


Figure 7.5: Priority sensor dialog box

The dialog box will dissappear automatically in a few seconds if it is not used by the operator.

If the main sensor fails, the system selects the other sensor with the lowest noise and makes it main.

> **NOTE!** If you select a new main sensor this may cause a jump in data due to the difference in measurements. This remark is fair for all modes except the **AutoHdg** mode.

7.3 Sensors Details

You can display a window with more detailed information about the sensors of the particular sensor group. For this purpose, select a softkey of necessary sensor group on the Navigation bar and press it.

There is a table containing the specified sensor group data at the top of the window.

> **NOTE!** The data of this table can be equal or have more detailed information relative to the data displayed in the main view of the Sensors window (when the **ALL** softkey is activated and all sensor groups are shown in the table).

At the bottom of the window either the parameters or graph is displayed for an appropriate sensor group. Use the Graph/Param softkey to switch between parameters and graph.

> **NOTE!** The graph can be provided for each of the sensor groups while the parameters can be shown for some of these groups only.

For more detailed information about the control a graph, refer to Section 5.8, page 81.

7.3.1 Gyro Sensor Details

General view of the top of the Gyro window for three gyrocompasses is shown in Figure 7.6.

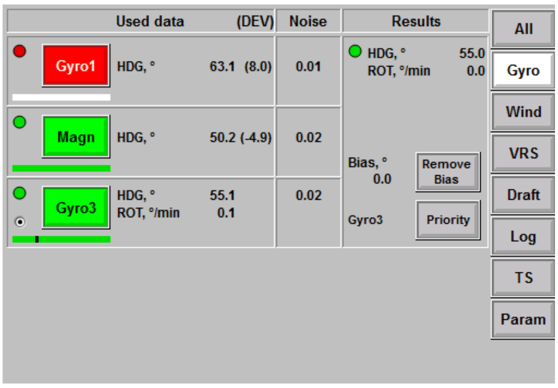


Figure 7.6: Gyro Details

Processing results:

– Vessel heading;

– Yaw rate.

BIAS is to provide a continuous estimation of heading while considerable jump is detected.
The jump can appear if:

1. main gyro was changed;

2. there was no correct data for a long time and then the data appeared. In this case BIAS is calculated.

If BIAS value is high (more than 2 degrees) or raw data and filter vary by reason of invalid data (e.g. unintended failures of the single compass) the alarm “<Gyro Name> raw data and filter discrepancy” will be generated.
If BIAS value is high it is highlighted by red color to draw your attention.
Sure that the raw data are correct and remove bias by pressing the corresponding softkey (see Figure 7.7).

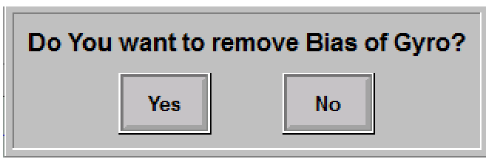


Figure 7.7: Remove Bias Window

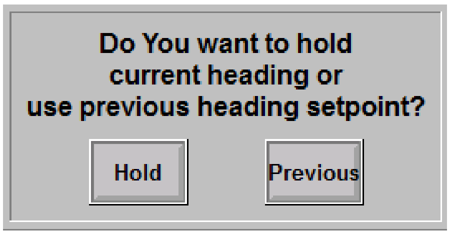


Figure 7.8: Window Remove Bias under Auto Heading Control

Note that in case the vessel is under auto heading control the heading either remains as current one or is kept as previously set one (see Figure 7.8).

Press **Hold** to keep the vessel in current heading,

Press **Previous** to rotate the vessel back in order to follow the previously set heading.

Data processing algorithm estimates a standard deviation of measuring noise. This value is taken into consideration if the filter operates for a long time starting since it has switched on. If the noise value is high (more than 2 degrees) it is highlighted by red color. Draw your attention to this sensor and monitor the graphs (see Figure 7.9). You should not select this sensor as the main one.

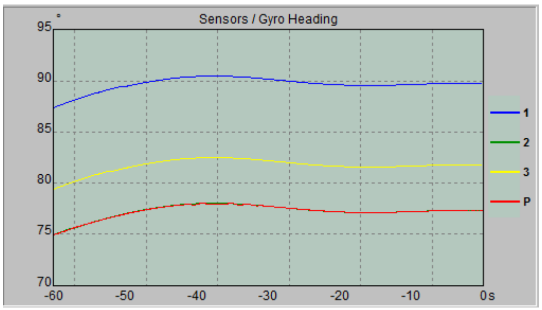


Figure 7.9: Gyro Trend view

In case of loosing good data from all of gyrocompasses (it means that course filter is not ready), **NAVIS NavDP 4000** can not use data not only from gyrocompasses, but also from reference system and wind sensor. It is due with relationship between absolute and relative (vessel) coordinate systems: course is the base. There is two steps of indicating:

1. Filter just get into "not ready" state. Messages from reference and wind sensor have not satisfy the accuracy criteria.
2. Filter has "not ready" state more than 3 minutes. Messages have status "Not used", reference and wind sensor are rejected from the system.

The number of alarms appears (see Appendix B, page 251, Sensors and Ref-systems).

The following parameters are provided for Gyro (see Figure 7.10):

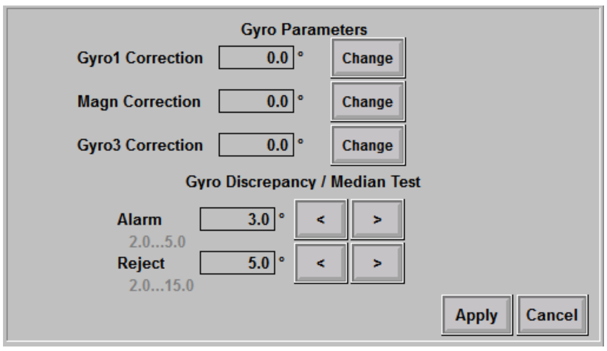


Figure 7.10: Gyro Parameters

Gyro Correction — value in degrees for Gyro data correction.

Press "Change" softkey to set new correction value.

Gyro Discrepancy / Median Test parameters:

Alarm — criterion for discrepancy alarm generation.

In case Bias value is higher than specified **Alarm** value (jump is detected), "Gyro Median Test: <Gyro Name> discrepancy" alarm is generated;

Reject — criterion for Gyro rejection.

In case Bias value is higher than specified **Reject** value (jump is detected), the Gyro is rejected. "Gyro Median Test: <Gyro Name> rejected" alarm is generated.

The corresponding Gyro softkey and Data Filter indicator become red-colored.

7.3.2 Wind Sensor Details

General view of the top of the Wind sensor window is shown in Figure 7.11.

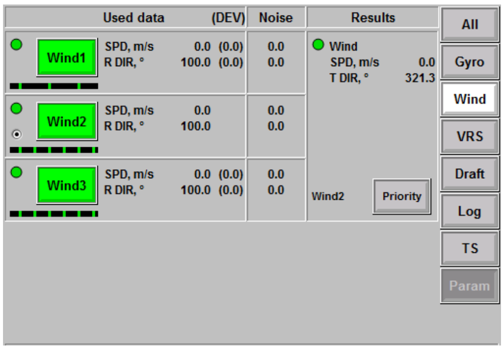


Figure 7.11: Wind details

Processing results:

– Wind speed

– Wind direction

When pressing processing results area, true/rel results view is swithced.
The following graphs are provided for Wind sensors (Figure 7.12):

– Wind speed (raw data, processing results)

– Wind direction (raw data, processing results)

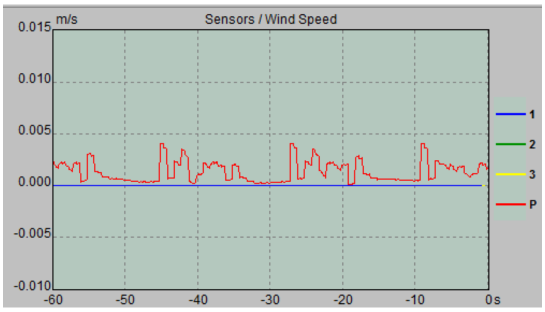


Figure 7.12: Wind Trend view

7.3.3 Vertical Reference Sensor (VRS) Details

General view of the top of the VRS window is shown in Figure 7.13.
Processing results:

– Pitch angle

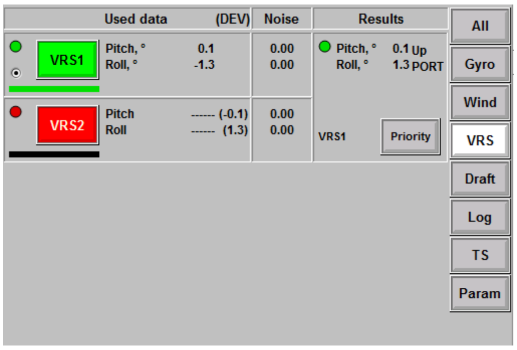


Figure 7.13: VRS Deatails

– Roll angle

The following parameters are provided for VRS (Figure 7.14):

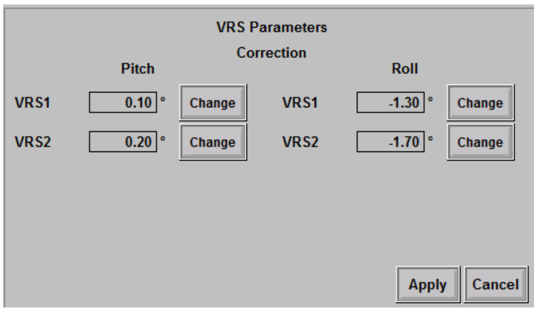


Figure 7.14: VRS Parameters

The following graphs are provided for VRS (Figure 7.15):

– Pitch angle (raw data, processing results)

– Roll angle (raw data, processing results)

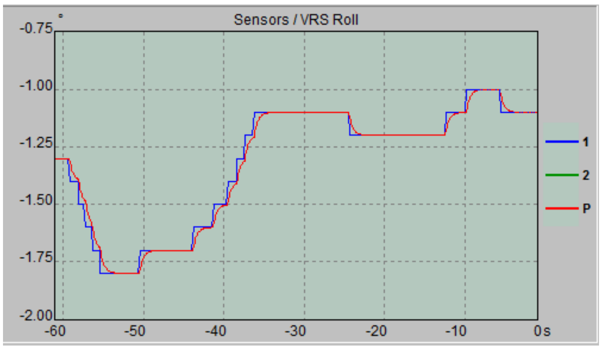


Figure 7.15: VRS Trend view

7.3.4 LOG Details

General view of top part of the LOG window is shown in Figure 7.16.
Used data:
relative velocity of the vessel

– Vx

– Vy

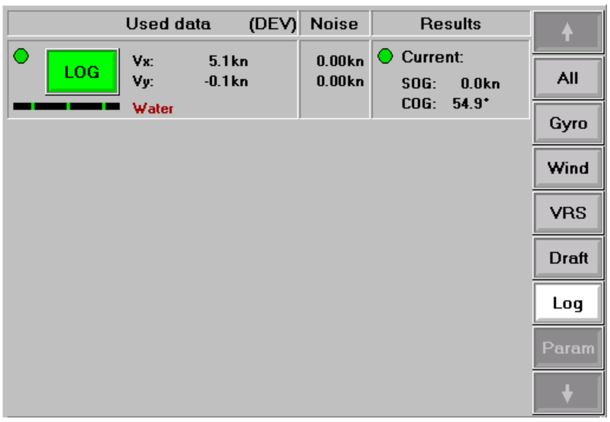


Figure 7.16: LOG details

or absolute velocity of the vessel

– Vgx

– Vgy

Processing result is current velocity.
The following graphs are provided for LOG (Figure 7.17):

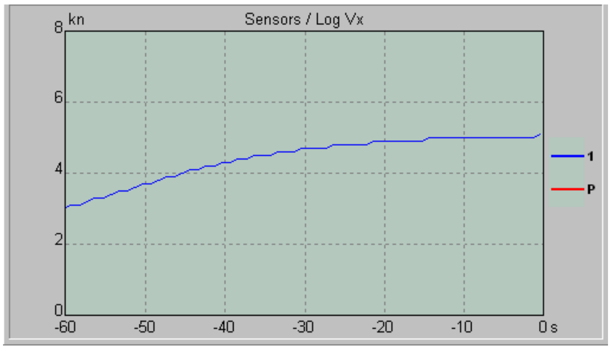


Figure 7.17: LOG Trend view

7.3.5 Draft Details

7.3.5.1 Draft Sensor detailed data

In general, draft/load sensor measures ship draft in several points and/or mean draft and loading/displacement values. Detailed data includes:

– Sensor softkey with indicators

– Ship contour with marked measurement points (if any)

– Draft measurements in specified points – raw data (if they are measured by sensor)

– Mean draft value (calculated or measured by sensor)

– Loading/displacement value (if it measured by sensor)

Processing results include:

– Mean draft (estimated or measured by sensor)

– Displacement (calculated by mean draft or measured by sensor)

– Loading (calculated by mean draft or measured by sensor)

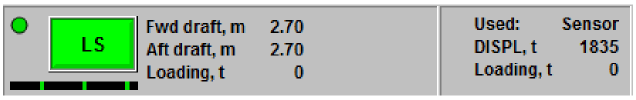


Figure 7.18: Draft sensor. Fragment of sensors window

If draft/load sensor is present, in “all sensors window” loading and draft info is shown (see figure 7.18). If there is no draft sensor, but **NAVIS NavDP 4000** is configured with “variable draft” option, manual input of draft/loading is allowed (see Sections 7.3.5.2, page 136, 7.3.5.4, page 137).

The top of the Draft Details window is shown in Figure 7.19.

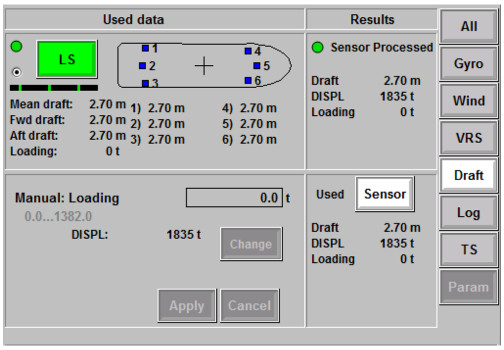


Figure 7.19: Draft sensor details

7.3.5.2 Manual draft value

Operator can change mean draft value manually. Optionally, operator input not draft but loading in tons (it is configured for each system).

Press **Change** softkey to show the draft/loading input dialog – see Figure 7.20.

When operator press **Ok**, value of displacement and loading corresponded the entered data are updated.

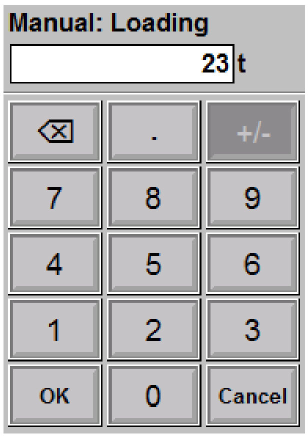


Figure 7.20: Input Manual Draft/Loading Value Dialog Example

7.3.5.3 Used draft

Used draft is sensor processed data or manual value. Press **Manual/Sensor** softkey to select the source of draft information.

When there are some problems with draft sensor and processing status of draft sensor is red, source is automatically switched to “manual”.

Indicator  shows which data is used – sensor or manual.

7.3.5.4 Variable draft function: no draft sensor

When there is no draft sensor connected to the **NAVIS NavDP 4000**, but variable draft function (option) is turned on, the top of the Draft Sensor window is shown in Figure 7.21.

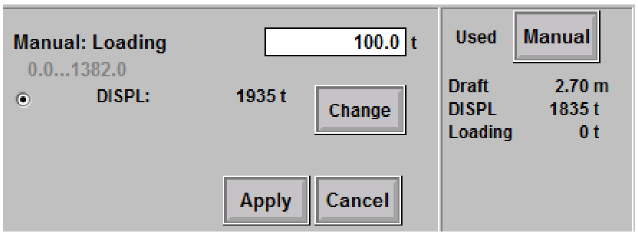


Figure 7.21: Draft info. No draft sensor, variable draft function

In this case, used data is manually inputted data, if they are correct.

7.3.5.5 Variable draft and loading graphs

The following graphs are provided for draft info (Figure 7.22):

- Loading (raw data, processing results)
- Draft (raw data, processing results)

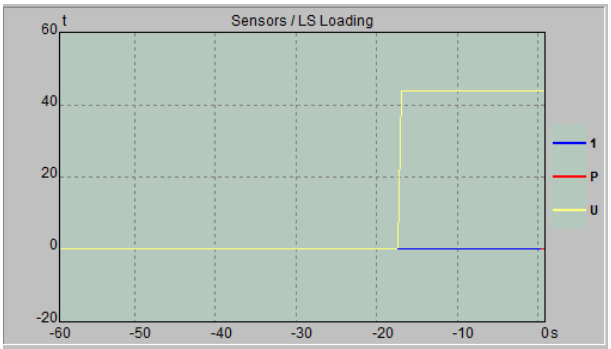


Figure 7.22: Draft sensor. Graphs

7.3.6 Tension Details

7.3.6.1 Tension detailed data

In general, tension sensor measures cable/pipe/other tension force in specified point.
Detailed data includes:

- Sensor softkey with indicators;
- Force measurement – raw data (if they are measured by sensor);
- Force manual value;
- Azimuth and elevation manual values.

> **NOTE!** Azimuth angle is horizontal force angle measured from Center Lateral Plane, clockwise (zero is force ahead, 180 degrees is force astern). Elevation angle is vertical force angle, positive means force upwards, negative is downwards, zero - horizontal.

Processed results include:

– Sum force status;

– Sum force value;

– Sum force direction: azimuth and elevaion values.

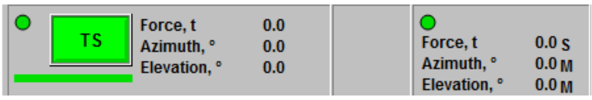


Figure 7.23: Tension sensor. Fragment of sensors window

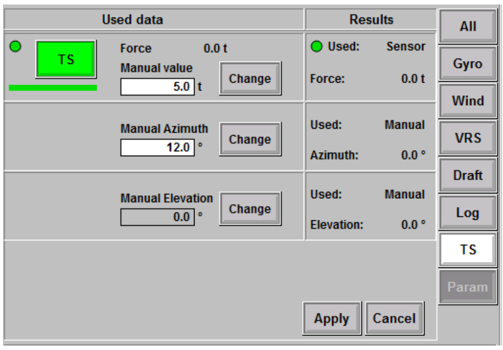


Figure 7.24: Tension sensor details

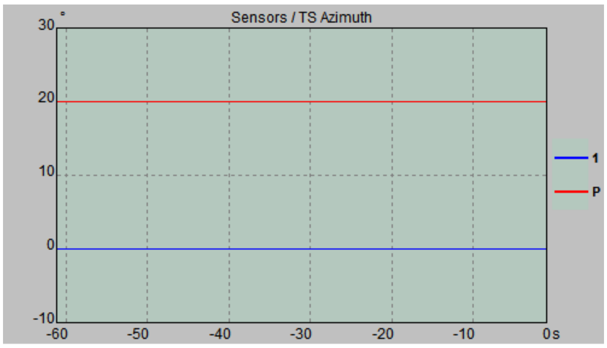


Figure 7.25: TS Graph

7.3.6.2 Variable draft and loading graphs

The following graphs are provided for tension info (see figure 7.25):

– Force (raw data, processed results);

– Azimuth angle;

– Elevation angle.

Chapter 8

Position References

8.1 Coordinate Systems

Position information may be provided by different position-reference systems (Ref-systems) and received in different forms as follows:

– global position-reference system (Latitude and Longitude in a geographic coordinate system)

– local position-reference system (Northing and Easting in a Cartesian coordinate system)

– local position-reference system in the UTM projection

Coordinate systems

Following coordinate system settings are available from Operator Station:

Use UTM (Yes/No) When use of UTM system is required, you should select Yes pressing the Change softkey and set UTM parameters;

When use of UTM system is not needed you should select No pressing the Change softkey. In this case a map view can be switched between Local N/E and Geo;

Map Coordinate System (Local N/E, Geo, UTM) A coordinate system where a map view and a vessel position setpoint are specified;

Route Coordinate System (Local N/E, Geo, UTM) A coordinate system where a route is specified.

See section 8.1 for entering the coordinates in different coordinate systems.

UTM Coordinates Parameters

The following parameters are available from Operator Station:

False Northing (Yes/No): abscissa origin is displaced by 10,000,000 m to the south of the Equator. Result: all points on the Equator have abscissas 10,000,000 m; points southern to the Equator have positive values less than 10,000,000 m; points in the northern hemisphere - more than 10,000,000 m.

False Easting (Yes/No): offset origin is displaced by 500,000 m to the west of central meridian. Result: on central meridian all points have offsets 500,000 m; points to the west of central meridian have positive values less than 500,000 m; points in eastern part of zone are defined with positive offsets more than 500,000 m.

Automatic Zone Calculation (Yes/No): automatic UTM zone determination right after the system start-up (when initial information about the vessel position is provided).

Select “Yes” pressing Change softkey to activate this function.

UTM Zone : manual setting of UTM zone. Use this option in case you need to use coordinates in some definite zone (possibly close to its end or even out of it). The zone can be changed at any moment - it will not lead to changing of ship movement.

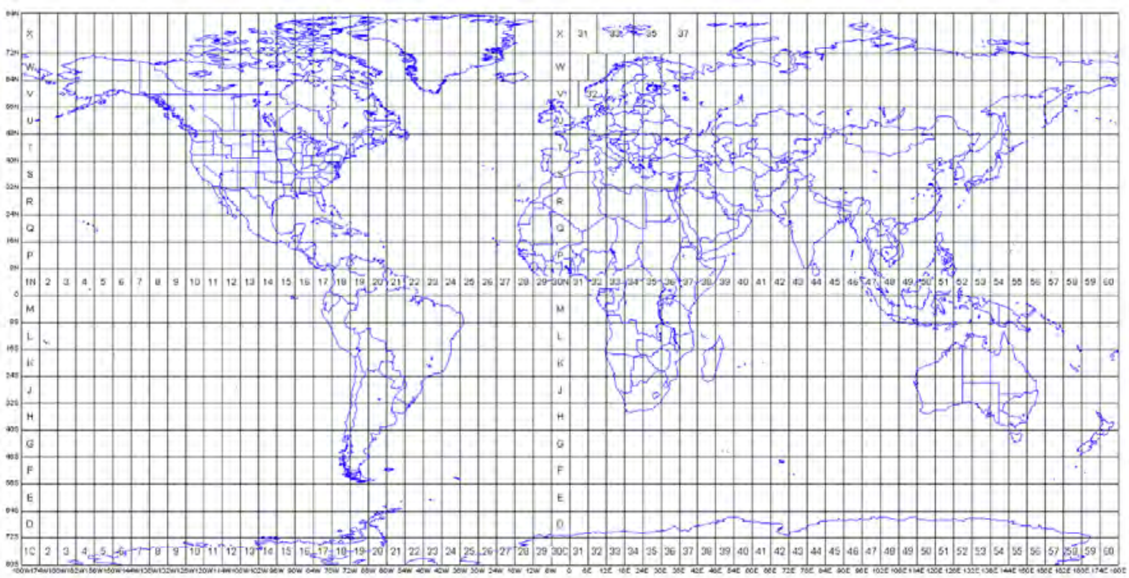
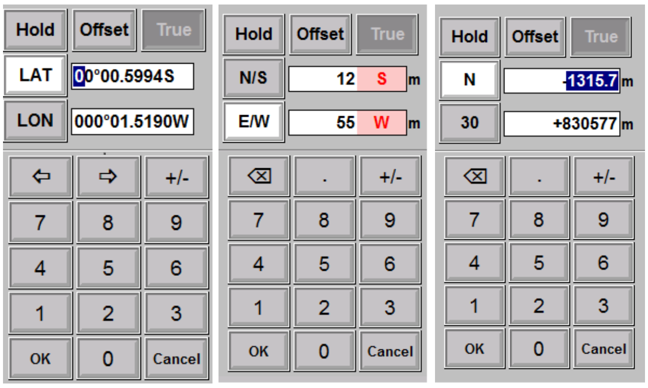


Figure 8.1: Numbers of UTM zones

AUTOPOS mode

To set values in different coordinate systems the dialogs represented on figure 8.2 are used:



(a) Geo (b) Local N/E (c) UTM

Figure 8.2: Value set up for different coordinate systems

> **NOTE!** Using the UTM system an operator can enter a zone number, different from the one specified in the system. It's convenient, if it's required to enter the known point coordinates, i.e. in map zone different from the current one.

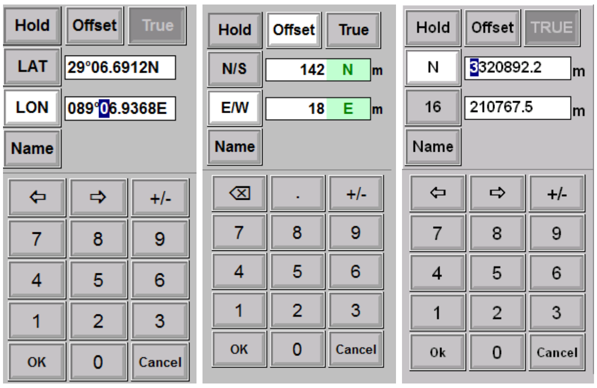
8.1.1 Target Offset

If the Target mode is available an operator can entry the offset it in meters. The offset is in N/E system in all cases whatever coordinate system is used in MAP View.

Waypoints in the different coordinate systems

Waypoint dialogues for different coordinate systems are represented on figure 8.3.

> **NOTE!** The waipoints dialogue coordinate system is the one that was set on Coord page of Param window.



(a) Geo (b) Local N/E (c) UTM

Figure 8.3: The waypoint set up dialogue for the different coordinate systems

Coordinate System of MAP View

The coordinate system displayed in MAP View (on a map) is changed with pressing the button (Local N/E, Geo or UTM depending on a current displaying of the coordinate system) on View Controls.

A map is in the Geo mode is shown in Figure 8.4.

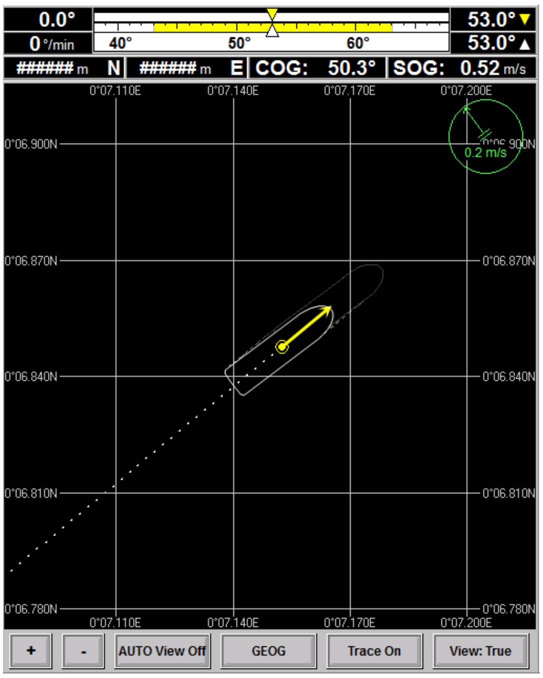


Figure 8.4: Map window in Geo mode

A map is in the UTM mode is shown in Figure 8.5.

A map is in the Local N/E mode ish shown in Figure 8.6.

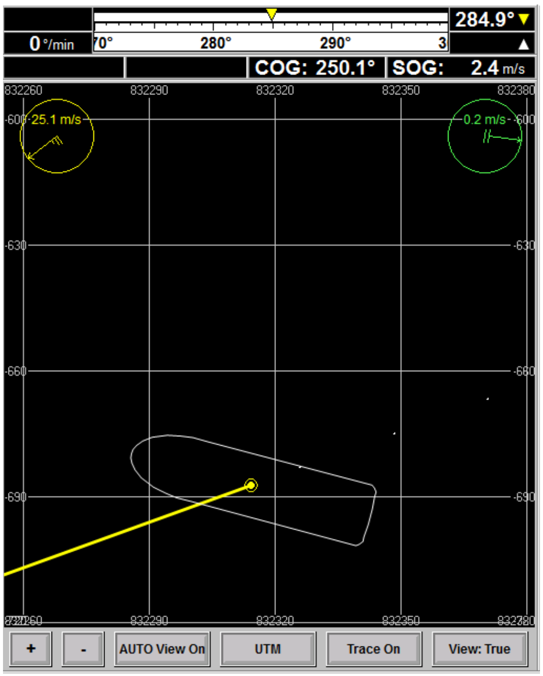


Figure 8.5: Map window in UTM mode

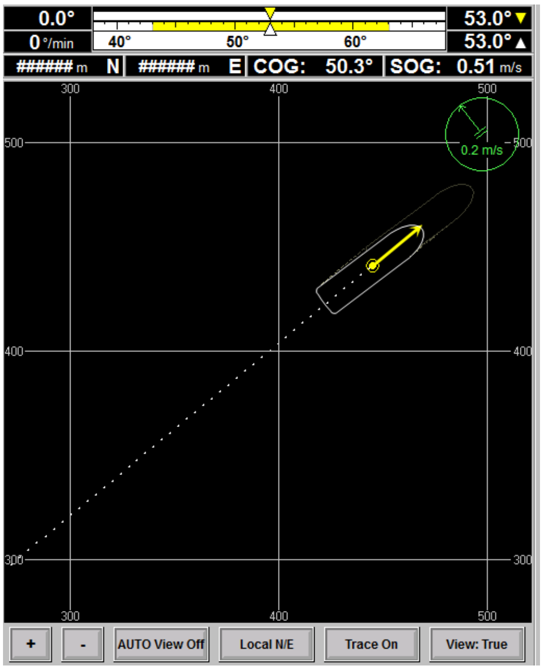


Figure 8.6: Map window in Local N/E mode

8.2 Noise estimation and Weights

Position estimation is calculated as weightened sum of all filtered selected ref-systems measurements. Weights are automatically calculated as function of noise estimated (lower weight corresponds to ref-system with higher noise).

Weight can be corrected in details window – see Section 8.8.4, page 150.

Estimated noise for each ref-system is the result of Kalman-based filtering. RMS value of estimated noise value is shown in **Ref** window.

8.3 Biasing

Bias of each Ref-system includes the following components:

1. Initial offset;
2. Jump estimation;
3. Slow drift estimation.

The position-reference system which starts as the first reference has a zero offset.

The second position-reference system will have some offset to provide continuous position estimation.

Jump is estimated by the filter when Ref-system measurements suddenly jump.

Slow drift is determined for each Ref-system using median test. Parameters of median test can be configured by operator.

Additionally, a bias of all Ref-system (common Bias) is determined when the Ref-system with non-zero weight is turned off to provide continuous estimation of position.

Thus, estimation of coordinates is calculated as a weighted total of all Ref-system.

All the values of weights and bias are shown in **Ref** window.

8.4 Origin Ref-system

One of used Ref-system is taken as Origin Ref (see Section 8.8.3, page 148).

Ship position and velocity estimation is weighted average of all selected ref-systems filtered data.

The estimated deviation between Origin Ref and each other selected Ref-system is called “Bias”.

This bias is estimated on-line and displayed in Ref Window (see figure 8.7).

If Origin Ref is failed or deselected, the system searches automatically for other Origin Ref. Preference is given to DGPS’s.

8.5 Absolute and Relative ref-systems

Ref-systems can be are absolute or relative. Absolute ref-systems allows estimating absolute ship position. Relative ref-systems allows estimating the relative ship position only, but it’s accuracy can be higher than accuracy of absolute systems.

Absolute ref-systems

GPS is absolute ref-system. When all GPS are off, **NAVIS NavDP 4000** can’t determine the Origin of Coordinate systems – Base Latitude and Base Longitude. Only Local N/E view of Map Window is available.

When the first good GGA-message from GPS is received by **NAVIS NavDP 4000**, the Base Latitude and Base Longitude are determined.

Relative ref-systems

HPR, Laser Radar, Taut Wire are relative ref-systems. When the first good message from transponder of relative ref-system is received, the first measurement is interpreted as the origin of local coordinate system of this transponder. This Origin of local system is shown in transponder table (click “Bias” heading of table to switch between “Bias/Origin” column). Since this time, all measurements of this transponder of relative sensor will interpreted relativelly the local system.

8.6 Position Reference Systems Settings

- Reference System Location. The location on the vessel (relative to its gravity center) of antenna or sensor head for the different reference systems, may be specified by the operator
- Manual weight correction
- Manual and auto-change of the Origin Reference

8.7 Position Reference Failure Detection

Prediction test – detection of sudden jumps based on model-based Kalman filters family.

Median test – detection of Ref-systems slow drift. Depending on system parameters, drifted ref-system will be rejected or alarm generated

Variance test – reduction of weights in accordance to noise variance

Signal droup-out test – detection of signal drop-out and signals redundance

Freeze test – detection of repeated measurements for a long period of time, when there are no recent data

8.8 Ref-system Interface and Operations

8.8.1 General

Ref Window displays the position reference systems data. An example of Ref Window is shown in Figure 8.7.

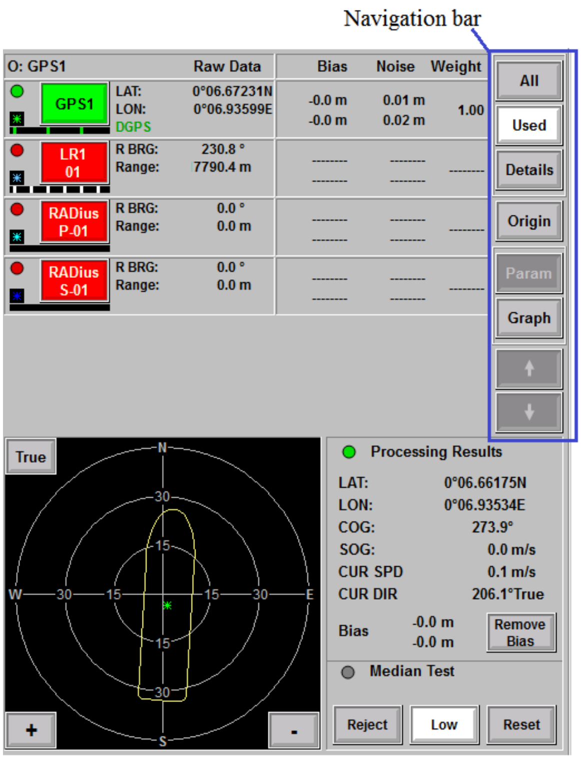


Figure 8.7: The position reference system window

Ref Window consists of two sub-windows — lower and upper. Upper Ref-Window can be in status **View** or **Param**. Lower — in status **Graph** or **Plot**.

8.8.1.1 Navigation bar

Navigation bar is used for changin displayed ref-systems set (**All** and **Used**), selection of Origin reference system **Origin**, view the parameters, graphs, and details for each ref-systems.

Up and down arrow softkeys allow to scroll a list of sensors, if required.

Use **All**, **Used**, **Details**, **View/Param** (available for the selected Ref-system) softkeys for switching a view of upper window and **Plot/Graph** softkeys for switching a view of lower window.

8.8.1.2 Top sub-window

All status — all Ref-systems are shown, which can be chosen or have already been chosen as Ref-systems. Ref-systems data are shown in table.

In left column a softkey with indicators and raw data are shown.

The name of “Origin Reference” is shown at the top-left.

In right columns “BIAS”, “Noise” and “Weight” are presented.

Used status — only used Ref-systems are shown.

Use the “Used” view as basic — at the same time all used Ref-systems are well shown and you can control status of all of them.

Details — press the softkey for displaying more detailed information concerning a Ref-system.

The following statuses are available for the selected Ref-system:

View status — displays information for the selected Ref-system. View depends on the Ref-system type.

Param status — allows changing parameters of the selected Ref-system.

8.8.1.3 Lower sub-window

Plot Ship position estimated based on different Ref-systems is shown as “*” symbol. Color of symbol “*” is shown near the Ref-system softkey.

The Ref-system plot is shown in two views — TRUE and REL (see Figure 8.8). It’s scale can be changed with softkeys “+” and “–” .

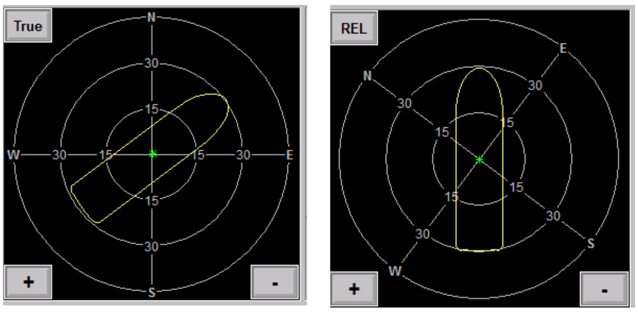


Figure 8.8: Ref-system Plot. True and relative views

On the right of the diagram the data processing results are shown (see Figure 8.9).

Clicking the backgound of Processing results switches the form of its presentation

filtration results the data displayed are changed (Lat/Lon/COG/SOG or X/Y/Vx/Vy).

General bias of position estimator is shown here and the “Remove BIAS” softkey is placed. See Section 8.8.3.1, page 148 for details.

Settings for median test is configured by softkey “Reject”, “Low”, “High” parameters. See Section 8.8.3.2, page 149 for details.

Graph In this mode graphs for all Ref-systems can be shown. An example of “Ref-system Graph” window is shown in Figure 8.10. Configuring of graph (class, group, imems) — see Section 5.8, page 81.

The following Data Groups are available

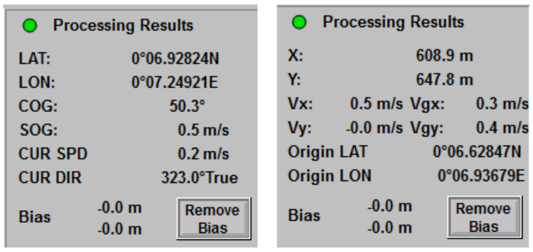


Figure 8.9: Ref-system Plot. Processed results

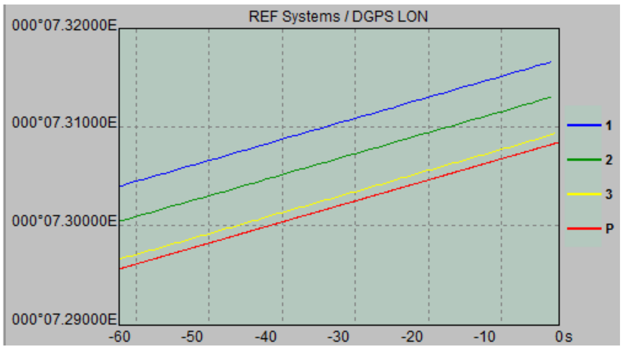


Figure 8.10: Ref-system Graph

DGPS Lat, DGPS Lon — DGPS Latitude and Longitude (measurements and processing results);

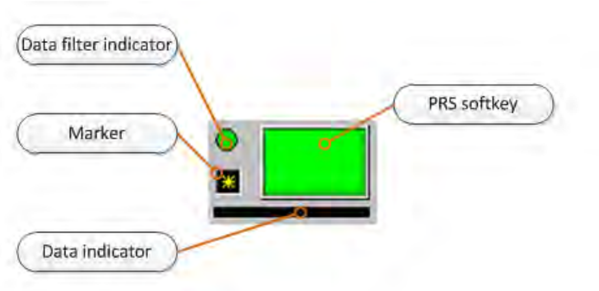
HPR X, HPR Y — hydroacoustic ref-buoys coordinates (measurements and processing results);

LR Bearing — Laser Radar Range and Bearing, measurements and processing results;

TW Alpha, TW Beta, TW Length — Taut Wire Outboard and Right Angles and Length (measurements and processing results).

8.8.2 Ref-system Softkey and Indicators

8.8.2.1 Color of the Ref-system Softkey



Light green Selected as Reference. Data from the Ref-system are being used by **NAVIS NavDP 4000**.

Dark green Data from the Ref-system are coming to **NAVIS NavDP 4000**; sensor is only monitored.

Red The ref-system fault is detected. It can for instance be if the filter had been receiving incorrect data for a long time, or there was no data at all, so that **NAVIS NavDP 4000** removed the Ref-system from operation. You can press the sensor softkey to try to put the sensor in operation.

Grey The sensor is not used or used as target or marked as mobile (potential target).

8.8.2.2 Data Filter Indicator

Green The filter is working. Normal operation. Data from the sensor are coming and being processed by the filter.

Grey The filter is not working.

Red The data received by the filter are incorrect for a long time, or there was no data from the sensor for a long time, or the filter has just started operation, and it takes a few second before the process has converged.

8.8.2.3 Data Indicator

The color of a single stroke provides you with the information about the corresponding piece of data.

Green The data received from the sensor have correct structure, they satisfy the accuracy criteria, and therefore, they are used by **NAVIS NavDP 4000**.

White The data received from the sensor have correct structure, however, they do not satisfy the accuracy criteria, and therefore, they are not used by **NAVIS NavDP 4000**.

Red The data received from the sensor have incorrect structure; therefore they are not used by **NAVIS NavDP 4000**.

Ref-system Marker

At **Map** Window, at Ref-systems Plot and at Details Plots following markers are used.
The small asterisk shows ship position estimated using this ref-system data. Color legend for this symbols is shown in main (“All” or “Used”) view of Ref-window.
For transponders (HPR beacons, LR reflectors, TW depressors, etc) circle, rhomb and square markers are used.

If the transponder is used as Reference, 10 marker is shown at plot.

If the transponder is used as Target, 4 marker is shown at plot, and an indicator “tgt” appears instead of the marker to the left of the Ref-system softkey.

If the transponder is used as mobile, 1 marker is shown at plot, and an indicator “mob” appears instead of the marker to the left of the Ref-system softkey.
If the status of transponder data processing is not ok, the marker is dashed.
Use **Target window** for work with targets (section 10.5, page 180).

8.8.2.4 Operations with Ref-system Softkey

A sensor’s name is the title of the proper sensor softkey.
Use the sensor softkey to operate a sensor. Press a sensor softkey to get dialog box for the specified sensor. The softkey configurations in the dialog box may vary depending on the current usage state and possibility for using the sensor as a target.
The softkey of the current usage state is white-colored.

– Dialog box example for sensors in case they are selected or cannot be used as targets is shown in Figure 8.11. menu for sensors

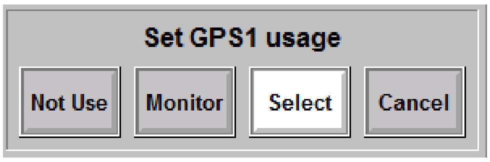


Figure 8.11: Dialog Box for the sensor in case it is Selected or cannot be used as target

Not Use — select this item if the sensor does not work properly or is not installed yet;

Monitor — select this item if you want to turn off the sensor temporarily;

Select — press to select the sensor;

Cancel — press to exit the dialog box without any changes.

– Dialog box example for sensors which can be used as targets in case they are not used at the moment (“Not Use”, “Monitor” or “Mobile” states) is shown in Figure 8.12.

Not Use — select this item if the sensor does not work properly or is not installed yet;

Monitor — select this item if you want to turn off the sensor temporarily;

Select — press to select the sensor;

Mobile — press to select the sensor as potential target. It will be displayed in “Target” window;

N/A — select this item if the sensor does not work properly and no data are received. The sensor will be excluded from the sensor list until its data are received again;

Cancel — press to exit the dialog box without any changes.

Figure 8.12: Dialog Box the for sensor which can be used as target in case “Not Use”

– If the sensor is used as Target at the moment dialog box is not displayed.

Use the “Target” window in order to change the list of assigned Targets.

8.8.3 Selecting Origin Ref-system

You are able to select an origin Ref-system between used Ref-system in Ref window.
Press **Origin** softkey on Navigation bar and select an origin Ref-system in the appeared dialog box (Figure 8.13).

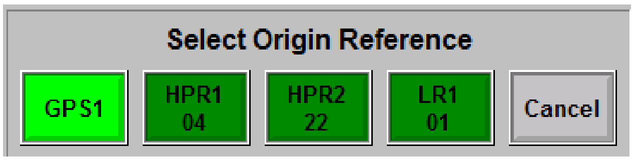


Figure 8.13: The Select Origin Reference Dialog

The colour of the Ref-system softkey varies with a Ref-system state:

light green — Ref-system is available and it’s origin at the moment;

dark green — Ref-system is available and it’s not origin at the moment and used by the system.

Press the dark green Ref-system softkey in the abovementioned dialog box to select another Ref-system as origin. The dialog box disappears right after selecting an origin Ref-system. Press the Cancel softkey to close the dialog box without any changes or it will be closed automatically in a few seconds.

> **NOTE!** The number and the type of Ref-system depend on a concrete system.

8.8.3.1 Remove BIAS

Press **Remove BIAS** softkey to remove bias for origin reference.
The dialog box in Figure 8.14 appears for acknowledging the removing.

Figure 8.14: Dialog box

After removing bias of the origin reference the estimation of ship position will corresponds the measurements of Origin Ref without offset.

As soon as bias of origin reference is removed, continuous position estimation is broken which causes ship “jumping” on the screen. After dead reckoning or after removing bias continuous position estimation will be broken. When ship is in auto-pos modes (Auto Position, Low Speed Track, High Speed Track) following dialogs will appear:

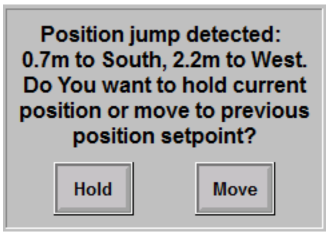


Figure 8.15: Dialog box in Auto Position Mode

In Auto Position Mode (figure 8.15):

If you choose “Hold” (hold position) current position will be set as new position setpoint.

If you choose “Move” — old positioning setpoint will be stored and ship will move to this point.

In Low Speed Track Mode (figure 8.16):

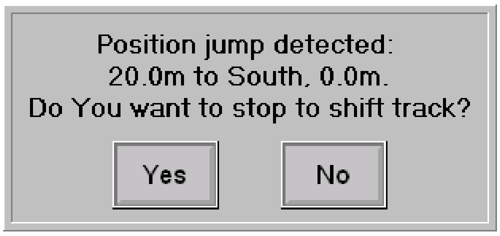


Figure 8.16: Dialog box in Low Speed Track Mode

If you choose “Yes” — System will switch to Auto Pos mode

Else ship will jump on a map, mode will Low Speed Track, and track will be without changes.

In High Speed Track Mode (figure 8.17):

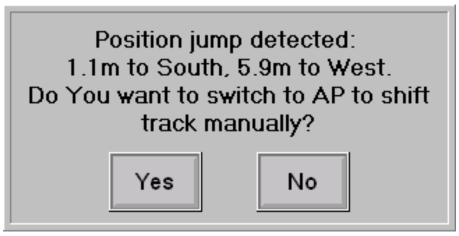


Figure 8.17: Dialog box in High Speed Track Mode

If you choose “Yes” — System will switch to Auto Heading mode Else ship will jump on a map, mode will High Speed Track, and track will be without changes.

8.8.3.2 Median Test

Press **Reject/Warning** softkey to select action type for median test:

Reject Reject drifting ref-system (with pre-alarm)

Warning Alarm only for drifting ref-system (with pre-alarm)

Press **Off/Low/High** softkey to select strategy for median test:

Off Median test is off

Low Reject ref-sensor when drift exceeds 2 x its accuracy

High Reject ref-sensor when drift exceeds its accuracy

Reset button resets estimated drift to 0 (“restart median filter”).

8.8.4 Detailed Information for Ref-system

Press the **Details** softkey on Navigation to select a Ref-system for more detailed information in appeared dialog box (Figure 8.18)

Figure 8.18: Dialog box

Select a Ref-system and press an appropriate softkey with Ref-system name or Cancel to close the dialog box without any changes.

8.8.5 Detailed Information for DGPS

For DGPS only "View", "Param" and "Graph" windows are available. "Plot" window is not avaliable.

8.8.5.1 DGPS View

DGPS view is shown in figure 8.19.

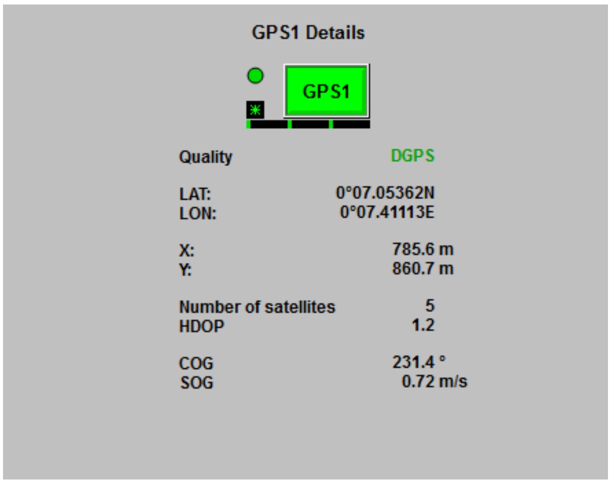


Figure 8.19: DGPS View

The sensor softkey with indicators and raw data are shown (in detail): Lat, Lon, X, Y (Local N/E system), Nsat (number of satellites), HDOP (horizontal dilution of precision GPS factor) - from GGA message, and COG, SOG from VTG message,

GPS Quality:

Not Available — Fix not available or invalid;

GPS — GPS SPS mode, fix valid;

DGPS — Differential GPS, SPS mode, fix valid;

GPS PPS — GPS PPS mode, fix valid;

RTK fixed — Real Time Kinematic. Sat system used in RTK mode with fixed integers;

RTK float — Float RTK. Sat system used in RTK mode with floating integers;

Estimated — Estimated (DR) mode;

Man Input — Manual Input mode;

Simulator — Simulator mode;

WAAS — WAAS Correction.

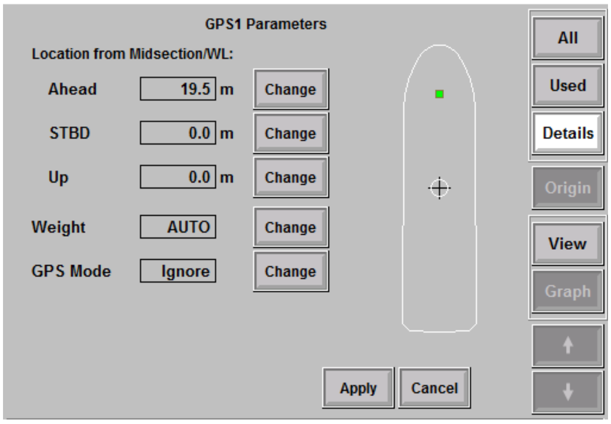


Figure 8.20: The GPS parameters window. Standard view

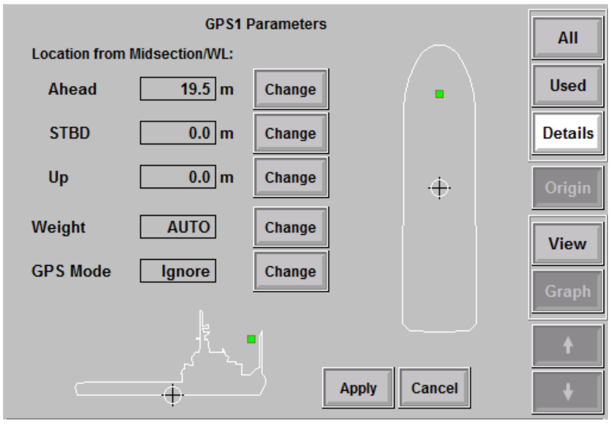


Figure 8.21: GPS parameters with the side view

8.8.5.2 DGPS Parameters

The GPS parameters window contains the scheme of the GPS antenna location on the vessel (see. figure 8.20). An additional side view of the vessel is displayed in some configurations (see figure 8.21). Press the softkey on Navigation bar to display parameters window of the selected GPS

Location denotes a position of GPS antenna.

> **NOTE!** The system is highly sensitive to these data; it's needed to specify them attentively. Coordinates are given relative to a midship frame.

Positive directions correspond to specified directions.

For example, if GPS is placed in aft part — Ahead coordinate will be negative.

For the sensor at portboard, coordinate STBD is negative.

Up — is calculated from a waterline.

Weight is a relative weight of the sensor at calculating of a ship position. It can be Low, High, and Auto. Use Auto, if you want the sensors have weight, proportional to noise level. In any cases it's reasonable to increase the weight of relative sensors, or to choose exactly "correct" or "incorrect" (a priori less or more precision sensor).

Accuracy is a priori dynamic accuracy of sensor (standard deviation, m). Accuracy parameter is used for ref-systems median test.

GPS Mode - work only in the mode with correction (Diff, WAAS, Float RTK, etc.) or it's possible to work without correction (available Standard Positioning Service (SPS) GPS mode) — Ignore.

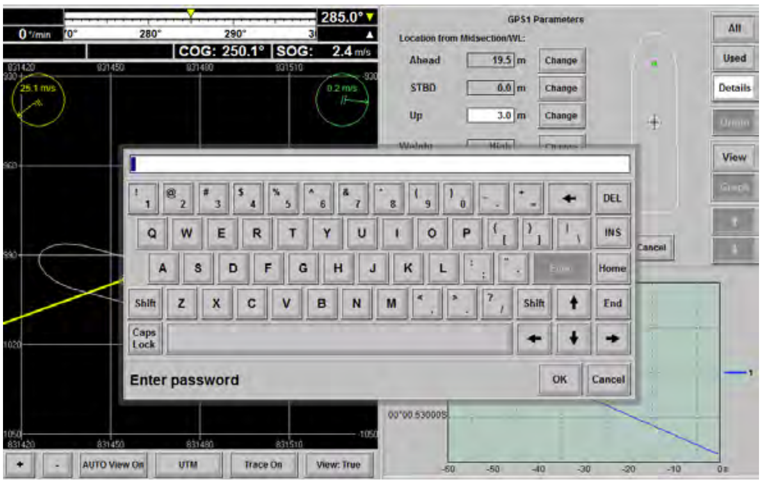


Figure 8.22: The password request for GPS parameters

8.8.6 Parameters protection

To protect parameters from unauthorized value changes the system requests a password just after the **Apply** softkey has been pressed. To input the password use the virtual keyboard (see Figure 8.22).

8.8.6.1 DGPS Graph

DGPS Graph is shown in figure 8.23.

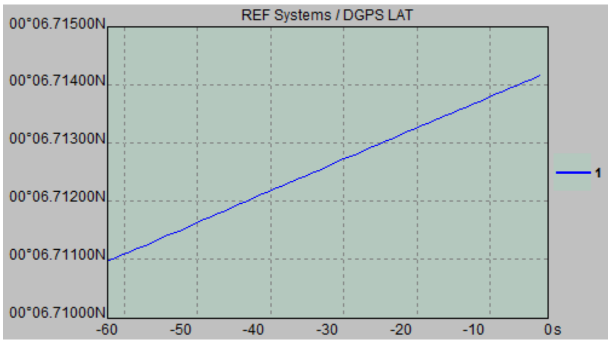


Figure 8.23: DGPS Graph

Graphs are shown in this mode: latitude and longitude.
For more information about view settings for graph refer to Section 5.8, page 81.

8.8.7 Detailed Information for Hydroacoustic System

For each HPR “View” / “Param” and “Plot” / “Graph” windows are available.

8.8.7.1 HPR View

HPR View is shown in figure 8.24.
In window with detailed information a table of ALL beacons of each HPR is shown. In the left column for each beacon softkeys with indicators, raw data are presented.
In the right table column for each beacon the coordinates are indicated in Local N/E.

8.8.7.2 HPR Parameters

HPR Parameters are shown in figure 8.25.
Location from CG includes a group of parameters determining the HPR-sensor position.
Weight is set analogously to the GPS weight.
Accuracy is set analogously to the GPS accuracy.

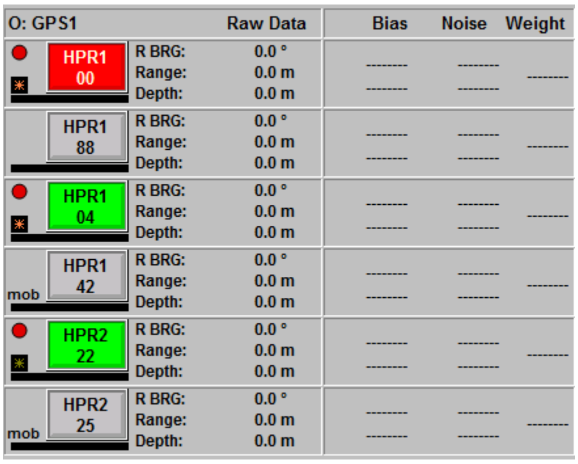


Figure 8.24: HPR View

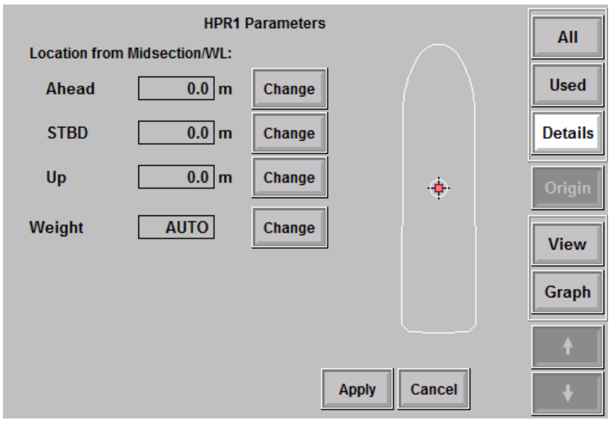


Figure 8.25: HPR Parameters

8.8.7.3 HPR Plot

HPR Plot is shown in figure 8.26.

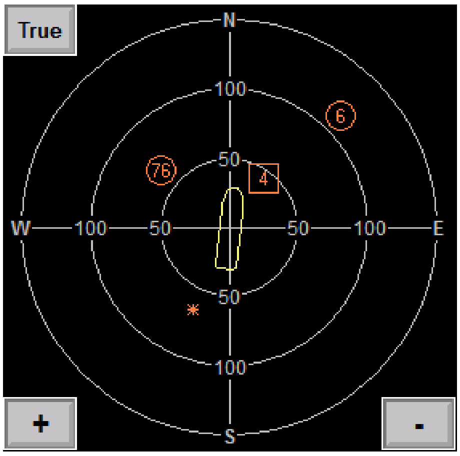


Figure 8.26: HPR Plot

Beacons of the given HPR are shown in this window, which are used as Ref (squares), as Tgt (rhombs) and others (circles).

Raw data from relative beacons is shown by stars.

Vessel is shown in the same way as it's shown in the map (ship position is calculated with all Ref-sensors), therefore it can not coincide with the HPR data.

8.8.7.4 HPR Graph

HPR Graph is shown in figure 8.27.

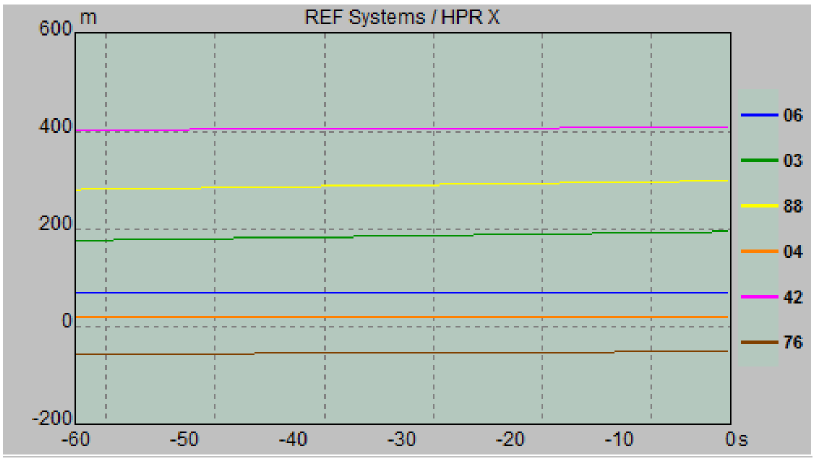


Figure 8.27: HPR Graph

Graphs are shown in this mode: HPR measurements (X and Y).

For more information about view settings for graph refer to Section 5.8, page 81.

8.8.8 Detailed Information for Laser Radar

For each LR "View" / "Param" and "Plot" / "Graph" windows are available.

8.8.8.1 LR View

LR View is shown in figure 8.28.

in window with detailed information a table of ALL transponders of each LR is shown. In the left column for each beacon softkeys with indicators, raw data are presented.

In the right table column for each beacon the coordinates are indicated in Local N/E.

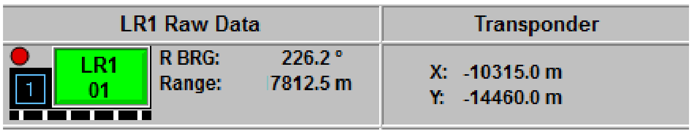


Figure 8.28: LR View

8.8.8.2 LR Parameters

LR Parameters are shown in figure 8.29.

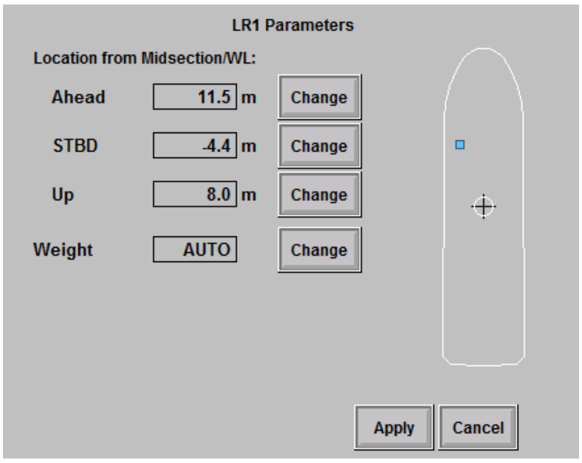


Figure 8.29: LR Parameters

Location from CG includes a group of parameters determining the LR-sensor position.
Weight is set analogously to the GPS weight.
Accuracy is set analogously to the GPS accuracy.

8.8.8.3 LR Plot

LR Plot is shown in figure 8.30.

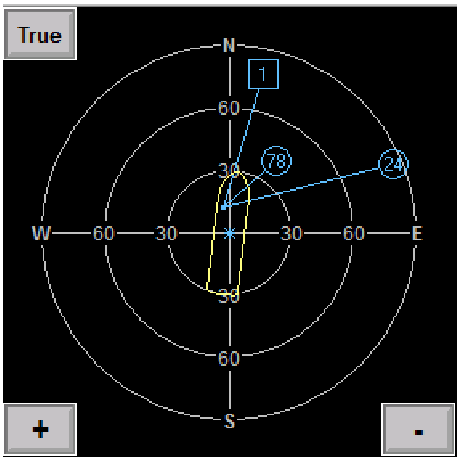


Figure 8.30: LR Plot

Transponders of the given LR are shown in this window, which are used as Ref (squares), as Tgt (rhombs) and others (circles).

Raw data from relative beacons is shown by stars.

Vessel is shown in the same way as it's shown in the map (ship position is calculated with all Ref-sensors), therefore it can not coincide with the LR data.

8.8.8.4 LR Graph

LR Graph is shown in figure 8.31.

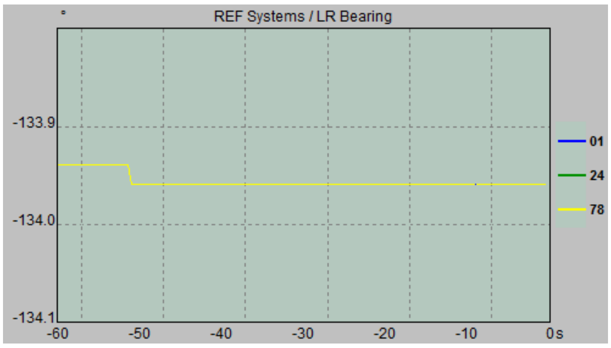


Figure 8.31: LR Graph

Graphs are shown in this mode: LR measurements (Distance and bearing).
For more information about view settings for graph refer to Section 5.8, page 81.

8.8.9 Detailed Information for Taut Wire System

For each TW “View” / “Param” and “Plot” / “Graph” windows are available.

8.8.9.1 TW View

The view of the window depends on the TW type: standard (see figure 8.32) or ATW (see figure 8.33)

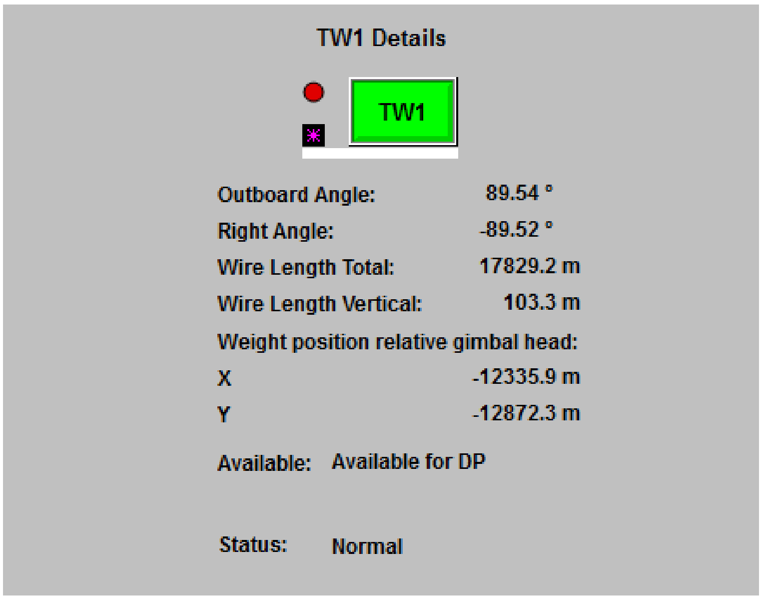


Figure 8.32: The standard TW view

The following alarm statuses can be displayed for the ATW system (the text of messages is red):

– PLC CPU Stopped
– PLC I/O Fault
– Angle Outrange
– Winch Fault
– Tension Fault
– Tension Outrange
– CP Link Fault

Every alarm status has the corresponding alarm message within the Alarm List.

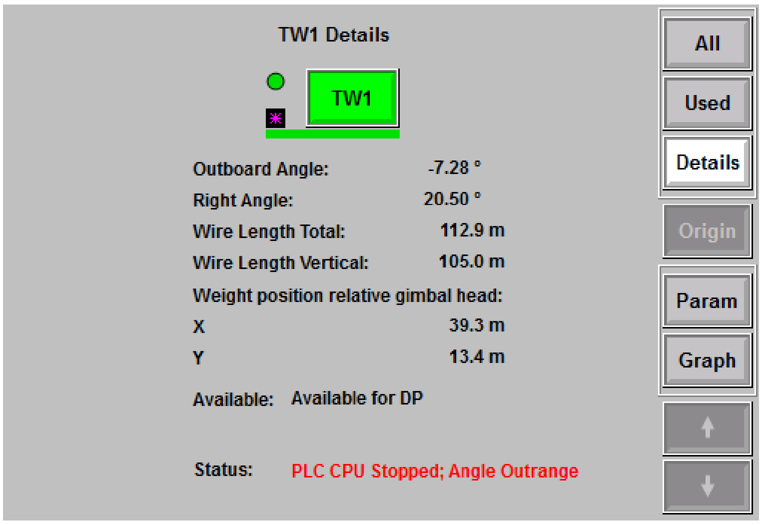


Figure 8.33: The ATW type view

8.8.9.2 TW Parameters

The window contains the TW location set up (see figure 8.34).

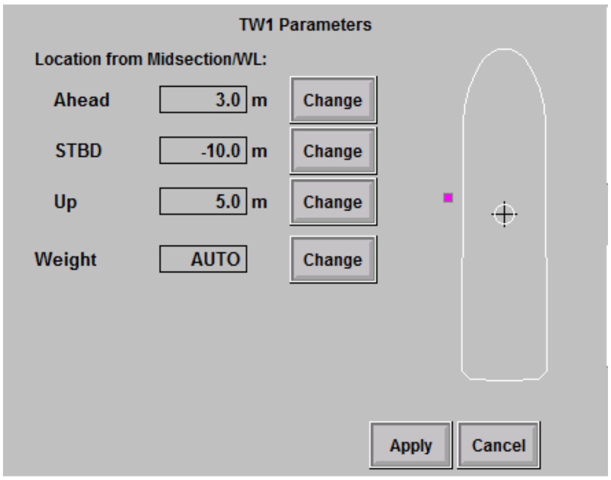


Figure 8.34: TW Parameters

The weight is set in the similar way as the GPS weight.

8.8.9.3 TW Plot

The window contains plot (see figure 8.35) with the following parameters displayed:

- vessel outline
- depressor weight position
- horizontal projection of the wire (from gimbal head to depressor weight)
- boundaries of the zone accessible with the given wire lenght

8.8.9.4 TW Graph

This window displays changes of the selected parameter (outboard angle/ rightward angle/ wire lenght) (see figure 8.36).

To open the settings dialog (see figure 8.37) press on the graph area.

The following keys are used for the parameters:

TW Alpha - outboard angle

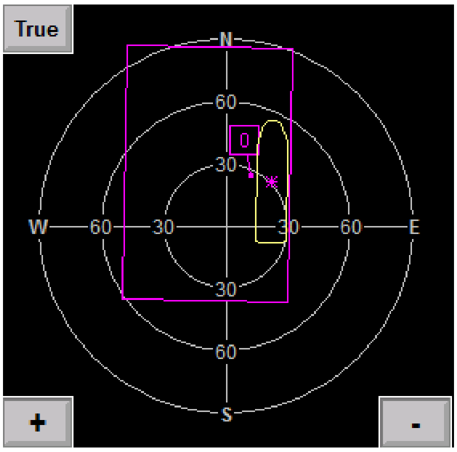


Figure 8.35: TW Plot

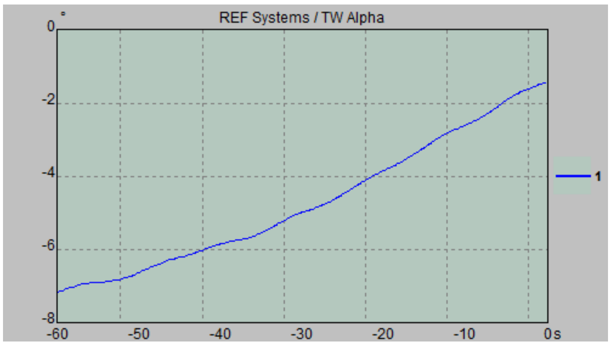


Figure 8.36: TW Graph

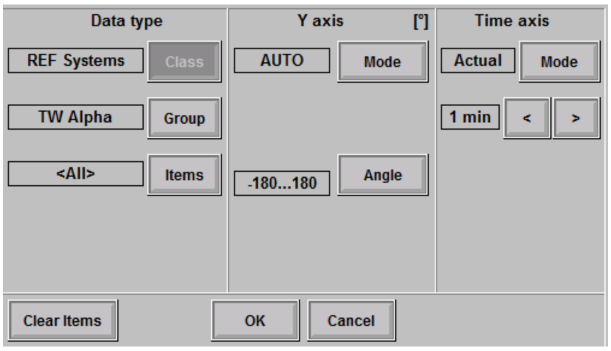


Figure 8.37: Graph settings dialog

TW Beta - rightwards angle

TW Length - wire length

For more information about view settings for graph see the Section 5.8, page 81.

Chapter 9

Control Modes

In this section, the operational modes are described. Although you may select any window to display information, including the Parameter Window in which you can change data, each operational mode is characterized by a particular set of parameters which must by carefully checked before you start operation is this mode.

You can select different control modes for the vessel's heading and position. Use the HDG softkey group to select a control mode for the heading, and the POS softkey group to select a control mode for the position. Having selected the control modes for both the heading and position, you activate the operational mode of **NAVIS NavDP 4000**. All the associated parameters must be set to the required values before you start operation in this mode. You can also activate the Remote COR and AWC functions while operating in a particular control mode.

9.1 General

The color of a softkey from the HDG softkey group or the POS softkey group informs you about the operations you can perform.

Case 1: softkey color — grey

The softkey is not activated. For instance, the Operator Station is switched on, however, the control has not been transferred to the station.

Case 2: softkey color — dark green

The softkey is activated, however the corresponding control mode is not activated. You can select this mode by pressing the softkey. The softkey starts blinking. If you press the softkey once again, it stops blinking. If the softkey is blinking but you are doing nothing, the softkey stops blinking after a few seconds. If you press the softkey while it is blinking, that is your confirmation. The softkey stops blinking and becomes light green, and the corresponding control mode is selected.

A number of buttons have been programmed so that at the moment of pressing, a bar is displayed on the screen where you must enter the value of a parameter, such as heading or position setpoint. A default value is always displayed. You can confirm the delault value by pressing the OK softkey, or input a new value and then press the OK softkey. In both the cases, the softkey becomes stops blinking and becomes light green, and the corresponding control mode is activated. You can also press the Cancel softkey to cancel.

Case 3: softkey color — light green

If a softkey has been programmed so that a bar appears on the screen when you press the softkey, this softkey is activated. In that case you press the softkey just in order to set a new value of the parameters, such as heading or position setpoint. Other softkeys are deactivated.

Therefore, you cannot deactivate a control mode by merely pressing the corresponding softkey. You can do that only by selecting another control mode.

Case 4: softkey color — dark red

The softkey is not activated. The dark red color informs you that the corresponding control mode cannot be activated. For instance, the Auto Heading control mode cannot be activated unless at least one heading reference sensor is in operation. After **NAVIS NavDP 4000** has recognized that the corresponding mode can be activated, the softkey becomes dark green.

Case 5: softkey color — light red

The softkey is not activated. The light red color means that a fault has occurred while **NAVIS NavDP 4000** was operating in the corresponding control mode. After the **NAVIS NavDP 4000** has recognized that the corresponding mode can be activated, the softkey becomes dark green.

9.2 Heading Control Modes

9.2.1 Manual Heading ("Knob" mode)

To activate this mode, operator use the **MAN** softkey in the **HDG** panel.

The rotational moment demand is proportional to the rotary **knob** position, provided that the knob symbol remains inside the grey area on the Thrust Ability Diagram.

Following options can be used in this mode:

– Auto Wind Compensation function (see Section 10.2, page 173)
– Remote COR position (COR in bow, stern, or other specified point)

The vessel motion in "Knob" mode is shown in Figure 9.1. This heading control mode can be combined with any position control mode.

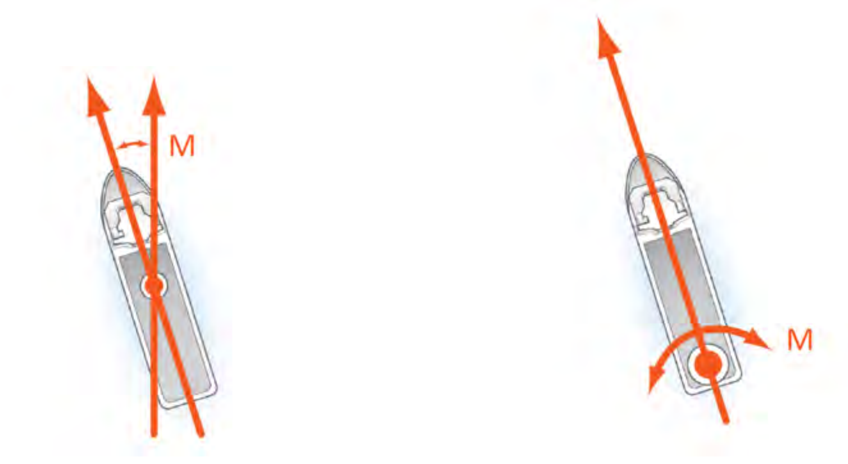


Figure 9.1: Manual Heading mode

9.2.2 ROT Heading Mode

To activate this mode, press the **ROT** softkey in the **HDG** panel.

Use the rotary knob for setting the rate of turn. The ROT demand is proportional to the value of the parameter ROT specified in the **HDG** tab of the **PARAM** window.

The vessel motion in ROT Heading mode is shown in Figure 9.2.

Following options can be used in this mode:

– Remote COR position (COR in bow, stern, or other specified point);
– Heading Gain (gain of the heading controller).

This heading control mode can be combined with any position control mode.

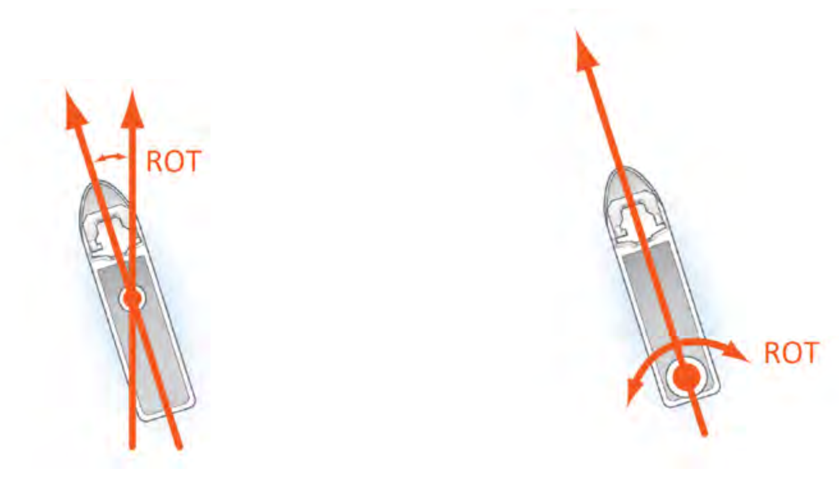


Figure 9.2: ROT Heading mode

> **NOTE!** The desired rate of turn will not be provided if there would not be enough available thrust (or power), or the demand is very big.

9.2.3 Auto Heading

The vessel motion in Auto Heading mode is shown in Figure 9.3.

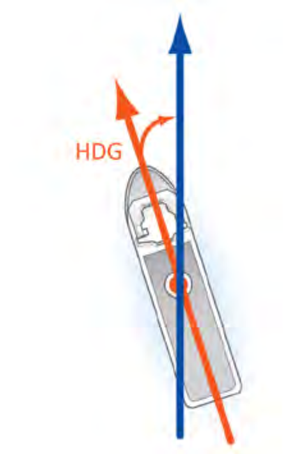


Figure 9.3: Auto Heading mode

This mode can be activated using **AUTO** softkey at in the **HDG** panel, Mode/Function Panel.

This heading control mode can be combined with any position control mode.

The rotational moment demand is calculated by the controller. During the operation operator can change heading setpoint.

When changing heading by the control panel's knob, the clockwise or counterclockwise direction of preset heading adjustment determines the vessel's turn direction. In case of entering from dialog window the letter **P** or **S** determines the direction of turn.

Following options can be used in this mode:

Change Heading Setopint (Preset Heading, Offset Heading)

Remote COR position (COR in bow, stern, or other specified point)

Minimal Power Heading (option)

When operator press this softkey, a dialog appears on the screen where you must input the heading setpoint value. The default value is the actual heading at the moment when you press the **AUTO** softkey.

Operator can select preset of heading setpoint or offset from present setpoint.

This mode can also be activated by pressing the **HOLD HGD** button on the Main or Portable Control Panel. In that case the heading setpoint is automatically set to the actual heading.

Following parameters of Heading Control Law are available from Operator Station:

Rate of Turn Upper limit to the rate of turn while heading control

Heading Gain Gain of the heading controller

Off-Heading Limit Maximum allowable difference between the actual heading and desired heading. If the limit is exceeded, an alarm is produced.

See Section 5.6, page 79 for details about enter heading setpoint.

9.2.4 Relative Bearing to Target

This mode can be activated only if the Target Follow mode is activated (the **Target** softkey in the POS panel is green).

Operator may set any Relative Bearing to the target which will be maintained by DP control system.

The Relative Bearing to the target input dialog will be activated by pressing the **Target** softkey in the HDG panel.

The vessel motion in Target mode is shown in Figure 9.4.

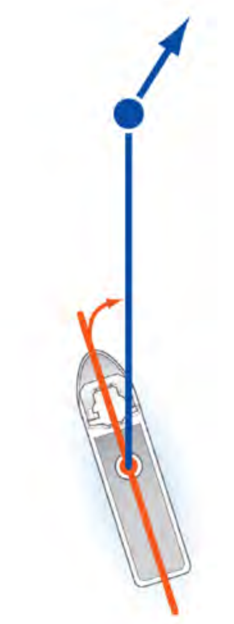


Figure 9.4: Relative Bearing to Target

The rotational moment demand is calculated by the controller.

9.2.5 High Speed Tracking

Track control at medium and high speeds by heading control. The rotational moment demand is calculated by the controller.

The vessel motion in High Speed Tracking mode is shown in Figure 9.5. During the operation, the vessel's heading is continuously directed along the current track leg.

Following options can be used in this mode:

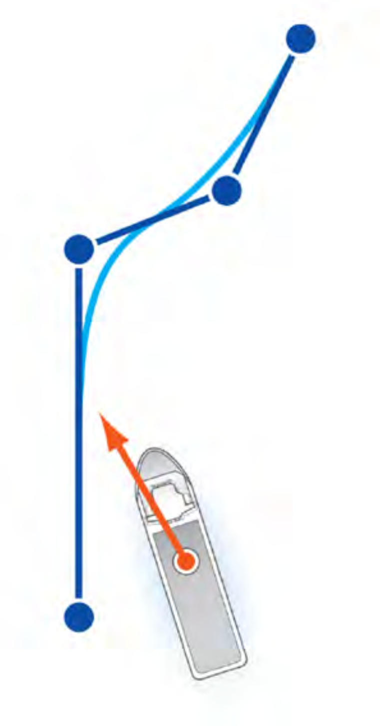


Figure 9.5: High Speed Tracking

- Waypoint table management (reverse track, copy track, edit points, change active route, external route loading (from ECDIS, for instance);
- Manual speed (from Joystick);
- Cross-track alarm.

Following parameters of Heading Control Law are available from Operator Station:

Off-Track Limit — specifies the track offset at which an alarm is produced;

Track Gain — specifies the tracking accuracy;

Turn Radius — specifies radius of turn when changing track leg;

Rudder limit — specifies the ceiling value of rudder offset.

See Section 10.6, page 189 for details.

9.2.6 Heading by Low Speed Track

This control mode is available only if the Low Speed Tracking control mode has been set for the position. The vessel motion in Low Speed Track mode is shown in Figure 9.6.

The rotational moment demand is calculated by the controller. During the operation, the vessel's heading is continuously directed with crab angle to track.

Following parameters of Heading Control Law are available from Operator Station:

Crab Angle Angle between track leg and desired heading

See Section 5.7, page 81 for details about crab angle.

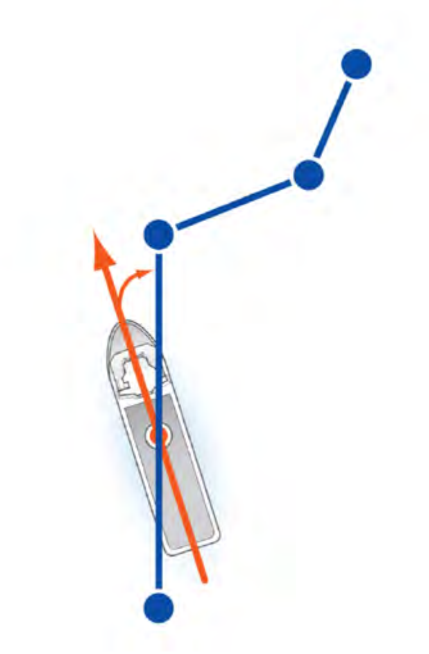


Figure 9.6: Low Speed Tracking

9.3 Position Control Modes

9.3.1 Manual Position

To activate this control mode for the vessel's position, press the **MAN** softkey in the **POS** panel. The softkey starts blinking. Press the softkey once again to cancel, or the **ENTER** softkey to acknowledge.

In this control mode, the vector force demand is proportional to the joystick position. It is recommended to initiate the Auto Thruster window to see what amount of the thrust can be produced in each direction. The vessel motion in Manual Position mode is shown in Figure 9.7.

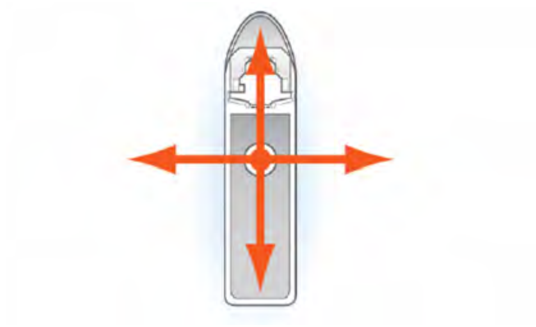


Figure 9.7: Manual Position

Following options can be used in this mode:

Wind Compensation function see Section 10.2, page 173

Remote COR position COR in bow, stern, or other specified point

Following parameters are available from Operator Station:

Joystick Gain Settings (Normal, High, Progressive)

9.3.2 Auto Position

See Section 5.5, page 76 for details about enter position setpoint.

To activate this control mode for the vessel's position, press the **AUTO** softkey in the **POS** panel. The softkey starts blinking. Press the softkey once again to cancel, or the **ENTER** softkey to acknowledge.

In this control mode, the vector force demand is calculated by the controller, and the joystick is disabled.

The controller continuously calculates the vector force demand in order to maintain the vessel on the desired location. The vessel motion in Auto Position mode is shown in Figure 9.8.

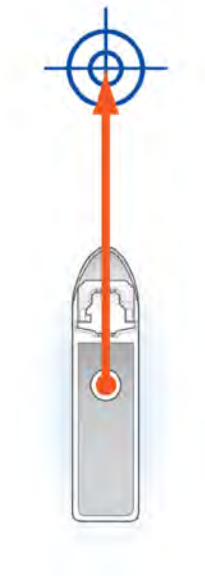


Figure 9.8: Auto Position

When you press the **AUTO** softkey, a bar appears on the screen where you must enter the position setpoint value. During the operation, you can press the **AUTO** softkey and set a new value for the position setpoint.

Following options can be used in this mode:

Position Setpoint Set Position Offset the position

Remote COR position COR in bow, stern, or other specified point

Following parameters are available from Operator Station:

Fore-aft speed Maximal allowed vessel speed in the surge direction

Athwartships speed Maximal allowed vessel speed in the sway direction

Position Gain Gain of Position Controller

Position Limit Limit for alarm

9.3.3 Manual Surge

To activate this control mode, press the **man SURGE** softkey in the **POS** panel. In the **HDG** panel, press the **AUTO** or **MANUAL** softkey.

The vessel longitudinal motion is controlled by the joystick (the lateral joystick axis is disabled). The vessel motion in Manual Surge mode is shown in Figure 9.9.

Figure 9.9: Manual Surge

NOTE! This mode is mostly intended for automatic maintaining the vessel on a straight path, while the vessel's motion in the surge direction is controlled manually. Therefore, you are recommended to use Auto heading control only.

This mode might be useful if the vessel is required to operate along a straight line, in the presence of wind, waves and current. First bring the vessel more or less close to an imaginary line along which the vessel is to be moved.

Press the **AUTO** softkey in the **HDG** panel and set the heading setpoint, so that the vessel is directed along the imaginary line. Then press the **man SURGE** softkey. After that a bar appears on the screen, where you must enter the position setpoint. If the current vessel's position is exactly on the path, you can just press the **HOLD** softkey and then **OK**, otherwise set a new position setpoint. In both the cases you will set the position setpoint, while the heading setpoint have been set earlier. These two values (the heading and position setpoints) define a straight line, along which the vessel will be moved. The controller calculates the lateral deviation from the line and tries to drive this deviation to zero; while the longitudinal vessel's motion is controlled by the joystick (the lateral joystick axis is disabled).

During the operation, you can change the position setpoint, which means that the required path shifts in parallel.

In this control mode, the X-part of demand force vector is calculated by the controller, and the joystick is disabled.

Following options can be used in this mode:

Position Setpoint Set Position Offset the position

Remote COR position COR in bow, stern, or other specified point

Following parameters are available from Operator Station:

Fore-aft speed Maximal allowed vessel speed in the surge direction

Position Gain Gain of Position Controller

Position Limit Limit for alarm

Joystick Gain Settings (Low, High, Progressive)

9.3.4 Manual Sway

Similar to the Manual Surge mode.

Use the **man SWAY** softkey.

In this control mode, the Y-part of demand force vector is calculated by the controller, and the joystick is disabled.

The vessel lateral motion is controlled by the joystick (the longitudinal joystick axis is disabled).

The vessel motion in Manual Sway mode is shown in Figure 9.10.

Following options can be used in this mode:

Position Setpoint Set Position Offset the position

Remote COR position COR in bow, stern, or other specified point

Following parameters are available from Operator Station:

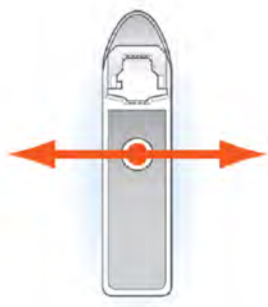


Figure 9.10: Manual Sway

Athwartships speed Maximal allowed vessel speed in the sway direction

Position Gain Gain of Position Controller

Position Limit Limit for alarm

Joystick Gain Settings (Normal, High, Progressive)

9.3.5 Speed Vector Control

The vessel motion in Speed Vector mode is shown in Figure 9.11.

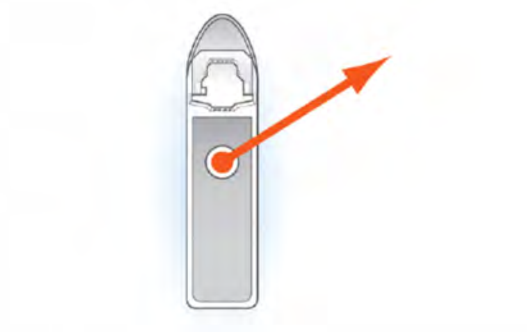


Figure 9.11: Speed Vector Control

First set the value for the SPEED VECTOR parameter in the JST page.

If you select **Joystick**, you will use the joystick for setting the longitudinal and lateral vessel's component speed setpoints. To activate this mode, press the **speed VECT** softkey in the **POS** panel. In the **HDG** panel, press the **AUTO** or **MANUAL** softkey. The controller will be trying to move the vessel with the component speeds accordingly to the joystick position.

If you select **Manual**, you must set exact values for the longitudinal and lateral vessel's component speed setpoints. To activate this mode, press the **speed VECT** softkey in the **POS** panel. A bar appears where you can enter the component speed setpoints. The controller will be trying to move the vessel with the component speeds accordingly to the required values. For the heading control, press the **AUTO** or **MANUAL** softkey in the **HDG** panel.

> **NOTE!** The desired speed vector will not be provided if there would not be enough available thrust (or power), or the demand is very big.

Joystick control of ship speed vector

Following parameters are available from Operator Station:

Speed Vector Used to select source of the desired vessel's speed in the Speed Vector mode (Joystick or Manual)

9.3.6 Position by Target Control

The vessel position is automatically controlled in this mode according to relative position of the vessel and the target(s). See Figure 9.12.

Figure 9.12: Position by Target Control

See Section 10.5, page 180 that describes how to assign the targets, operate in the **Target** window and set the parameters for following the target.

In this mode the vessel heading can be controlled either automatically or manually. See Section 10.5, page 180 for more detailed information.

9.3.7 Position mode: LS Track Control

The vessel position is controlled automatically in this mode according to relative position of the vessel and the track see Figure 9.13.

The vessel heading can be controlled either manually or automatically.

See Section 10.6, page 189 that describes how to set a track(s), operate in the **Track** window and set the parameters for following the track.

Following options can be used in this mode:

- Waypoint table management (reverse track, copy track, edit points, change active track, external track loading (from ECDIS, for instance);
- Cross-track alarm;
- Stop at last waypoint;
- Change heading;
- Auto heading by track (with crab angle setting);
- Minimal power heading.

Following parameters are available from Operator Station:

Vessel speed Vessel speed settings;

WP Pass Strategy Non-stop and stop strategy (waypoint passing strategy);

Off-Track Limit Specifies the track offset at which an alarm is produced;

Position Gain Specifies the tracking accuracy;

Turn Radius Specifies radius of turn when changing track leg;

WP Predict Alarm Specifies weather an alarm should be issued when the vessel approaches the waypoint.

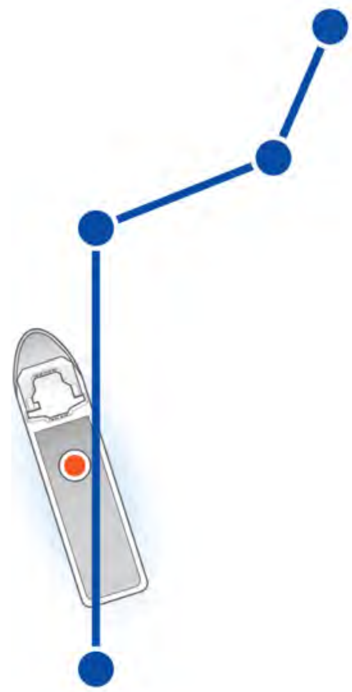


Figure 9.13: Position mode: LS Track Control

See Section 10.6, page 189 for more information.

Chapter 10

System Functions

10.1 Remote Center of Rotation (Pivot Point)

When using dynamic positioning, the operator has the ability to alter the point at which the vessel rotates around. Normally this point is located at the Center of Gravity. When a heading change is carried out the vessel will spin “on a dime”, staying relatively in the same position.

The operator may choose to change the center of rotation for a number of reasons related to the operation currently underway. Some examples of changing the COR:

- to the position of a crane wire that is connected subsea, so that a change in heading doesn’t pull laterally on the load;
- to the location of the diving bell, so that a rotation does not move the dive bell closer to a subsea structure;
- to the roberts hoop, so that a change in heading does not pull the diver into danger;
- to the tip of a pipe lay stinger so that you can adjust to the best weather heading, without changing the location of the tip in relation to the survey line;
- off the vessels bow centered on a spar, so that the vessel rotates around that spar while maintaining a constant distance (weather vane).

Use the **FUNC** panel to select these functions (see Figure 10.1):

These functions can be used for different operational modes. In this section you learn how each of the functions relates to a particular operational mode.

This function is used in **IJ** and **DP** mode only. A default COR position is in the center of gravity. If COR is set at the center of gravity, the **remote COR** softkey is dark, otherwise it is lit up. Press the **remote COR** softkey.

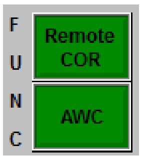


Figure 10.1: FUNC Panel

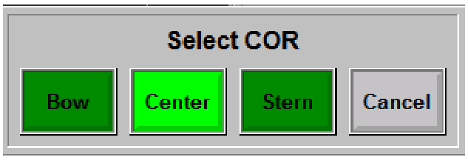


Figure 10.2: Dialog box Remote COR

It starts blinking, and a dialog appears on the screen (see Figure 10.2)

which shows the actual COR position. The remote COR softkey starts blinking. Select a new COR position or press Cancel.

The actual COR position is displayed on the screen as a yellow circle with an arrow (Figure 10.3).

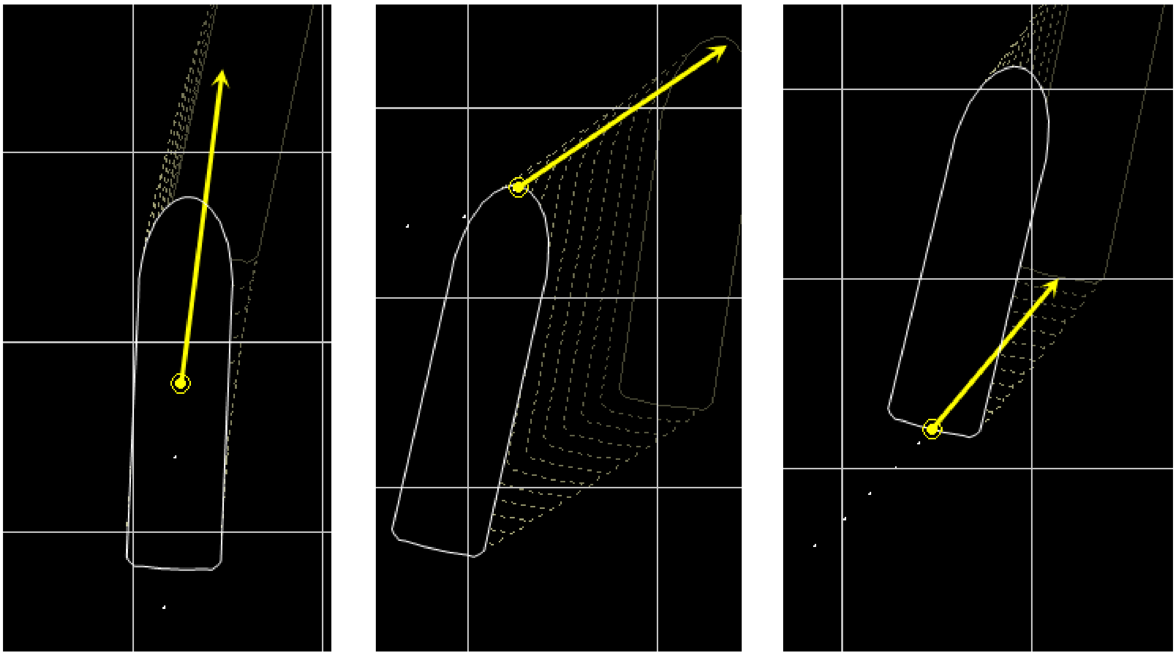


Figure 10.3: COR position: COR at Center, Bow, Stern

The arrow shows the direction in which COR moves and how much its speed is; exact values for the COR course and speed are displayed at the top of the screen and denoted as COG and SOG consequently.

If COR is set at the bow or stern, the softkey remote COR is lit up. In what follows it is described how the position of COR relates to a control mode activated.

Custom set of COR points

The option is custom set of COR points. Use arrow softkeys to select COR point. See Figure 10.4

Editing COR points

The option is editable COR points. Use Param / COR to edit available COR points list.

Auto Heading and Auto Position

Press the **AUTO** softkey in the **POS** panal.

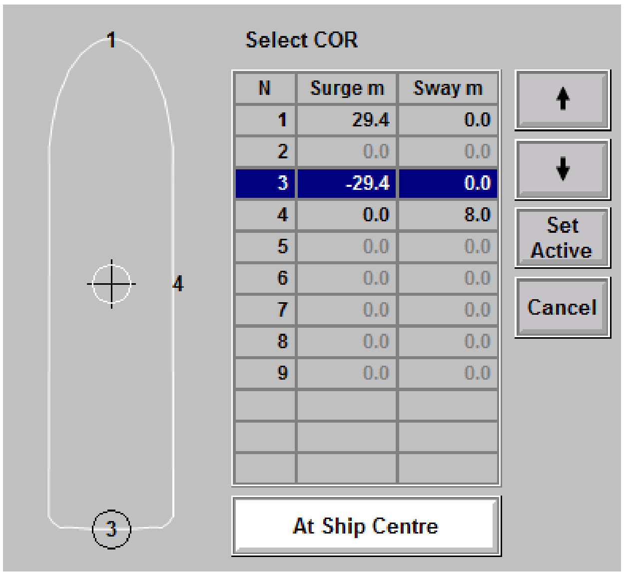


Figure 10.4: A COR point selection dialogue box

A window appears in which you can see the actual vessel coordinates. Note that these are the coordinates of the actual COR.

If you enter new position setpoint or offsets with respect to the actual coordinates, you set a new position setpoint with respect to COR already chosen.

If you then change COR during the operation (while the system is moving the vessel to a new position) it would not affect the maneuver, because any change in the COR position would be automatically followed by corrections of the position setpoint. Therefore, you should hardly care of the COR position if you want to transfer the vessel to a new position without changing its heading.

If you are going to change the vessel heading too, take into account that the resulting vessel position would depend on the COR location. For instance, assume that the vessel heading and position are kept by the DP system, and you enter the heading offset, say, 15 degrees. If COR is assigned at the bow, the DP system tries to hold the bow motionless while rotating the stern; if COR is assigned at the stern, the DP system tries to hold the stern motionless while rotating the bow. Since the directions of rotation differ, the resulting position of the center of gravity would not be the same.

Manual Heading and Auto Position

Select a COR position. Then press the **AUTO** softkey in the **POS** panel. A window appears in which you can see the actual vessel coordinates and set the position setpoint (in terms of the COR position selected). In this mode, the control system maintains COR at the position setpoint, while turning the vessel accordingly to the rotary knob angle. If you do not rotate the rotary knob (i.e. it is in neutral position), you can select a new position for COR without influencing the maneuver, because a change in the COR position automatically causes the corresponding change in the position setpoint. However, if you operate the rotary knob at the time, take into account that the moment demand depends on the COR position.

Auto Heading and Manual Position

Press the **AUTO** softkey in the **HDG** panel. A window appears in which you can see the actual heading and set the heading setpoint. In this mode, the control system generates forces in the surge and sway axes accordingly to the joystick position, while maintaining the vessel at a desired heading. In this mode, the actual COR position does not matter.

10.2 Automatic Wind Compensation

If the **AWC** softkey is not highlighted, as shown below, this function is not active

Press the **AWC** softkey, it starts blinking. Press the **ENTER** softkey to acknowledge, or the AWC softkey to cancel. If you acknowledge, the AWC softkey becomes highlighted, as shown below

The AWC function is now activated, see Figure 10.7. To deactivate, press the AWC softkey, it starts blinking. Press the **ENTER** softkey to acknowledge, or the AWC softkey to cancel.

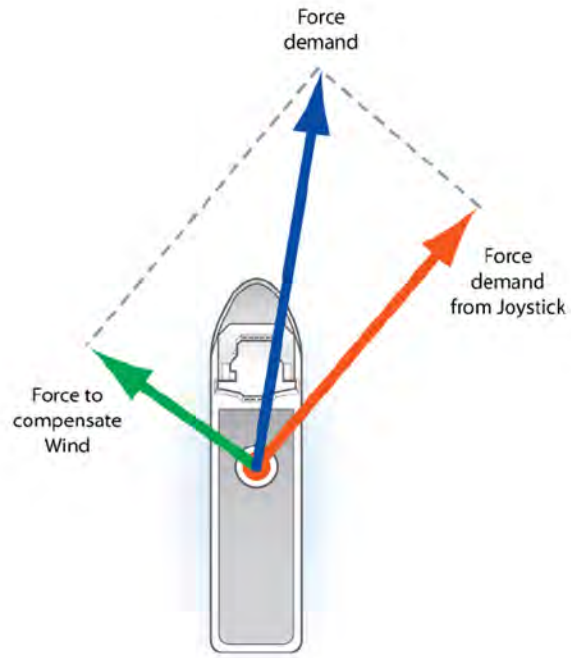


Figure 10.5: AWC function

If you acknowledge, the **AWC** softkey becomes dark, and the AWC function is not active. See Figure 10.6

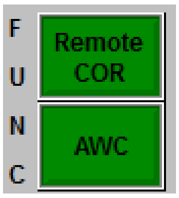


Figure 10.6: FUNC Panel: AWC function disabled

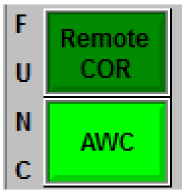


Figure 10.7: FUNC Panel: AWC function enabled

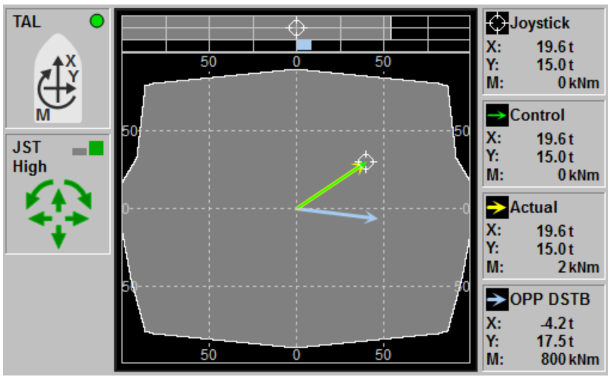


Figure 10.8: Thrust ability diagram. AWC function is OFF

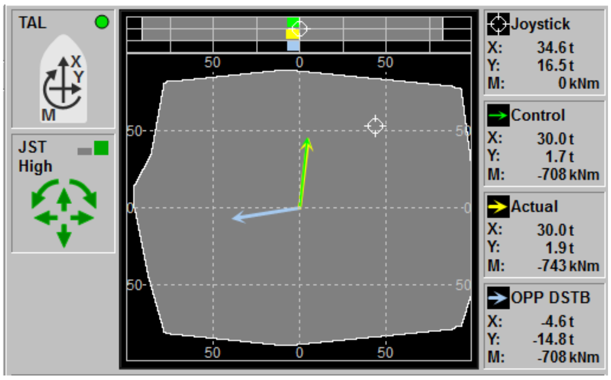


Figure 10.9: Thrust ability diagram. AWC function is ON

When you tilt the joystick, the corresponding vector force demand $\mathbf{F}_{demand}$ is being calculated.

If the AWC function is activated, the vector force demand is calculated as sum of demand, depending on joystick position, and the force needed to compensate the wind disturbance $\mathbf{F}_{disturb}$. See figure 10.5 for details. You can consider this as a shift in the joystick axes.

The same can be said about the rotary knob.

If the AWC function is not activated, the total moment demand depends on how much you rotate the knob. If the AWC function is activated, the total moment demand also includes an AWC component.

See Section 6.1.2, page 102 for details on thrust ability diagram.

10.3 Minimal power heading

Minimal power heading is the estimated value of heading setpoint Minimal Power mode On/Off. The vessel heading is controlled so as to minimize the power used by the thrusters (usually the vessel is brought as close to the resulting weather force direction as possible).

By default the vessel is positioned with bow directed against the environment disturbance, but the operator can change it to the stern against the disturbance.

In case the sector parameter is ON, the vessel turns as mentioned above but the bow will stay inside the preset sector.

This function operates in **Auto Position** and **Hold Area**(if available) modes.

The function is activated by the "Min Power" softkey. After preesing the softkey a dialog (10.10) appears.

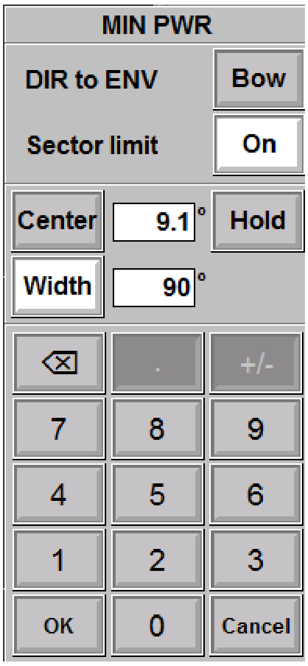


Figure 10.10: The Min Power dialog, sector is ON, bow direction

For the positioning "Stern", the settings dialog looks like represented on the figure 10.11

When the Min Power function is on the holding sector is displayed in the Map window (10.12).

In case the sector parameter is OFF, the sector value is 360°and setting dialog reduces for the kind of figure 10.13

This function is optional.

For switching the function off (emergency or ordinary) select another heading control mode.

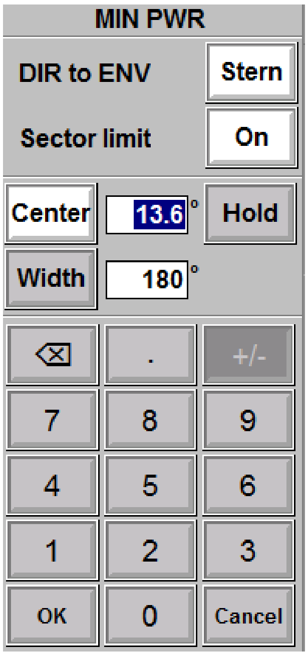


Figure 10.11: The Min Power dialog, sector is ON, stern direction

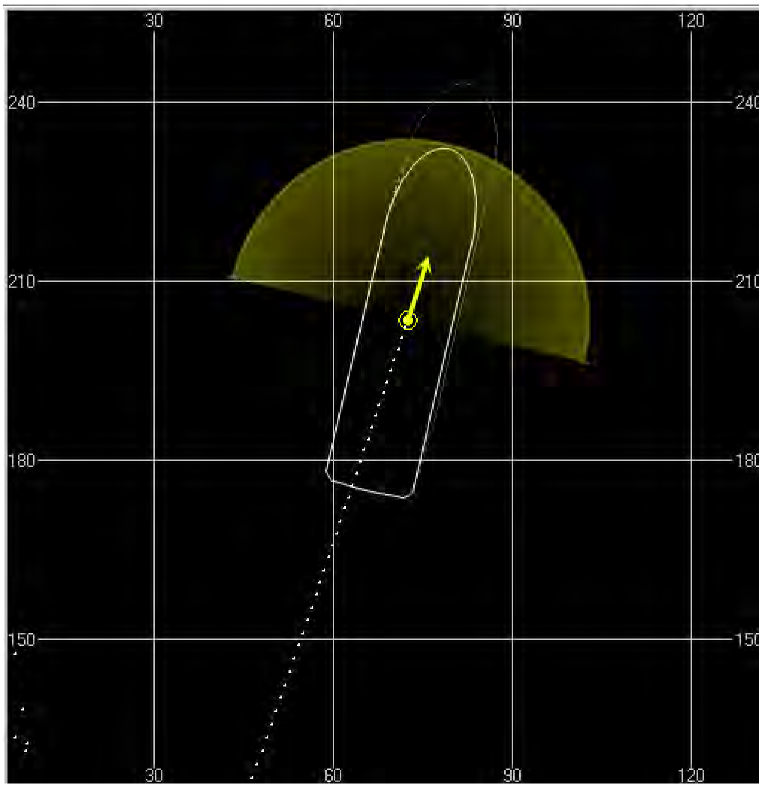


Figure 10.12: Map Window when the Min Power function is ON, and Sector parameter is ON

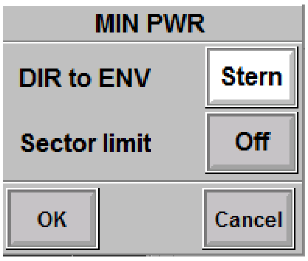


Figure 10.13: The Min power dialog, sector is OFF

10.4 Hold Area

The function provides holding the vessel position in a presist area. If the function is available, the Parameters window contains the corresponding tab named Hold Area (see figure 10.14), where the following parameters are available:

Fore-Aft speed

Athwartships speed

Hold Area gain — gain of Hold Area controller;

Hold Area Radius — the maximum area radius;

Warning Radius — (% of the Hold Area Radius) — an alarm is generated in case the vessel approach to this radius;

Stop Radius — (% of the Hold Area Radius) — the radius of the area where the vessel stops.

The absolute units are the global parameter that set in the Units tab.

The function runs by the **Hold Area** softkey pressing. After the softkey's been pressed the setting dialog appears (see figure 10.15).

When the Hold Area function is on the Map view displays two circles specifying Hold area (yellow solid) and Warning Radius (yellow dashed).

This function is optional.

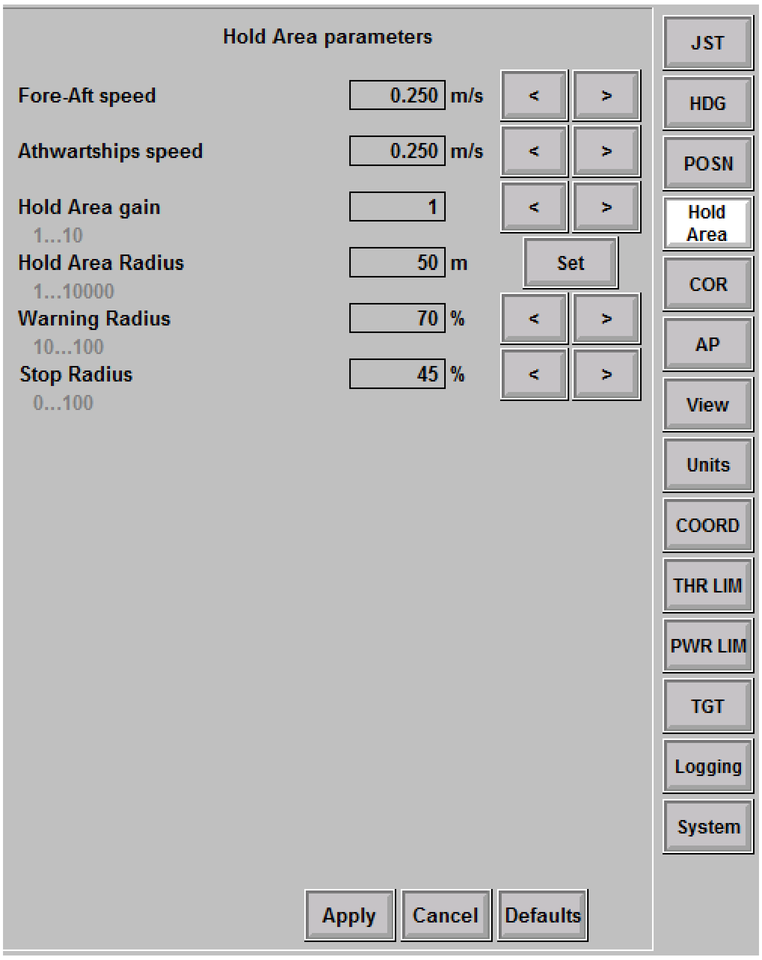


Figure 10.14: Hold Area parameters

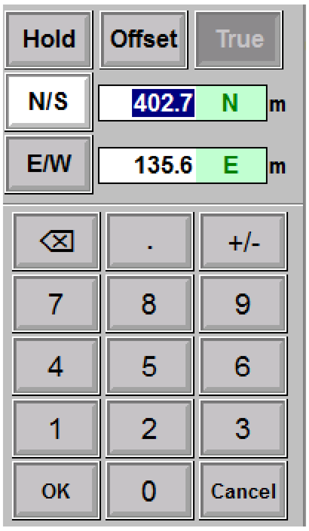


Figure 10.15: Hold Area settings dialog

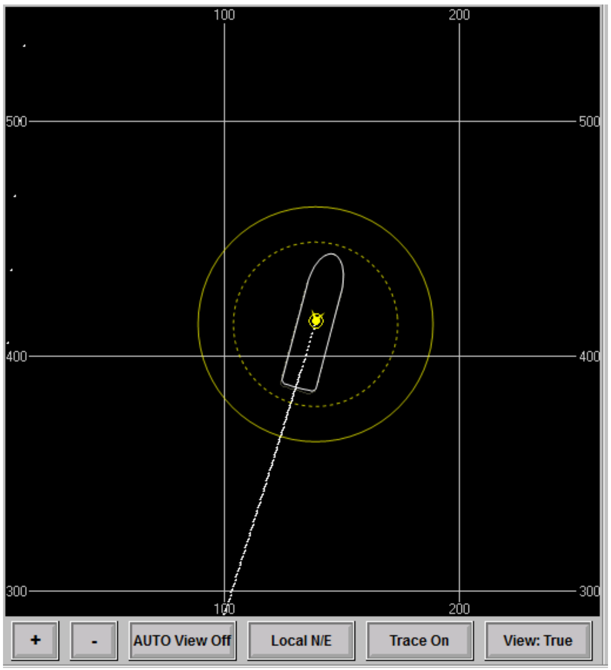


Figure 10.16: Map View when Hold Area is on

10.5 Target Following

Target Following mode is intended for following the target or moving the vessel within a definite range around the target selected.

Target window allows you to configure Target Following mode. Press the Select window and select "Target" to display the Target window. Using Target window you can:

– select a mode: MultiTarget or SingleTarget mode

– select a target/targets

– display all transponders that can be selected as targets

– monitor the target/targets which is selected on the Target plot

Target window is divided into 2 parts. All transponders are displayed on the top of the Target window. The transponders are selected as targets or are available to be selected as targets.

The lower part of the window consists of:

– Target plot/Graph;

– Target Processing results.

Transponders Table

The following transponder softkeys and indicators are presented in this table:

Transponder softkey. Press Transponder softkey with an appropriate transponder name to select a definite transponder as the target. This softkey begins blink. Then you could:

– press Enter softkey to acknowledge. Transponder softkey becomes white-colored.

– press Transponder softkey again to cancel. Transponder softkey becomes grey-colored.

Data indicator shows the data status:

black-colored indicator means that there is no any data

green-colored indicator means the data are correct and used by the system

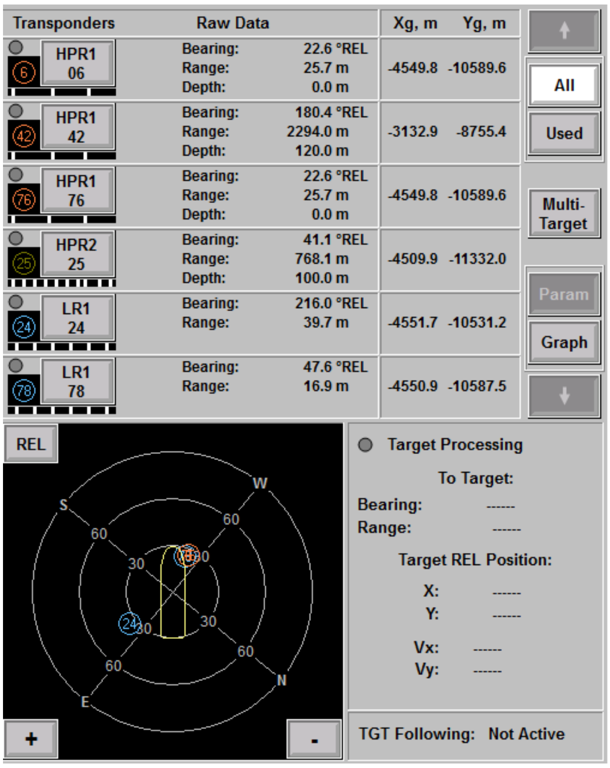


Figure 10.17: Target Window Example

white-colored indicator means the data are not used by the system

red-colored indicator means the data message is decoded with mistake

Filter status indicator shows the filter status:

green-colored indicator means that the filter is started up and operated

red-colored indicator means that the processing result is doubtful. For example, there is no correct data for a long time and the filter is under predicted

grey-colored indicator means that the filter has never started up or there is no any data at all

The transponder is shown with the **ID indicator** both on the Target view and on the Target plot:

ID transponder is indicated in the **circle** if it hasn't been selected as target. The color of the transponder is the same as the sensor one.

ID transponder is indicated in the **rhomb** if it has been selected as target. The color of the transponder is the same as the sensor one.

Transponders selected as position-reference systems are not displayed in the Target window.

Used Press the softkey in the softkey group to display only the used targets in the Target window. In this case Used softkey is white-colored.

ALL Press the softkey to monitor all the transponders.

When the target is selected its number is indicated on the right of Transponder softkey (e.g. Tgt#1). Only two targets can be selected as the maximum in case of **MultiTarget** mode activated, and only one target in case **SingleTarget** mode operated.

> **NOTE!** If a maximum of targets has been assigned (if MultiTarget mode is activated) at selecting a new target, Tgt#1 of the targets selected before will be canceled. Tgt#2 becomes Tgt#1 and a new target selected becomes Tgt#2.

Disabling MultiTarget mode only one target remains selected as Tgt#1.

Target Plot

Target Plot at the bottom of the Target window shows transponders located relative to the vessel.
See the description of the transponder ID indicators on the Target view for transponders indicated on the Target plot.
Target Processing results are presented on the right of the Target plot.
In case the **SingleTarget mode** is activated (MultiTarget softkey is grey-colored) the following data are displayed:

Range to target (see Figure 10.18)

Bearing to target — is presented by:

- absolute value if the Plot is displayed in True mode.
- relative value if the Plot is displayed in Rel mode.

Target coordinates are presented by:

- Xg, Yg if the Plot is displayed in True mode (Local N/E),
- Target X, Target Y if the Plot is monitored in Rel mode (vessel coordinate system)

Target movement are presented by:
if the Plot is displayed in True mode

COG — Course Over Ground (direction of target movement)

SOG — Speed Over Ground (speed of target movement)

if the Plot is displayed in Rel mode

Vx — Speed on X direction

Vy — Speed on Y direction

In case the **MultiTarget mode** is activated the following data are displayed:

Range to Tgt#1 (see Figure 10.25)

Bearing to Tgt#1 that can be presented by:

- absolute value if the Plot is displayed in True mode.
- relative value if the Plot is displayed in Rel mode.

Target Course is indicated with:

- absolute value (direction from Tgt#1 to Tgt#2) if the Plot is displayed in True mode,
- relative value if the Plot is monitored in Rel mode.

Vessel coordinates in Target coordinate system

- if the Plot is displayed in Rel mode: Ship X, Y in Target Ref-System.
- if the Plot is displayed in True mode: Target Ref-System Origin Xg, Yg (Local N/E)

Target movement are presented by:
if the Plot is displayed in True mode

COG — Course Over Ground (direction of target movement)

SOG — Speed Over Ground (speed of target movement)

if the Plot is displayed in Rel mode

Vx — Speed on X direction

Vy — Speed on Y direction

Target processing status indicator

Green-colored if the filter status of all the targets selected is green-colored (two targets in MultiTarget mode, one target in SingleTarget mode)

Red-colored if the filter is in prediction mode and there was no any correct data for a long time or the data for the vessel heading are doubtful (see Gyro processing results status)

Grey-colored if:

- the filter has never been started up
- number of activated targets is insufficient
- filter status indicator of any target is red-colored

TGT Following state:

Not Active — Target following is not active

Following — Target following in process

Stopping — Vessel reachs the target radius

Target Graph

Press Graph softkey in the softkey group to display the graphs at the bottom of the Target window instead of the Target plot. Graphs can be configured in the same way. These graphs allow an operator to estimate the history of the target on-line position.

Target Operation. Single Target Following Mode

Single target is selected in this mode.

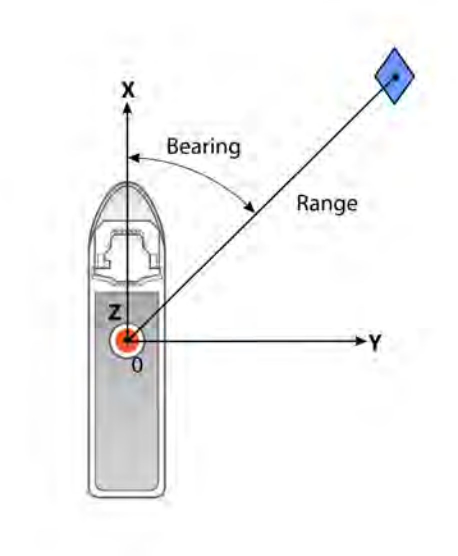


Figure 10.18: Single Target Following Mode: Coordinate Systems

Enter the Target Following mode by pressing TARGET softkey on POS panel.

TARGET softkey is available if the target processing status indicator is not grey-colored. Target Following mode is not recommended in case the target processing status indicator is red-colored however this mode is available and TARGET softkey is red-colored.

The dialog box appears just after pressing TARGET softkey that allows you to enter relative or absolute offset (target coordinates in vessel coordinate system). It means that the vessel should follow the target within the preset range.

Yellow circles is drawn on the Map - within which the target can be moved.

For example, if the target must be offset by 100m to the south of the vessel, the yellow circle will be drawn at the distance of 100m to the south of the vessel within which the target must be located.

Reaction radius (circle radius) is set in TGT page of Param window.

The vessel moves when the target is beyond the Reaction radius and stops when the vessel enters Stop Radius. Stop Radius is usually 70% of the reaction radius (the values are set in Param window)

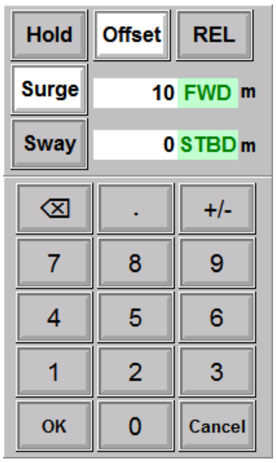


Figure 10.19: Single Target: Input offset

Reaction Radius (RR) (Watch Circle), which defines a circle of operation, within which the Target can move without causing the vessel to move.

It only moves when it crosses the boundary of the circle of operation. The center of this circle is the target (see Figure 10.20).

A Stop Radius (SR), which is automatically determined based on the Watch Circle and defines a circle at which the vessels stops when entering it. The target is at the center of this circle

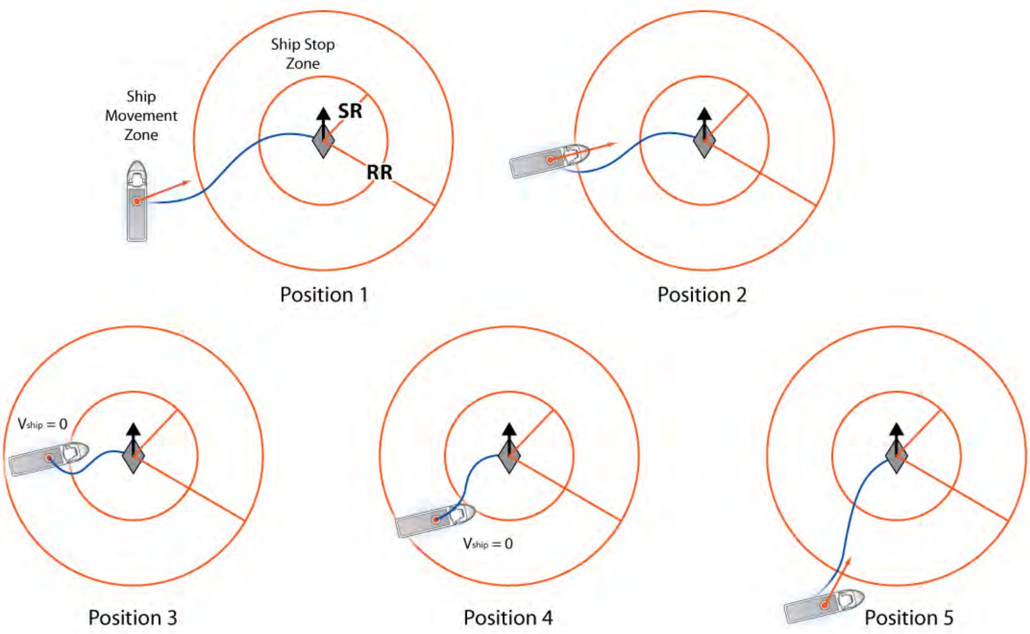


Figure 10.20: Reaction Radius

Position 1. The ship is outside of the Reaction Radius (Watch Circle) and moving towards the target. The target is moving forward.

Position 2. The ship is moving towards the target, crossing the Watch Circle. The target is moving forward.

Position 3. The ship is inside the circle of operation. It has entered the Stop Radius and is stopped. The target is moving forward.

Position 4. The ship is inside the circle of operation. It does not move. The target is moving forward.

Position 5. The ship has crossed the circle of operation. It starts moving. The target is moving forward.

In addition to the mode for position control mode “target following” you can select the heading control mode for following the target (TARGET softkey on HDG panel) (see Figure 10.21). This softkey is available only if the Target Following position control mode is activated. In this case the vessel heading setpoint will be considered as the sum of target course and preset offset.

Figure 10.21: Heading Control Mode “Target”

For example, if the zero offset is set, a vessel heading setpoint will be equal to a target course. If 20 degrees are set for the offset, the heading setpoint will be equal to target course plus 20 degrees.

When following the target it’s not allowed to change the target list and change over from SingleTarget to MultiTarget mode and vice versa. When trying to take these actions the following alarm will be generated “Can not change target settings in target following mode.”

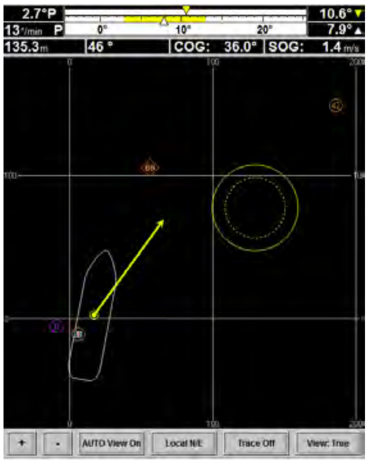


Figure 10.22: Map View, the relative bearing is to the target

In the Figure 10.22 the offset is set by 100m from the target, the relative bearing is to the target (zero offset).

In the Figure 10.23 the vessel is within the yellow circle, the target is in the green circle, th relative bearing is to the target. Control goal is achieved, then the vessel will follow the target.

The same situation is displayed in the Figure 10.24 but the reaction radius is increased.

If it’s impossible to follow the target (if Target processing status indicator grey-colored) another position control mode will be selected automatically (AUTO POS, if it possible, and MANUAL POS otherwise).

Target Operation. Multi Target Following Mode

Two targets are selected in this mode: Tgt#1 and Tgt#2 where Tgt#1 defines the target position and Tgt#2 — the target direction. It means that the vessel will follow Tgt#1 keeping the direction to Tgt#2 (see figure 10.26).

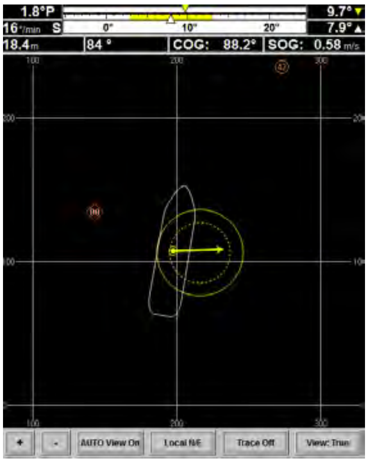


Figure 10.23: Map View, control goal is achieved, RR=30m

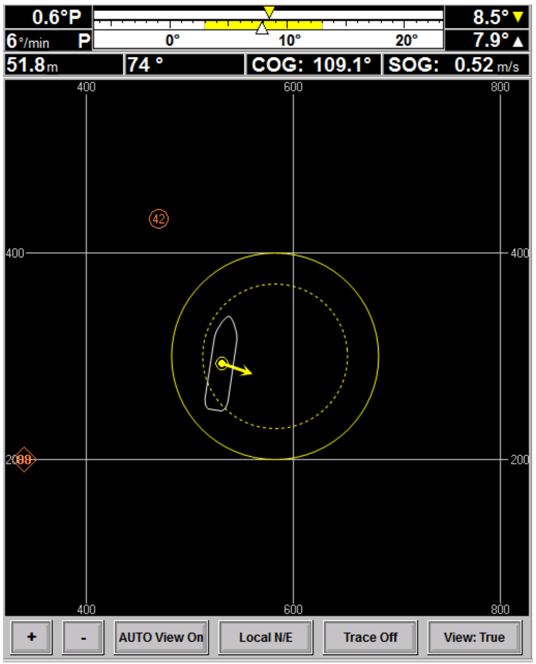


Figure 10.24: Map View, control goal is achieved, RR=100m

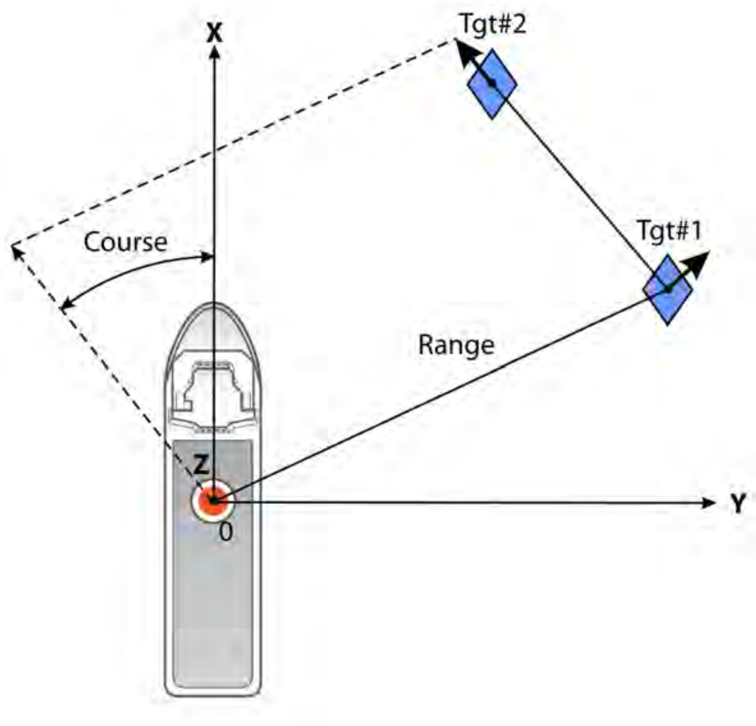


Figure 10.25: Multi-Target Following Mode: Coordinate Systems

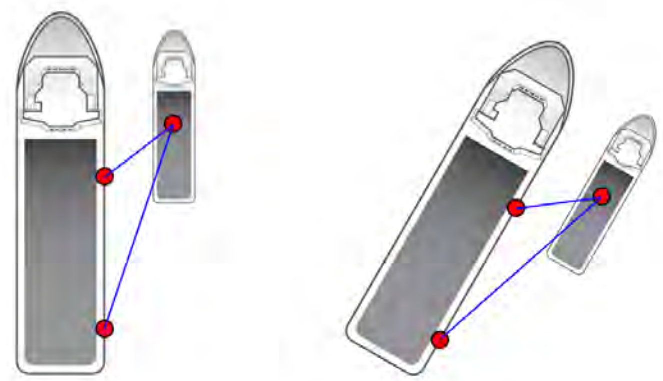
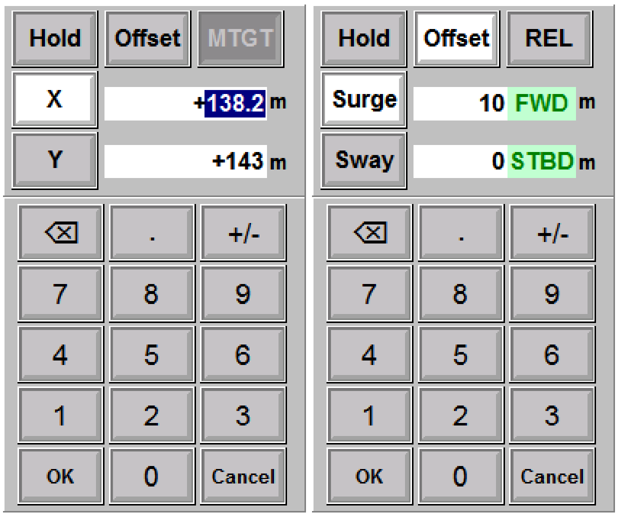


Figure 10.26: Multi-Target Following Mode: Basic Principles



(a) Vessel Position Setting (b) Input Offset

Figure 10.27: Dialog Box for the Vessel Position Setting in MultiTarget Mode

If the operator selects MultiTarget mode and two transponders as targets the dialog box for the vessel position setting in the target coordinate system will be displayed by pressing **MTarget** softkey, see Figure 10.27.

Target coordinate system:

– the origin is in the Tgt#1;

– X-axis is directed to Tgt#2;

– Y-axis is perpendicular to Tgt#2 so that the shortest turning from X-axis to Y-axis will be directed clockwise.

Figure 10.28: Map View in Multi-Target

One yellow-colored circle is drawn in this mode, see Figure 10.28. This is a circle within which a vessel center has to be situated. Circle radius is equal to reaction radius.

Vessel heading can be controlled:

– manually

– automatically

– in Target Following mode. In this case the heading setpoint is considered as target course plus preset offset.

For example, if you enter 20°for the offset, the heading setpoint will be equal to the target course plus 20°.

10.6 Tracking

All the parameters related to the tracking mode must be set before you activate this mode.

10.6.1 Track Control Activation

Before activation this mode, make one of the routes in the Track window active (see Section 10.6.3, page 190).
After active route is set, **LS Track** (or HS Track) softkey on the bottom panel becomes dark green.
If there are no routes in the system, you must first create one using the route editor, get it from a flash drive or external source.

NOTE!	Before starting track mode, vessel must be brought close enough to the starting waypoint (besides that, in AP mode vessel's heading must be close to the leg direction).

To activate the Track mode:

– in DP mode, press **LS Track** softkey on the POS panel.
Low speed track mode will be activated;
– in AP mode, press **HS Track** softkey on the HDG panel.
High speed track mode will be activated.

Having pressed **LS Track** (HS Track) softkey, it starts blinking. Press once again to cancel, or the **ENTER** softkey to confirm.
If confirmed, the softkey becomes light green, and the **NAVIS NavDP 4000** starts operation in the track control mode.
Use **Track** and **Map** windows to see how the vessel follows the route.

10.6.2 Track Following Strategy

In **HS Track** mode the heading is automatically controlled to ensure following along the track.
Also in HS Track mode the vessel follows the track in optimal way with the track approach direction (difference between the vessel COG and leg direction) limited by the predefined value. The track approach direction decreases as the vessel appears closer to the track.
In **LS Track** mode operator can choose heading control strategy by pressing **AUTO**, **MAN**, **LS Track** or **MinPWR** (option) softkey in the HDG panel.
If the operator chooses **LS Track** heading, the vessel heading setpoint will be determined by the track depending on Track following parameters of "Param" tab (see Section 10.6.3, page 190). It will be either equal to the leg direction (with crab angle) or taken from the active track waypoints table.
The following data are displayed for the Track mode (see Figure 10.29):

BOD — Bearing origin destination;

BTW — Bearing to waypoint;

DTW — Distance to waypoint;

XTE — X-track error.

By default, when the Track Control mode is selected, the ship moves to the nearest leg of the route, which is calculated automatically. You can choose any waypoint as a starting point by using "Goto WP" option (see Section 10.6.3, page 190).
Also pay attention on number of limitations of track catching or changing by new (external) track.

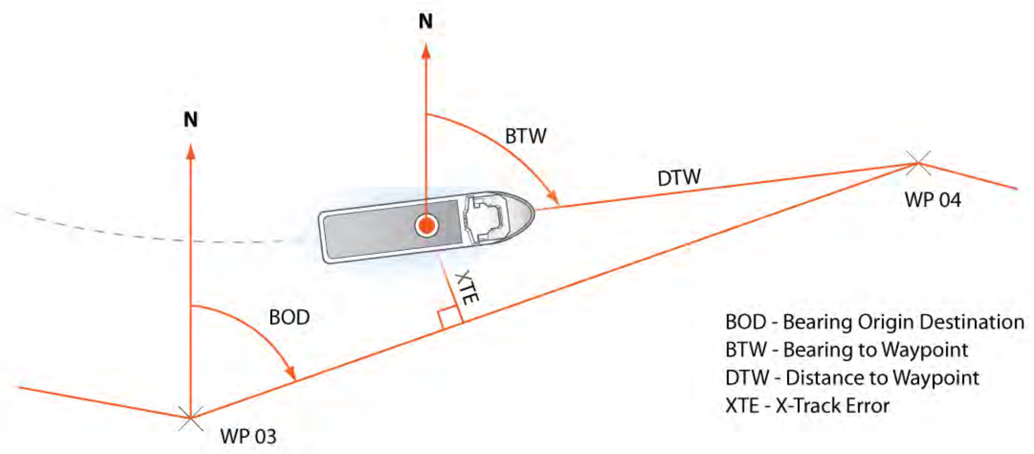


Figure 10.29: Track Mode

– in DP mode: distance to the new track should be less than 100 m;
– in AP mode: distance to the new track should be less than 3 nm;
– in AP mode: difference between course desired by track and current course shouldn't be more than 60 degrees;
– when external track was sent, system checks if vessel is on **LS Track** mode or no.
  In positive case, new track is ignored and alarm is appeared;
– **NAVIS NavDP 4000** system allows to choose tracking mode, parameters of that mode and active route only together. For example, track in dredging mode can be active and dredging mode can be run only if rules described above are accomplished.

10.6.3 Track Window

The Track window (see Figure 10.30) is used to create, edit, delete, save to / and load from USB flash drive, load external route by COM/Ethernet port and for monitoring the track following.

Press **Select window** softkey on the **SYS** panel for choosing the **Track window**.

The top section displays route list or the waypoint table (depending on selected mode).

It could be switched to the following modes:

RT List — a route list;

Param — the track paremeters settings;

Active — a list of an active route waypoints.

To switch to the mode press the proper softkey placed on the right console. The softkey of selected mode is white indicated.

The bottom section contains the waypoint motion control console.

10.6.3.1 RT List Mode

A list of routes with their characteristics is displayed in **RT List** mode.

The following characteristics are displayed for every route:

Date — creation date/time;

Route — route name;

WP — number of waypoints.

The following actions are available in the RT List mode:

Set active — to set a route up as active one;

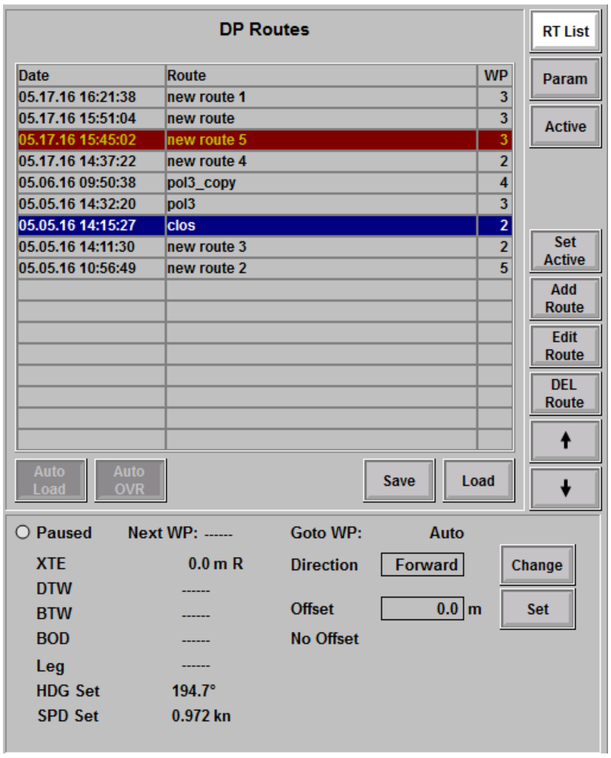


Figure 10.30: Track Window Example

Add route — to add a new route;

Edit route — to edit a route;

DEL route — to delete a route;

Auto load — a route is automatically loaded from the external source;

Auto OVR — an old route is overwritten by the new one with the same name;

Save — to save a route to an external device;

Load — to load a route from an external device.

Set Active

To set a route up as active, select it in the list and press **Set active** softkey. The window will be switched to the Active mode. Press the **RT List** softkey to switch to the list of routes back.

Active route row is highlighted with dark red and is not editable (see Figure 10.30). Only one route can be active.

To deactivate the route select the active one and press the **Set active** softkey. The route becomes inactive.

NOTE!	If the Following track mode is on, editing, switching or deactivating the active route is not allowed.

NOTE!	Both an empty route* and a route with one waypoint are not allowed to be activated.

* Empty route is the route that has no waypoints.

Add Route

To add a new route manually press **Add Route** softkey.
In the opened dialog window select a route type to be added (see Figure 10.31):

Empty — to create a new empty route. The route default name is "new route";

Copy — to copy the current route. The new route default name is "[selected route name]_copy";

Copy&Revert — to copy the current route with reverse order of waypoints. The new route default name is "[selected route name]_revert";

Copy&Shift — to copy the current route with shifting it to coordinates specified by operator. The operator can input coordinates using the dialog window. The new route default name is "[selected route name]_shifted".

Cancel — to cancel a new route creating.

> **NOTE!** The name of any new route could be changed in the "RT Edit" mode ("Edit Route" softkey).

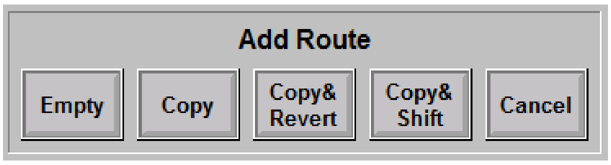


Figure 10.31: Add Route Dialog Window

> **NOTE!** In case the empty route (or one-point route) is selected, an empty route is added by default without calling the dialog.

Edit Route

Press **Edit Route** softkey to switch to **RT Edit** mode.
In this mode the following actions are available:

- change a route name;
- add a waypoint;
- edit a waypoint;
- delete a waypoint;
- edit a leg.

1. To change a route name press **Route Name** softkey and enter a new name by using screen keyboard.

   The route name is protected from duplication. In case the name in the entry field is the same as one of the existing the entry field is red and the **OK** softkey is disable (see Figure 10.32).

2. To add a waypoint press **Add Point** softkey.

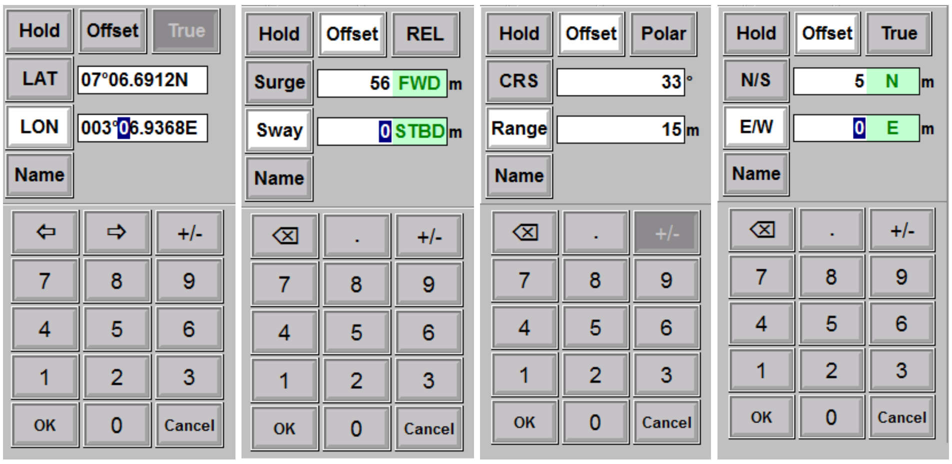
   In the opened window set the following parameters:

   - waypoint name;
   - coordinates. Operator can specify absolute coordinates in a route's coordinate system or offset (see Figure 10.33).

3. To edit selected waypoint press **Edit Point** softkey.

   Dialog window for editing waypoint is similar to the window for adding waypoint (see Figure 10.33).

Figure 10.32: Protection from the Route Name Duplication



(a) Geo (b) Realtive (c) Polar (d) True

Figure 10.33: Add/Edit Waypoint Window

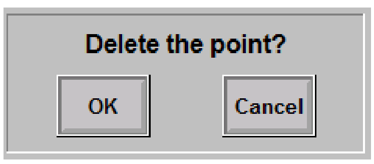


Figure 10.34: Delete Point Dialog

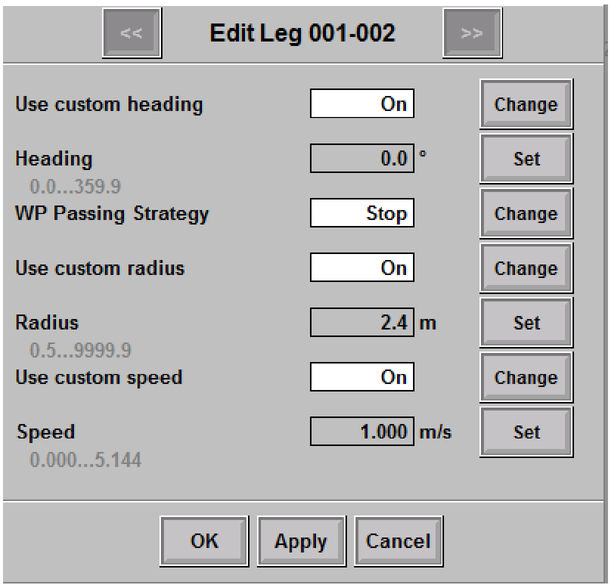


Figure 10.35: Edit Leg window

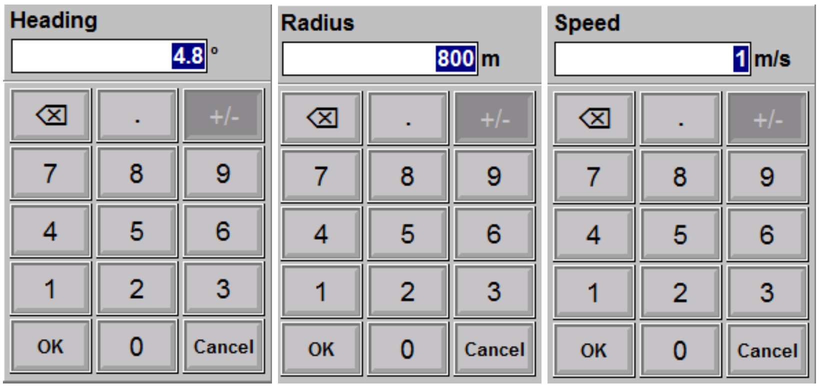
4. To delete selected waypoint press **DEL Point** softkey (see Figure 10.34).

   To select a point, use the arrow softkeys.

5. To edit the strategy of leg passing press **Edit Leg** softkey (see Figure 10.35).

   Set the following parameters for the leg if necessary (see Figure 10.36):

   – vessel heading;
   – waypoint passing strategy;
   – radius;
   – vessel speed.

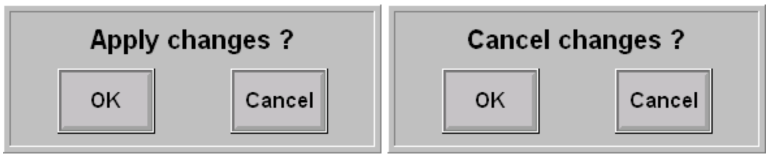


(a) Heading (b) Radius (c) Speed

Figure 10.36: Parameter Setting for the Custom Leg

To exit from the **RT Edit** mode press either **Apply** softkey if the changes should be applied or **Cancel** if should not (see Figure 10.37).

NOTE! An active route is not allowed to edit in the most of system configurations.



(a) (b)

Figure 10.37: Apply and Cancel Dialog Windows

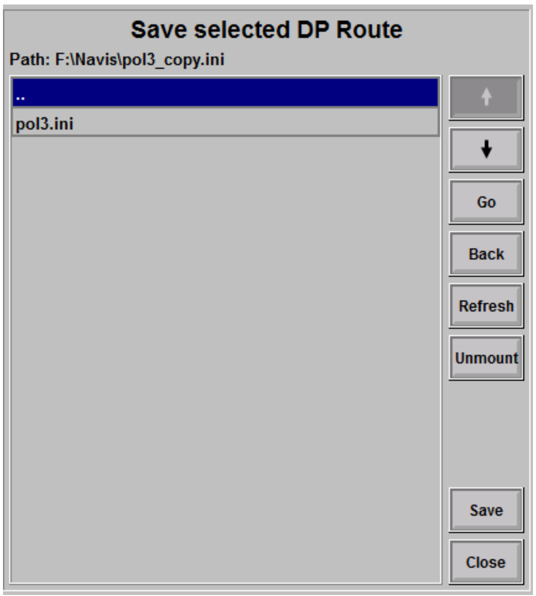


Figure 10.38: Save Route Dialog

Auto Load

In case the data retrieving is required from an external source (ECDIS) the function is activated.

Depending on the configuration a route is loaded non-stop or one-time. In case of non-stop loading the **Auto Load** softkey is white indicated while the mode is on.

In case of getting route with an existing name, but the **Auto OVR** is off, the route gets a new name like “[route name]+1”.

In case the **Auto OVR** is on and the route with the existing name is got, the following events are possible:

– the route is not active — the route is overwritten;
– the route is active, editing is allowed — route is overwritten;
– the route is active, editing is not allowed — the route gets a new name like “[route name]+1”.

Save

A route can be saved to an external device (for example USB flash drive).

Insert USB flash drive into USB port and press **Save** softkey. The **Save selected DP Route** dialog appears (see Figure 10.38).

To switch the folder or device, press the **Go** softkey and select the one.

Then press the **Save** softkey. In case the route with the same name, the **Replace** softkey is displayed instead of the **Save** one.

The route is saved immediatly after the proper softkey has been pressed. The route file has the name “[route name].ini” and text format and can be edited manually.

More details see in the Appendix F, page 301.

After the route is saved, press the **Unmount** softkey to safety remove the USB flash drive.

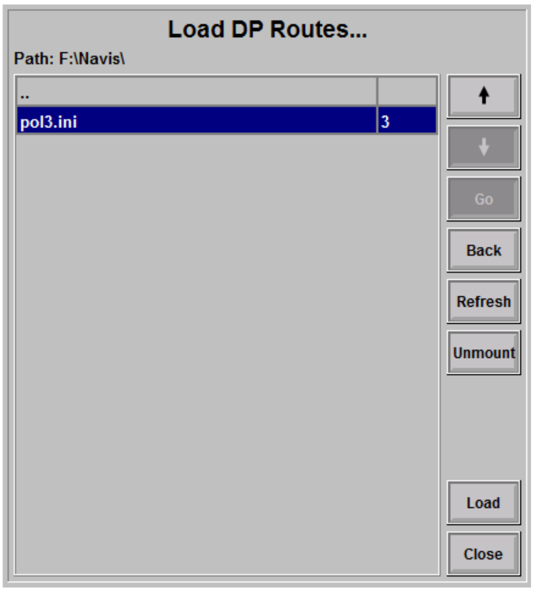


Figure 10.39: Load Route Dialog

NOTE!	Keep in mind that after the **Unmount** softkey is pressed, the USB flash drive is not visible for the system. To make it visible, remove the device and then insert in again.

Load

NOTE!	This function is available for the DP routes only. It does not support external route formats.

The route saved before can be loaded into the DP system.

Insert the external device (USB flash drive) and press the **Load** softkey. The **Load DP Routes** dialog appears (see Figure 10.39).

The file name (route name) and the number of waypoints are displayed for every route.

When route is selected it is automatically displayed on the map (in the MAP window), but keep in mind that only the waypoints with coordinates inside the visible area are displayed.

The route is added to the list just after the **Load** softkey is pressed.

10.6.3.2 The Track Following/Alarm Parameters (Param)

The two parameter groups are available in this mode (see Figure 10.40):

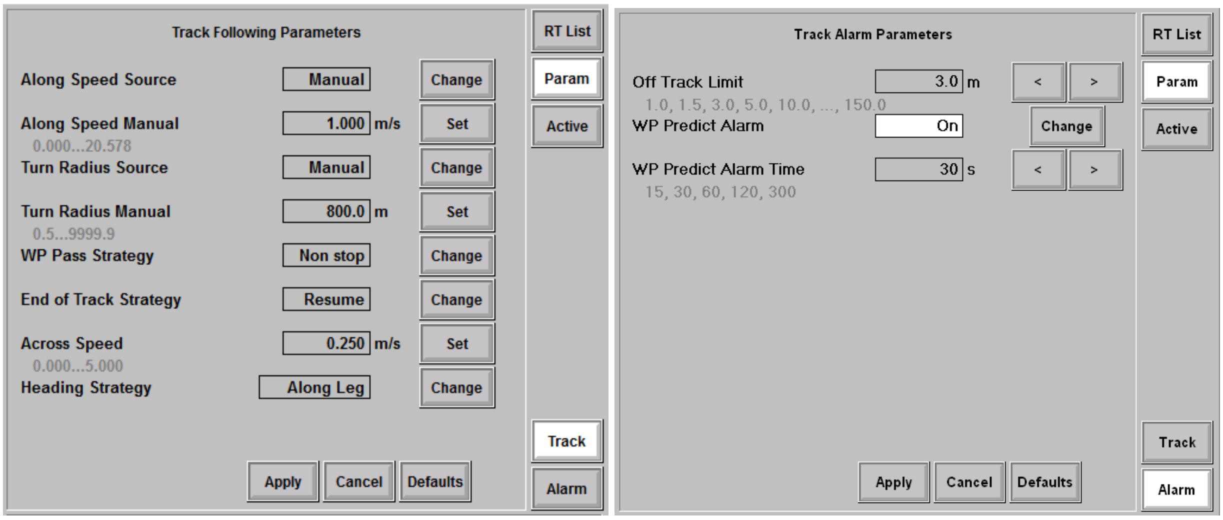
– Track;
– Alarm.

The mode is used to set up both the LS Track and HS Track.

For more LS Track details see the Section 9.2.6, page 164 and HS Track details see the Section 9.2.5, page 163.

Set the parameters of tracking in the “Track Following Parameters” window (“Track” softkey):

– Along Speed Source (manual, joystick or table);
– Along Speed Manual, m/s;
– Turn Radius Source (manual or table);
– Turn Radius Manual, m;
– WP Pass Stategy (non stop or stop);
– End of Track Strategy (resume or stop);



(a) Track Parameters (b) Alarm Parameters

Figure 10.40: Track Following/Alarm Parameters Window

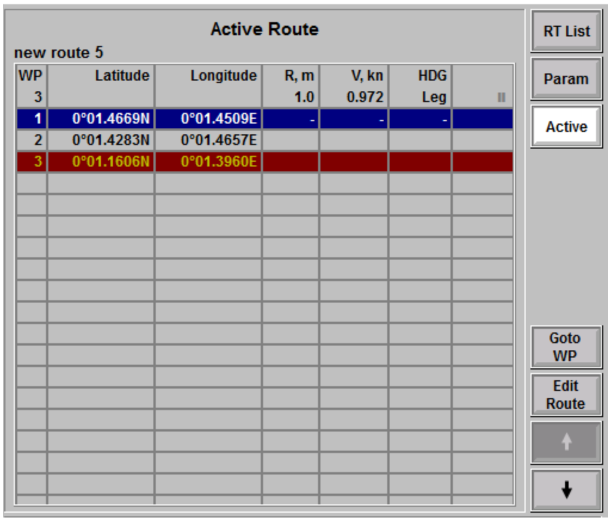


Figure 10.41: Active Route Window

– Across Speed, m/s;
– Heading Strategy (along leg or table).

Set the parameters of alarms in the “Track Alarm Parameters” window (“Alarm” softkey):

– Off Track Limit, m;
– WP Predict Alarm (on/off);
– WP Predict Alarm Time, if WP predict alarm is on.

Press **Apply** softkey if the changes should be applied, **Cancel** if should not or **Defaults** if the default values should be set.

10.6.3.3 Active Route

Press **Active** softkey to switch to **Active Route** mode.
The window contains the waypoint list of an active route (see Figure 10.41).
The following information is displayed for each waypoint:

WP — the sequence number of the waypoint;

Figure 10.42: Goto WP dialog

Latitude, Longitude/ Course, Distance — the coordinates of the waypoint;

> **NOTE!** A coordinate system is selected in Coord page of Param window.

R, m — the turning radius;

V, m/s — the vessel speed between selected point and the next one;

HDG — heading during the passing of the leg;

 — strategy of the waypoint passing.

> **NOTE!** In case LS Track (HS Track) mode is not activated none of waypoints is highlighted in the Waypoint table.

If there is no active route the table is empty.
The operator can choose the next waypoint by pressing **Goto WP** softkey (see Figure 10.42.
In particular, it is possible to go to the next waypoint having passed several intermediate ones.

10.6.3.4 Waypoint Motion Control Console

In case of any Track mode (LS Track, HS Track) is on, the bottom section of the window displays the following parameters:
At the bottom of the window the information about the waypoint specifies (see Figure 10.43):

State of track mode:

Not Active — LS (or HS) Track mode is not selected;

Following — LS (or HS) Track mode is activated;

Paused — LS (or HS) Track mode is paused.

When following the track the operator can change the state from **Following** to **Paused**.

Press the softkey **LS Track/HS Track** on POS (HDG) panel to change a track mode state.

In the opened dialog window press either **OK** softkey to approve the changes or **Cancel** to leave the window without any changes.

The text of the dialog window depends on the current track mode state (see Figure 10.44.

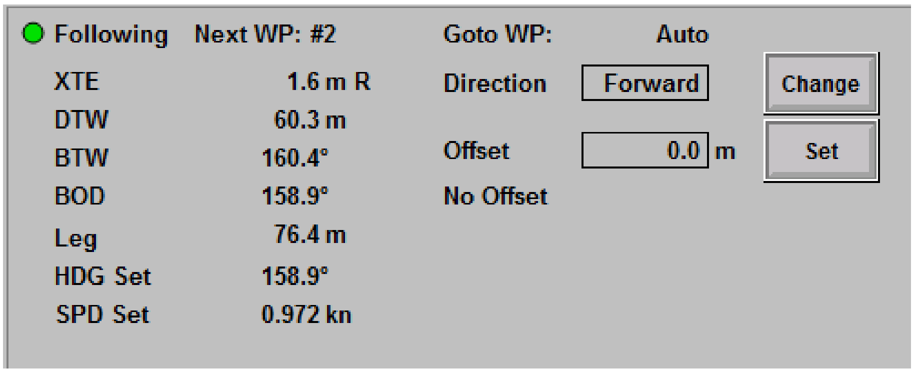
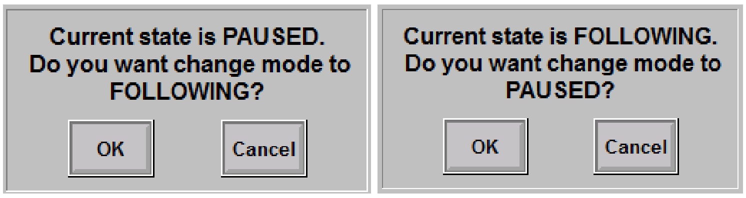


Figure 10.43: Waypoint Motion Control Console



(a) State is Paused (b) State is Following

Figure 10.44: State Switching Dialog

Track mode state depends on the current value of “End of Track Strategy” parameter set in “Track” page of “Param” window.

If **Stop** is selected for this parameter, a track status should be changed from **Following** to **Paused**.

Next WP# — a waypoint number which is followed by the vessel;

The coordinates of the waypoint followed by the vessel are shown with such indicators as:

XTE — X-track error;

> **NOTE!** For XTE: **R** means X-Track Error on Starboard. **L** means X-Track Error on Portside.

DTW — distance to waypoint;

BTW — bearing to waypoint;

BOD — bearing origin destination;

Leg — distance from the previous point to the following waypoint;

HDG Set — vessel’s heading;

SPD Set — vesssel’s speed;

Goto WP — the next waypoint. Values (Auto or WP#) are edited by pressing **Goto WP** softkey;

Direction — direction of motion along the track.

Possible directions are Forward and Reverse. To modify the direction press **Change** softkey (see Figure 10.45);

Offset — the offset of the desired track.

Press the **Set** softkey to specify the offset (see Figure 10.46).

In the opened window set the offset parameters:

Figure 10.45: Change Direction

No Offset — without offset;

Normal — orthogonal offset of each leg;

Geo — offset of the entire route on a specified number of meters in a given direction in degrees;

Parallel – parallel offset of the entire track;

Leg — parallel offset of the entire track's segment (other points are still fixed).

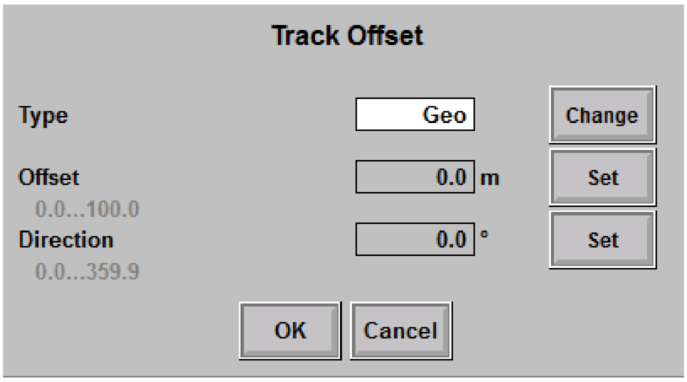
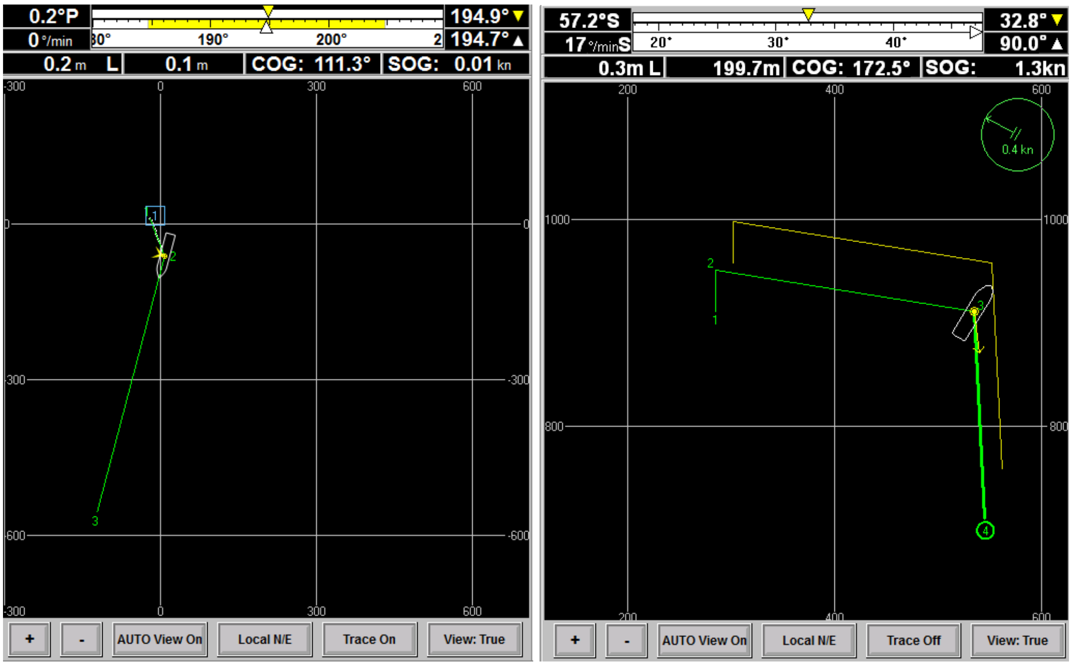


Figure 10.46: Offset Dialog

Active route is displayed on the Map window by green color.

When offset is nonzero, vessel COR point moves along the shifted (perpendiculary to each leg) track. Shifted track is olive colored (see Figure 10.47).



(a) Active Track (b) Offset Track

Figure 10.47: Map Window

10.7 Autopilot Function

NOTE!	Autopilot (AP) is not approved for navigation and cannot be used as navigation equipment.

WARNING!	AP mode is intended for performing control from control stations with forward orientation located on the navigation bridge. It is not recommended to use this mode at the control stations with aft orientation! In case AP mode is present and used from the control station with aft orientation, the operator should set and change heading with special care and attention!

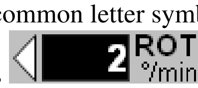
Autopilot function is used for heading control of vessel at high speed.

In the Autopilot mode, the right part of the Operator Interface Screen is only used for displaying the Autopilot window (see Figure 10.48). The left part can be used for displaying other windows.

Use the center part of Autopilot window to get steering system controls status (see Figure 10.49)

The bottom of the Autopilot window contains controls to change the Autopilot parameters (see figure 10.50)

There are compass rose at the top of the Autopilot window and some additional information.

The main part is half the compass rose, which is scaled in degrees. On the inner arc digit designation of heading are shown. On the outer arc scale with divisions at 5 degrees are shown, and also the common letter symbols are represented (in circles) (see figure 10.51). Direction and speed of vessel rotation are shown as 

below the compass rose scale. Units of rotation speed can be changed on PARAM window on Units tab (see 5.9, page 85).

The yellow triangle pointer and yellow digit bar are used for displaying the actual heading, while the green triangle pointer and green digit bar are used for displaying the heading setpoint. The white digit indicator displays a new value for the heading setpoint.

Difference between the set and the actual heading is shown by the number in degrees on left or right (depending on the direction of the deviation) of digit bar.

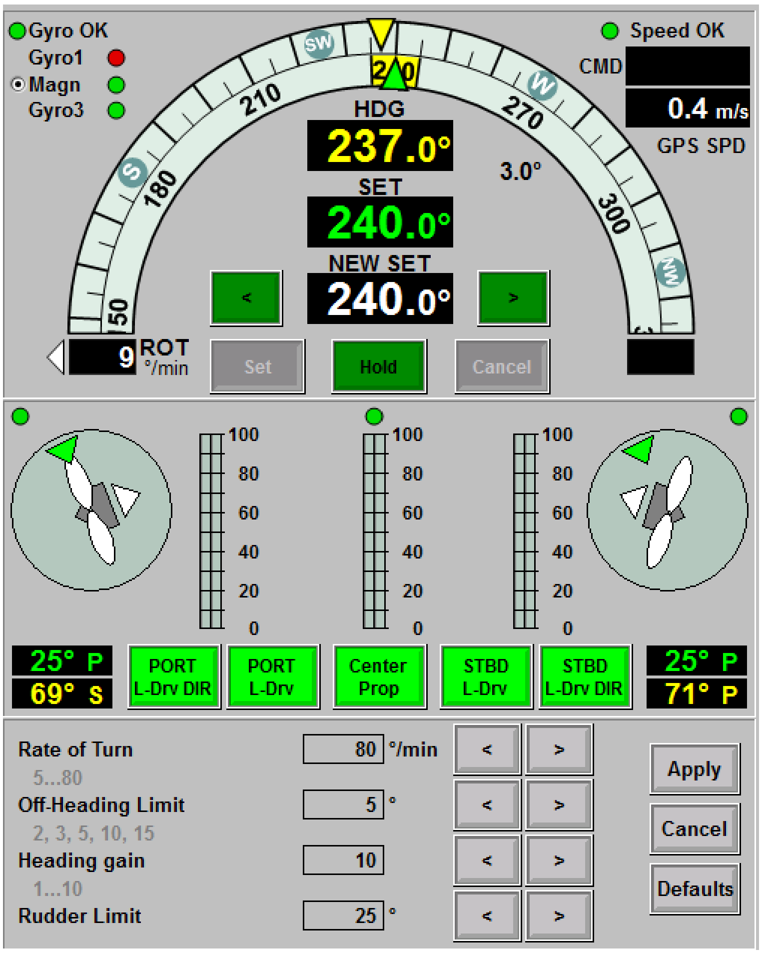


Figure 10.48: Autopilot window example

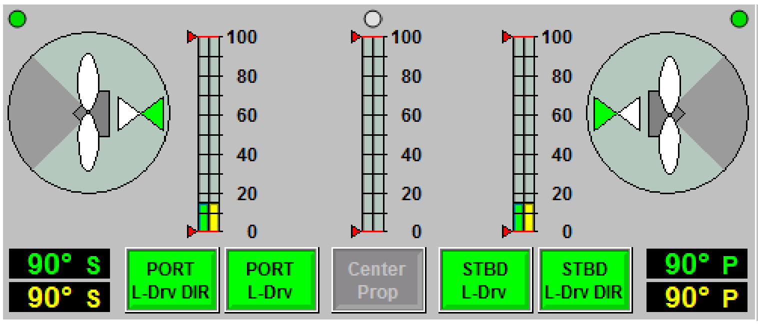


Figure 10.49: Steering System Monitoring Area

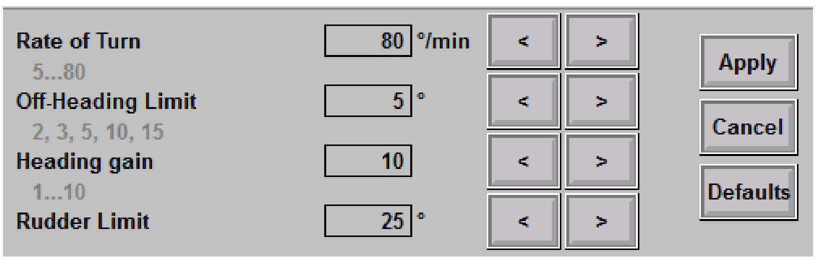


Figure 10.50: The Autopilot parameters

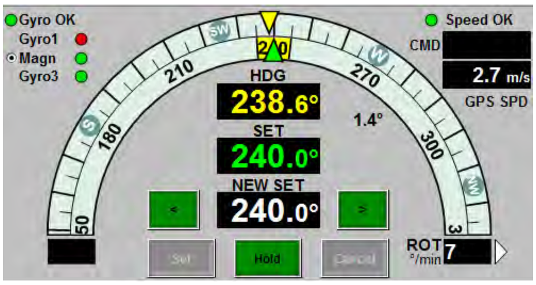


Figure 10.51: The Autopilot Heading Indicator

Gyro(s) status indicator is placed in the upper left corner. Also in this place you can see the HW monitor status indicator, if Hardware Monitor function exists.

Value of the speed of gravity which based on the statement of the GPS sensor are located in the upper right corner. Units of velocity can be changed on PARAM window on Units tab (see 5.9, page 85).

The white digits (set heading) change if you press < and >. If one of these keys is kept holding, the new heading changes by 1 degree 3 times per second. When change exceeds 5 degrees, the new course changing rate will be 10 degree 3 times per second. When input new heading, **Set** and **Cancel** softkeys are enabled (see figure 10.52).

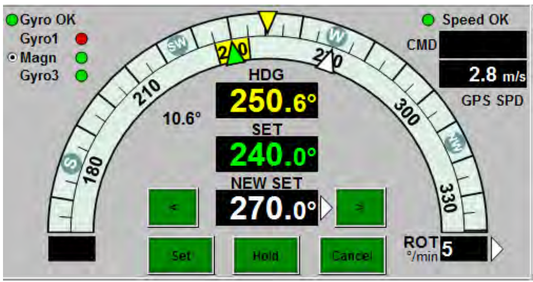


Figure 10.52: The Autopilot Heading Indicator. New heading input

As soon as you press the **Set** softkey, the heading setpoint (green digits) becomes equal to the new value (white digits), and the vessel starts changing the heading to the new set value.

The second yellow triangle shows the direction in which the heading is to be changing so that to achieve the new set value. If the direction changes, the orientation of the triangle changes too.

Use the **Hold** softkey to set the heading setpoint equal to the actual heading. When you press the **Hold** softkey, it starts blinking. If pressed **Hold** is unconfirmed within 30 sec the preset heading is unchanged and Hold stops to blink.

Press it once more to cancel, or the **ENTER** softkey to confirm. When you press the **ENTER** softkey, the value of the actual heading at the moment of pressing becomes the heading setpoint value.

There is the alternative way to set new heading. Press the **AUTO** softkey in the **HDG** softkey group of the Mode/-Function Panel to set a new value for the heading setpoint in the appeared dialog box (Figure 10.53).

10.7.1 Dodge mode

The Dodge mode allows the operator to control vessel's heading from HCS with rotary knob manually.

To enter **Dodge** mode press **Dodge** softkey as shown on figure 10.54. It starts to blink. Then press Enter softkey and Dodge softkey becomes light green. It shows **NAVIS NavDP 4000** is in Dodge mode.

Turn MCP rotary knob right (clockwise) and left (counterclockwise). Rudders (azimuth thrusters) will follow knob control accordingly.

To exit **Dodge** mode press **Dodge** softkey again. It starts to blink. Then press Enter softkey and Dodge softkey becomes dark green. It shows **NAVIS NavDP 4000** keeps heading automatically. At that actual heading is taken as preset heading

If pressed **Dodge** is unconfirmed within 30 sec the current control mode is unchanged and **Dodge** stops to blink.

Switch to the Dodge mode using the MCP4000 series

Operating in the AUTOHDG mode double press the **HDG** pushbutton to switch the mode to **Dodge**.

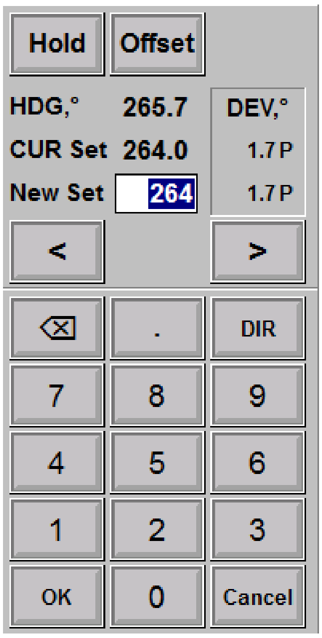


Figure 10.53: Input Heading Setpoint dialog

Figure 10.54: Dodge button on the Mode/Function Panel

The switching from **Dodge** to AUTOHDG is performed in the same way, i.e. by double press on the **HDG** pushbutton. In this case the actual heading becomes the preset one.

Switch to the Dodge mode using the MCP2000 series

These control panels do not allow switching the mode from AUTOHDG to **Dodge**, but it is possible to switch the mode from **Dodge** to AUTOHDG. To switch to the AUTOHDG mode double press the **HDG** pushbutton. In this case the actual heading becomes the preset one.

If the actual mode is AUTOHDG, then the double press on the **HDG** pushbutton sets the actual heading as the preset one but the mode does not switch to **Dodge**.

10.7.2 Automatic Speed Control function

Automatic Speed Control function is provided as option. To turn on this function, press **Speed** softkey. Set speed dialog will be activated (Figure 10.55). Use **Hold** to hold current speed.

WARNING!	Don't set too small speed, it can cause bad headingkeeping quality.

Speed setpoint value is shown in Autopilot window as well as on the control panel's LCD in the "AP Speed" line (in case the configuration contains MCP4000 with LCD).

This function can be used also in Dodge and HS Track modes.

10.7.3 Manual position

Operating in AP Mode propeller(s) and/or azimuthal thrusters can be under the bridge control. In this case the **MAN** softkey of the POS group is gray.

In case propeller(s) and/or azimuthal thruster(s) can be controlled via joystick, the **MAN** softkey is light-green if the MAN mode is on and dark-green if the AutoSpeed mode is on.

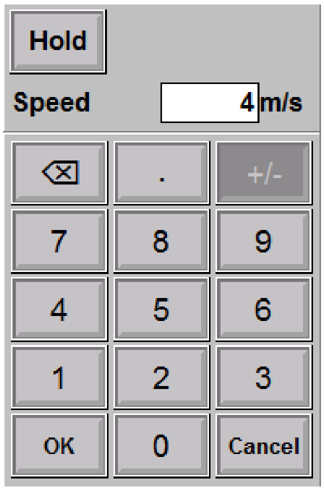


Figure 10.55: AP Set Speed dialog window

> **NOTE!** The AutoSpeed mode is optional and depends on the configuration.

10.7.4 Steering System Monitoring Area

The independent rudders in **NAVIS NavDP 4000** are used to steer the vessel in Autopilot mode, the Steering System Monitoring Area contains the following indicators for each rudder:

Rudder angle (bar-graph). Green bar shows rudder command. Yellow shows actual angle. Red triangles shows rudder command limits.

Rudder softkeys See Section 6.2.1, page 111 for status details.

Steering System Status indicator.

Also, if propellers are used in AP, the Steering System Monitoring Area contains the following indicators for each propeller:

Propeller thrust (bar-graph). Green bar shows thrust command. Yellow bar shows actual thrust. Red triangles shows thrust command limits.

Propeller softkeys See Section 6.2.1, page 111 for status details.

Steering System Status indicator.

Azimuth thrusters in **NAVIS NavDP 4000** are used to steer the vessel in Autopilot mode, the Steering System Monitoring Area contains the following indicators for each thruster:

Azimuth thruster direction indicator Green triangle shows direction command. White triangle shows actual direction.

Azimuth thruster digital indicators (actual, command)

Azimuth thruster thrust (bar-graph). Green bar shows thrust command. Yellow bar shows thrust feedback. Red triangles shows thrust command limits.

Thruster softkeys See Section 6.2.1, page 111 for status details.

Steering System Status indicator.

Steering System Status indicator color:

Grey Not ready

Green Under AP control

Red Failure

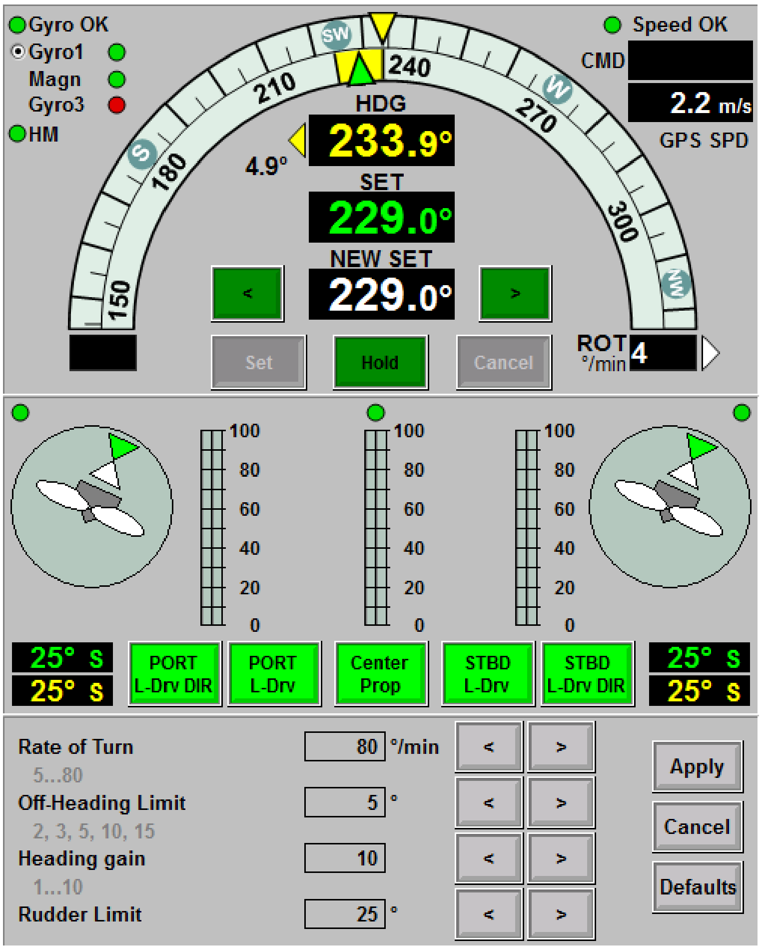
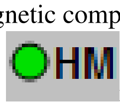


Figure 10.56: The Autopilot window with Monitor Heading indicator

10.7.5 Heading Monitor function

> **NOTE!** This function is available in the Autopilot operating mode only. The function presence depends on system configuration.

The function compares the heading data incoming from gyro(s) and/or magnetic compass (magnetic heading).

In case the system contains Monitor Heading there is additional indicator 

in the sensor group of the Autopilot window (see Figure 10.56) .

The MH indicator has the following color code:

green — the function is ON, there is no off-limit discrepancy;

red — the function is ON, there is off-limit discrepancy;

light-gray — the function is OFF, there is no monitoring.

In the DP mode the HM indicator is green in case the data incomes from two or more sensors and light-gray in case the data incomes from the one sensor only.

The minimal sensor configurations for monitoring process are the following:

- Gyro+Gyro (two gyros)
- Gyro+Magnetic (gyro and magnetic compass)

In case the system contains three or more sensors (with or without a magnetic compass) the data must income at least from two of them.

The off-limit discrepancy is set in the Gyro parameters area (see Section 7.3.1, page 131, Figure 7.10).

10.8 Capability Analysis

Capability Analysis is performed to investigate the limiting environmental disturbances (waves, wind and current) under which the vessel position and heading can be maintained. The analysis can be performed for set thruster and power configurations and environmental conditions.

The results of Capability Analysis are presented on the Capability Plot.

Two modes are provided for the Capability Plot: **Real Mode** and **Hypothetic Mode**.

Real mode — the vessel's capability to maintain its position and heading is evaluated with regards to both present conditions of thrusters and power components and environmental disturbances (waves, wind and current);

Hypothetic mode — the vessel's capability is evaluated with regards to both simulated failures and limitations of thrusters and power components and combinations of waves, wind and current.

Use the Capability Plot to determine operational limits and the optimal vessel heading for safe operations.

Capability Plot

A Capability Plot (see Figure 10.57) is displayed in the CAP Analysis window. Press **Select window** on **SYS** panel and select **Cap Analysis** item for displaying.

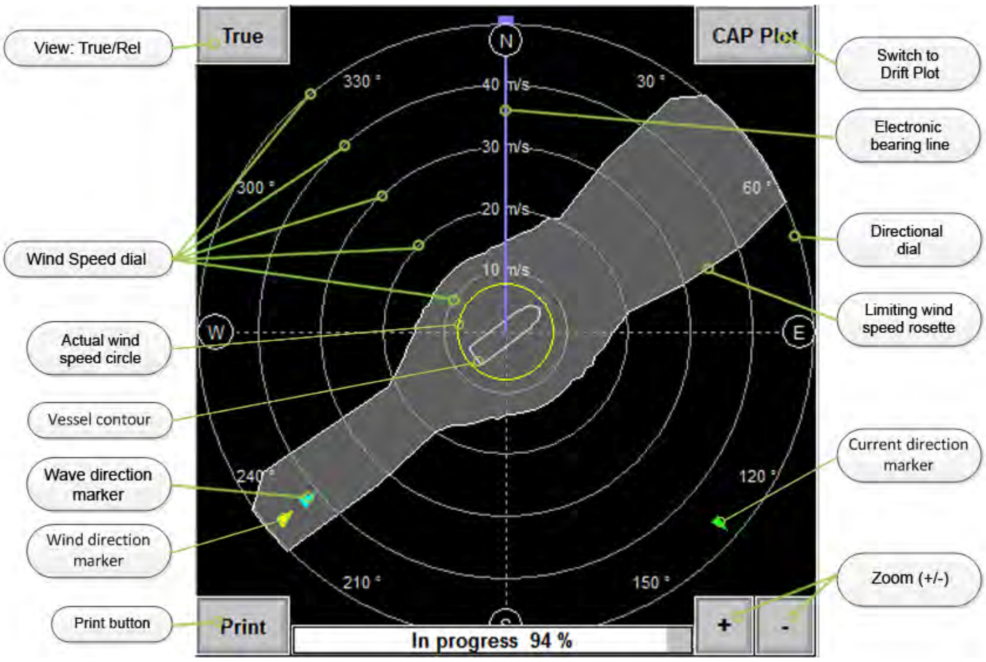


Figure 10.57: Capability Plot

Capability Plot Softkeys

TRUE/REL — CAP Plot view.

The Capability Plot is displayed in two views (see Figure 10.58):

TRUE — orientation to the North;

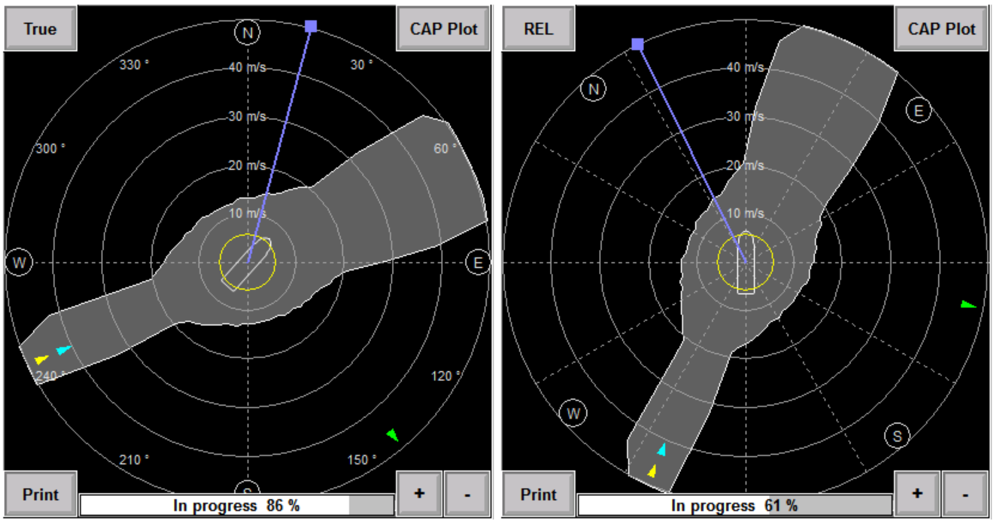
REL — orientation to the vessel's heading.

Press **TRUE/REL** softkey to switch the present view.

The view selected by the operator persists after **NAVIS NavDP 4000** restarting.

CAP Plot — the Plot name.

Press the **CAP Plot** softkey for switching to the Drift Analysis (see Section 10.9, page 218).



(a) View: TRUE (b) View: REL

Figure 10.58: Capability Plot View

> **NOTE!** Switching to Drift analysis is available in DP control mode only.

Print — Capability Plot printout (see Section 10.8, page 217).

Zoom In, Zoom Out — Capability Plot view scale.

Press “+” and “–” softkeys to change the scale of the Capability Plot view (Zoom In/Zoom Out).

Capability Plot Legend

White-colored vessel contour is displayed in the centre of the plot. It is directed to the present heading.

Wind speed dial is displayed as **white** circles for 10, 20, 30, 40 and 50 m/s (the units are set and may be changed in “Units” Page of “Param” window — see Section 5.9, page 85). The circle for 50 m/s is overlapped with the directional dial.

Present wind speed is displayed as **yellow** circle. It allows the operator to evaluate the vessel’s capability to maintain position at the present wind speed.

Green marker indicates current direction.

Yellow marker indicates wind direction.

Cyan marker indicates wave direction. It matches the wind direction in Auto mode.

Electronic Bearing Line (EBL)

EBL (Electronic Bearing Line) is displayed as **lilac** line. It is directed to the North by default.

EBL is intended for selecting direction for which the limiting wind speed at which the vessel is able to maintain its position and heading to be determined.

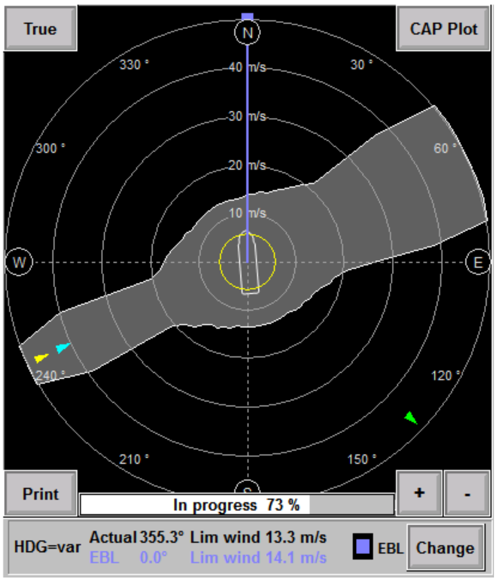
- Assume, the operator needs to know the limits for the vessel heading 0°. For this purpose EBL value should be set as 0°. The limiting wind speed is about 14.1 m/s (see Figure 10.59).
- For the heading 30° the limiting wind speed is about 18.0 m/s.

The calculated limiting wind speed values both for the present heading and for the EBL direction are displayed under the Capability Plot.

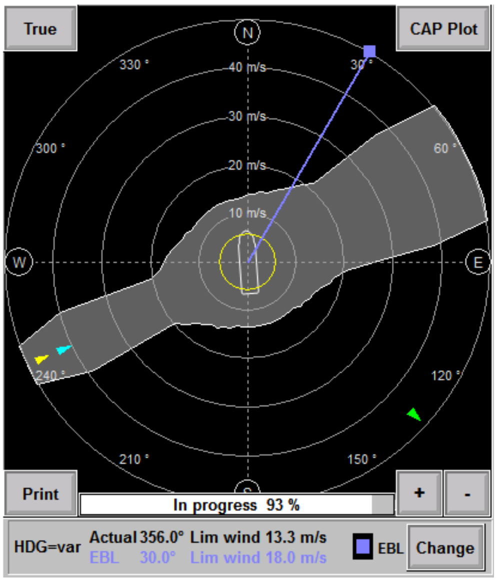
Press **Change** softkey near the **EBL** text to set a new EBL direction.

In the opened dialog box enter a new value for the EBL direction and press **OK** (see Figure 10.60).

The following areas depending on both wind and wave disturbances and current speed are presented in the Plot:



(a) EBL 0°



(b) EBL 30°

Figure 10.59: Limiting Wind Speeds for Different EBL Directions

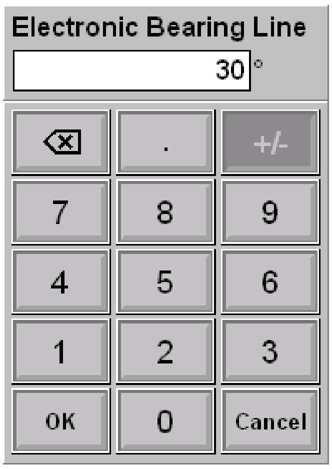


Figure 10.60: Dialog Box for EBL Direction Setting

1. **Grey area** — the vessel is able to maintains its position and heading. The difference between the forces from wind, waves and current can be compensated by active thrust.
2. **Black area** — the vessel is not able to maintain its position. The force from environmental disturbances exceed maximum thrust value.

Real Mode

Capability Analysis in **Real Mode** is performed for actual thruster configuration and present environmental conditions. In this mode, the Capability view looks as in Figure 10.61.

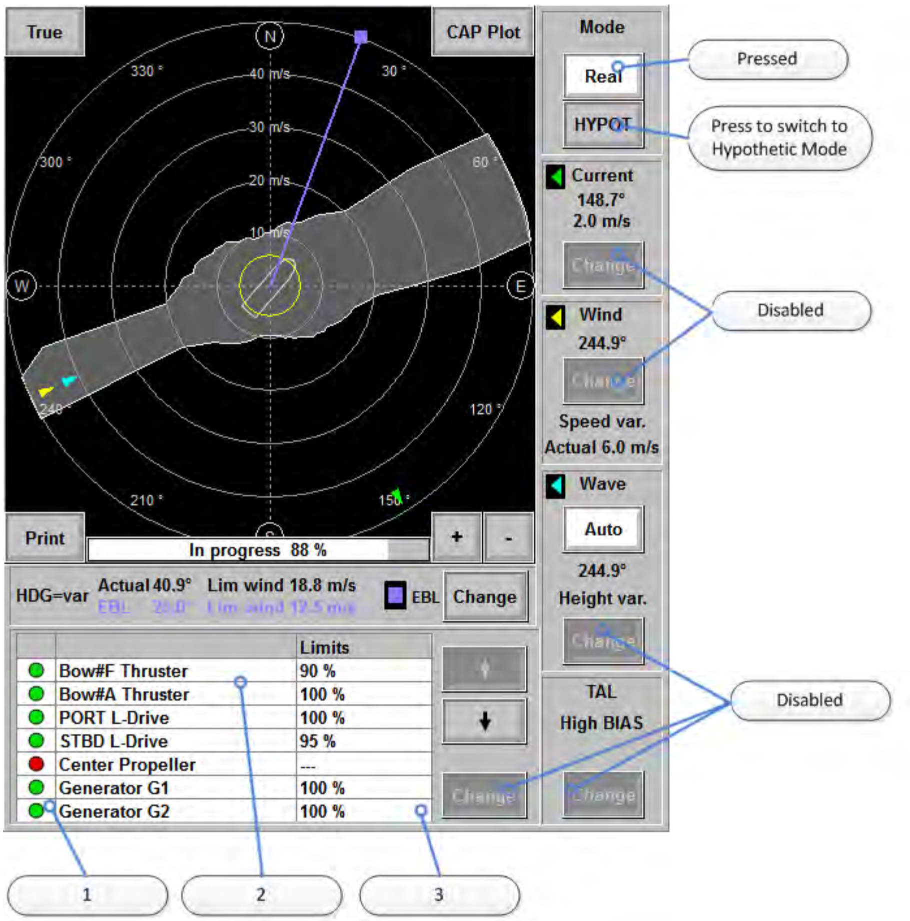


Figure 10.61: The Capability View in Real Mode

Thruster and Power Configuration

A list of the DP system components (thrusters, power components, bus tie breakers) is displayed in the bottom of the Capability Analysis window (see Figure 10.61).

1 — Status of each component is indicated by colored round indicator.

Green color means:

- for the thruster: it operates normally and is included in the Auto Thruster group;
- for the power component: it is connected to a bus and operates normally;
- for bus tie breaker: it is closed.

Red color means:

- for the thruster: it is not included in the Auto Thruster group or failed;
- for the power component: it is disconnected from a bus or failed;
- for bus tie breaker: it is open.

2 — Component name.

3 — Power limits for power components and thrust limits for the thrusters in percent, or position On/Off for tie breakers.

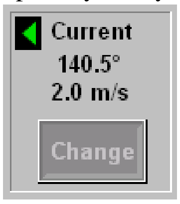
In case the component is inactive (with red-colored indicator), the dashes are displayed instead of values for power/thrust limits.

Use the **Arrow Keys** softkeys to navigate the component list. These softkeys are not available in Real Mode if all the components fill the table displaying on the screen.

The **Change** softkey is not available in Real Mode and is highlighted by dark grey color.

Wind, Waves and Current

The information about the present environmental conditions (wind, waves and current) is displayed in the right part of the Capability Analysis window.



The values for current direction and speed are displayed under the **Current** text.

The values for wind direction and speed are displayed under the **Wind** text.
Speed var. means that the wind speed can be read on the Capability Plot.

The present wave direction is displayed in degrees under the **Wave** text. It matches the wind direction in Auto mode.
Height var. means that the wave height is calculated automatically as a function of the wind speed (see Figure 10.62).

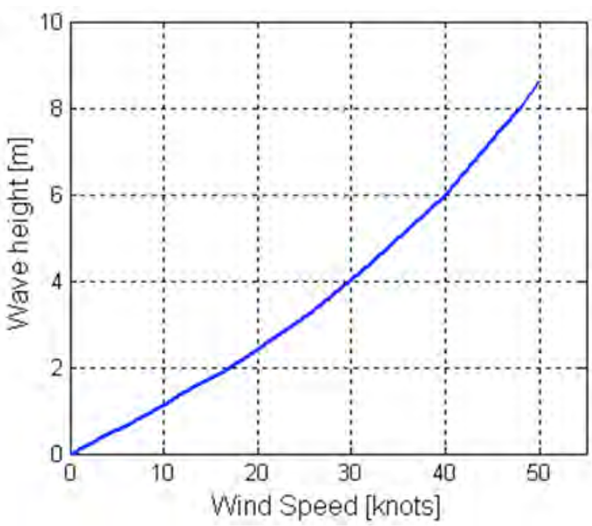


Figure 10.62: Relationship between Wave Height and Wind Speed

> **NOTE!** Wind and current speeds are indicated in values set by the operator in "Units" page of "Param" window.

Change softkeys for setting current, wind and wave parameters are unavailable and highlighted by dark grey color in **Real Mode**.

TAL mode name is displayed in the lower right part of the Capability Analysis window and is unavailable for changing.

The Capability Plot is continually being refreshed. The refresh period lasts for a few seconds. While refresh is being performed, the refresh indicator shows the calculation progress in percent:

Hypothetic Mode

Use this mode to evaluate the vessel's capability to maintain its position and heading in different set conditions by:

- simulating thruster and power component failures;
- changing wind, wave and current directions;
- changing current speed and wave height;
- manual changing thrust and/or power limits;
- changing TAL mode.

> **NOTE!** Switching to Hypothetic mode is available in DP control mode only.

In this mode, the Capability view looks as in Figure 10.63.

Selection of Hypothetic Power and Thruster Configuration

A list of the DP system components (thrusters, power components, bus tie breakers) is displayed in the bottom of the Capability Analysis window (see Figure 10.63), so that different power and thruster configurations can be analyzed. Each component can be activated and deactivated.

1 — Status of each component is indicated by colored round indicator.

Green color means:

- for the thruster: it is activated;
- for the power component: it is activated;
- for bus tie breaker: it is closed.

Red color means:

- for the thruster: it is deactivated;
- for the power component: it is deactivated;
- for bus tie breaker: it is open.

2 — Component name.

3 — Power limits for power components and thrust limits for the thrusters in percent, or position On/Off for tie breakers.

In case the component is deactivated, the dashes are displayed instead of values for power/thrust limits.

Use the Arrow softkeys to select a DP system component in the component list.
Press **Change** softkey to activate/deactivate thruster or power component and to set thrust/power limits.
In the opened dialog box (see Figure 10.64):

- press the softkey with the thruster/power component name to activate/deactivate the component.
  The softkey is highlighted by **light green** color in case the component is activated, and by **dark green** color in case it is deactivated.

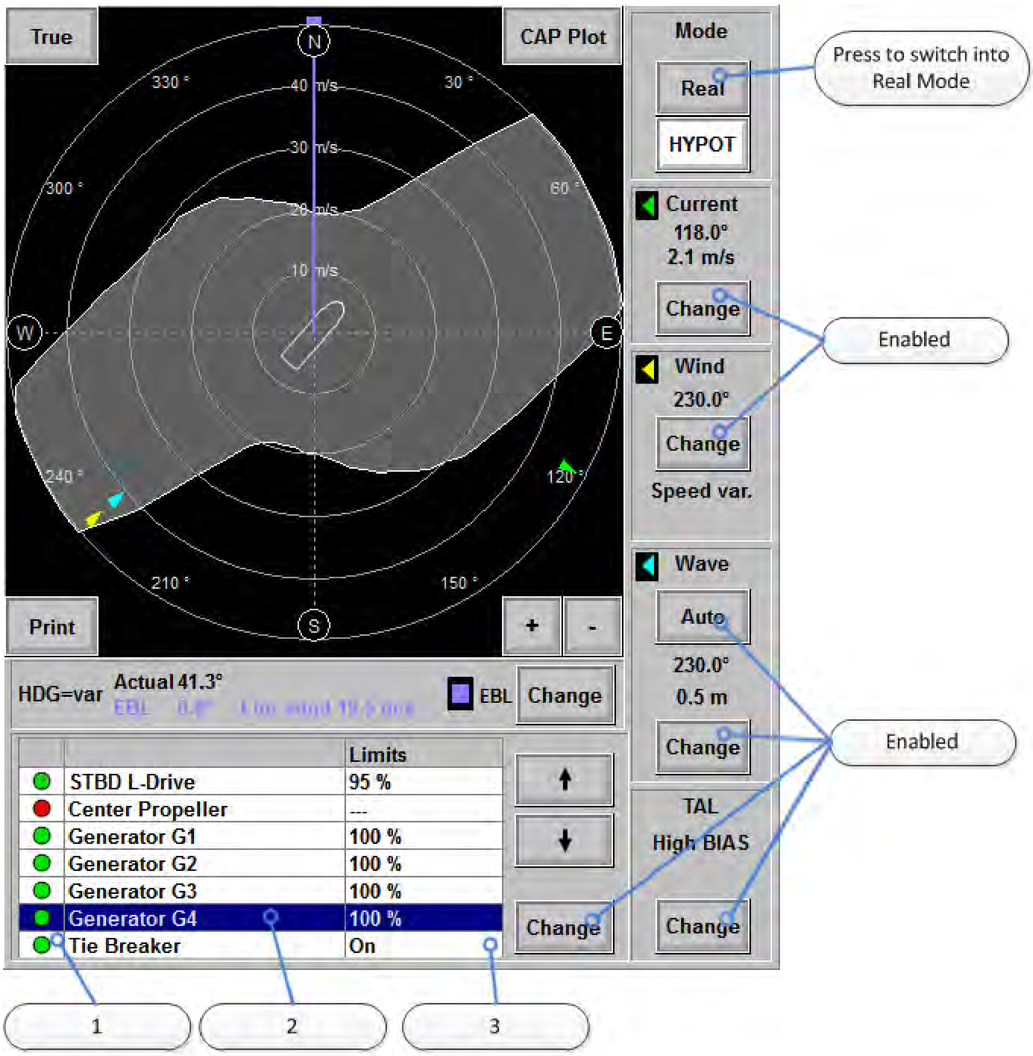


Figure 10.63: The Capability View in Hypothetic Mode

– enter a value for either thrust or power limit in the **Limit** field.
– press **OK** softkey to apply all changes and leave the dialog box. In case an incorrect value is set for the component limits **OK** softkey is unavailable.

Press **Cancel** to leave the dialog box without any changes.

Figure 10.64: Example of the Dialog Box for Editing the Thrust/Power Limits

When the tie breaker is selected, **On/Off** softkey is displayed near its name and state instead of "Change" softkey (see Figure 10.65). Press this softkey to change the tie breaker's position.

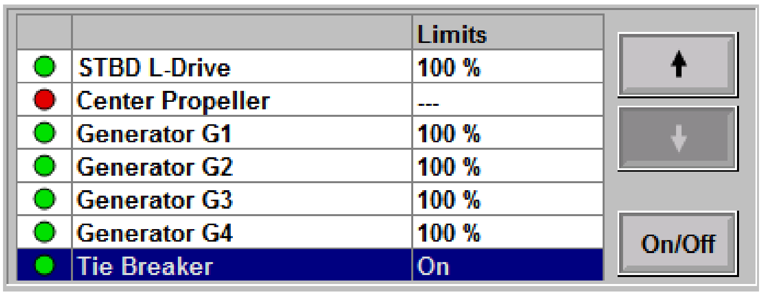


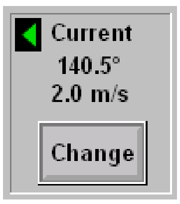
Figure 10.65: Indication of the Tie Breaker's State

Selection of Hypothetic Environmental Conditions (Wind, Waves and Current)

Current

Press **Change** softkey to set values for the current direction and speed.
In the opened dialog box (see Figure 10.66):

– select the current direction value:
  – enter a new value in degrees in the **DIR** field or
  – press **Hold** softkey to enter present value for the current direction;
– press **SPD** softkey and enter a new value for the current speed in the corresponding field;
– press **OK** softkey to apply the choice and leave the dialog box. In case incorrect values are entered for the current direction/speed, **OK** softkey is unavailable.
  Press **Cancel** softkey to leave the dialog box without any changes.



The values for current direction and speed set in the dialog box are displayed under the **Current** text.

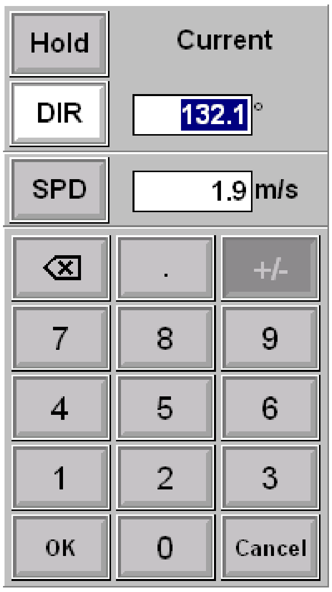


Figure 10.66: Example of the Dialog Box for Current Direction/Speed Settings

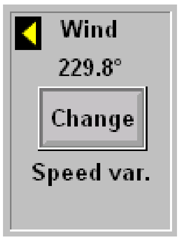
Wind

Press **Change** softkey to set a new value for the wind direction.

In the opened dialog box (see Figure 10.67):

- select the wind direction value:
  - enter a new value in degrees in the **DIR** field or
  - press **Hold** softkey to enter present value for the wind direction;
- press **OK** softkey to apply the choice and leave the dialog box. In case an incorrect value is entered for the wind direction, **OK** softkey is unavailable.
  Press **Cancel** softkey to leave the dialog box without any changes.

Figure 10.67: Example of the Dialog Box for Wind Direction Setting



The value for wind direction set in the dialog box is displayed under the **Wind** text.
Speed var. means that the wind speed can be read on the Capability Plot.

Wave

In **Auto** mode the wave direction matches the wind direction and the wave height is calculated by the system as a function of the wind speed (see Figure 10.62). In this case **Auto** softkey is highlighted by white color and **Change** softkey is unavailable.

Press the **Auto** softkey, so the **Change** softkey becomes available. Press the **Change** softkey for manual input of the wave parameters (direction and height).

In the opened dialog box (see Figure 10.68):

- select the wave direction value:
  - enter a new value in degrees in the **DIR** field or
  - press **Hold** softkey to enter present value for the wave direction;
- press **H** softkey and enter a new value for the wave height in the corresponding field;
- press **OK** softkey to apply the choice and leave the dialog box. In case incorrect values are entered for the wave direction/height, **OK** softkey is unavailable.
  Press **Cancel** softkey to leave the dialog box without any changes.

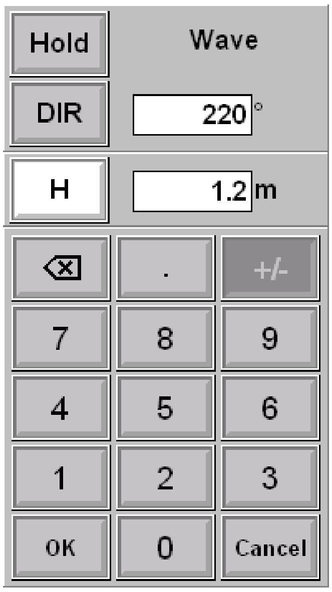


Figure 10.68: Example of the Dialog Box for Wave Direction/Height Settings

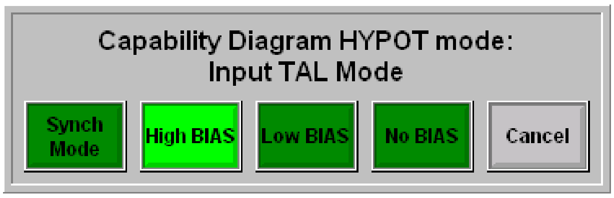
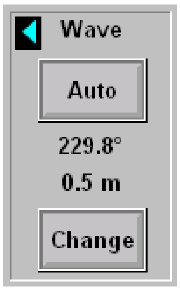


Figure 10.69: TAL Mode Selection Dialog Box

The value for wave direction is displayed under the **Wave** text in the **Auto** mode.
Height var. means that the wave height is calculated automatically as a function of the wind speed.



The values for wave direction and height set in the dialog box are displayed under the **Wave** text in the manual mode.

NOTE!	Both wind speed and wave height are indicated in values set by the operator in "Units" page of "Param" window.

NOTE!	Refresh is carried out not continually in Hypothetic Mode. The operator should change value of any parameter (wind, current direction, etc.) and apply it, then the refresh process starts.

Selection of Hypothetic TAL Mode

To select a TAL mode:

– press **Change** softkey located under the TAL mode name;
– select a desired TAL mode in the opened dialog box (see Figure 10.69).

Capability Plot Printout (option)

To get the Capability Plot printout press the **Print** softkey located in the lower left corner of the Plot. The actual plot is printed on the configured in **NAVIS NavDP 4000** system for printing information (usually Screen printer).

The printout contains (see Figure 10.70):

– the plot in the selected mode (Real or Hypothetic) and view (TRUE or REL);
– the vessel heading;
– wind, current and wave directions in true and relative coordinates;
– current speed;
– wave height (in case it is manually entered in the Hypothetic mode);

- thrust limits;
- TAL mode.

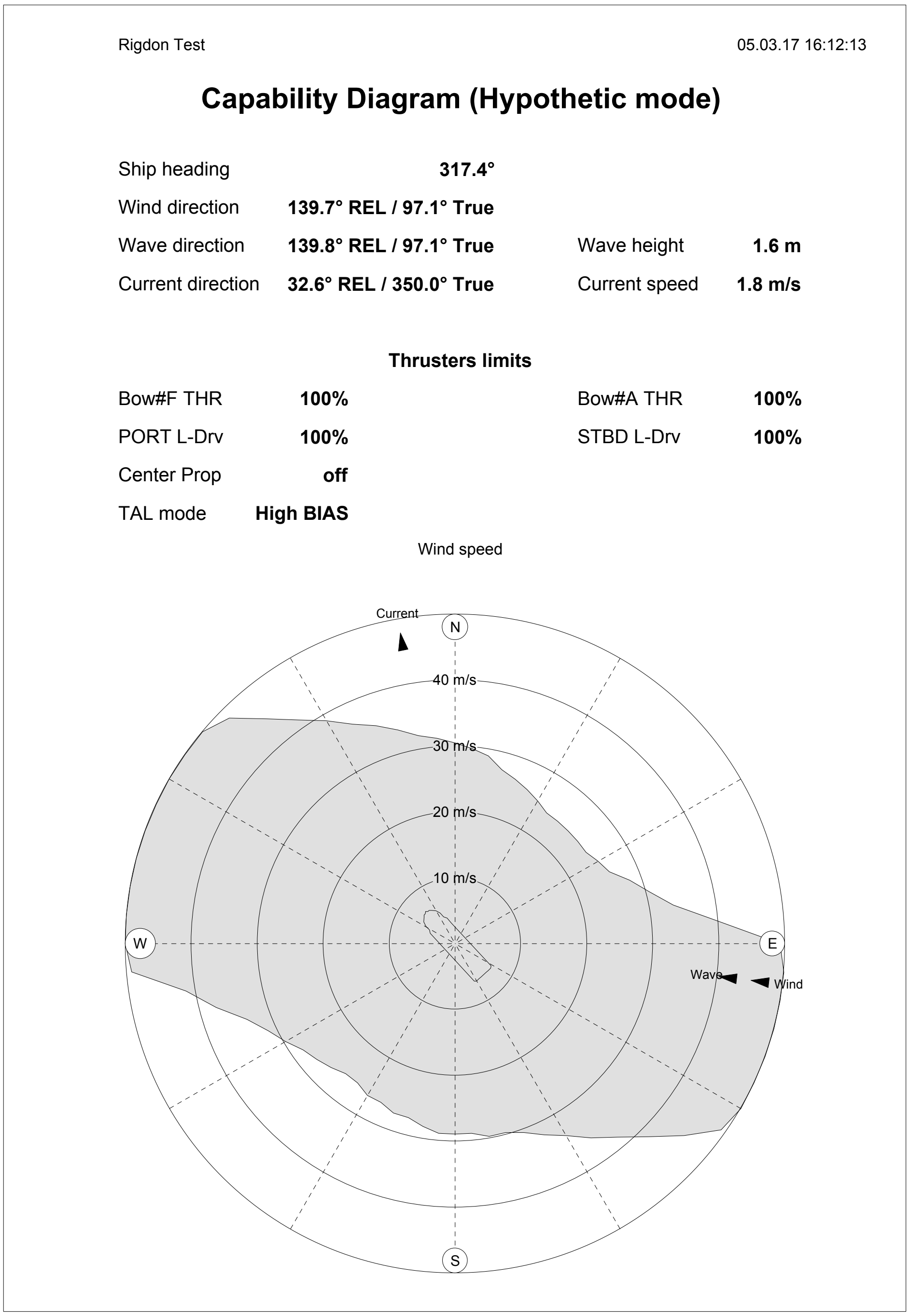


Figure 10.70: Example of the Capability Plot Printout (Hypothetic Mode, TRUE view)

10.9 Drift Analysis

Drift Analysis is performed to predict the vessel's hypothetic drift for set failures and environmental disturbances (waves, wind and current).

The Drift Analysis is closely connected to the Capability Analysis in Hypot mode (see Section 10.8, page 212) because they share the same system configurations and environmental disturbances set by the operator. Drift Analysis is performed in HYPOT mode.

Use Drift Analysis to predict the vessel's hypothetic drift in different set conditions by:

– simulating thruster and power component failures;
– changing wind, wave and current directions;
– changing current speed and wave height;
– manual changing thrust and/or power limits;
– changing TAL mode.

The results of Drift Analysis are presented on the Drift Plot (see Figure 10.71).
To open a Drift Analysis window:

– press **Select window** on **SYS** panel;
– select **Cap Analysis** item;
– press "CAP Plot" softkey located in the upper right corner of the Capability Plot for switching to the Drift Plot.

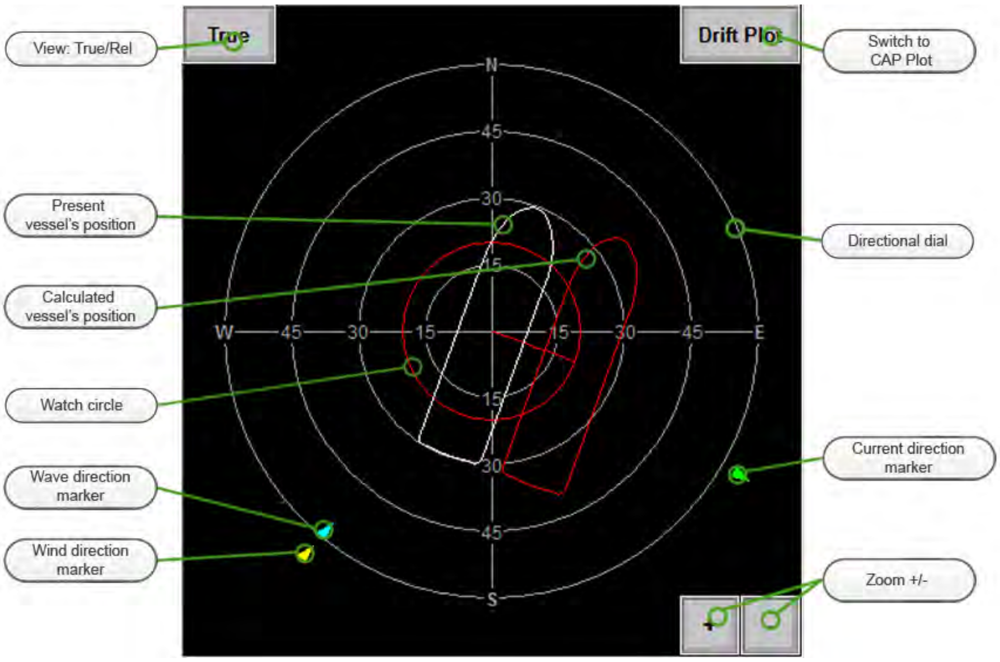


Figure 10.71: Drift Plot

Drift Plot

Drift Plot Softkeys

TRUE/REL — Drift Plot view.

The Drift Plot is displayed in two views (see Figure 10.72):

TRUE — orientation to the North;

REL — orientation to the vessel's heading.

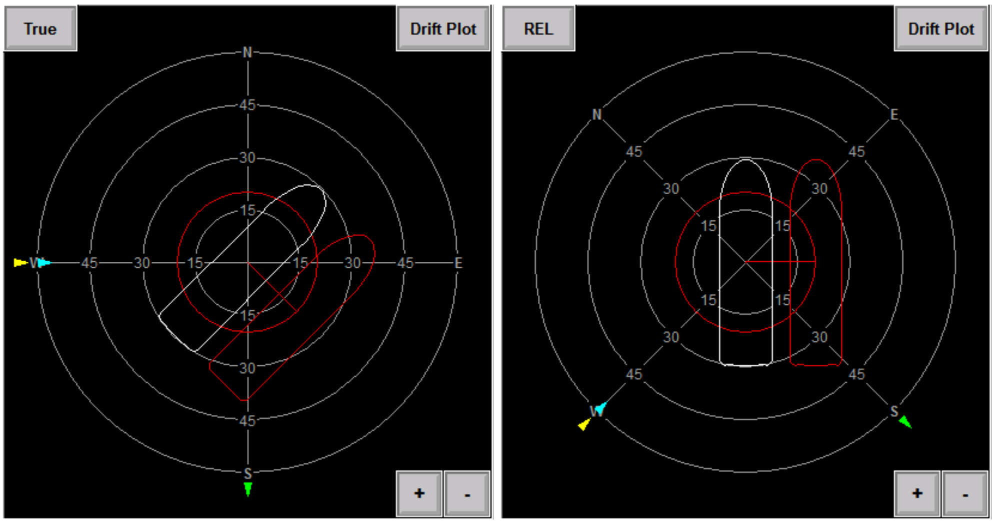
Press **TRUE/REL** softkey to switch the present view.
The view selected by the operator persists after **NAVIS NavDP 4000** restarting.
Drift Plot — the Plot name.

Press the **Drift Plot** softkey for switching to the Capability Analysis (see Section 10.8, page 207).

NOTE! Switching to Capability analysis is available in DP control mode only.

Zoom In, Zoom Out — Drift Plot view scale.

Press "+" and "–" softkeys to change the scale of the Drift Plot view (Zoom In/Zoom Out).



(a) View: TRUE (b) View: REL

Figure 10.72: Drift Plot View

Drift Plot Legend

White-colored vessel contour shows the present vessel's position. It is located in the centre of the plot and directed to the set heading.

Red-colored vessel contour shows the calculated vessel's position.

Green marker indicates current direction.

Yellow marker indicates wind direction.

Cyan marker indicates wave direction. It matches the wind direction in Auto mode.

Red-colored Watch Circle indicates set drift limit.

Press **Change** softkey near the **Watch Circle Radius** text to set a watch circle radius.
In the opened dialog box enter a new value for the watch circle radius and press **OK** (see Figure 10.73).

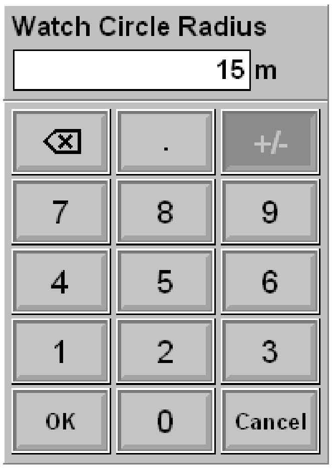


Figure 10.73: Dialog Box for Watch Circle Radius Setting

Cross time and present heading are displayed under the Drift Plot (see Figure 10.74).
In case the vessel is capable to maintain its position without any drift for the set failure configurations and environmental disturbances (current, wind and waves), the dashes are displayed instead of values for the cross time and heading (see Figure 10.75).

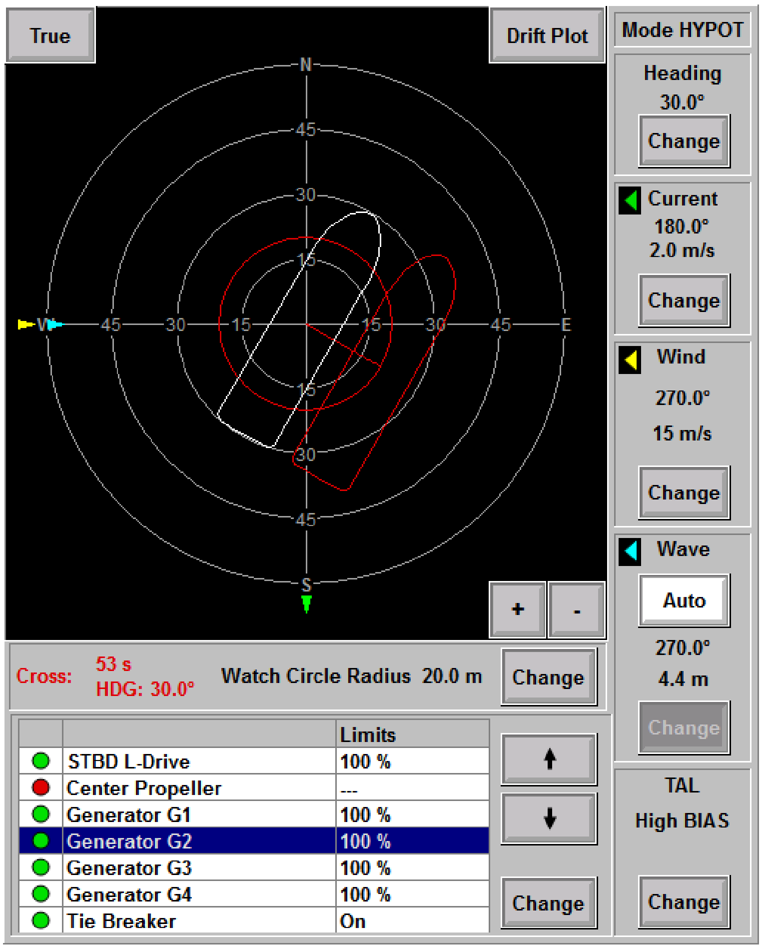


Figure 10.74: Drift Plot Window

> **NOTE!** Drift analysis is performed in DP control mode only. Otherwise, zero values are displayed for the cross time and heading.

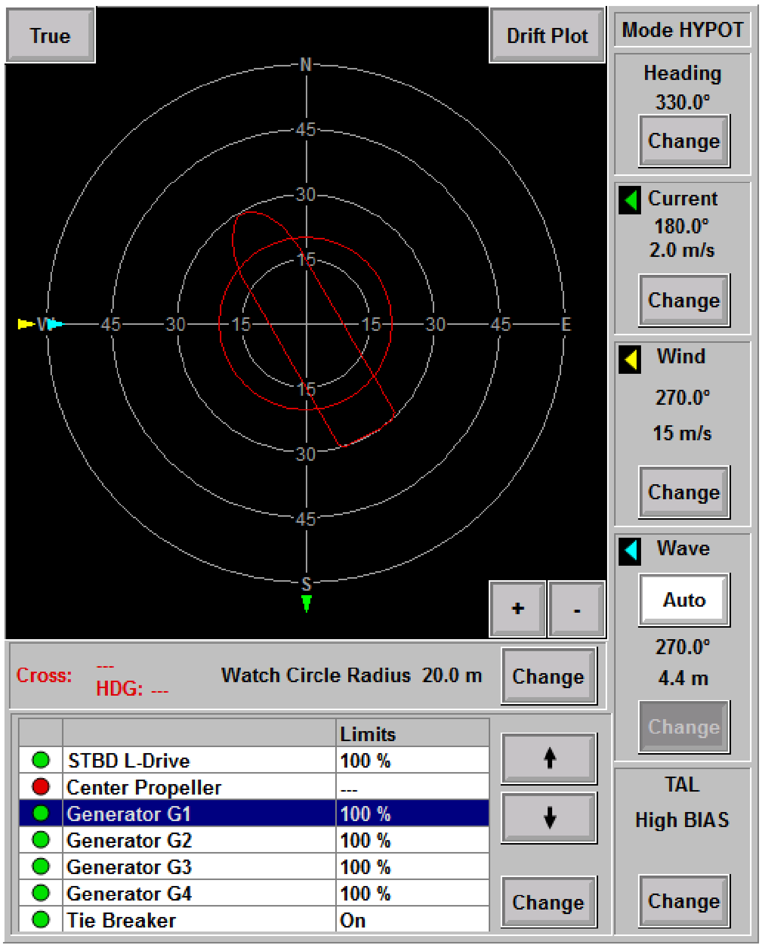


Figure 10.75: Drift Plot View without Vessel's Drift

Selection of Hypothetic Power and Thruster Configuration

A list of the DP system components (thrusters, power components, bus tie breakers) is displayed in the bottom of the Drift Analysis window (see Figure 10.74), so that different power and thrusters configurations can be investigated. Each component can be activated and deactivated.

Round indicator shows status of each component.

Green color means:

- for the thruster: it is activated;
- for the power component: it is activated;
- for bus tie breaker: it is closed.

Red color means:

- for the thruster: it is deactivated;
- for the power component: it is deactivated;
- for bus tie breaker: it is open.

Power limits for power components and thrust limits for the thrusters in percent, or position On/Off for tie breakers are displayed to the right of the component name. In case the component is deactivated, the dashes are displayed instead of values for power/thrust limits.

Use the Arrow softkeys to select a DP system component in the component list.
Press **Change** softkey to activate/deactivate thruster or power component and to set thrust/power limits.
In the opened dialog box (see Figure 10.76):

– press the softkey with the thruster/power component name to activate/deactivate the component.
  The softkey is highlighted by **light green** color in case the component is activated, and by **dark green** color in case it is deactivated.
– enter a value for either thrust or power limit in the **Limit** field.
– press **OK** softkey to apply all changes and leave the dialog box. In case an incorrect value is set for the component limits **OK** softkey is unavailable.

Press **Cancel** to leave the dialog box without any changes.

Figure 10.76: Example of the Dialog Box for Editing the Thrust/Power Limits

When the tie breaker is selected, **On/Off** softkey is displayed near its name and state instead of “Change” softkey (see Figure 10.77). Press this softkey to change the tie breaker’s position.

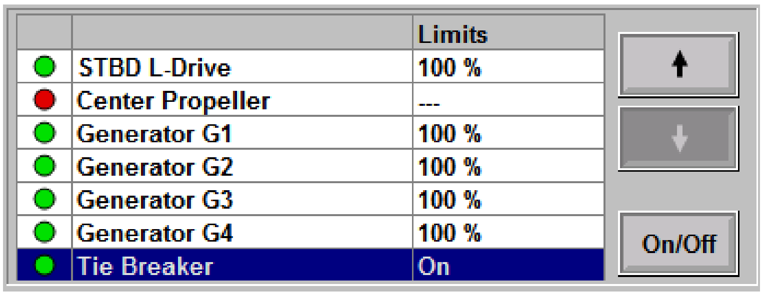


Figure 10.77: Indication of the Tie Breaker’s State

Heading Setting

Press **Change** softkey to set a new heading value.
In the opened dialog box (see Figure 10.78):

– select the heading value:
  – enter a new value in degrees in the **DIR** field or
  – press **Hold** softkey to enter the present heading value;
– press **OK** softkey to apply the choice and leave the dialog box. In case incorrect heading value is entered, **OK** softkey is unavailable.
  Press **Cancel** softkey to leave the dialog box without any changes.

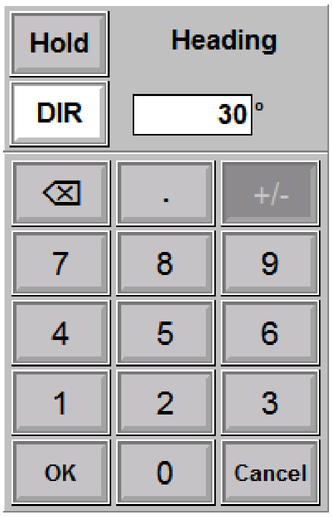
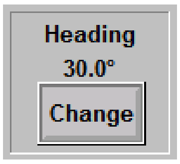


Figure 10.78: Example of the Dialog Box for Heading Setting



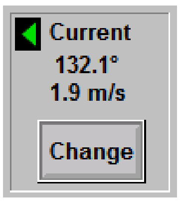
The heading value set in the dialog box is displayed under the **Heading** text.

Selection of Hypothetic Environmental Conditions (Wind, Waves and Current)

Current

Press **Change** softkey to set values for the current direction and speed.
In the opened dialog box (see Figure 10.79):

- select the current direction value:
  - enter a new value in degrees in the **DIR** field or
  - press **Hold** softkey to enter present value for the current direction;
- press **SPD** softkey and enter a new value for the current speed in the corresponding field;
- press **OK** softkey to apply the choice and leave the dialog box. In case incorrect values are entered for the current direction/speed, **OK** softkey is unavailable.
  Press **Cancel** softkey to leave the dialog box without any changes.



The values for current direction and speed set in the dialog box are displayed under the **Current** text.

Wind

Press **Change** softkey to set a new value for the wind direction.
In the opened dialog box (see Figure 10.80):

- select the wind direction value:
  - enter a new value in degrees in the **DIR** field or
  - press **Hold** softkey to enter present value for the wind direction;
- press **SPD** softkey and enter a new value for the wind speed in the corresponding field;

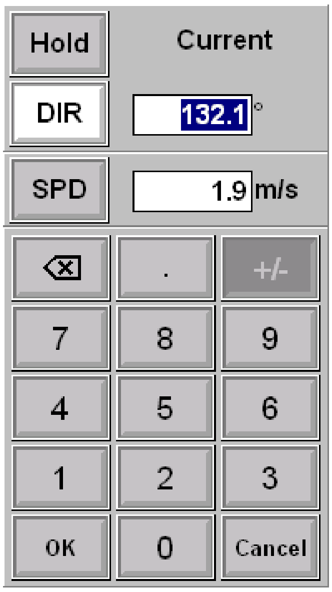


Figure 10.79: Example of the Dialog Box for Current Direction/Speed Settings

– press **OK** softkey to apply the choice and leave the dialog box. In case incorrect values are entered for the wind direction/speed, **OK** softkey is unavailable.
  Press **Cancel** softkey to leave the dialog box without any changes.

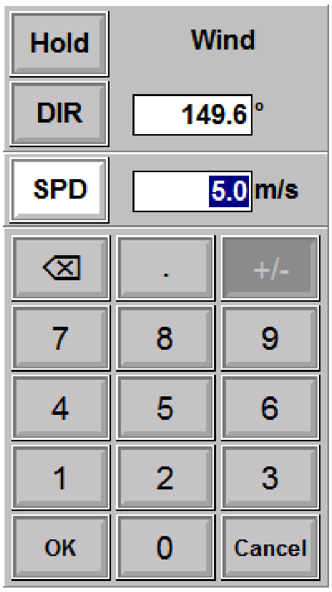
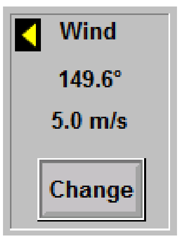


Figure 10.80: Example of the Dialog Box for Wind Direction/Speed Settings



The values for wind direction and speed set in the dialog box are displayed under the **Wind** text.

Wave

In **Auto** mode the wave direction matches the wind direction and the wave height is calculated by the system as a function of the wind speed (see Figure 10.82). In this case **Auto** softkey is highlighted by white color and **Change** softkey is unavailable.

Press the **Auto** softkey, so the **Change** softkey becomes available. Press the **Change** softkey for manual input of the wave parameters (direction and height).

In the opened dialog box (see Figure 10.81):

- select the wave direction value:
  - enter a new value in degrees in the **DIR** field or
  - press **Hold** softkey to enter present value for the wave direction;
- press **H** softkey and enter a new value for the wave height in the corresponding field;
- press **OK** softkey to apply the choice and leave the dialog box. In case incorrect values are entered for the wave direction/height, **OK** softkey is unavailable.
  Press **Cancel** softkey to leave the dialog box without any changes.

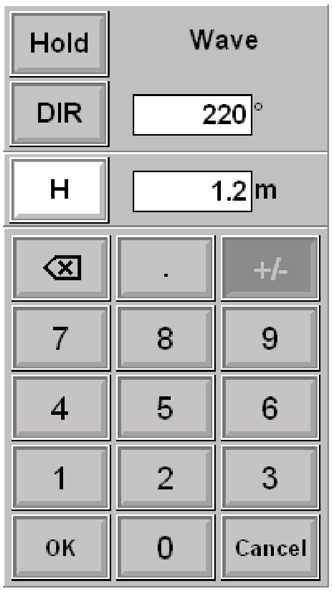
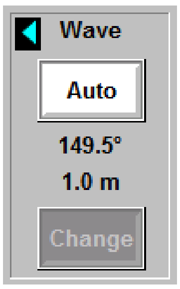
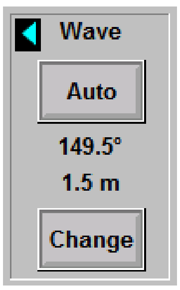


Figure 10.81: Example of the Dialog Box for Wave Direction/Height Settings



The values for wave direction and height calculated by the system are displayed under the **Wave** text in the **Auto** mode.



The values for wave direction and height set in the dialog box are displayed under the **Wave** text in the manual mode.

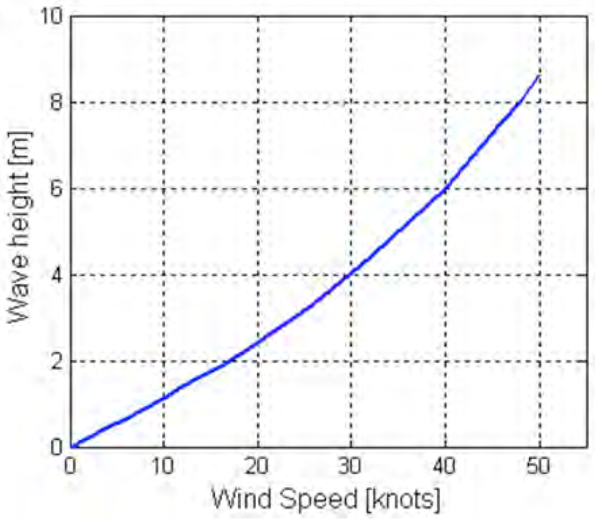


Figure 10.82: Relationship between Wave Height and Wind Speed

NOTE!	Both wind speed and wave height are indicated in values set by the operator in "Units" page of "Param" window.

NOTE!	Plot and cross time refresh is carried out not continually. The operator should change value of any parameter (heading, wind, current direction, etc.) and apply it, then the plot and data are being refreshed.

Selection of Hypothetic TAL Mode

To select a TAL mode:

- press **Change** softkey located under the TAL mode name;
- select a desired TAL mode in the opened dialog box (see Figure 10.83).

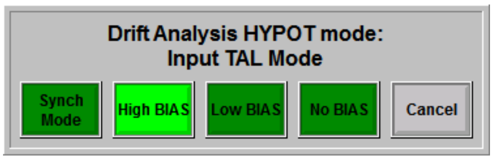


Figure 10.83: TAL Mode Selection Dialog Box

10.10 Consequence Analysis

The consequence analysis is performed to determine whether the vessel is able to maintain its position if a single or group failure occurs.

Possible consequences are based on the actual environmental disturbances, enabled thrusters and power plant (generators, circuit breakers, tie breakers) status.

Typical worst-case single failures are:

- Thruster failure;
- Power component failure;
- Circuit breaker/tie breaker failure.

Consequence analysis alarm is available.
Consequence analysis is available for DP class 2 ships.
The Consequence Analyses Window is shown in Figure 10.84.

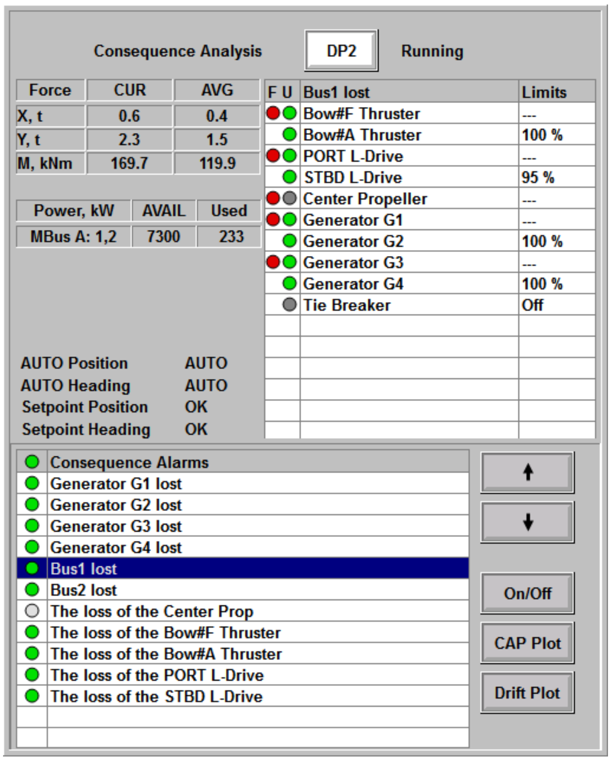


Figure 10.84: The Consequence Analysis Window Example

The mandatory parameters list is displayed at the left side of the window. The following values are required for the function operation:

AUTO Position AUTO
AUTO Heading AUTO
Setpoint Position OK
Setpoint Heading OK

I.e.

- the **NAVIS NavDP 4000** system operates in the Auto Heading and Auto Position modes;
- actual course and position are close to the demanded values.

In case one of the values does not meet the conditions, the operations is stopped.
In general, the parameters can take the following values:

- AUTO Position — type **AUTO** indicates that positioning mode chosen is suitable for consequence analysis calculation;
- AUTO Position — type **Other** indicates that positioning mode chosen is not suitable for consequence analysis calculation;
- AUTO Heading — type **AUTO** indicates that heading mode chosen is suitable for consequence analysis calculation;
- AUTO Heading — type **Other** indicates that heading mode chosen is not suitable for consequence analysis calculation;
- Setpoint Position — **OK** indicates that station keeping is good for consequence analysis;
- Setpoint Position — **No** indicates that system is not ready for consequence calculation.
  That could be of the following reasons:
  - Vessel is moving to new set point;
  - Vessel is beyond set position limits.
- Setpoint Heading — **OK** indicates that heading control is good for consequence analysis;

– Setpoint Heading — **No** indicates that system is not ready for consequence calculation. That is the case when vessel went out from set heading limits. This status would not happened when vessel changes heading and yet not gets to new set heading.

The **DP2/Off** softkey switches the function ON and OFF. The action needs to be approved by the **ENTER** softkey. The current analysis process and the function state is displayed near the **DP2/Off** softkey.

In case the function is deactivated, the updating of information is stopped.

The following cases are possible:

1. **The function is not active, the process is stopped**.

   softkey Off
   message Stopping

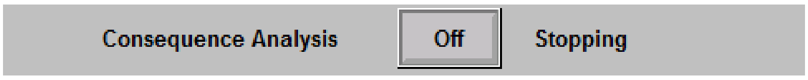


Figure 10.85: The consequence analysis is stopped

2. **The function is active, the process is stopped**.

   The causes are the following:

   – the system does not operate in the automatic modes AutoHDG and AutoPOS;
   – or the vessel is moving to new set point;
   – or the vessel is beyond set position/heading limits.

   Switch to the automatic modes or set heading and/or position values close to the present ones.

   softkey DP2
   message Stopping

Figure 10.86: The consequence analysis function is active but some conditions are not fulfilled

3. **The function is active, the process is running**

   softkey DP2
   message Running

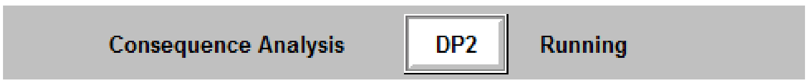


Figure 10.87: Teh consequence analysis is active

The window (see figure 10.88) contains the system components list and the list of their possible failures.

The system component list

The following information is displayed in the list:

1 — the failure effect indicator;
2 — indicator of the component state in the system;
3 — component name, list;
4 — thrust limits for thrusters, power limits for power components (the values are set in the **Param** window) and tie breaker states.

Indicators are color-coded.

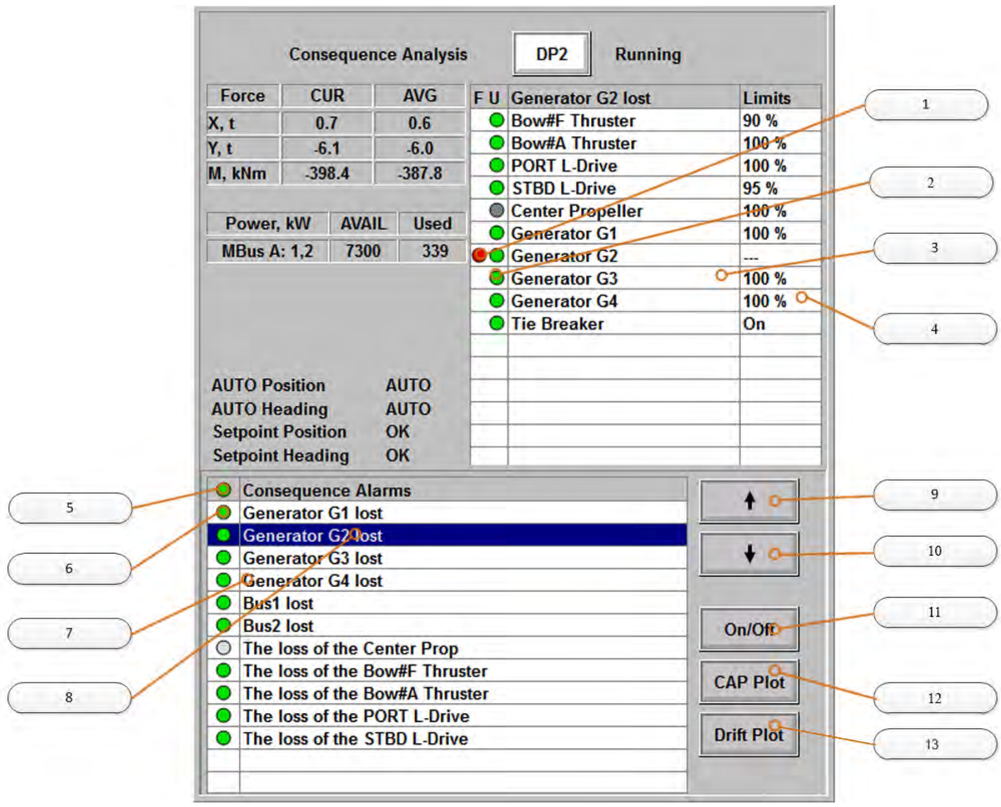


Figure 10.88: The Consequence Analysis Window with Legend

The failure effect indicator (1):

red — the failure **(8)** selected in the **System failure list** leads to failures of one or more components. These elements are marked with red round indicators (**1**) and the dashes are displayed instead of values for power/thrust limits. The list can contain one or more red failure indicators;

not visible — the selected failure does not affect on the component operation.

Indicator of the component state in the system (2):

green — the component is active. The component activity means:

- for the power component: it operates normally (powers a bus) and the corresponding tie breaker is closed;
- for the thruster: it operates normally and is included in the Auto Thruster group;
- for circuit/tie breaker: it is closed.

dark grey — the component is inactive. It means:

- for the power component: it is disconnected from a bus or failed;
- for the thruster: it is not included in the Auto Thruster group or failed;
- for circuit/tie breaker: it is open.

The system failure list

5 — the consequence indicator showing Consequence analysis general state;
6 — indicator of the component state in the Consequence analysis;
7 — a failure name;
8 — selected failure. You can select a worst-case failure by touching the touchscreen or using arrow softkeys. As soon as a worst-case failure has been selected, The Consequence Analysis function informs you which elements would be inactive in case of this failure (see **(1)** indicator).

The consequence indicator (5):

light grey — all components included in the analysis are not active (there are no red or green indicators and at least one indicator is light-grey);
dark grey — there is no failure included in the analysis (all indicators are dark-grey);
green — at least one active component is included in the analysis (at least one indicator is green and there are no red indicators);
red — there is at least one critical failure of component, included in the analysis (at least one indicator is red).

The indicator of the component state in the Consequence analysis (6):

light grey — the failure is included in the analysis but the component is not active;
dark grey — the failure is excluded from the analysis;
green — the failure is included in the analysis and the component is active;
red — a critical failure of the component (the failure is included in the analysis). The critical failure is the failure after which the thrusters are not able to produce sufficient thrust and/or power components — sufficient amount of power for the vessel's capability to maintain its position.
The alarm message is generated in this case.

Softkeys

9 and **10 softkeys** are used to go through the list.
On/Off (11) softkey is for the including to the analysis and excluding from the analysis the selected failure.
CAP Plot (12) softkey opens the Capability plot window and activates the capability analysis function in the Hypothetic mode.
Drift Plot (13) softkey opens the Drift plot window and activates the drift analysis function.

The table on Figure 10.89 contains the current and average values of the thruster forces.

Force	CUR	AVG
X, t	-5.6	-5.6
Y, t	-11.6	-11.6
M, kNm	-648.5	-661.2

Figure 10.89: The forces indicator

The table on Figure 10.90 contains available and used power values on the buses.

Power, kW	AVAIL	Used
MBus A: 1,2	4672	625

Figure 10.90: The power indicator

In case of two or more buses are off, they considered as separate ones, as well as the used power value is displayed.

10.11 CPU Temperature Monitoring

NAVIS NavDP 4000 provides two-level temperature monitoring:
Two sensors are installed in the system:

- CPU temperature sensor;
- System temperature sensor.

To view the present CPU and System temperatures select **Services** item ⇒ **Info** on the Starter screen (see Figure 10.91).
For each sensor the alarms of two categories are generated:

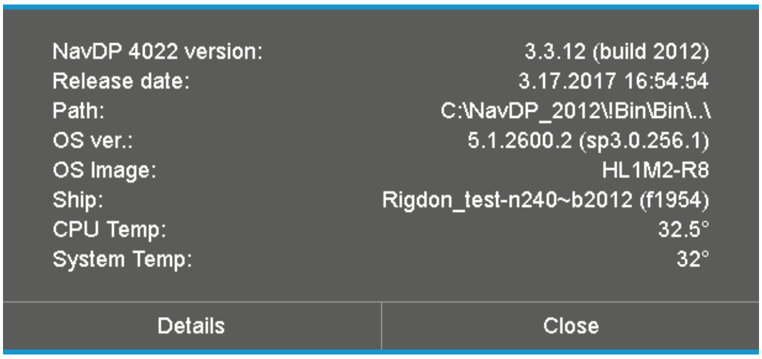


Figure 10.91: CPU and System Temperature in the “Info” Window

– Warning and voice message “Warning. Computer overheat!” (the temperature value is put in brackets) in case the temperature is above 75° C.

– Error and voice message “Attention! Computer overheat!” (the temperature value is put in brackets) in case the temperature is above 80° C.

All temperature limit values are set by service engineers during **NAVIS NavDP 4000** configuration and may differ for different system versions.

The warning “Invalid data on temperature sensor” is generated for both sensors when the measured temperature is below 5° C. This alarm is generated in case the connection with the sensor is failed).

In case of high temperature please turn off DP Computer with overheated CPU and remove the external cause of the overheat if any contacting Navis service.

10.12 System Diagnostics Function. System Monitor Window

Information for the system components is displayed in the **System Monitor** window.

The Mimic Diagram is located at the top of the window. It displays the current system configuration and the state of:

– the thrusters and thruster control systems;
– the control unit’s PLC;
– CPU and workstations (for Multi-WS systems);
– the main and portable control panels;
– the data logger station (if any);
– the printers (if any);
– the data links;
– the sensors and position reference systems.

At the bottom of the window tables displaying component states are presented.

An examples of system monitor windows for different class of DP Systems are shown in Figures 10.92, 10.93 and 10.94.

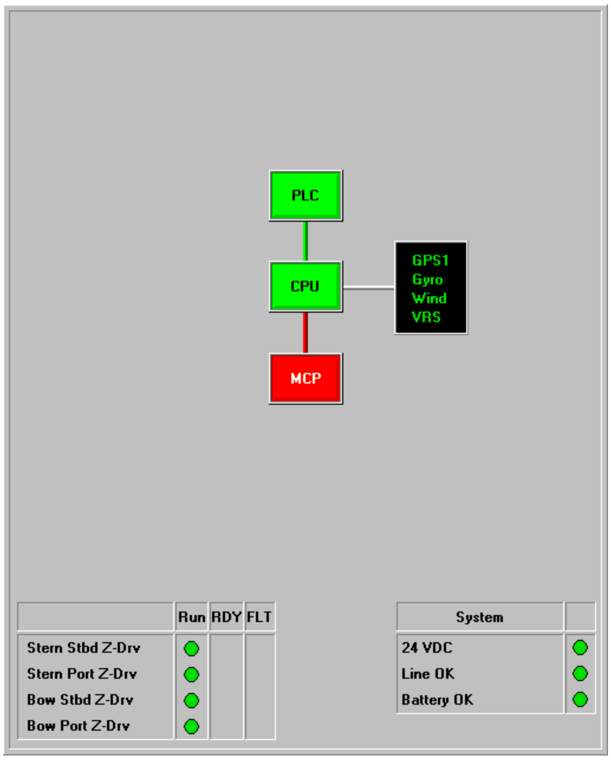


Figure 10.92: System Monitor Window Example — DP Class 0 System

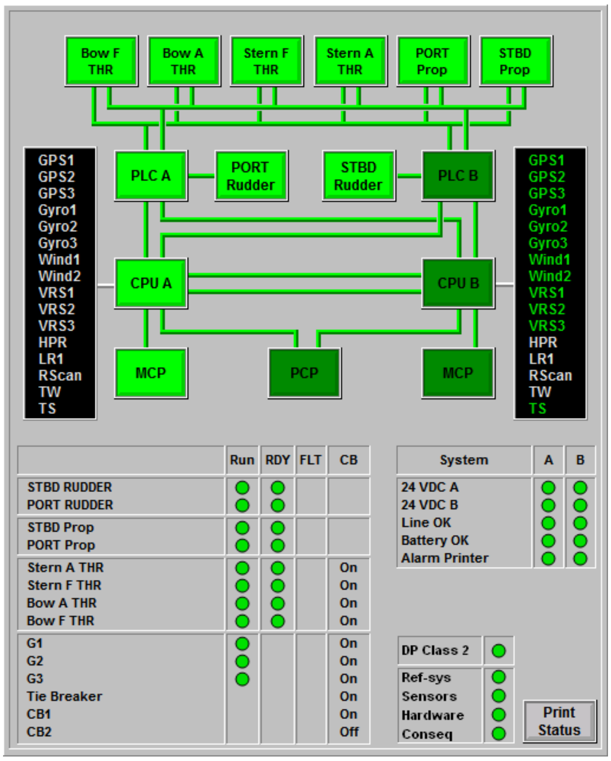


Figure 10.93: System Monitor Window Example — DP Class 2 System

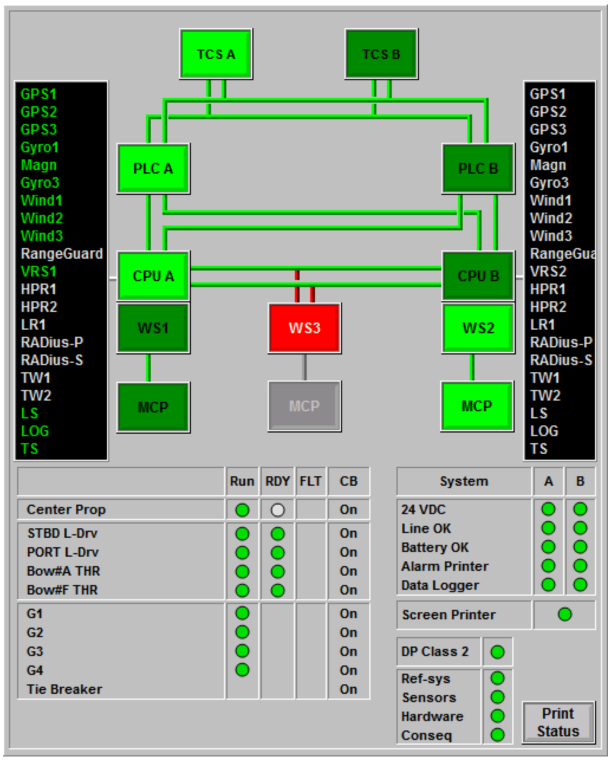


Figure 10.94: System Monitor Window Example — DP Class 2 System with 3 Workstations

10.12.1 Component State Indication on the Mimic Diagram

General

System components are displayed on the Mimic Diagram as elements/softkeys highlighted by light-green, dark-green, grey or red color (see Figure 10.94). The color depends on the component's state.

> **NOTE!** Components for which control transfer is available (CPUs, workstations, control panels) are displayed on the Mimic Diagram as softkeys of the corresponding color.

Light-green color shows that

- the component operates normally (e.g., thruster, printer and data logger station);
- the component is Master and operates normally (e.g., CPU, WS and MCP);

Dark-green color shows that the component is Slave and operates normally (e.g., CPU, WS and MCP);

Red color shows that the component is lost (connection is failed, no power, etc.);

Grey color shows that the component's state is unknown (e.g., operator station to which the control panel is connected is not started up).

Sensor and Ref-System Indication

Block with a list of sensors and ref-systems connected to the CPU is displayed for each CPU on the Mimic Diagram. The sensor/PRS name in the list shows the sensor/PRS state. It can be light-green, light-grey or red.

Light-green color shows that the sensor/PRS operates normally (data from the sensor are used by the system);

Light-grey color shows that data from the sensor/PRS are coming to the system, however, they are not used (the sensor is excluded from usage either by the operator or by the system automatically);

Red color shows that

- the sensor/PRS is lost (connection is failed, the sensor failure, etc.) or
- the CPU to which the sensor/PRS is connected is lost (connection between CPUs is failed, no power, etc.).

Data Communication Link Indication

Ethernet link and Genius bus are displayed on the Mimic Diagram as lines highlighted by light-green, grey or red color. The color depends on the link state.

Light-green color shows that the data link is OK;

Red color shows that Ethernet link / Genius bus is lost (connection is failed, invalid data, etc.);

Grey color shows that state of Ethernet link / Genius bus is unknown (e.g., operator station is not started up).

10.12.1.1 Control Transfer

The operator can transfer control to another PLC, CPU or Workstation by using the Mimic Diagram.

1. **Change of Active PLC**

   To change active PLC:

   - press and hold for a few seconds dark-green softkey of the slave (inactive) PLC on the Mimic Diagram;
   - press **OK** in the opened dialog box to apply the control transfer (see Figure 10.95).

> **NOTE!** Control transfer to another PLC is available from the Master WS/CPU only.

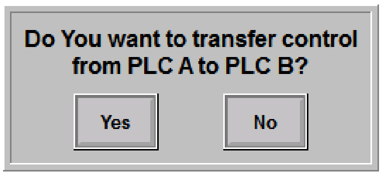
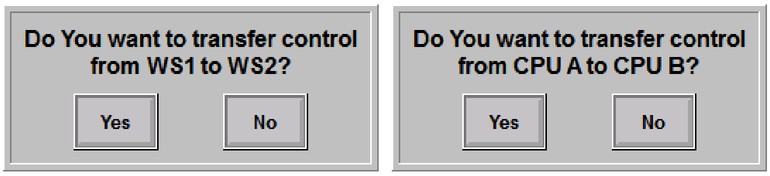


Figure 10.95: Example of the Dialog Box for Active PLC Change

2. **Change of Master Workstation/CPU**

   To change the master WS/CPU:

   – press and hold for a few seconds dark-green softkey of the slave WS/CPU on the Mimic Diagram;
   – press **OK** in the opened dialog box to apply the control transfer (see Figure 10.96).



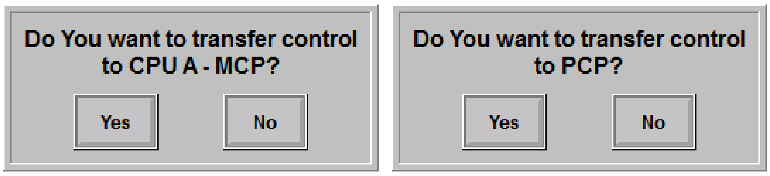
(a) Master WS Change (b) Master CPU Change

Figure 10.96: Example of the Dialog Box for Control Transfer to Another WS/CPU

3. **Control Transfer to MCP/PCP**

   To transfer control to another MCP (PCP):

   – press and hold for a few seconds dark-green softkey of the slave MCP/PCP on the Mimic Diagram;
   – press **OK** in the opened dialog box to apply the control transfer (see Figure 10.96).



(a) Control Transfer to MCP (b) Control Transfer to PCP

Figure 10.97: Example of the Dialog Box for Control Transfer to Another Control Panel

10.12.2 Component State Tables

1. **Thruster and Power system component states table**.

   The following data are displayed for each thruster:

   – "Run", "Rdy", "Flt" indicators;
   – circuit breaker (CB) state: On/Off;
   – "Mode" text indicator (option) (see Section 6.1.3, page 105 for details).

   The following data are displayed for each Power system component: "Run" indicator and CB state: On/Off.

   TB state (On/Off) is displayed for each tie breaker.

2. **System state table**. States of the following components are displayed:

– 24 VDC power supply
  The green indicator shows that the power is applied, the red color means a fault.
  For DP class 2 systems: each single DP control system (DP-A and DP-B) receives one signal from its own 24 VDC power supply and from the same power supply of the other system.
– Line failure signal from the corresponding UPS;
– Low Battery signal from the corresponding UPS;
– Printer (see Section 2.9, page 47 for details);
– Data Logger station (option, see Section H.1, page 319 for details).

3. **DP Class 2 monitoring table**.

   DP Class 2 monitoring is performed to evaluate the system configuration compliance with the redundancy requirements for DP class 2.

   DP Class 2 monitor function can be turned on/off from **PARAM** window, **System** tab (see Figure 10.98).

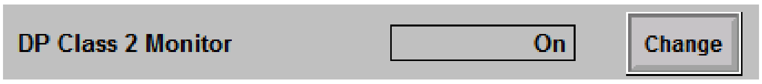


Figure 10.98: DP Class 2 Monitor Function Turning On/Off

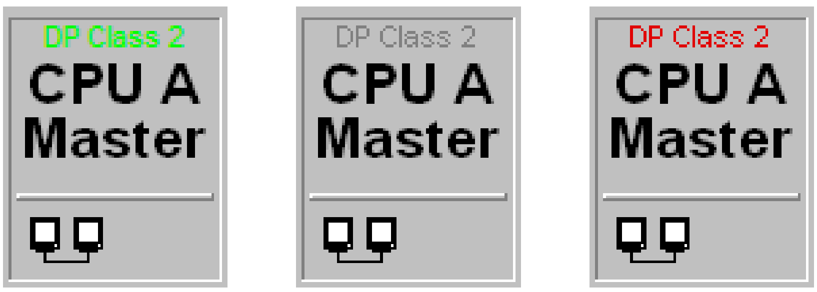
DP Class 2 system state is displayed both as colored round indicator in **System Monitor** window and as **"DP Class 2"** text of the corresponding color (green, grey or red) located on the **Master CPU** panel (see Figures 10.99 and 10.100).

In case DP Class 2 monitor function is turned off, the **"DP Class 2"** text is grey-colored.

NOTE!	Monitoring is available for DP Class 2 systems.

NOTE!	DP Class 2 monitoring is performed in DP control mode only.

WARNING!	The indication is intended for information only. The operator should not use it as the only source for evaluating the system configuration compliance with DP class 2.



(a) The system complies with DP class 2

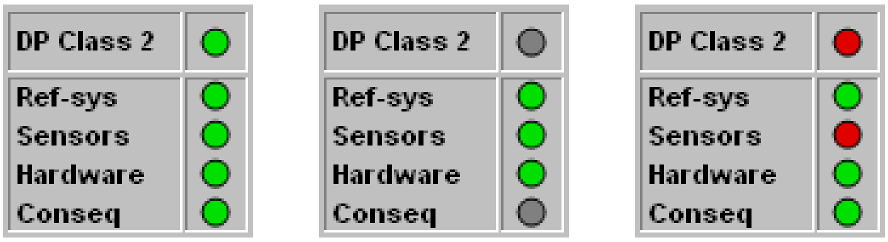
(b) The system's compliance with DP class 2 is unknown

(c) The system is not complying with DP class 2

Figure 10.99: DP Class 2 Indication on the "Master CPU" Panel

DP Class 2 system state. The indicator is color-coded. Possible colors are: green, grey and red (see Figure 10.100).

Green color shows that the current system configuration complies with the redundancy requirements for DP class 2 (all item indicators in the table are green-colored);



(a) The system complies with DP class 2 (b) The system's compliance with DP class 2 is unknown (c) The system is not complying with DP class 2

Figure 10.100: DP Class 2 Indication in the "System Monitor" Window

Grey color means that the compliance with DP class 2 is unknown:

- vessel's control is performed from the bridge (**NAVIS NavDP 4000** is inactive) or DP Class 2 monitor function is turned off by the operator. In this case all item indicators in the table are grey-colored;
- Consequence analysis function is inactive ("Conseq" indicator is grey-colored). However, state indicators for sensors, ref-systems and hardware must be green-colored.

Red color means that

- the system configuration is not complying with DP class 2 by some criteria (there is one or more red indicator in the table);
- PMS function is turned off by the operator (for more detailed information see Section 6.4, page 118).

In case the system configuration is not complying with DP class 2, the Alarm message is generated: "Set configuration isn't complying to DP class 2".

Ref-sys state. Possible colors are: green and red.

Green color shows that

- quantity of ref-systems complies with the particular Classification Society requirements for DP systems class 2 (see Table 10.1);
- at least two ref-systems are based on different physical principles;
- ref-systems operate normally (data are used by the system).

Red color shows that quantity and/or state of the ref-systems do not comply with DP class 2.

Requirements of different classification societies to the minimum number of ref-systems for DP class 2 are specified in the table 10.1.

Sensors state. Possible colors are: green and red.

Green color shows that

- quantity of sensors complies with the particular Classification Society requirements for DP systems class 2 (see Table 10.1);
- sensors operate normally (data are used by the system).

Red color shows that quantity and/or state of the sensors do not comply with DP class 2.

Requirements of different classification societies to the minimum number of sensors for DP class 2 are specified in the table 10.1.

Hardware state. Possible colors are: green and red.

Green color shows that

- system configuration complies with DP class 2 (see Table 10.2);
- hardware components operate normally.

Red color shows that quantity and/or state of the hardware components do not comply with DP class 2.

Minimum required quantity of Hardware components for DP class 2 is specified in the Table 10.2.

Consequence analysis state. Possible colors are: green, grey and red.

Green color shows that the Consequence analysis function is active and the analysis process is running;

Grey color shows that

- the Consequence analysis function is inactive;

	ABS	ABS (EHS)	BV	RINA	CCS	DNV (DYN-POS)	DNV (DPS)	GL	LR	IRS	TL	RS
PRS	3	4	3	3	3	3	3	3	3	3	3	3
Gyro Compass	3	4	3	2	2	3	3	3	3	3	3	3
Wind Sensor	3	4	2	2	2	3	2	2	2	2	2	3
VRS	3	4	2	2	2	3	2	3	3	3	2	3

Table 10.1: Minimum Required Quantity of Sensors and Ref-systems

Hardware Component	**Quantity**
PLC	2
CPU	2
Workstation	2
Ethernet Network	2
Genius Bus	2

Table 10.2: Minimum Required Quantity of Hardware Components

- some conditions for the analysis are not fulfilled;
- there is at least one failure, excluded from the analysis by the operator.

Red color shows that there is at least one critical failure (for more detailed information see Section 10.10, page 227).

10.12.3 On-line Diagnostics (Option)

On-line diagnostics is optional. The operator provides remote access to the **NAVIS NavDP 4000** system. Navis Service engineer performs the diagnostics.

On-line diagnostics is used for:

- detection and rectification problems related to the software and calibration;
- identification the faulty hardware components to be changed as well as for supporting recommendations for the crew in case of hardware failures.

10.13 Status Page Printing (Option)

Status page includes information about (see Figure 10.101):

- Date, time;
- Control mode;
- Joystick Position;
- Environment (wind speed and direction);
- Position info;
- Sensor data;
- Position reference systems raw data;
- Heading info;
- Vessel speed;
- Pitch and roll;
- Thrusters (commands, feedbacks, status, etc.);
- System configuration compliance with DP Class 2.

The following ways are available to print status page.

1. One-time printing. Press **"Print Status"** softkey in the **System Monitor** window.

2. Periodically printing.

   The Printing settings are located on the PARAM⇒System window.

   Set period in the “Status Page Printing” field by choosing one of the following values: 10 min, 30 min, 1 h, 2 h, 3 h, 4 h, 6 h, 12 h, 24 h.

   After the period has been set, press the “Apply” softkey.

Alarm printer will be used.
This function is optional.

```
NavDP 4022 Status page
17:48:42  April 10 2018
Ship: Rigdon Test    DP System: CCA

Mode: DP
Heading Control Mode:  Auto       Position control mode: Auto

TAL Mode: High BIAS

Joystick Position    X:     0%     Y:     0%     M:     0%

Environment:   Wind Speed         6.0 m/s   Wind Direction      35°

POSITION INFO:   Position Datum: WGS-84   Position Presentation: Geo

                         Lat            Lon               X          Y
Origin Position:      30°00.00434N    89°59.99782W       0.00       0.00
Actual Position:      29°59.97098N    89°59.95816W     -61.64      63.77
Position Setpoint:    29°59.97114N    89°59.95853W     -61.35      63.18

STATE OF SENSORS:
Gyro1    : Selected         Magn     : Selected         Gyro3    : Selected
VRS1     : Selected         VRS2     : Not Selected     Wind1    : Selected
Wind2    : Selected         Wind3    : Selected         RG       : Not Selected
LOG      : Selected         LS       : Selected         TS       : Selected


POSITION REFERENCE SYSTEMS:
Ref-sys           Weight
GPS1               0.07   Lat, Lon:  29°59.97698N 89°59.96813S
GPS2               0.12   Lat, Lon:  29°59.97409N 89°59.96332S
GPS3               0.70   Lat, Lon:  29°59.97098N 89°59.95815S
LR1-1              0.03   Range:        75.10 m Bearing:        7.94°
LR1-24             0.03   Range:        75.10 m Bearing:        7.94°
LR1-78             0.03   Range:        75.10 m Bearing:        7.94°


HEADING INFO:
Main gyro: Gyro1   Actual Heading:   304.5°   Heading Setpoint:   304.5°

VESSEL SPEED:
SOG:         0.0 m/s    COG:       285.6°

Roll:      -1.6°   Pitch:    +0.1°


Draft:       2.7 m Auto


Resultant force:
Control force        X:     0.72 t Y:    2.03 t Mz:  49.05 tm
Disturbance force    X:    -0.00 t Y:    1.40 t Mz:   7.61 tm


THRUSTERS:
Name                  Force,t Power,kW PitchCmd  PitchFb   RPMCmd     RPMFb   Status
Center Prop             -0.0       0                          0.0       0.0     NS
Bow#F THR                1.0      26                        366.7     368.8     S
Bow#A THR                1.0      26                        366.7     368.8     S
PORT L-Drv               4.4      99                        403.2     414.1     S
STBD L-Drv               4.4      98                        401.0     391.0     S


STEERING:
Name                    DirCmd    DirFb
PORT L-Drv               86.5      85.9
STBD L-Drv              -86.9     -85.0


Power Monitoring System:

MBus A: 1,2:
G1                 :       63 kW       ON BUS
G2                 :       63 kW       ON BUS
G3                 :       62 kW       ON BUS
G4                 :       62 kW       ON BUS
TOTAL DP POWER AVAILABLE:      5475 kW
TOTAL POWER USED:               220 kW


DP Class 2 Monitor:

Overall status:              Not complying
Sensors status:              Not complying
Ref system status:           Complying
Hardware status:             Not complying
Consequence analysis status: Complying


END OF STATUS PAGE
```

Figure 10.101: The Status Page Example

10.14 DP Footprint Plot (Option)

DP Footprint function is intended to estimate vessel's position keeping quality in real time conditions: with actual configuration/status of thruster/power components and present environmental disturbances (waves, wind and current).

The vessel's deviations from position setpoint are graphically displayed on DP Footprint Plot.

In case DP Footprint function is available, additional "Foot Print" softkey will be displayed below the map in "Map" window (see Figure 10.102).

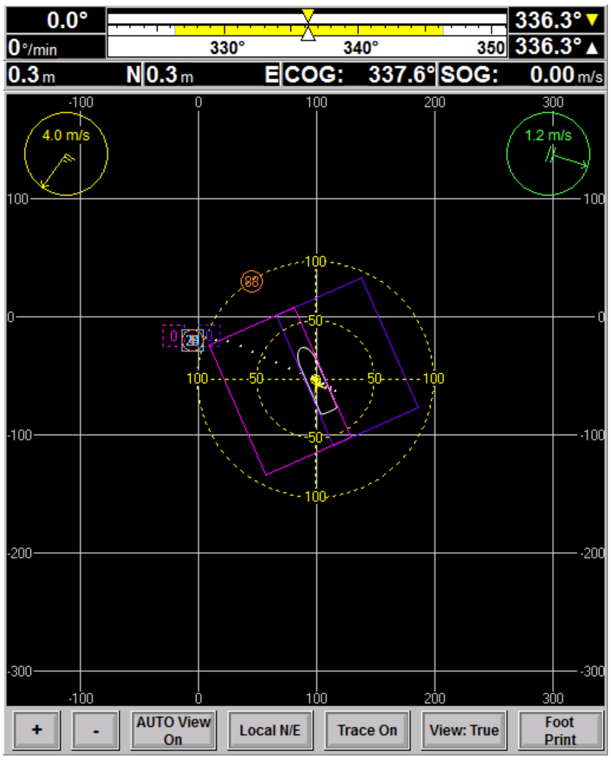


Figure 10.102: Map Window, "Foot Print" softkey is enabled

To conduct DP Footprint plot:

1. Choose auto control modes:
   - AUTO Position;
   - AUTO Heading.

> **WARNING!** For conducting DP Footprint plot it is recommended to select a safe location away from structures, other vessels, etc.

2. Set the following DP Footprint parameters in "System" page of "PARAM" window.

   Observation number (10, 15, 20) — number of points marked as **X** on the plot and displaying the vessel deviations;

   Plotting interval (30 s, 1 min, 2 min, 5 min) — a period of time for plotting a regular mark of the vessel position.

3. Press "Foot Print" softkey to get DP Footprint Plot printout.

   The Plot is printed out on the Network printer configured in **NAVIS NavDP 4000** system for printing information (usually Screen printer).

> **NOTE!** "Foot Print" softkey becomes available after all position marks corresponding to the selected Observation number are plotted. The process may take up to 100 minutes.

If “Foot Print” softkey is disabled (dark-grey), make sure that auto control modes were chosen and it was enough time to plot the selected number of points.

DP Footprint Plot contains the following data (see Figure 10.103):

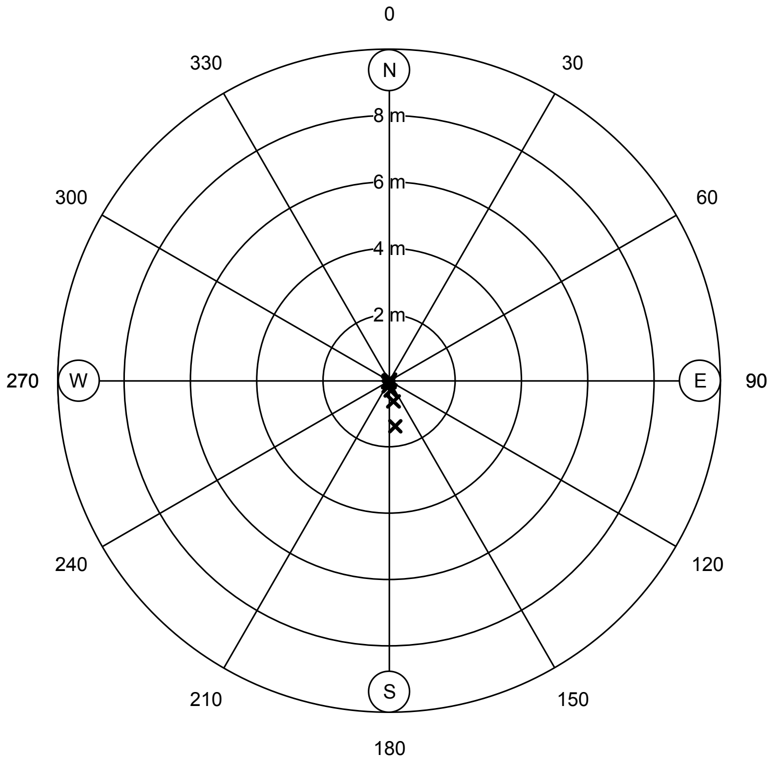
– vessel location;
– vessel heading;
– observation number;
– plotting interval;
– each PRS status;
– each thruster status;
– TAL mode;
– wind speed/direction;
– DP current speed/direction;
– fields for manual filling by the Operator (e.g. wave height/direction and current speed/direction values).

The plot is automatically scaled depending on PRS/thruster quantity.

Rigdon Test

DP Footprint Plot

04.03.18 16:03:15



DP Operator:

Location:
29°59.9605N
89°59.9295W
Auto Heading: 314.7°

Observation number:10
Plotting interval: 30 s

Position References:	
GPS1:	100% On
GPS2:	100% On
GPS3:	100% On
LR1-01:	100% On
LR1-24:	100% On
LR1-78:	100% On

Enviroment average:	
Wind Speed:	8.1 m/s
Wind Dir:	34.9°
DP Current Speed:	1.4 m/s
DP Current Dir:	114.2°
Wave Height:	
Wave Dir:	
Current Speed:	
Current Dir:	

Thrusters:	
Bow#F THR:	On
Bow#A THR:	On
PORT L-Drv:	On
STBD L-Drv:	On
Center Prop:	Off
TAL Mode:	High BIAS

Comments:

Figure 10.103: DP Footprint Plot Example

Chapter 11

Simulator

11.1 Built-in Trainer Function

DP system is delivered with a Built-in Trainer function which provides simulations for operator basic training.
Build-in Trainer is designed to explore the interface, rather than to evaluate the quality of the system.
Simulations are performed at the system console. No additional equipment is required. The trainer can be used only when the system is not in use for DP operations.
Before the simulation session, operator can input:

– Initial conditions. Vessel initial speed, initial heading, Latitude and longitude can be changed.

– Enviromental Conditions. Wind speed and direction, Current speed and direction, Wave height and direction, Water depth settings can be changed.

NOTE!	Before using DP in real mode, it is strongly recommended to do simple DP-operations in built-in-trainer mode.

All DP-functions and modes can be used in simulator mode:

Auto positioning with position setpoint change from control panel or DP screen;

Manual positioning (use joystick)

Auto heading with heading setpoint change from control panel or DP screen;

Manual heading (use knob)

NOTE!	Use built-in track editor to edit track, no way to load external track, all interfaces with external devices (like ECDIS, all sensors, etc) are disabled in simulator mode.

Track control

Thrusters In built-in trainer all thrusters assued to be available, operator can include/exclude it from auto thrust allocation group.

11.2 Simulator Settings

If a control system is switched on, select **Simulator Mode** on the Main Screen to start the control system operation in the **Simulator Mode**.
Simulator submenu looks as shown in Figure 11.1.
Select **Settings** to set Starting Conditions

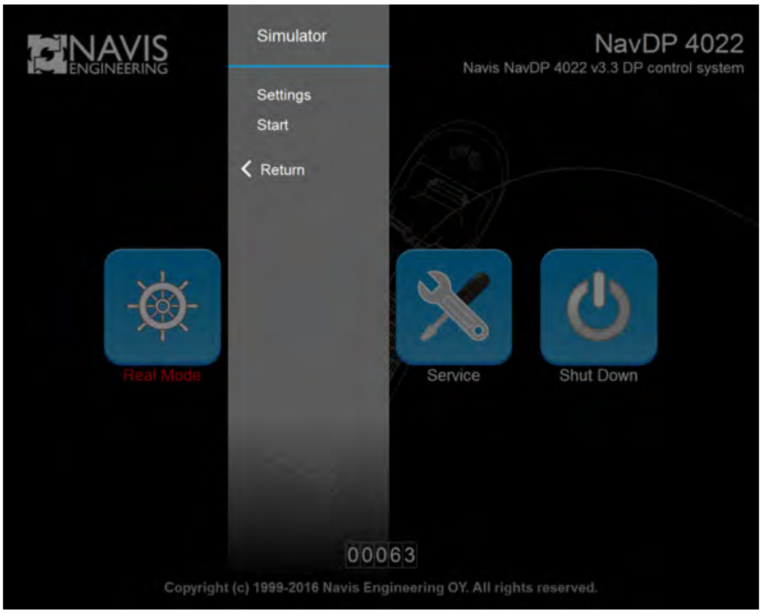
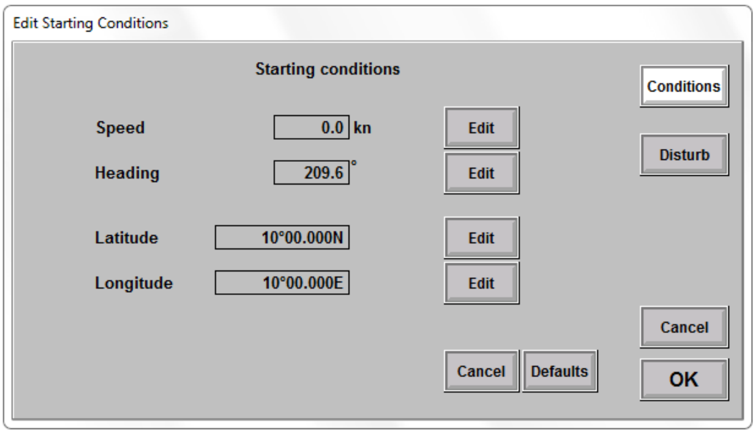
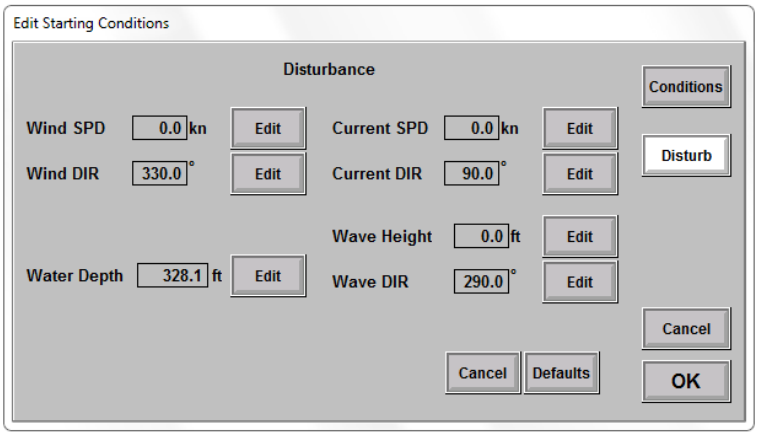


Figure 11.1: Simulator start menu



and Environment Conditions



Select **Start** to start the simulation mode. Select **Return** to return back.

11.3 Operation

In the **Simulator mode** you can perform almost all DP-operations available in **Real mode**.

In **Simulator Mode** use Param window (view SIMUL) to change Environment Conditions.
You can change the following parameters:

– Wind speed
– Wind direction
– Current speed
– Current direction
– Water depth
– Wave height
– Wave direction

The range of admissible values for each parameters is indicated below.

You can change also commands for not-in-DP propellers (simulating bridge control of propellers – only for **Autopilot mode**).

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Appendix A

Synchronized/Independent Modes for DP-2 Systems (Visual)

There are two sort of system configuration considering the Synchronization mode:

– the Syncronized mode is available to switch to the Independent one and vice versa
– Synchronized in the only mode, the switching is not available

When operating in the Independent mode changes are applied for the station where they were performed only.

When operating in Synchronized mode the most of parameters changes are available on the Master station only. Some exclusions aredescribed below.

All tabs of the PARAM window are available to switch between on the Slave station. But the most of values are not available to change on the Slave station when operating in synchronized mode. The exclusions that can be changed for the every work station in any mode are the following:

– The operations on the Logging tab is an independent operation
– Palette settings changing is the synchronized operation

Appendix B

Alarm Messages List

Type	*On-screen alarm text*	*Example*
Error	(ETHERNET) utilization is extremely high	Enet Bus A utilization is extremely high
Warning	(ETHERNET) utilization is high	Enet Bus A utilization is high
Error	(TEMPS) temperature is extremely high	CPU temperature is extremely high
Warning	(TEMPS) temperature is high	CPU temperature is high
Warning	(TEMPS) temperature is invalid	CPU temperature is invalid
Error	Audio directory not found	Audio directory not found
Error	Alarm history damaged. System restart recommended	Alarm history damaged. System restart recommended
Info	——— Time offset change	——— Time offset change
Error	Error in Date/Time settings. Please rewrite it	Error in Date/Time settings. Please rewrite it
Error	(CPANELS_SHORT) low storage space	MCP low storage space
Error	(WSS): (CPANELS_SHORT) low storage space	WS 1: MCP low storage space
Info	(CPANELS_SHORT) system info	MCP system info
Info	(WSS): (CPANELS_SHORT) system info	WS 1: MCP system info
Warning	Switch to Bridge mode before turning the system off	Switch to Bridge mode before turning the system off
Info	Power off request received	Power off request received
Error	Invalid Mode Selector state	Invalid Mode Selector state
Warning	Insufficient Thrust	Insufficient Thrust
Error	Thruster system is not available for DP	Thruster system is not available for DP
Info	Thruster system is not available for DP surge operations	Thruster system is not available for DP surge operations
Info	Thruster system is not available for DP sway operations	Thruster system is not available for DP sway operations
Info	Ready for AUTO Mode operation	Ready for AUTO Mode operation
Error	Unable to transfer control. The system is not operable	Unable to transfer control. The system is not operable
Warning	Unable to transfer control due to PCP lost link	Unable to transfer control due to PCP lost link
Critical	The system is not operable	The system is not operable
Critical	Different versions of CPU software detected	Different versions of CPU software detected
Critical	Different versions of (CPU_AB_WITH_BACKUP) and (WSS_WITH_BACKUP) software	Different versions of Computer A and WS 1 software
Critical	Different timezone settings on CPU detected	Different timezone settings on CPU detected
Warning	Clearing PLC faults table	Clearing PLC faults table

Error	Clearing PLC Faults failed	Clearing PLC Faults failed
Warning	Enabling PLC Faults failed on slave	Enabling PLC Faults failed on slave
Warning	Disabling PLC Faults failed on slave	Disabling PLC Faults failed on slave
Error	Enabling PLC Faults failed	Enabling PLC Faults failed
Error	Disabling PLC Faults failed	Disabling PLC Faults failed
Info	PLC Faults enabled	PLC Faults enabled
Info	PLC Faults disabled	PLC Faults disabled
Error	Main DP System Error	Main DP System Error
Error	Backup DP System Error	Backup DP System Error
Error	Lost all WS	Lost all WS
Error	Lost active WS	Lost active WS
Error	Signal-Controller redundant network error	Signal-Controller redundant network error
Error	AP Fault - Switch To Manual Steering	AP Fault - Switch To Manual Steering
Error	Low Speed - Switch To Manual Steering	Low Speed - Switch To Manual Steering
Error	AP Speed REF Failed. Switch to Manual Speed	AP Speed REF Failed. Switch to Manual Speed
Error	AP Heading - No Valid Data	AP Heading - No Valid Data
Error	AP Steering Failed	AP Steering Failed
Error	AP - Off Heading	AP - Off Heading
Error	Heading Monitor Off	Heading Monitor Off
Warning	HS Track is Not Approved for Navigation	HS Track is Not Approved for Navigation
Warning	Track Control not initiated: Too Big Distance to Track	Track Control not initiated: Too Big Distance to Track
Warning	Track Control not initiated: Too different angles of Heading and BOD	Track Control not initiated: Too different angles of Heading and BOD
Warning	Active track rejected	Active track rejected
Info	Active track changed	Active track changed
Info	External track loaded	External track loaded
Info	External track not loaded	External track not loaded
Warning	External track not loaded: can not change active track	External track not loaded: can not change active track
Info	External track overwritten	External track overwritten
Error	Error on loading external track	Error on loading external track
Info	Track overwritten because of start synchronization	Track overwritten because of start synchronization
Error	Off Track Limit	Off Track Limit
Info	Track Complete	Track Complete
Info	New Way Point	New Way Point
Warning	Track trimmed to maximal allowed length	Track trimmed to maximal allowed length
Error	The Vessel is about to reach a new Way point	The Vessel is about to reach a new Way point
Info	Track: Pause Mode	Track: Pause Mode
	JDP	
Error	Heading limit excess	Heading limit excess
Error	Position limit excess	Position limit excess
Error	Position offset program limit excess	Position offset program limit excess
Error	Vessel outside the hold area	Vessel outside the hold area
Warning	Vessel approaching the hold area border	Vessel approaching the hold area border
Error	Course outside Min Power sector	Course outside Min Power sector
Info	External DP Setpoint was loaded	External DP Setpoint was loaded
Error	Set Cartesian coordinates for HPR message	Set Cartesian coordinates for HPR message
Warning	UTM zone is too far	UTM zone is too far
Warning	UTM coordinates is not applicable	UTM coordinates is not applicable
	Synchronize	
Warning	Synchronize knob	Synchronize knob

Warning	Synchronize joystick	Synchronize joystick
Warning	Synchronize joystick and knob	Synchronize joystick and knob
Error	AWC is not available: No good Wind data	AWC is not available: No good Wind data
Error	AUTO Heading is not available: No Heading data	AUTO Heading is not available: No Heading data
Error	AUTO Positioning is not available: No Position data	AUTO Positioning is not available: No Position data
Error	Target Following is not available: target filter not ready	Target Following is not available: target filter not ready
Error	Can not change target settings in target following mode	Can not change target settings in target following mode
Error	Control System: function error	Control System: function error
Error	I/O System: function error	I/O System: function error
Error	DRG: No Data Received	DRG: No Data Received
Error	DH: No Data Received	DH: No Data Received
Error	DEICO: No Data Received	DEICO: No Data Received
Error	ST: No Data Received	ST: No Data Received
Sensors and Ref-systems		
Error	(SENSORS): No Data Received	GPS: No Data Received
Info	(GPSS): VTG: No Data Received	GPS: VTG: No Data Received
Info	(GYROS): ROT: No Data Received	Gyro: ROT: No Data Received
Error	(RANGEGUARDS): No Data Received from (RGSNSS)	RangeGuard: No Data Received from Sensor 1
Error	(RANGEGUARDS): No Parameters Received from (RGSNSS)	RangeGuard: No Parameters Received from Sensor 1
Error	(RANGEGUARDS): Red Alarm on (RGSNSS)	RangeGuard: Red Alarm on Sensor 1
Error	(RANGEGUARDS): Amber Alarm on (RGSNSS)	RangeGuard: Amber Alarm on Sensor 1
Warning	(RANGEGUARDS): Red Alarm Unconfigured on (RGSNSS)	RangeGuard: Red Alarm Unconfigured on Sensor 1
Warning	(RANGEGUARDS): Amber Alarm Unconfigured on (RGSNSS)	RangeGuard: Amber Alarm Unconfigured on Sensor 1
Error	(MULTI_SENSOR_DEVICES): No Data Received	LR: No Data Received
Warning	(SENSORS): No Data on (CPU_AB)	GPS: No Data on Computer A
Warning	(SENSORS): No Data on (IO_DEVICE_CHANNELS)	GPS: No Data on Channel 1
Error	(SENSORS): no good data for a long time	GPS: no good data for a long time
Error	(MULTI_SENSOR_DEVICES): no good data for a long time	HPR: no good data for a long time
Error	(SENSORS): Invalid Data	GPS: Invalid Data
Warning	(MULTI_SENSOR_DEVICES): End of range	HPR: End of range
Warning	(LRS): End of range	LR: End of range
Warning	(TWS): End of range	TW: End of range
Error	(HPRS): Common Alarm	HPR: Common Alarm
Warning	(SENSORS_IO_DEVICES_ROUTE_DEVICES): COM port data rate limit exceeded	GPS: COM port data rate limit exceeded
Warning	(WSS): (SENSORS_IO_DEVICES_ROUTE_DEVICES) COM port data rate limit exceeded	WS 1: GPS COM port data rate limit exceeded
Warning	(SENSORS_IO_DEVICES_ROUTE_DEVICES) (IO_DEVICE_CHANNELS): COM port data rate limit exceeded	GPS Channel 1: COM port data rate limit exceeded

Warning	(WSS): (SENSORS_IO_DEVICES_ROUTE_DEVICES) (IO_DEVICE_CHANNELS) COM port data rate limit exceeded	WS 1: GPS Channel 1 COM port data rate limit exceeded
Warning	(GPSS): No differential mode	GPS: No differential mode
Warning	(GPSS): No Valid Position Data (Bad Quality)	GPS: No Valid Position Data (Bad Quality)
Error	(GPSS): Data frozen	GPS: Data frozen
Warning	(TWS): Angle out of limit	TW: Angle out of limit
Error	(TWS): Hardware alarm: PLC CPU Stopped	TW: Hardware alarm: PLC CPU Stopped
Error	(TWS): Hardware alarm: PLC Input/Output Fault	TW: Hardware alarm: PLC Input/Output Fault
Error	(TWS): Hardware alarm: Inclinometer Out of Range	TW: Hardware alarm: Inclinometer Out of Range
Error	(TWS): Hardware alarm: Winch Drive Failed	TW: Hardware alarm: Winch Drive Failed
Error	(TWS): Hardware alarm: Tension Sensor Failed	TW: Hardware alarm: Tension Sensor Failed
Error	(TWS): Hardware alarm: Tension Out of Range	TW: Hardware alarm: Tension Out of Range
Error	(TWS): Hardware alarm: Control Panel Link Failure	TW: Hardware alarm: Control Panel Link Failure
Error	Stepper Gyro Fault	Stepper Gyro Fault
Warning	(RANGEGUARDS): number of working sensors changed	RangeGuard: number of working sensors changed
Warning	Magnetic Compass is Not Approved for Navigation	Magnetic Compass is Not Approved for Navigation
Error	Base Point of Local N/E Coordinate System is Too Far	Base Point of Local N/E Coordinate System is Too Far
Error	Base Point of Local N/E Coordinate System is shifted	Base Point of Local N/E Coordinate System is shifted
Error	Reference Systems Discrepancy	Reference Systems Discrepancy
Info	REF Median Test started	REF Median Test started
Info	REF Median Test terminated	REF Median Test terminated
Warning	(REFS) : Median Test : Warning	GPS : Median Test : Warning
Warning	(MULTI_SENSOR_DEVICES) : Median Test : Warning	HPR : Median Test : Warning
Error	(REFS) : Median Test: Reject Recommended	GPS : Median Test: Reject Recommended
Error	(MULTI_SENSOR_DEVICES) : Median Test : Reject Recommended	HPR : Median Test : Reject Recommended
Error	(REFS) : Median Test : Rejected	GPS : Median Test : Rejected
Error	(MULTI_SENSOR_DEVICES) : Median Test : Rejected	HPR : Median Test : Rejected
Error	(GYROS) : Median Test : Rejected	Gyro : Median Test : Rejected
Error	Gyro discrepancy	Gyro discrepancy
Error	Gyro raw data and filter discrepancy	Gyro raw data and filter discrepancy
Error	VRS discrepancy	VRS discrepancy
Error	Wind discrepancy	Wind discrepancy
Error	Displacement mismatch	Displacement mismatch
Warning	All Gyro Sensors are Not Selected	All Gyro Sensors are Not Selected
Warning	All Position Sensors are Not Selected	All Position Sensors are Not Selected
Error	Loss of Reference System Redundancy	Loss of Reference System Redundancy
Warning	All VRS Sensors are Not Selected	All VRS Sensors are Not Selected
Warning	All Wind Sensors are Not Selected	All Wind Sensors are Not Selected
Warning	All RangeGuard Sensors are Not Selected	All RangeGuard Sensors are Not Selected

Warning	Load Sensor is Not Selected	Load Sensor is Not Selected
Warning	Log Sensor is Not Selected	Log Sensor is Not Selected
Warning	Tension Sensor NON-SELECTED	Tension Sensor NON-SELECTED
Info	Main Reference Changed	Main Reference Changed
Info	Main Gyro Changed	Main Gyro Changed
Info	Main VRS Changed	Main VRS Changed
Info	Main Wind Sensor Changed	Main Wind Sensor Changed
Info	Main LOG Sensor Changed	Main LOG Sensor Changed
Info	Gyro filter started	Gyro filter started
Info	Position filter started	Position filter started
Info	Wind filter started	Wind filter started
Info	RangeGuard filter started	RangeGuard filter started
Info	VRS filter started	VRS filter started
Info	Target filter started	Target filter started
Error	Gyro filter not ready	Gyro filter not ready
Error	Position filter not ready	Position filter not ready
Error	Target filter not ready	Target filter not ready
Warning	Wind filter not ready	Wind filter not ready
Warning	RangeGuard filter not ready	RangeGuard filter not ready
Warning	VRS filter not ready	VRS filter not ready
Warning	Load filter not ready	Load filter not ready
Warning	Log filter not ready	Log filter not ready
Critical	Heading dead reckoning	Heading dead reckoning
Critical	Position dead reckoning	Position dead reckoning
Error	Position and Wind Data Unreliable: No Heading Data	Position and Wind Data Unreliable: No Heading Data
Error	Position and Wind Filters Fault: No Heading Data	Position and Wind Filters Fault: No Heading Data
Warning	Position jump detected	Position jump detected
Info	Small position jump detected	Small position jump detected
Warning	Heading estimation jump detected	Heading estimation jump detected
Error	(LRS) data jump detected	LR data jump detected
Warning	Position setpoint is shifted by operator	Position setpoint is shifted by operator
Warning	Position setpoint is automatically shifted	Position setpoint is automatically shifted
Info	Position jump resolved	Position jump resolved
Error	Position jump. Use Remove Bias in REF window	Position jump. Use Remove Bias in REF window
Warning	Heading setpoint is changed	Heading setpoint is changed
Info	Heading estimation jump resolved	Heading estimation jump resolved
	Thrusters Interface	
Info	(TTHRS) ready to start	Bow FWD Thruster ready to start
Error	(THRS) is not available	PORT Propeller is not available
Error	(RUDDERS) is not available	PORT Rudder is not available
Error	(THRS) I/O Box is not available	PORT Propeller I/O Box is not available
Error	(RUDDERS) is not available	PORT Rudder is not available
Error	(GENERATORS) Generator I/O Box is not available	PORT Shaft Generator I/O Box is not available
Error	Alarm generation stopped: no disk space	Alarm generation stopped: no disk space
Warning	Low disk space	Low disk space
Info	Screenshots are saved	Screenshots are saved
Error	Screenshots are not saved: no disk space	Screenshots are not saved: no disk space
Info	=============== IVCS started =========================	=============== IVCS started =========================
Info	=============== IVCS finished =========================	=============== IVCS finished =========================
Info	(CPU_AB) is turned off manually	Computer A is turned off manually

Info	Shutdown signal received from PLC	Shutdown signal received from PLC
Info	Shutdown button has been pressed from starter window	Shutdown button has been pressed from starter window
Info	Shutdown system button has been pressed from (WSS) starter window	Shutdown system button has been pressed from WS 1 starter window
Info	Shutdown station button has been pressed from (WSS) starter window	Shutdown station button has been pressed from WS 1 starter window
Info	Shutdown computer button has been pressed from (WSS) starter window	Shutdown computer button has been pressed from WS 1 starter window
Info	============= (CPU_AB) started ======================	============= Computer A started ======================
Info	============= Backup CC started =======================	============= Backup CC started =======================
Info	============= (CPU_AB) finished =====================	============= Computer A finished =====================
Info	============= Backup CC finished ======================	============= Backup CC finished ======================
Info	= = (WSS) started = = = = = = = = = = = = = =	= = WS 1 started = = = = = = = = = = = = = =
Info	= Backup WS started = = = = = = = = = = = = =	= Backup WS started = = = = = = = = = = = = =
Info	= = (WSS) finished = = = = = = = = = = = = =	= = WS 1 finished = = = = = = = = = = = = =
Info	= Backup WS finished = = = = = = = = = = = =	= Backup WS finished = = = = = = = = = = = =
Info	UPS battery low	UPS battery low
Info	————————- Real mode turned on — ——————-	————————- Real mode turned on — ——————-
Info	—————————- JDP mode ready — ————————	—————————- JDP mode ready — ————————
Info	————————- Real mode turned off — ———————	————————- Real mode turned off — ———————
Info	——————– Simulator mode turned on ———————	——————– Simulator mode turned on ———————
Info	——————– Simulator mode turned off ——————–	——————– Simulator mode turned off ——————–
Mode Selector		
Info	—— DP Select ON ——	—— DP Select ON ——
Info	—— DP Select OFF ——	—— DP Select OFF ——
Info	—— IJ Select ON ——	—— IJ Select ON ——
Info	—— IJ Select OFF ——	—— IJ Select OFF ——
Info	—— AP Select ON ——	—— AP Select ON ——
Info	—— AP Select OFF ——	—— AP Select OFF ——
Info	—— MODE: Passive Mode On ——	—— MODE: Passive Mode On ——
Info	—— MODE: Stand By Mode On ——	—— MODE: Stand By Mode On ——
Info	—— MODE: DP Mode On ——	—— MODE: DP Mode On ——
Info	—— MODE: Autopilot Mode On ——	—— MODE: Autopilot Mode On ——
Info	DP_HDG: AUTO Heading Control On	DP_HDG: AUTO Heading Control On
Info	DP_HDG: Manual Heading Control On	DP_HDG: Manual Heading Control On
Info	DP_HDG: Target Following Heading On	DP_HDG: Target Following Heading On
Info	DP_HDG: COG Pilot On	DP_HDG: COG Pilot On
Info	DP_HDG: Heading Track Control On	DP_HDG: Heading Track Control On
Info	DP_HDG: Min Power Heading Control On	DP_HDG: Min Power Heading Control On
Info	DP_HDG: ROT Pilot On	DP_HDG: ROT Pilot On
Info	DP_HDG: HDG Hold Area On	DP_HDG: HDG Hold Area On
Info	DP_HDG: Rainbow Mode On	DP_HDG: Rainbow Mode On
Info	DP_HDG: FPSO Mode On	DP_HDG: FPSO Mode On

Info	AP_HDG: AUTO Course Keeping On	AP_HDG: AUTO Course Keeping On
Info	AP_HDG: Manual Course Keeping On	AP_HDG: Manual Course Keeping On
Info	AP_HDG: Heading Track Control On	AP_HDG: Heading Track Control On
Info	AP_ROT: Manual Yaw Rate Control On	AP_ROT: Manual Yaw Rate Control On
Info	AP_HDG: Dodge	AP_HDG: Dodge
Info	DP_POS: AUTO Positioning Control On	DP_POS: AUTO Positioning Control On
Info	DP_POS: Hold Area Positioning Control On	DP_POS: Hold Area Positioning Control On
Info	DP_POS: Manual Position Control On	DP_POS: Manual Position Control On
Info	DP_POS: Anchor Assistance On	DP_POS: Anchor Assistance On
Info	DP_POS: Position Free Mode On	DP_POS: Position Free Mode On
Info	DP_POS: Target Following On	DP_POS: Target Following On
Info	DP_POS: Low Speed Track Control On	DP_POS: Low Speed Track Control On
Info	DP_POS: Manual Surge On	DP_POS: Manual Surge On
Info	DP_POS: Manual Sway On	DP_POS: Manual Sway On
Info	DP_POS: Manual Speed Vector On	DP_POS: Manual Speed Vector On
Info	DP_POS: Manual Speed On	DP_POS: Manual Speed On
Info	DP_POS: Towing Position Control On	DP_POS: Towing Position Control On
Info	TAL Mode: ModeName	TAL Mode: ModeName
Thrusters, TAL, Power Monitoring		
Info	System change TAL Mode	System change TAL Mode
Info	TAL AP Mode: ModeName	TAL AP Mode: ModeName
Info	System change TAL AP Mode	System change TAL AP Mode
Info	COR: Remote Center Of Rotation Off	COR: Remote Center Of Rotation Off
Info	COR: Remote Center Of Rotation On	COR: Remote Center Of Rotation On
Info	AWC On	AWC On
Info	AWC Off	AWC Off
Error	(RUDDERS) Angle Mismatch	PORT Rudder Angle Mismatch
Error	(TTHRS) Direction Mismatch	Bow FWD Thruster Direction Mismatch
Error	(TTHRS) Thrust Mismatch	Bow FWD Thruster Thrust Mismatch
Error	(PROPS) Thrust Mismatch	PORT Propeller Thrust Mismatch
Error	(TTHRS) Direction/Thrust Mismatch	Bow FWD Thruster Direction/Thrust Mismatch
Info	PMS Function On	PMS Function On
Error	PMS Function Off	PMS Function Off
Error	(THRS) overload	PORT Propeller overload
Warning	(THRS) imminent power reduce	PORT Propeller imminent power reduce
Error	(ENGINES) overload	PORT Main Engine overload
Warning	(ENGINES) exceeded limit	PORT Main Engine exceeded limit
Error	(GENERATORS) Generator overload	PORT Shaft Generator overload
Warning	(GENERATORS) Generator exceeded limit	PORT Shaft Generator exceeded limit
Warning	(GENERATORS) Generator imminent power reduce	PORT Shaft Generator imminent power reduce
Error	Too high voltage at (GENERATORS) Generator	Too high voltage at PORT Shaft Generator
Error	Too low voltage at (GENERATORS) Generator	Too low voltage at PORT Shaft Generator
Error	(GENERATORS) Generator frequency out of range	PORT Shaft Generator frequency out of range
Error	(GENERATORS) Generator frequency out of range	PORT Shaft Generator frequency out of range
Info	(GENERATORS) Generator Circuit Breaker open	PORT Shaft Generator Circuit Breaker open
Info	(GENERATORS) Generator Circuit Breaker close	PORT Shaft Generator Circuit Breaker close

Info	(THRS) Circuit Breaker open	PORT Propeller Circuit Breaker open
Info	(THRS) Circuit Breaker close	PORT Propeller Circuit Breaker close
Info	(BUS_TIE_BREAKS) open	Bus Tie Breaker open
Info	(BUS_TIE_BREAKS) close	Bus Tie Breaker close
Info	Generator protection mode On	Generator protection mode On
Warning	Generator protection mode Off	Generator protection mode Off
Info	ME protection mode On	ME protection mode On
Warning	ME protection mode Off	ME protection mode Off
Error	(MBUSS) Blackout Prevention	BusA Blackout Prevention
Error	(ENGINES) Overload Protection	PORT Main Engine Overload Protection
Self-Testing		
Error	(ETHERNET) Error	Enet Bus A Error
Self-Testing		
Error	(ETHERNET) Error On CPU	Enet Bus A Error On CPU
Self-Testing		
Error	(ETHERNET) Error on (WSS_WITH_BACKUP)	Enet Bus A Error on WS 1
Error	Unable to start (ETHERNET)	Unable to start Enet Bus A
Error	Unable to start Backup (ETHERNET)	Unable to start Backup Enet Bus A
Info	(CPANELS) becomes active	Main control panel becomes active
Info	(WSS): (CPANELS) becomes active	WS 1: Main control panel becomes active
Info	(CPANELS) becomes active	Main control panel becomes active
Info	(WSS): (CPANELS) becomes active	WS 1: Main control panel becomes active
Error	(CPANELS) 24VDC A lost	Main control panel 24VDC A lost
Error	(CPANELS) 24VDC B lost	Main control panel 24VDC B lost
Error	(CPANELS): connection lost	Main control panel: connection lost
Error	(WSS): (CPANELS) connection lost	WS 1: Main control panel connection lost
Error	(CPANELS): connection lost	Main control panel: connection lost
Error	(WSS): (CPANELS) connection lost	WS 1: Main control panel connection lost
Error	(CPANELS): joystick error	Main control panel: joystick error
Error	(WSS): (CPANELS) joystick error	WS 1: Main control panel joystick error
Error	(CPANELS): joystick error	Main control panel: joystick error
Error	(WSS): (CPANELS) joystick error	WS 1: Main control panel joystick error
Info	(CPANELS) software update started	Main control panel software update started
Info	(WSS): (CPANELS) software update started	WS 1: Main control panel software update started
Warning	(CPANELS) software update is not allowed	Main control panel software update is not allowed
Warning	(WSS): (CPANELS) software update is not allowed	WS 1: Main control panel software update is not allowed
Error	(CPANELS) software update failed	Main control panel software update failed
Error	(WSS): (CPANELS) software update failed	WS 1: Main control panel software update failed
Warning	(CPANELS) audio list incomplete	Main control panel audio list incomplete
Warning	(WSS): (CPANELS) audio list incomplete	WS 1: Main control panel audio list incomplete
Info	(CPANELS): take control granted	Main control panel: take control granted
Info	(WSS): (CPANELS) take control granted	WS 1: Main control panel take control granted
Info	(CPANELS): take control granted	Main control panel: take control granted
Warning	(CPANELS): give control forced	Main control panel: give control forced
Warning	(WSS): (CPANELS) give control forced	WS 1: Main control panel give control forced
Warning	(CPANELS): give control forced	Main control panel: give control forced
Info	Take control granted due to no active CP	Take control granted due to no active CP
Info	Take control granted due to enter idle mode	Take control granted due to enter idle mode

Error	(PLCS) is not available	PLC is not available
Error	CPU lost connection to (PLCS) on bus A	CPU lost connection to PLC on bus A
Error	CPU lost connection to (PLCS) on bus B	CPU lost connection to PLC on bus B
Error	(PLCS) I/O module lost	PLC A I/O module lost
Error	24VDC lost	24VDC lost
Error	12VDC lost	12VDC lost
Error	12VDC B lost	12VDC B lost
Error	UPS - Line Failure	UPS - Line Failure
Error	Low Battery - Please shutdown system	Low Battery - Please shutdown system
Error	UPS - Replace Battery	UPS - Replace Battery
Error	Backup Power Supply 24VDC lost	Backup Power Supply 24VDC lost
Error	(PLCS) lost all Genius connections	PLC lost all Genius connections
Error	CU A 24VDC lost	CU A 24VDC lost
Error	CU A 24VDC from B lost	CU A 24VDC from B lost
Error	CU A 12VDC lost	CU A 12VDC lost
Error	CU A 12VDC from B lost	CU A 12VDC from B lost
Error	UPS A Line Failure	UPS A Line Failure
Error	UPS A Low Battery - Please shutdown system	UPS A Low Battery - Please shutdown system
Error	UPS A Replace Battery	UPS A Replace Battery
Error	CU B 24VDC from A lost	CU B 24VDC from A lost
Error	CU B 24VDC lost	CU B 24VDC lost
Error	CU B 12VDC lost	CU B 12VDC lost
Error	CU B 12VDC from A lost	CU B 12VDC from A lost
Error	UPS B Line Failure	UPS B Line Failure
Error	UPS B Low Battery - Please shutdown system	UPS B Low Battery - Please shutdown system
Error	UPS B Replace Battery	UPS B Replace Battery
Warning	(THRS) I/O Box lost connection to (GENIUS)	PORT Propeller I/O Box lost connection to Genius bus A
Warning	(PLCS_12) lost connection to (GENIUS)	PLC A lost connection to Genius bus A
Warning	(RUDDERS) I/O Box lost connection to (GENIUS)	PORT Rudder I/O Box lost connection to Genius bus A
Warning	(IO_BOXES) I/O Box lost connection to (GENIUS)	Bow FWD Thruster I/O Box lost connection to Genius bus A
Warning	(TCSS) lost connection to (GENIUS)	TCS lost connection to Genius bus A
Error	(GENIUS) Error	Genius bus A Error
Error	No 24VDC A on (THRS) I/O Box	No 24VDC A on PORT Propeller I/O Box
Error	No 24VDC B on (THRS) I/O Box	No 24VDC B on PORT Propeller I/O Box
Error	No 24VDC A on (IO_BOXES) I/O Box	No 24VDC A on Bow FWD Thruster I/O Box
Error	No 24VDC B on (IO_BOXES) I/O Box	No 24VDC B on Bow FWD Thruster I/O Box
Error	(THRS) I/O box lost I/O module	PORT Propeller I/O box lost I/O module
Error	(IO_BOXES) I/O box lost I/O module	Bow FWD Thruster I/O box lost I/O module
Error	(TCSS) is not available	TCS is not available
Error	(IO_BOXES) I/O Box is not available	Bow FWD Thruster I/O Box is not available
Error	(CPUS) Error	Computer Error
Info	Change master due to CPU error	Change master due to CPU error
Error	Error: 24VDC Lost	Error: 24VDC Lost
Error	CU A Error: 24VDC A Lost	CU A Error: 24VDC A Lost
Error	CU B Error: 24VDC B Lost	CU B Error: 24VDC B Lost
Error	(MXS) is not available	MX1 is not available
Error	(MXS) firmware protocol mismatch	MX1 firmware protocol mismatch

Error	(MXS) configuration mismatch	MX1 configuration mismatch
Warning	(SENSORS): baudrate mismatch in configuration	GPS: baudrate mismatch in configuration
Error	(MXS) 24VDC A lost	MX1 24VDC A lost
Error	(MXS) 24VDC B lost	MX1 24VDC B lost
Warning	(MXS) lost connection to (ETHERNET)	MX1 lost connection to Enet Bus A
Error	(WSS) Error	WS 1 Error
Error	Backup WS Error	Backup WS Error
Warning	Form Designer started	Form Designer started
Warning	Form Designer closed. Please restart system	Form Designer closed. Please restart system
Info	PLC A becomes active	PLC A becomes active
Info	PLC B becomes active	PLC B becomes active
Info	(CPU_AB) becomes active	Computer A becomes active
Info	(WSS) becomes active	WS 1 becomes active
Info	Main DP System becomes active	Main DP System becomes active
Info	Backup DP System becomes active	Backup DP System becomes active
Error	Unable to take control	Unable to take control
Info	Dual Master	Dual Master
Info	Dual Slave	Dual Slave
Info	Remote computer started	Remote computer started
Info	We press Take Control button from Control Panel	We press Take Control button from Control Panel
Info	Remote press Take Control button from Control Panel	Remote press Take Control button from Control Panel
Info	Master lost connection with all PLC	Master lost connection with all PLC
Info	Master unable to establish connection with PLC	Master unable to establish connection with PLC
Info	Master lost all Control Panels	Master lost all Control Panels
Info	User press the CPU button from the System Diagram page	User press the CPU button from the System Diagram page
Info	User press the WS button from the System Diagram page	User press the WS button from the System Diagram page
Info	Change master due to new work mode	Change master due to new work mode
Info	User press take control on (CPANELS)	User press take control on Main control panel
Info	Take mastership due to lost link with (CPANELS)	Take mastership due to lost link with Main control panel
Info	Take mastership when make active (CPANELS)	Take mastership when make active Main control panel
Info	Take mastership due to WSSelect	Take mastership due to WSSelect
Info	Take control pressed on starter	Take control pressed on starter
Info	Become slave by unknown reason	Become slave by unknown reason
Info	User change PLC master from System Diagram page	User change PLC master from System Diagram page
Info	We lost Ethernet communication with Master	We lost Ethernet communication with Master
Info	Cannot become MASTER, because no connection to PLC	Cannot become MASTER, because no connection to PLC
Info	Cannot become MASTER, because not ready	Cannot become MASTER, because not ready
Info	Cannot become MASTER, because some computer error	Cannot become MASTER, because some computer error
Info	Cannot become MASTER, because no Control Panels	Cannot become MASTER, because no Control Panels
	Printers	
Error	Printer unavailable	Printer unavailable

Error	Network alarm printer unavailable	Network alarm printer unavailable
Info	Printing screen	Printing screen
Warning	Printing screen failed	Printing screen failed
Info	——— Network alarm printer settings changed	——— Network alarm printer settings changed
Error	Test for alarm system	Test for alarm system
Warning	Test for audio volume	Test for audio volume
Warning	Set configuration isn't complying to DP class 2	Set configuration isn't complying to DP class 2
Info	DP Class 2 Monitor On	DP Class 2 Monitor On
Error	DP Class 2 Monitor Off	DP Class 2 Monitor Off
	Lost Feedback	
Error	Lost (RUDDERS) feedback signal	Lost PORT Rudder feedback signal
Error	Lost (ENGINES) power feedback signal	Lost PORT Main Engine power feedback signal
Error	Lost (THRS) power feedback signal	Lost PORT Propeller power feedback signal
Error	Lost (THRS) RPM feedback signal	Lost PORT Propeller RPM feedback signal
Error	Lost (TTHRS) Direction feedback signal	Lost Bow FWD Thruster Direction feedback signal
Error	Lost (THRS) pitch feedback signal	Lost PORT Propeller pitch feedback signal
Error	Lost (THRS) thrust feedback signal	Lost PORT Propeller thrust feedback signal
Error	Lost (GENERATORS) Generator power feedback signal	Lost PORT Shaft Generator power feedback signal
Error	Lost (THRS) circuit breaker signal	Lost PORT Propeller circuit breaker signal
Error	Lost (GENERATORS) Generator circuit breaker signal	Lost PORT Shaft Generator circuit breaker signal
Error	Connection lost with data recorder server	Connection lost with data recorder server
Error	Incompatible version	Incompatible version
Warning	Low disk space in data recorder server	Low disk space in data recorder server
Error	Logging stopped, disk full in data recorder server	Logging stopped, disk full in data recorder server
Warning	Logging continuous mode is on for a long time	Logging continuous mode is on for a long time
Info	Memory control: started write to file	Memory control: started write to file
Info	Memory control: stopped write to file	Memory control: stopped write to file
Error	Low of Virtual Memory! ... message shown	Low of Virtual Memory! ... message shown
Info	TestVx Maneuver Started	TestVx Maneuver Started
Info	TestVx Maneuver Stopped	TestVx Maneuver Stopped
Info	TestWz Maneuver Started	TestWz Maneuver Started
Info	TestWz Maneuver Stopped	TestWz Maneuver Stopped
Info	COR Test Started	COR Test Started
Info	COR Test Stopped	COR Test Stopped
Info	COR Test Off	COR Test Off
Info	AP TestWz Started	AP TestWz Started
Info	AP TestWz Stopped	AP TestWz Stopped
Info	AP Test Started	AP Test Started
Info	AP Test Stopped	AP Test Stopped
Info	Exhibition Test Started	Exhibition Test Started
Info	Exhibition Test Stopped	Exhibition Test Stopped
Warning	Exhibition Test Not Available	Exhibition Test Not Available
Info	Time Auto Synchronize: is ON ((GPSS))	Time Auto Synchronize: is ON (GPS)
Info	Time Auto Synchronize: is OFF	Time Auto Synchronize: is OFF

Error	Time Auto Synchronize: no ZDA data ((GPSS))	Time Auto Synchronize: no ZDA data (GPS)
Error	Time Auto Synchronize: Selected GPS was turned off	Time Auto Synchronize: Selected GPS was turned off
Info	——— CPU Time was corrected	——— CPU Time was corrected
Info	System Time was corrected	System Time was corrected
Info	TAL Replay Started	TAL Replay Started
Info	TAL Replay Stopped	TAL Replay Stopped
Consequence Analysis		
Warning	Conseq analysis: power critical if (BUSS) lost	Conseq analysis: power critical if (BUSS) lost
Warning	Conseq analysis: power critical if (GENERATORS) Generator lost	Conseq analysis: power critical if (GENERATORS) Generator lost
Warning	Conseq analysis: thrust critical if (ENGINES) lost	Conseq analysis: thrust critical if (ENGINES) lost
Warning	Conseq analysis: thrust critical if (TTHRS) lost	Conseq analysis: thrust critical if (TTHRS) lost
Dynamic Alarms		
Warning	System change TAL Mode: mode1 -> mode2	System change TAL Mode: mode1 -> mode2
Warning	Track trimmed to maximal allowed length.	Track trimmed to maximal allowed length.
Warning	External track trimmed to maximal allowed length.	External track trimmed to maximal allowed length.
Info	New way point.	New way point.
Info	TAL Mode: MODE.	TAL Mode: MODE.
Info	Cyclic data stored to: FOLDERNAME	Cyclic data stored to: FOLDERNAME
Warning	Gyro Discrepancy: gyroN and gyroM.	Gyro Discrepancy: gyroN and gyroM.
Warning	Gyro Median Test: gyroN discrepancy.	Gyro Median Test: gyroN discrepancy.
Warning	Gyro Median Test: gyroN rejected.	Gyro Median Test: gyroN rejected.
Warning	GyroN raw data and filter discrepancy	GyroN raw data and filter discrepancy
Warning	Heading Jump Detected: XXX^o PORT	Heading Jump Detected: XXX^o PORT
Warning	Bias of Main Gyro is removed by operator.	Bias of Main Gyro is removed by operator.
Warning	Change Main SENSOR: snsN -¿ snsM	Change Main SENSOR: snsN -¿ snsM
Warning	LRN data jump detected.	LRN data jump detected.
Warning	Position jump detected.	Position jump detected.
Warning	Bias of Origin Reference is removed by operator.	Bias of Origin Reference is removed by operator.

Appendix C

Parameter Description

The parameters included in the parameter pages are described below. For each parameter, all the control modes are indicated in which this parameter is used.

Joystick Parameters

JOYSTICK GAIN

Meaning	The Joystick Gain determines the ratio of the joystick tilt angle to the force value as well as of the knob rotation angle to the turn moment value in Manual Position mode. The ratio of the joystick tilt angle to the speed value is determined in the Manual Speed Vector mode.
Mode	Manual Position, Manual Speed Vector
Values	Normal, High, Progressive
Editing/ Viewing	JST

DP SPEED VECTOR

Meaning	Used to select the source of the desired vessel's speed in the Speed Vector mode
Mode	Speed Vector
Values	Manual, Joystick
Editing/ Viewing	JST

DP Heading Parameters

RATE OF TURN

Meaning	Upper limit to the rate of turn while heading control
Mode	All heading control modes
Values	3, 6, 12, 18, 24, 30, 60, 120 °/min
Editing/ Viewing	HDG

HEADING GAIN

Meaning	Gain of the heading controller
Mode	Auto heading control modes
Values	1–10
Editing/ Viewing	HDG

HEADING ACCELERATION GAIN

Meaning	Acceleration gain of the heading controller
Mode	Auto heading control modes
Values	1–10
Editing/ Viewing	HDG

OFF-HEADING LIMIT

Meaning	Maximum allowable difference between the actual heading and desired heading. If the limit is exceeded, an alarm is produced.
Mode	All auto heading control modes
Values	2, 3, 5, 10, 15
Editing/ Viewing	HDG

ALWAYS USE SHORTEST TURN

Meaning	The shortest turn settings
Mode	All auto heading control modes
Values	Yes, No
Editing/ Viewing	HDG

Position Parameters

FORE-AFT SPEED

Meaning	Maximum allowable vessel's speed in the surge direction while auto position control.
Mode	All auto position control modes
Values	From 0.005 m/s
Editing/ Viewing	POSN

ATHWARTSHIPS SPEED

Meaning	Maximum allowable vessel's speed in the sway direction while auto position control.
Mode	All auto position control modes
Values	From 0.005 m/s
Editing/ Viewing	POSN

POSITION GAIN

Meaning	Gain of the position controller
Mode	Auto position control modes, LS Track
Values	1–10
Editing/ Viewing	POSN

POSITION ACCELERATION GAIN

Meaning	Acceleration gain of the position controller
Mode	Auto position control modes
Values	1–10
Editing/ Viewing	POSN

POSITION LIMIT

Meaning	Maximum allowable difference between the actual position and desired position. If the limit is exceeded, an alarm is produced.
Mode	All auto position control modes
Values	1.0, 2.0, 3.0, 5.0, 10.0,...30.0
Editing/ Viewing	POSN

SPEED VECTOR GAIN

Meaning	Controller gain while Speed Vector control
Mode	Speed Vector
Values	1–10
Editing/ Viewing	POSN

Hold Area Parameters

FORE-AFT SPEED

Meaning	Maximum allowable vessel's speed in the surge direction in the Hold Area mode.
Mode	Hold Area
Values	From 0.010 m/s
Editing/ Viewing	Hold Area

ATHWARTSHIPS SPEED

Meaning	Maximum allowable vessel's speed in the sway direction in the Hold Area mode.
Mode	Hold Area
Values	From 0.010 m/s
Editing/ Viewing	Hold Area

HOLD AREA GAIN

Meaning	Gain of the hold area controller
Mode	Hold Area
Values	1–10
Editing/ Viewing	Hold Area

HOLD AREA RADIUS

Meaning	Maximum area radius
Mode	Hold Area
Values	1–10000 m
Editing/ Viewing	Hold Area

WARNING RADIUS

Meaning	% of the Hold Area Radius. An alarm is generated in case the vessel approach to this radius.
Mode	Hold Area
Values	10–100 %
Editing/ Viewing	Hold Area

STOP RADIUS

Meaning	% of the Hold Area Radius. The radius of the area where the vessel stops.
Mode	Hold Area
Values	0–100 %
Editing/ Viewing	Hold Area

COR Point Edit

The page contains a vessel layout view and the COR list.

Arrows Up and Down

Meaning	Navigation between the points (table rows)
Mode	Service controls
Values	–
Editing/ Viewing	COR

EDIT

Meaning	Calls the coordinate settings dialog
Mode	Service control
Values	–
Editing/ Viewing	COR

Auto Pilot parameters

RATE OF TURN

Meaning	The ceiling value of the turning angle
Mode	AP
Values	5–80 °/min
Editing/ Viewing	AP

OFF-HEADING LIMIT

Meaning	The ceiling value of the off-heading. In case of the value surpassing an alarm is generated.
Mode	AP
Values	2, 3, 10, 15 °
Editing/ Viewing	AP

HEADING GAIN

Meaning	The heading gain settings
Mode	AP
Values	1–10
Editing/ Viewing	AP

SPEED GAIN

Meaning	The speed gain settings
Mode	AP
Values	1–10
Editing/ Viewing	AP

RUDDER LIMIT

Meaning	The ceiling value of rudder offset. In case of the value surpassing an alarm is generated.
Mode	AP
Values	5, 10, 15, 20, 25, 30, 35, 40, ... 67 °
Editing/ Viewing	AP

TRACK GAIN

Meaning	The HS TRACK gain settings.
Mode	AP
Values	1–10
Editing/ Viewing	AP

USE MANUAL SPEED

Meaning	Enabling and disabling manual speed entry
Mode	AP
Values	On, Off
Editing/ Viewing	AP

MANUAL SPEED

Meaning	Manual speed entry
Mode	AP
Values	0–15.43 m/s
Editing/ Viewing	AP

View

GRID

Meaning	Set the grid is displayed or not
Mode	All view modes
Values	On, Off
Editing/ Viewing	VIEW

SUBGRID

Meaning	Set the subgrid displayed or not. The subgrid is a more precisely measuring grid.
Mode	All view modes
Values	On, Off
Editing/ Viewing	VIEW

PALETTE

Meaning	The day/night color scheme setting
Mode	Global parameter
Values	Day, Night
Editing/ Viewing	VIEW

THEME

Meaning	The visual theme setting
Mode	Global parameter
Values	Classic, Light, Dark
Editing/ Viewing	VIEW

SHOW DP

Meaning	The setpoint is displayed or not
Mode	Any JDP control mode
Values	On, Off
Editing/ Viewing	VIEW

TRANSPONDERS VISIBILITY

Meaning	The transponder display settings
Mode	All control modes
Values	Show All, None, Targets, Targets/REF
Editing/ Viewing	VIEW

Show all all transponders are displayed

Targets/Refs only the targets and reference sensors are displayed

Targets the targets only

None transponders are not displayed

SHOW TAUT WIRE AREA

Meaning	Set if the taut area is displayed or not
Mode	All control modes
Values	On, Off
Editing/ Viewing	VIEW

TRACE POINTS: VISIBLE

Meaning	The vessel track visualization. The track is displayed as dotted trail.
Mode	All control modes
Values	On, Off
Editing/ Viewing	VIEW

TRACE POINTS: STEP

Meaning	Set the time slot between trace points (sec).
Mode	All control modes
Values	1, 2, 5, 10, 20, 30, 60
Editing/ Viewing	VIEW

TRACE POINTS: DEPTH

Meaning	The period the vessel track is displayed for
Mode	All control modes
Values	1 min, 5 min, 10 min, 1 hr
Editing/ Viewing	VIEW

CONTOUR TRACE: VISIBLE

Meaning	The vessel track visualization. The track is displayed as vessel contour.
Mode	All control modes
Values	On, Off
Editing/ Viewing	VIEW

CONTOUR TRACE: STEP

Meaning	Set the time slot between trace contours (sec).
Mode	All control modes
Values	1, 2, 5, 10, 20, 30, 60
Editing/ Viewing	VIEW

CONTOUR TRACE: DEPTH

Meaning	The period the vessel contour track is displayed for
Mode	All control modes
Values	1 min, 2 min, 5 min, 10 min, 30 min, 1 hr
Editing/ Viewing	VIEW

PREDICT: VISIBLE

Meaning	The vessel predicted track visualization.
Mode	All control modes
Values	On, Off
Editing/ Viewing	VIEW

PREDICT: STEP

Meaning	Set the time slot between trace contours (sec).
Mode	All control modes
Values	5, 10, 30, 60
Editing/ Viewing	VIEW

PREDICT: DEPTH

Meaning	The period the vessel predicted track is displayed for
Mode	All control modes
Values	30 sec, 1 min
Editing/ Viewing	VIEW

Units Parameters

LONG DISTANCE

Meaning	Distance units setting
Mode	Global parameter
Values	m, ft, cbl, nm
Editing/ Viewing	UNITS

SHORT DISTANCE

Meaning	Length units setting
Mode	Global parameter
Values	m, ft
Editing/ Viewing	UNITS

VELOCITY

Meaning	Vessel velocity units setting
Mode	Global parameter
Values	m/s, kn, km/h
Editing/ Viewing	UNITS

WIND SPEED

Meaning	Wind speed units setting
Mode	Global parameter
Values	m/s, kn, km/h
Editing/ Viewing	UNITS

POWER

Meaning	Power units setting
Mode	Global parameter
Values	kW, HP
Editing/ Viewing	UNITS

FORCE

Meaning	Force units setting
Mode	Global parameter
Values	kN, t
Editing/ Viewing	UNITS

RATE OF TURN

Meaning	Rate of turn units setting
Mode	Global parameter
Values	°/s, °/min
Editing/ Viewing	UNITS

MOMENT OF FORCE

Meaning	Moment of force units setting
Mode	Global parameter
Values	kNm, tm
Editing/ Viewing	UNITS

Coordinate Systems

USE UTM

Meaning	Set if UTM system is used or not
Mode	Global parameter
Values	Yes, No
Editing/ Viewing	COORD

MAP COORDINATE SYSTEM

Meaning	The MAP window coordinate system setting
Mode	MAP
Values	Local N/E, GEOG, UTM
Editing/ Viewing	COORD

ROUTE COORDINATE SYSTEM

Meaning	Route coordinate system setting
Mode	ROUTE
Values	Local N/E, GEOG, UTM
Editing/ Viewing	COORD

BASE POINT

Meaning	The base point setting (for the Local N/E coordinates)
Mode	Global parameter
Values	Set the fix coordinates to the base point with the dialog
Editing/ Viewing	COORD

UTM Coordinates Parameters

FALSE NORTHING

Meaning	Set if the false northing is used or not
Mode	Global parameter
Values	Yes, No
Editing/ Viewing	COORD

FALSE EASTING

Meaning	Set if the false easting is used or not
Mode	Global parameter
Values	Yes, No
Editing/ Viewing	COORD

AUTOMATIC ZONE CALCULATION

Meaning	Set if ones are calculated automatically just after the system has been started
Mode	Global parameter
Values	Yes, No
Editing/ Viewing	COORD

UTM ZONE

Meaning	Manual setting of the UTM zone(available in case the automatic zone calculation is off)
Mode	Global parameter
Values	1,2, ... 60
Editing/ Viewing	COORD

Thrust Limits

NOTE! Number of thrusters and propellers depends on the configuration.

BOW#FWD THRUSTER LIMIT

Meaning	Front bow thruster limit
Mode	All modes for Auto Thruster Group thrusters.
Values	0–100
Editing/ Viewing	THR LIM

BOW#AFT THRUSTER LIMIT

Meaning	Afterhead bow thruster limit
Mode	All modes for Auto Thruster Group thrusters.
Values	0–100
Editing/ Viewing	THR LIM

PORT L-DRIVE LIMIT

Meaning	Port l-drive thruster limit
Mode	All modes for Auto Thruster Group thrusters.
Values	0–100
Editing/ Viewing	THR LIM

STBD L-DRIVE LIMIT

Meaning	Starboard l-drive thruster limit
Mode	All modes for Auto Thruster Group thrusters.
Values	0–100
Editing/ Viewing	THR LIM

PROPELLERS AHEAD LIMIT

Meaning	Propellers ahead limit
Mode	All modes for Auto Thruster Group thrusters.
Values	0–100
Editing/ Viewing	THR LIM

RUDDER LIMIT

Meaning	Maximum Rudder angle
Mode	All modes for Auto Thruster Group thrusters.
Values	0–45
Editing/ Viewing	THR LIM

DP Power Limits

NOTE! Number of generators depends on the vessel configuration

PMS FUNCTION

Meaning	PMS Function switch on/off
Mode	All modes
Values	On, Off
Editing/ Viewing	PWR LIM

GENERATOR G1

Meaning	G1 power limit
Mode	All modes
Values	0–100
Editing/ Viewing	PWR LIM

GENERATOR G2

Meaning	G2 power limit
Mode	All modes
Values	0–100
Editing/ Viewing	PWR LIM

DP GENERATOR OVERLOAD PROTECTION

Meaning	The protection switch on/off
Mode	All modes
Values	On, Off
Editing/ Viewing	PWR LIM

GEN IMMINENT POWER ALARM

Meaning	The imminent power alarm switch on/off
Mode	All modes
Values	On, Off
Editing/ Viewing	PWR LIM

GEN IMMINENT POWER

Meaning	The ceiling value (in percents of power charging). If it's surpassed an alarm is generated. Available if the Imminent Power Alarm is on
Mode	All modes
Values	0–100
Editing/ Viewing	PWR LIM

Target parameters

TGT REACTION RADIUS

Meaning	The target reaction radius setting
Mode	Follow TGT
Values	3, 5, 10, 15, 30, 50, 100, 150
Editing/ Viewing	TGT

STOP RADIUS

Meaning	The stop radius setting. (% of the TGT Reaction radius)
Mode	Follow TGT
Values	1–100
Editing/ Viewing	TGT

TGT FOLLOW SPEED

Meaning	The vessel speed setting in process of the target following
Mode	Follow TGT
Values	0.1–2.6 m/s, increment size 0.1 m/s
Editing/ Viewing	TGT

Logging

NOTE! The page view depends on the system configuration, in particular, if the Data Logger recorder is configured or not

BlackBox

Meaning	The forced data logging function (if configured)
Mode	All modes
Values	On, Restart
Editing/ Viewing	Logging

Remote

Meaning	The remote log switch on/off
Mode	All modes
Values	On, Off
Editing/ Viewing	Logging

Local

Meaning	The local log switch on/off
Mode	All modes
Values	On, Off
Editing/ Viewing	Logging

Data Set

Meaning	The recorded data set setting
Mode	All modes
Values	Standard, Full
Editing/ Viewing	Logging

Current Log area

Name

Meaning	The current record interval time stamp and index are displayed
Mode	All modes
Values	Static field
Editing/ Viewing	Logging

Duration

Meaning	The record mode selection
Mode	All modes
Values	Periodic, Continuous
Editing/ Viewing	Logging

Label

Meaning	Set the automatically generated label
Mode	All modes
Values	The automatically generated value
Editing/ Viewing	Logging

System Parameters

DP CLASS 2 MONITOR

Meaning	Monitoring switch on/off. Used to evaluate the system configuration compliance with the redundancy requirements for DP class 2
Mode	Global parameter
Values	On, Off
Editing/ Viewing	System

SYSTEM DATE

Meaning	The date setting
Mode	Global parameter
Values	MM.DD.YY
Editing/ Viewing	System

SYSTEM TIME

Meaning	The time setting
Mode	Global parameter
Values	HH:MM:SS
Editing/ Viewing	System

TIME ZONE

Meaning	The time zone setting (GMT).
Mode	Global parameter
Values	-12...+12
Editing/ Viewing	System

TIME AUTO SYNC

Meaning	Settings of the system time automatic synchronization by GPS ZDA messages
Mode	Global parameter
Values	Off, GPS1, GPS2, GPS3
Editing/ Viewing	System

ALARM PAGE PRINTING

Meaning	The alarm page printing settings
Mode	Global parameter
Values	Off or the printing time step 10 min, 30 min, 1 hr, 2 hr, 3 hr, 4 hr, 6 hr, 12 hr, 24 hr
Editing/ Viewing	System

STATUS PAGE PRINTING

Meaning	The status page printing settings
Mode	Global parameter
Values	Off or the printing time step 10 min, 30 min, 1 hr, 2 hr, 3 hr, 4 hr, 6 hr, 12 hr, 24 hr
Editing/ Viewing	System

WINDOWS SYNC MODE

Meaning	Used to select Windows Sync Mode
Mode	Global parameter
Values	Synchronized, Independent
Editing/ Viewing	System

LANGUAGE

Meaning	Used to select operator interface language
Mode	Global parameter
Values	English, Russian
Editing/ Viewing	System

DP Footprint Settings

OBSERVATION NUMBER

Meaning	Used to select number of points for displaying the vessel deviations on the plot
Mode	Global parameter
Values	10, 15, 20
Editing/ Viewing	System

PLOTTING INTERVAL

Meaning	Used to select a period of time for plotting a regular mark of the vessel position
Mode	Global parameter
Values	30 s, 1 min, 2 min, 5 min
Editing/ Viewing	System

Appendix D

Sensors and Ref-Systems Raw Data

D.1 Sensors Raw Data

NAVIS NavDP 4000 receives data from sensors using RS-232/RS-422 interfaces. Following protocols are used:

Compasses

Type	*Data*	*Comments*
GYRO	Heading, ROT	The system receives HDT or THS message.ROT message is an option.
Magnetic Compass	Heading, Deviation	The system receives HDT, HDG or HDM message

HDT Message: Heading — True

The message format:

```
$--HDT,x.x,T*hh
```

where:

x.x — Heading Degrees

T — True

hh — Checksum

Example

```
$HEHDT,316.70,T*1C
```

ROT Message: Rate of Turn

The message format:

```
$--ROT,x.x,A*hh
```

where:

x.x — Rate of turn, deg/min. “–” — bow turns to port

A — Status. A = Data Valid, V = Data invalid

hh — Checksum

Example

```
$HEROT,060.1,A*2C
```

THS Message: True Heading and Status

The message format:

`$--THS,x.x,a*hh`

where:

x.x — Heading Degrees, true

a — Mode indicator

hh — Checksum

Mode indicator:

A — Autonomous

E — Estimated (Dead reckoning)

M — Manual input

S — Simulator mode

V — Data not valid (including standby)

Example

`$HETHS,316.70,E*1A`

HDG Message: Heading — Deviation and Variation

The message format:

`$--HDG,x.x,x.x,a,x.x,a*hh`

where:

x.x — Magnetic Sensor heading in degrees

x.x — Magnetic Deviation, degrees

a — Magnetic Deviation direction. E = Easterly, W = Westerly

x.x — Magnetic Variation, degrees

a — Magnetic Variation direction. E = Easterly, W = Westerly

hh — Checksum

Example

`$HEHDG,311.2,1.7,W,0.0,E*50`

HDM Message: Heading — Magnetic

The message format:

`$--HDM,x.x,M*hh`

where:

x.x — Heading Degrees, magnetic

M — Magnetic

hh — Checksum

Example

`$HEHDM,311.40,M*18`

Wind Sensor

Type	*Data*	*Comments*
Wind Sensor	Wind speed and direction (relative)	The system receives MWV message.

MWV Message: Wind Speed and Angle

The message format:

```
$--MWV,x.x,a,x.x,a,a*hh
```

where:

x.x — Wind Angle, 0 to 359 degrees

a — Reference. R = Relative, T = True

x.x — Wind Speed

a — Wind Speed Units, K/M/N

a — Status. A = Data Valid

hh — Checksum

Example for relative coordinates

```
$WIMWV,053.0,R,11.3,N,A*16
```

Vertical Reference Sensor (VRS)

Type	*Data*	*Comments*
VRS	Pitch, roll	NVVRS message — Navis proprietary message
VRS	Pitch, roll	TSS1 message — ASCII format message
MRU	Pitch, roll	PRDID message
MRU	Pitch, roll	PSXN message — Seatex A.S proprietary message

NVVRS Message

The message format:

```
$NVVRS,xxx.xx,xxx.xx*hh
```

where:

xxx.xx — Pitch (in hundreds degree)

xxx.xx — Roll (in hundreds degree)

hh — Checksum

Example

```
$NVVRS, 0.00,4.90*42
```

TSS1 Message

The message format:

```
:aabbbb shhhhxsrrrr spppp
```

where:

aa — 2 char hex number with SWAY acceleration, in 0.03835 m/s^2 units.

bbbb — 4 char hex number with HEAVE acceleration, in 0.000625 m/s^2 units.

hhhh — 4 char decimal number with HEAVE position in centimetres, positive up

s — 1 character of sign: ¡SPACE¿ if positive, "–" if negative.

x — Status character. Below is a description of the various characters.

rrrr — 4 char decimal number with ROLL angle in hundreds of a degree.

s — 1 character of sign: ¡SPACE¿ if positive, "–" if negative.

pppp — 4 char decimal number with PITCH angle in hundreds of a degree.

s — 1 character of sign: ¡SPACE¿ if positive, "–" if negative.

The TSS1 data string contains 27 characters in five data fields.

The acceleration fields contain ASCII-coded hexadecimal values.

Horizontal acceleration uses units of 3.83 cm/s^2 in the range zero to 9.81 m/s^2.

Vertical acceleration uses units of 0.0625 cm/s^2 in the range -20.48 to +20.48 m/s^2.

The motion measurements contained in the data string will be in real time, valid for the instant when the Sensor begins to transmit the string.

Motion measurements include ASCII-coded decimal values.

Heave measurements are in cm in the range -99 to +99 metres. Positive heave is above datum.

Roll and pitch measurements are in 0.01 degrees in the range -90 deg (-9000) to +90 deg (9000). Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.

Status flag

U — UNAIDED MODE — SETTLED CONDITION

The Sensor is operating without any input from a gyrocompass, a GPS receiver or a Doppler log.

u — UNAIDED MODE — SETTLING

The Sensor is operating as above but is still awaiting the end of the 3 minutes settling period after poweron or a change of mode or heave bandwidth.

G — GPS AIDED MODE — SETTLED CONDITION

The Sensor is receiving and using velocity aiding signals from a GPS receiver or a Doppler log.

g — GPS AIDED MODE — SETTLING

The Sensor is receiving velocity aiding signals from a GPS receiver or a Doppler log, but is still awaiting the end of the 3 minutes settling period after power-on or a change of mode or heave bandwidth.

H — HEADING AIDED MODE — SETTLED CONDITION

The Sensor is receiving and using heading aiding signals from a gyrocompass.

h — HEADING AIDED MODE — SETTLING

The Sensor is receiving heading aiding signals from a gyrocompass but is still awaiting the end of the 3 minutes settling period after power-on or a change of mode or heave bandwidth.

NOTE! The gyrocompass may take several hours to settle after it has been powered-on. During this time, gyrocompass aiding of the Sensor will not be perfect.
The status flag does NOT indicate this condition.

Example

```
:000000 -0000G 0000  0490
```

PRDID MRU Message

The message format:

```
$PRDID,PPP.PP,RRR.RR,hhh.hh*hh
```

where:

PPP.PP — Pitch angle

RRR.RR — Roll angle

hhh.hh — Heading

hh — Checksum

Example

```
$PRDID,000.00,004.90,000.00*74
```

PSXN MRU Message

The proper message of Seatex A.S (SeateX Norway).
The message format:

```
$PSXN,10,xx,x.xx,x.xx,x.xx,x.xx,x.xx,x.xx*hh
```

where:

10 — MRU message identifier, data is stable (if data is unstable the number is **11**)

xx — User defined token (from 10 till 100)

x.xx — ROLL (radians)

x.xx — PITCH (radians)

x.xx — HEAVE (meters)

x.xx — DATE (in seconds since 1 January 1970 00:00:00)

x.xx — Redudant field

hh — Checksum

Example

```
$PSXN,10,019,5.100e-2,-5.100e-2,1.234e+0,771598427,,*61
```

Draft Sensor

Type	*Data*	*Comments*
Load monitor or draft sensor	Draft in specified points, mean draft, ship loading	DLM message, other proprietary formats

DLM Message: Ship Draft/Loading

The message format:

```
$--DLM,xxxx,xxxx,xxxx,xxxx,xxxx,xxxx.xx*hh
```

where:

xxxx — Draught point 1 [cantimeters], Fore draught of ship

xxxx — Draught point 2 [cantimeters], Aft draught of ship

xxxx — Draught point 3 [cantimeters], Left amidships draught of ship

xxxx — Draught point 4 [cantimeters], Right amidships draught of ship

xxxx — Draught average [cantimeters], draft at centre (average draft calculated in load computer) May be null (empty field) if unavailable

xxxx.xx — Load [tons], Displacement or Load (depending on configuration) May be null (empty field) if unavailable

hh — Checksum

Number of draught points (fields) may vary.

Example

```
$PFDLM,101,100,99,101,100,99,100,0*52
```

LOG Sensor

Type	*Data*	*Comments*
Load water or ground LOG	Velocity of the vessel	VBW, VHW

VBW Message: Dual Ground/Water Speed

The message format:

```
$--VBW, x.x, x.x, A, x.x, x.x, A, x.x, A, x.x, A*hh
```

where:

x.x — Longitudinal water speed, "–" means astern

x.x — Transverse water speed, "–" means port

A — Status, A = data valid

x.x — Longitudinal ground speed, "–" means astern

x.x — Transverse ground speed, "–" means port

A — Status, A = data valid

x.x — Stern transverse water speed

A — Status: stern water speed, A = data valid, V = data invalid

x.x — Stern transverse ground speed

A — Status: stern ground speed A = data valid, V = data invalid

hh — Checksum

Example

```
$VDVBW,16.3,,A,14.8,,V*4F
```

VHW Message: Water Speed and Heading

The message format:

```
$--VHW,x.x,T,x.x,M,x.x,N,x.x,K*hh
```

where:

x.x — Degress True

T — True

x.x — Degrees Magnetic

M — Magnetic

x.x — Knots (speed of vessel relative to the water)

N — Knots

x.x — Kilometers (speed of vessel relative to the water)

K — Kilometres

hh — Checksum

Example

```
$VDVHW,,,,,16.5,N,,*09
```

Tension Sensor

The message format:

```
$PPDMT,xxx.x,xxx.x,xxxx.x,A*hh
```

where:

PP — Talker identifier

xxx.x — Velocity in meters, min negative for pay out and positive pay in (reserved field)

xxx.x — Force in KN

xxxx.x — Wire on drum meters (reserved field)

A — Status (A/V — valid/invalid)

hh — Checksum

Example

```
$PPDMT,,98.00,,A*33
```

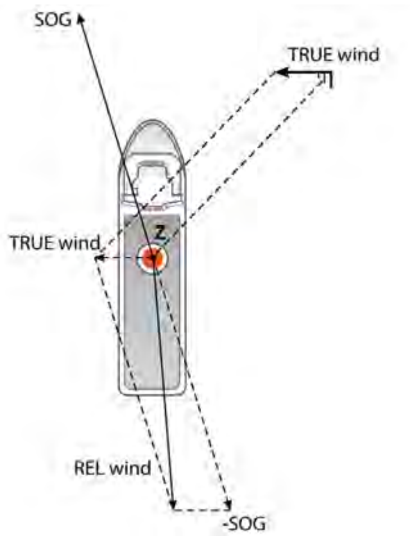


Figure D.1: True and relative (apparent) wind

D.2 Ref-Systems Raw Data

Differential GPS

Type	*Data*	*Comments*
GPS	Lat, Lon, Quality, Number of satellites, HDOP, COG, SOG	The system receives GGA and VTG messages from GPS. VTG is an option. Latitude, Longitude, Quality, Number of satellites, HDOP are taken from GGA-message. COG, SOG are taken from VTG-message.

GGA Message: Global Positioning System Fix Data. Time, Position and Fix Related Data for a GPS Receiver

The message format:

```
$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh
```

where:

hhmmss.ss — Time (UTC)

llll.ll — Latitude

a — N or S (North or South)

yyyyy.yy — Longitude

a — E or W (East or West)

x — GPS Quality Indicator:

0 — Fix not available,
1 — GPS SPS mode,
2 — Differential GPS SPS mode,
3 — GPS PPS mode,
4 — Real Time Kinematic. Satellite system used in RTK mode with fixed integers,
5 — Float RTK. Satellite system used in RTK mode with floating solution,
6 — Estimated (dead reckoning) mode,
7 — Manual input mode,
8 — Simulator mode,
9 — WAAS.

xx — Number of satellites in view, 00–12

x.x — Horizontal Dilution of precision

x.x — Antenna Altitude above/below mean-sea-level (geoid)

M — Units of antenna altitude, meters

x.x — Geoidal separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "–" means mean-sea-level below ellipsoid

M — Units of geoidal separation, meters

x.x — Age of differential GPS data, time in seconds since last SC104 type 1 or 9 update, null field when DGPS is not used

xxxx — Differential reference station ID, 0000–1023

hh — Checksum

Example

```
$GPGGA,110621.86,3000.12870,N,09000.48093,W,2,05,1.2,,,,,10.0,0100*5F
```

VTG Message: Track Made Good and Ground Speed

Navis provides two types of VTG message format: with (NMEA 2.3 and later) and without FAA mode indicator. The message format:

```
$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh
```

where:

x.x — Track Degrees

T — True

x.x — Track Degrees

M — Magnetic

x.x — Speed Knots

N — Knots

x.x — Speed Kilometers Per Hour

K — Kilometers Per Hour

a — FAA mode indicator (see Note 1)

hh — Checksum

Example

```
$GPVTG,288.2,T,,,00.8,N,01.6,K,A*4F
```

> **NOTE!** 1: The mode indicator provides status information and/or validity of operating devices (such as positioning systems, velocity sensors, etc.). The possible indications are as follows:

A — Autonomous mode;

D — Differential mode;

E — Estimated (dead reckoning) mode;

M — Manual input mode;

P — Precise. Satellite system used in precision mode.

S — Simulator mode;

N — Data not valid.

> **NOTE!** The mode indicator field should not be a null field.

ZDA Message: Time & Date

The message format:

```
$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh
```

where:

hhmmss.ss — UTC time (hours, minutes, seconds, milliseconds)

xx — UTC day (01–31)

xx — UTC month (01–12)

xxxx — UTC year

xx — Local zone hours (00 to ±13)

xx — Local zone minutes (00 to +59)

hh — Checksum

Example

```
$GPZDA,083504.92,26,05,2017,02,00*60
```

Hydroacoustic System

Type	*Data*	*Comments*
HPR	X, Y, Depth	The system receives the data from HPR (on each beacon) in different formats (i.e., Nautronix ATS ASCII II, Sonardyne HPR-418, GAPS, etc.) and convert them in X, Y (Local N/E) and Depth views.

GAPS PTSAX Message

The message format:

```
$PTSAX,NNNNN,hhmmss.ss,jj,mm,aaaa,BBB,XXXXX.X,YYYYY.Y,A,PPPP.P,A,CCCC.C*hh
```

where:

NNNNN — Recurrence frame number

hhmmss.ss — Time in hours, minutes, seconds, milliseconds

jj — Day (01–31)

mm — Month (01–12)

aaaa — Year

BBB — Transponder No (1–128); (-1..-128) — unknown transponder

XXXXX.X — X-coordinates, +forward, meters

YYYYY.Y — Y-coordinates, +starboard, meters

A — Position validity (X, Y, Z) 0 to F: binary coding of acoustic channel validity

PPPP.P — Calculated depth in meters

A — Depth validity (0 — None, 1 — Calculated, 2 — Sensor)

CCCC.C — Sensor depth in meter

hh — Checksum

Example

```
$PTSAX,#00001,083635.99,08,12,2014,042,119.90,139.90,F,120.0,0,100.0*35
```

Sonardyne ATS ASCII

The message format:

```
dd mmm yy hh:mm:ss B:d X:ddd.d Y:ddd.d D:ddd.d P:d.d r:d.d H:ddd.d
```

where:

B: — Beacon index 0=ship, 1-10=beacons

X: Y: — Coordinates in meters (mathematic system upOY - right OX)

D: — Depth in meters

P: — Ship pitch, deg Positive pitch is Bow up

R: — Ship roll DEG Positive roll is Port up

H: — Ships heading relative to North in degrees, 0..360

Example

```
 19 Sep 95 11:32:53 B:4 X:-107.3 Y:102.2 D:99.8 P:0.2 R:-0.3 H:25.4
 19 Sep 95 11:32:54 B:0 X:416739.9 Y:5579729.2 D:1.2 P:0.2 R:-0.3 H:25.4
```

Sonardyne HPR 418

```
 HPR 418 Message 1 Format (Beacons): || HPR 418 Message 2 Format (Vessel):

------------------------------------||-------------------------------------|
 Field name                | Size| Offset|| Field name              | Size| Offset|

----------------------|-----|-------||-----------------------|-----|-------|
 Start Character (0x55)| 1    | 0      || Start Character (0x55)| 1    | 0      |
 Block Length          | 2    | 1      || Block Length          | 2    | 1      |
 Message Type          | 1    | 3      || Message Type          | 1    | 3      |
 Destination           | 1    | 4      || Destination           | 1    | 4      |
 Tp_index              | 2    | 5      || Tp_array              | 1    | 5      |
 Operation_mode        | 1    | 7      || Td_num                | 1    | 6      |
 Sync_mode             | 1    | 8      || Pos_East              | 4    | 7      |
 Tp_type               | 1    | 9      || Pos_North             | 4    | 11     |
 Tp_operation          | 1    | 10     || Depth                 | 4    | 15     |
 Pos_data_from         | 1    | 11     || Horr_err_ellipse_dir  | 4    | 19     |
 Reply_status          | 1    | 12     || Horr_err_ellipse_major| 4    | 23     |
 Filt_x_pos            | 4    | 13     || Horr_err_ellipse_minor| 4    | 27     |
 Filt_y_pos            | 4    | 17     || Z_Standard_deviation  | 4    | 31     |
 Filt_z_pos            | 4    | 21     || Pos_type              | 1    | 35     |
 x_pos                 | 4    | 25     || Pos_status            | 1    | 36     |
 y_pos                 | 4    | 29     || P_course              | 4    | 37     |
 z_pos                 | 4    | 33     || P_roll                | 4    | 41     |
 Slant_range           | 4    | 37     || P_pitch               | 4    | 45     |
 P_course              | 4    | 41     || Diagnostic            | 2    | 49     |
 P_roll                | 4    | 45     || Sumcheck              | 2    | 51     |
 P_pitch               | 4    | 49     || Stop character (0xAA) | 1    | 53     |
 Td_beam               | 1    | 53     ||--------------------------------------
 Td_type               | 1    | 54     |
 Td_num                | 2    | 55     |
 Diagnostic            | 2    | 57     |
 Stand_dev             | 4    | 59     |
 Instr_data            | 4*n  | 63     |
 Sumcheck              | 2    | 63+4*n|
 Stop character (0xAA) | 1    | 65+4*n|
```

Simrad SSBL

The message format:

```
$PSIMSSB,hhmmss.ss,c-c,c,c-c,c,c,c,x.x,x.x,x.x,x.x,c,x.x,x.x*hh
```

where:

hhmmss.ss Clock

c-c — Tp code (B01, B33, B47)

c — Status (A — Ok, else error)

c-c — Error code

c — Coordinate system (H — Stbd/Fwrd, N — N/E, E — E/N)

c — Orientation

c — SW filter (M — Measured, F — Filtered, P — Predict)

x.x — X coordinate

x.x — Y coordinate

x.x — Depth

x.x — Expected accuracy

c — Additional info (N — none, C — compass, I — inclinometer)

x.x — First add value (Empty, Tp compass or Tp x inclination)

x.x — Second add value (Empty or Tp y inclination)

hh — Checksum

Example

```
$PSIMSSB,085405.61,B42,A,,C,H,M,134.5,114.5,120.0,,,,*20
```

Simrad LBP

LBL (long-base-line) systems use networks of sea-floor mounted baseline transponders as reference points for navigation.

The message format:

```
$PSIMLBP,hhmmss.ss,a,aa,a-a,a,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh
```

where:

hhmmss.ss — Clock

a — Tp array (1)

aa — Type (Ve)

a-a — Status (A — Ok, else — error)

a — Coordinates

x.x — X coordinate

x.x — Y coordinate

x.x — Depth

x.x — Major

x.x — Minor

x.x — Direction

x.x — Depth (stdev)

hh — Checksum

Example

```
$PSIMLBP,085735.18,1,Ve,A,C,-132.40,-112.40,120.00, 3.0, 3.0, 0.0, 3.0*6E
```

TRACKPOINT POREG Message

- TRACKPOINT 3 PORTABLE USBL TRACKING SYSTEM:
- Models:
  - 4430C,
  - 4213C
  - 4113C
  - Desktop Version Models:
    * 4430C-DT
    * 4213
    * 4113C-DT
- ORE Offshore
- 4 Little Brook Road
- West Wareham
- MA 02576 USA

DATA OUTPUT FORMAT: "POREG"
Applicable To: Trackpoint 3 and Trackpoint 3P (Models 4450A, 4430C)
Output sentence for Format NMEA "G" (Trackman Out Only)
The message format:

```
$POREG,##,HHMMSS.SS,PHSA,PHSB,PHSC,QF,EC,SLANT_RG,-DPA-,-BRNG-,--X (m)--,
--Y (m)--,--Z(m)--,-HDNG-,-PTCH-,-ROLL-,TMP*hh
```

where

X — The port "–" to starboard "+" direction which the target is referenced to (e.g., bow of vessel or north).

Y — The aft "–" to bow "+" direction which the target is referenced to. (e.g., bow of vessel or north)

Z — The targets depth. Referenced from the plane of the hydrophone elements or offset point to the target.

QF — Quality factor (01-10)
QUALITY FACTOR: The QUALITY FACTOR is a value (1-10) determined by the system on each reply that is detected. The system uses the phase or time counts from each of the hydrophone elements to determine the quality of the signal. If the phase counts are consistent on all three channels throughout the reply burst the quality factor is very high. If the phase counts have jitter or are inconsistent then the quality factor is low.

EC — Error code
The ERROR CODE or WARNING CODE is a one- or two- digit error code indicating that the data received could not be used for a valid position fix, or it can represent a warning to let an operator know that the position accuracy could be compromised.

hh — Checksum

Example

```
$POREG,01,235959.99,0780,0230,0000,10,00,99999.99,89.99,125.50,
000000.22,-00000.33,00505.44,125.88,-00.03,-00.02,-05*16
```

Laser Radar, RADius

Type	*Data*	*Comments*
Laser Radar (CyScan, FanBeam)	Bearing, Range	The system receives the data from LR in MDL Standard format
RADius	Bearing, Range	The system receives the data from RADius in format PSXRAD.

Laser Radar Data MDL Standard/MDL Multi-Target

The message format:

```
MDL Standard (0x0008)                  | MDL Multi-Target (0x0040)
A 19 character string                  | A 22 character string
delimited only by <CR> and <LF> with bearing measured bow clockwise.
CHARACTER INDEX DESCRIPTION FORMAT
"01 1098.70 123.45(013 010)"           | "01 0097.80 217.11 13(013 010)"
0-1   ID / Target Number      nn       | 0-1   ID / Target Number      nn
2     Space (0x20h)           X        | 2     Space (0x20h)           X
3-9   Range (m)               nnnn.nn  | 3-9   Range (m)               nnnn.nn
10    Space (0x20h)           X        | 10    Space (0x20h)           X
11-16 Bearing (degrees)       nnn.nn   | 11-16 Bearing (degrees)       nnn.nn
17    carriage return (0x0Dh) X        | 17    Space (0x20h)           X
18    line feed (0x0Ah)       X        | 18-19 NMEA style checksum in hex CC
                                       | 20    carriage return (0x0Dh) X
                                       | 21    line feed (0x0Ah)       X
```

Example

```
01 1098.70 123.45(013 010) - Standard
01 0097.80 217.11 13(013 010) - Multi-Target
```

PSXRAD, NMEA Proprietary Format

The message format:

```
$PSXRAD,I,hhmmss.ss,nn,ss,tid,rrrr.rr,aa.a,bbb.bb,ss.s,+vv.vv,ff.f,dd.dd,sn,S*hh
```

where:

I — ID for Interrogator, range 1–9

hhmmss.ss — Time of position hour, minutes, seconds

nn — Number of transponders set up for tracking, range 0–99

ss — Sequence number (multiple transponders), range 0 – (nn-1)

tid — Transponder ID, the number is the transponder frequency in 10KHz resolution. 150 is then 1.5 MHz transponder

rrrr.rr — Range in meters, decimal centimetres

aa.a — Range accuracy estimate (1 -sigma level in m)

bbb.bb — Bearing to transponder 0.00 to 360.00 degrees

ss.s — Bearing accuracy estimate (1-sigma level in deg)

+vv.vv — Vertical angle to transponder (-90.0..90.0), the “+” sign is omitted when positive.

ff.f — Vertical angle accuracy estimate (1 - sigma level in deg)

dd.dd — Velocity relative to transponder (doppler) m/s, the “+” sign is omitted when positive.

sn — Signal to noise in DB 0–90, 10–15 is poor, ¿ 15 is good

S — Status 0–9 (0 — No reply (not tracking transponder), 1 — Other error, do not use, 2 — Range only, 3–8 — TBD, 9 — Valid Status)

hh — Checksum

Example

```
$PSXRAD,00,104853.01,10,1,01,69.40,1.0,360.00,1.0,+0.00,1.0,+0.00,20,9*33
```

Taut Wire System

Type	*Data*	*Comments*
Taut Wire	Outboard angle α, right angle β, Length, available for DP status	The system receives the data from Taut Wire in the form of PTW-message.

PTW Taut Wire Message

The message format:

```
$--PTW,aaa.aa,bbb.bb,s,xx,nnn.n*hh
```

where:

aaa.aa — Outboard angle

bbb.bb — Right angle

s — Status (‘A’ -available, ‘N’-n/a)

xx — Error code

nnn.n — Length (from zero-length pos)

hh — Checksum

Example

```
$PCPTW,-72.22,-81.40,A,00,876.1*03
```

D.3 VDR Data Standard

This section provides a list of NMEA-messages used for data transmition to the Voyage Data Recorder (VDR), and a brief description of the message formats.

Descriptions of the message fields refer to the following modes:

– Operational Modes (AP, DP, Bridge) — see Section 2.1, page 22;
– Control Modes (Auto HDG, Track HDG, etc.) — see Sections 9.2, page 161 and 9.3, page 165.

ALA Message: Set Detail Alarm Condition

The message format:

```
$RCALA,134352.18,OT,DP,,1703,H,A,A|CPU_A_ACTIVE*4D
```

where

hhmmss.ss — Event time

aa — System indicator of an original alarm source

aa — Subsystem equipment indicator of an original alarm source

xx — An instance number of an equipment/unit/item (not used)

xxx — Type of alarm

a — Alarm condition (H = alarm state, threshold exceeded, N = normal state)

a — Alarm's acknowledgement state (A = acknowledged, V = not acknowledged)

c–c — Alarm's description text (alarm's source_alarm's ID)

hh — Checksum

Example

`$RCALA,122644.57,OT,DP,,1425,N,A,|CP_0_SOFTWARE_UPDATE_STARTED*74`

ALR Message: Set Alarm State

The message format:

`$--ALR,hhmmss.ss,xxx,A,A,c--c*hh`

where

hhmmss.ss — Time of an alarm condition change, UTC

xxx — Unique alarm number (identifier) in an alarm source

A — Alarm condition (A = threshold exceeded, V = not exceeded)

A — Alarm's acknowledge state (A = acknowledged, V = not acknowledged)

c–c — Alarm's description text (alarm's source_alarm's ID)

hh — Checksum

Example

`$RCALR,134352.18,1703,A,A,A|CPU_A_ACTIVE*74`

GLL Message: Geographic Position — Latitude/Longitude

The message format:

`$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A,a*hh`

where

llll.ll — Latitude

a — N/S

yyyyy.yy — Longitude

a — E/W

hhmmss.ss — UTC of position

A — Status (A = data valid, V = data invalid)

a — Mode indicator (A = Autonomous mode, E = Estimated mode (dead reckoning), N = Data not valid)

hh — Checksum

Example

`$RCGLL,2959.9999,N,08959.9992,W,123315.71,V,E*6E`

HDT Message: Heading, True

The message format:

```
$--HDT,x.x,T*hh
```

where

x.x — Heading, degrees

T — True

hh — Checksum

Example

```
$RCHDT,335.2,T*34
```

HTD Message: Heading/Track Control Data

The message format:

```
$--HTD,A,x.x,a,a,a,x.x,x.x,x.x,x.x,x.x,x.x,x.x,a,A,A,A,x.x*hh
```

where

A — Override (Empty — field is not used)

x.x — Commanded rudder angle, degrees

Value	Condition
Rudder angle	AP mode
Empty	Other cases

a — Commanded rudder direction

Value	Condition
L	Port command: AP mode
R	STBD command: AP mode
Empty	Other cases

a — Selected steering mode

Value	Condition
M	Manual: Bridge mode
S	Standalone: DP/AP (Auto HDG)
T	Track control: DP/AP (Track HDG)
R	Rudder control: DP/AP (other modes)

a — Turn mode

Value	Condition
R	Radius controlled: AP (Track HDG)
T	Turn rate controlled: DP (excluding Manual HDG), AP (Auto HDG, ROT HDG)
N	Turn is not controlled: DP (Manual HDG), AP (other modes)

x.x — Commanded rudder limit, degrees (unsigned)

Value	Condition
Max rudder limit	DP/AP mode
Empty	Other cases

x.x — Commanded off-heading limit, degrees (unsigned)

Value	Condition
Off-heading limit	DP/AP (Auto HDG)
Empty	Other cases

x.x — Commanded radius of turn for heading changes, n.miles

Value	Condition
Radius of turn	AP (Track HDG)
Empty	Other cases

x.x — Commanded rate of turn for heading changes, deg/min

Value	Condition
Rate of turn	DP (excluding Man HDG), AP (Auto HDG, ROT HDG)
Empty	Other cases

x.x — Commanded heading-to-steer, degrees

Value	Condition
Desired heading	DP/AP (Auto HDG)
Empty	Other cases

x.x — Commanded off-track limit, n.miles (unsigned)

Value	Condition
Off-track limit	DP/AP (Track HDG)
Empty	Other cases

x.x — Commanded track

Value	Condition
Commanded track	DP/AP (Track HDG), track status is following
Empty	Other cases

a — Heading reference in use

Value	Condition
T	True: DP/AP mode
Empty	Other cases

A — Rudder status

Value	Condition
A	Within limits: AP (Auto/Dodge HDG)
V	Limit reached or exceeded: AP (Auto/Dodge HDG)
Empty	Other cases

A — Off-heading status

Value	Condition
A	Within limits: DP/AP (Auto HDG)
V	Limit reached or exceeded: DP/AP (Auto HDG)
Empty	Other cases

A — Off-track status

Value	Condition
A	Within limits: AP (Track HDG)
V	Limit reached or exceeded: AP (Track HDG)
Empty	Other cases

x.x — Vessel heading, degrees

Value	Condition
Vessel heading	Map is available
Empty	Map is not available

hh — Checksum

Example

`$RCHTD,,3.7,R,S,T,20.0,5.0,,45.0,0.0,,,T,A,V,,84.9*44`

PRC Message: Propulsion Remote Control Status

The message format:

`$--PRC,x.x,A,x.x,a,x.x,a,a,x*hh`

where

x.x — Lever demand position

Value	Condition
$\pm(0-100)$ %, from full astern to full ahead	Propeller is in use, "–" — astern
Empty	Propeller is not used

A — Lever demand status

Value	Condition
A	Data valid: Propeller is in use
Empty	Propeller is not used

x.x — RPM demand value

Value	Condition
$\pm(0-100)$ %, from zero to maximum RPM	FPP / CPP (combined control) is in use, "–" — astern
Empty	CPP (constant RPM) is in use / Propeller is not used

a — RPM mode indicator

Value	Condition
R	RPM: FPP / CPP (combined control) is in use
V	Data invalid: CPP (constant RPM) is in use
Empty	Propeller is not used

x.x — Pitch demand value

Value	Condition
$\pm(0-100)$ %, from full astern to full ahead	CPP is in use, "–" — astern
Empty	FPP is in use / Propeller is not used

a — Pitch mode indicator

Value	Condition
P	Per cent: CPP is in use
V	Data invalid: FPP is in use
Empty	Propeller is not used

a — Operating location indicator (B = Bridge, always)

x — Number of engine or propeller shaft

Value	Condition
0	Single / On center-line propeller
Odd	Starboard propeller
Even	Port propeller

hh — Checksum

Example

`$RCPRC,-25.0,A,,V,-45.1,P,B,2*60`

`$RCPRC,75.0,A,,V,85.8,P,B,1*63`

ROR Message: Rudder Order Status

The message format:

`$--ROR,x.x,A,x.x,A,a*hh`

where

x.x — Starboard (or single) rudder order

Value	Condition
Rudder order angle	"–" — bow turns to port, unsigned — to STBD
Empty	Data invalid / no data

A — Status

Value	Condition
A	Data valid
V	Data invalid / no data

x.x — Port rudder order

Value	Condition
Rudder order angle	"–" — bow turns to port, unsigned — to STBD
Empty	Data invalid / no data

A — Status

Value	Condition
A	Data valid
V	Data invalid / no data

a — Command source location (as TRC) (B = Bridge, always)

hh — Checksum

Example

`$RCROR,-22.0,A,34.0,A,B*1A`

NOTE! if more than two rudders are used data from the other rudders are not taken into account for ROR and RSA messages.

RSA Message: Rudder Sensor Angle

The message format:

`$--RSA,x.x,A,x.x,A*hh`

where

x.x — Starboard (or single) rudder sensor

Value	Condition
Relative rudder angle	"–" — bow turns to port, unsigned — to STBD
Empty	Data invalid / no data

A — Status

Value	Condition
A	Data valid
V	Data invalid / no data

x.x — Port rudder sensor

Value	Condition
Relative rudder angle	"–" — bow turns to port, unsigned — to STBD
Empty	Data invalid / no data

A — Status

Value	Condition
A	Data valid
V	Data invalid / no data

hh — Checksum

Example

`$RCRSA,-22.0,A,34.0,A*7B`

TRC Message: Thruster Control Data

The message format:

`$--TRC,x,x.x,a,x.x,a,x.x,a,a*hh`

where

x — Number of thruster, bow or stern

Value	Condition
Odd	Bow thruster
Even	Stern thruster

x.x — RPM demand value

Value	Condition
$\pm(0-100)$ %, from zero to maximum RPM	FPP / CPP (combined control) thruster is in use, "–" — port
$0-100$ %, from zero to maximum thrust	Waterjet is in use
Empty	CPP (constant RPM) thruster is in use / Thruster is not used

a — RPM mode indicator

Value	Condition
R	RPM: FPP / CPP (combined control) thruster is in use
P	Per cent: Waterjet is in use
V	Data invalid: CPP (constant RPM) thruster is in use / Thruster is not used

x.x — Pitch demand value

Value	Condition
$\pm(0-100)$ %, from port to starboard	CPP thruster is in use, "–" — port
Empty	FPP thruster / Waterjet is in use / Thruster is not used

a — Pitch mode indicator

Value	Condition
P	Per cent: CPP thruster is in use
V	Data invalid: FPP thruster / Waterjet is in use / Thruster is not used

x.x — Azimuth demand

Value	Condition
$0-360^0$, direction of thrust in degrees	Azimuth thruster / Waterjet is in use
Empty	Tunnel thruster / Thruster is not used

a — Operating location indicator (B = Bridge, always)

a — Sentence status flag

Value	Condition
C	Thruster is in use
R	Thruster is not used

hh — Checksum

Example

```
$RCTRC,3,15.3,R,,V,,B,C*7B

$RCTRC,1,15.3,R,,V,,B,C*79

$RCTRC,2,402.6,R,,V,88.3,B,C*50

$RCTRC,4,401.4,R,,V,271.8,B,C*68
```

TRD Message: Thruster Response Data

The message format:

```
$--TRD,x,x.x,a,x.x,a,x.x*hh
```

where

x — Number of thruster, bow or stern

Value	Condition
Odd	Bow thruster
Even	Stern thruster

x.x — RPM response

Value	Condition
$\pm(0-100)$ %, from zero to maximum RPM	FPP / CPP (combined control) thruster is in use, "–" — port
$0-100$ %, from zero to maximum thrust	Waterjet is in use
Empty	CPP (constant RPM) thruster is in use / Thruster is not used

a — RPM mode indicator

Value	Condition
R	RPM: FPP / CPP (combined control) thruster is in use
P	Per cent: Waterjet is in use
V	Data invalid: CPP (constant RPM) thruster is in use / Thruster is not used

x.x — Pitch response value

Value	Condition
$\pm(0-100)$ %, from port to starboard	CPP thruster is in use, "–" — port
Empty	FPP thruster / Waterjet is in use / Thruster is not used

a — Pitch mode indicator

Value	Condition
P	Per cent: CPP thruster is in use
V	Data invalid: FPP thruster / Waterjet is in use / Thruster is not used

x.x — Azimuth response

Value	Condition
$0-360^0$, direction of thrust in degrees	Azimuth thruster or Waterjet is in use
Empty	Tunnel thruster / Thruster is not used

hh — Checksum

Example

```
$RCTRD,3,-17.8,R,,V,*59

$RCTRD,1,-17.9,R,,V,*5A

$RCTRD,2,400.5,R,,V,90.8*55

$RCTRD,4,403.3,R,,V,269.2*68
```

Appendix E

Routes transferring and uploading

E.1 RTE Messages: Routes

```
$--RTE,x.x,x.x,a,c--c,c--c, ..... c--c*hh<CR><LF>
```

where:

x.x — Total number of messages being transmitted

x.x — Message Number

a — Message mode

- c = complete route, all waypoints
- w = working route, the waypoint you just left, the waypoint you're heading to, then all the rest

c–c — Waypoint ID (more waypoints follow)

***hh** — Checksum

E.2 WPL Message: Waypoint Location

```
$--WPL,llll.ll,a,yyyyy.yy,a,c--c*hh<CR><LF>
```

where:

llll.ll — Latitude

a — N or S (North or South)

yyyy.yy — Longitude

a — E or W (East or West)

c–c — Waypoint name

***hh** — Checksum

Appendix F

Route Format

The route file has the .ini extension and is formated as follows:

```
[General]
Version = 2
Id = d69ebea5-7214-4d2f-aed4-d783ae5b8f89
Name = test route
CreationDate = 10.13.2014 12:17:02
ModificationDate = 10.13.2014 12:19:06
RouteType = Simple

[Points]
Columns = Name,NMEALat,NMEALon,TurnRad,Velocity,Hdg,Type
WP1 = ,2959.9994,N,08959.9993,W,,,,
WP2 = ,3000.0072,N,08959.9993,W,60.5275,1.0000,1.0,Non Stop
WP3 = ,3008.0072,N,08955.9993,W,,,,
```

Waypoints coordinates dont't depend on the displayed coordinate global parameter and saved in the GEO format.

Appendix G

DPShell Service Utility

G.1 Standard Configuration (with a Touchscreen Display)

DPShell utility description for the system configuration including a touchscreen display is specified below. For description of the monitorless configuration see Section G.2, page 310.

G.1.1 Entering the Service Menu on DP/IJ Computer

1.1. Power up control system **NAVIS NavDP 4000** on DP/IJ computer (see Section 3.1, page 50).

1.2. Wait for **DPShell** Start Screen appearance (see Figure G.1).

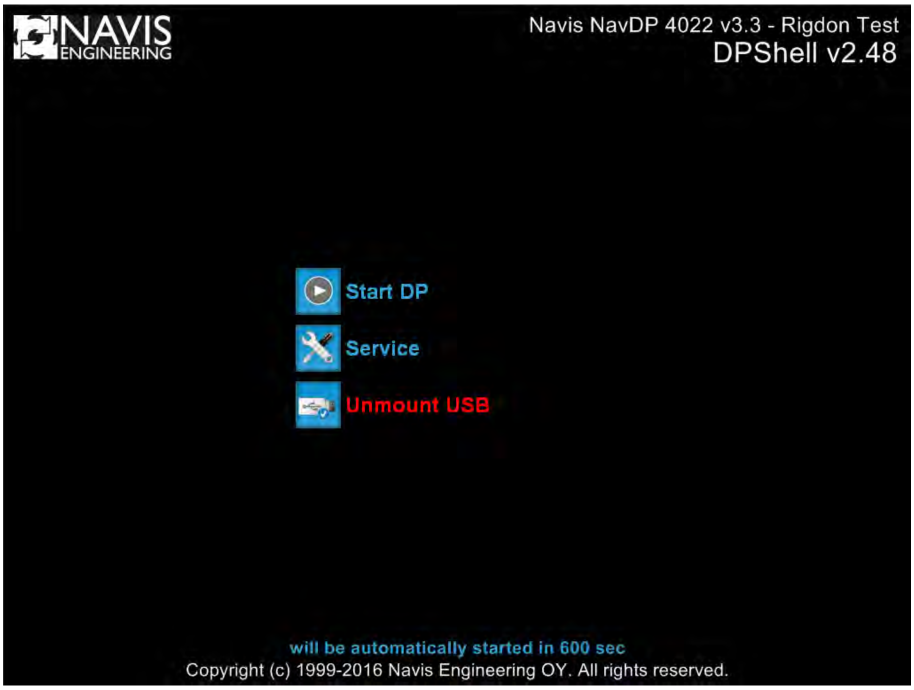


Figure G.1: DPShell Main menu

This is the screen with the following menu items:

Start DP — **NAVIS NavDP 4000** start. **DPShell** utility will start the system automatically after a delay of:

- 60 seconds — a standard delay (USB flash drive is not connected);
- 600 seconds — in case of connected USB flash drive.

The timer is displayed at the bottom of the Start Screen (see Figure G.1).

If you tap on a free area of the screen countdown will stop and **NAVIS NavDP 4000** will not start automatically.

Service — DP/IJ computer switching into “Service Mode”.

Unmount USB — management of USB flash drive safe removing.

Item “Unmount USB” is displayed in menu if USB flash drive is connected.

1.3. Press “Service” item to enter the service menu before **NAVIS NavDP 4000** automatic start.

If **NAVIS NavDP 4000** has started automatically shut down the system using a normal shut down procedure (see Section 3.6, page 55) and follow steps from item 1.1.

1.4. Enter password “16” using a screen keyboard and press “OK” (see Figure G.2).

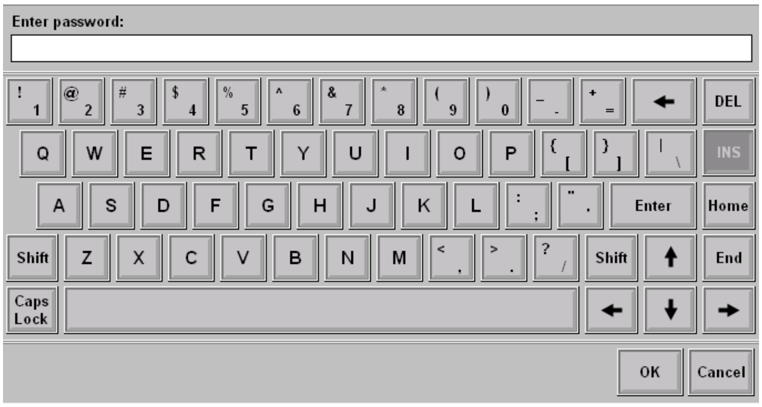


Figure G.2: DPShell. Enter password

If you entered wrong password, “Operation ‘Choose User-Level’ completed with error(s)” message will appear.

Press “Close” button and follow steps from item 1.3.

1.5. When you enter a correct password service menu will appear (see Figure G.3).

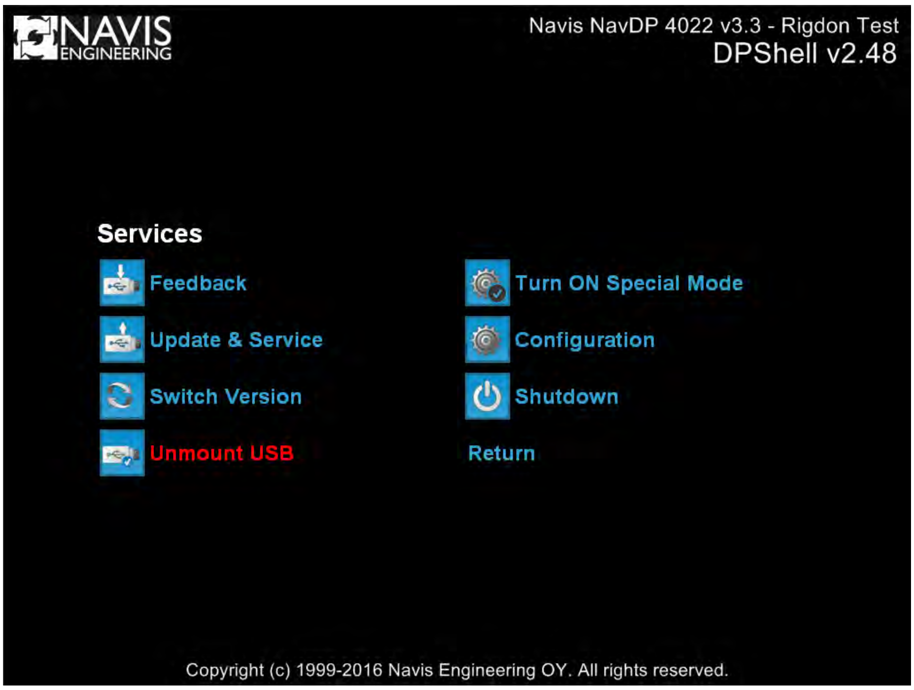


Figure G.3: DPShell Service menu

G.1.2 Leaving the Service Menu on DP/IJ Computer

1.1. DP/IJ control computer is in service menu (see Figure G.3).

1.2. To leave a service menu:

1.2.1 Close an active window (if any) by pressing “Done” button.

1.2.2 Press “Return” item in menu “Services”.

1.2.3 If “Unmount USB” item is displayed in the start screen press this item for safe removing of the USB flash drive:

- wait for “Operation ‘Unmount removable drive’ completed successfully” message;
- disconnect USB flash drive from USB port;
- press “Close” button.

1.3. To start **NAVIS NavDP 4000** press “Start DP” button (see Section 3.1, page 50).

1.4. To shut down **NAVIS NavDP 4000** use a normal shut down procedure (see Section 3.6, page 55).

G.1.3 Creating Feedback Package

1.1. Switch DP/IJ control computer into “Service Mode” (see Section G.1.1, page 302).

1.2. Press “Feedback” item in “Services” menu.

1.3. In “Feedback List” window press “Create New Feedback” item.

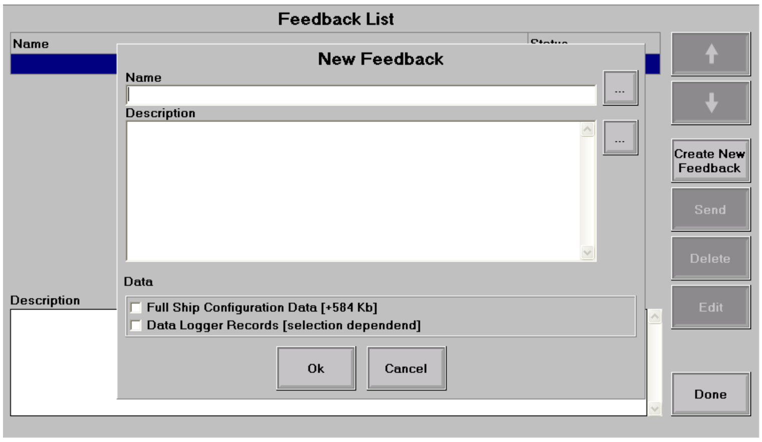


Figure G.4: DPShell. Creating feedback

1.4. In “New Feedback” window (see Figure G.4):

1.4.1 Enter any package name in field “Name” (square button ‘...’ opens a screen keyboard).

1.4.2 Enter any comments in field “Description” (optional).

If field “Description” is empty, a warning message will appear: “Description is not specified. Continue?”. Press “YES” button if description is not required; otherwise press “NO” and enter comments in the “Description” field.

1.4.3 Mark additional data (data checkboxes) for adding into feedback (if otherwise was not requested) and press “OK” button:

- Full Ship Configuration Data;
- Logging Records / Data Logger Records;
- Printer Pages;
- Tracks List.

Number and structure of the additional data may vary depending on the system configuration and its state.

1.4.4 If advanced logging option (Data Logger Station) is used (for more details see Section H.1, page 319), after ticking “Data Logger Records” box and pressing “OK” button the following dialog window will appear (see Figure G.5):

- select records for sending in the dialog window and press “Export” button;
- wait for “Export finished successfully” message. This operation may take up to several minutes;
- close the message and the dialog windows by pressing “Close” button.

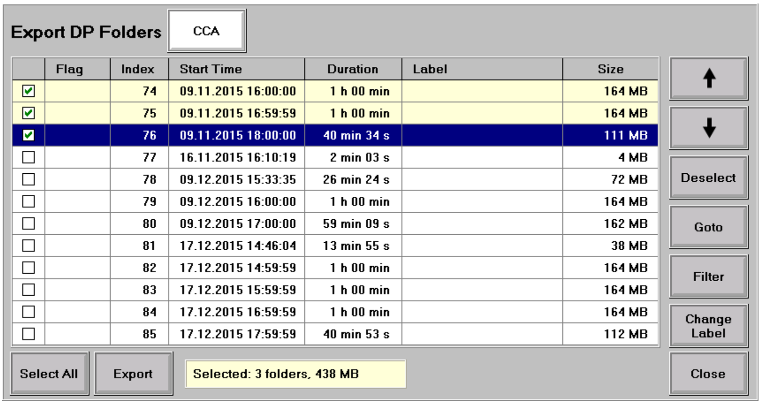


Figure G.5: DPShell. Choice logging records to send

1.5. Wait for “Operation ‘Add feedback to archive’ completed successfully” message.

1.6. Press “Close” button.

1.7. Next, if feedback package was created successfully **DPShell** suggests you to copy feedbacks to USB flash drive. If you don’t want to copy feedback right now just press “Cancel” button, otherwise you should make sure that USB flash drive is connected and act the same manner as in section G.1.4, page 305, item 1.5.3.

G.1.4 Copying Feedback Package to USB Flash Drive

1.1. Switch DP/IJ control computer into “Service Mode” (see Section G.1.1, page 302).

1.2. Insert USB flash drive into DP/IJ control computer USB port.

1.3. Wait for item “Unmount USB” will turn red.

1.4. Press “Feedback” item in “Services” menu

1.5. In “Feedback List” window:

1.5.1 If you want to copy only one particular Feedback Package select it by using arrow buttons for navigation.

1.5.2 Press “Send” button.

Figure G.6: DPShell. Choice feedbacks to send

1.5.3 New dialog will suggest you to make choice what do you want to copy:
- Not Sent Feedbacks;
- All Feedbacks;
- Selected Feedback.

1.5.4 Select required item and press “OK”. Wait for “Operation ‘Send feedback’ completed successfully” message will appear.
This operation may take up to several minutes.

1.5.5 Press “Close” button (Package status will be changed to “Sent”).

1.6. After copying you can delete sent feedback packages (see Section G.1.6, page 306).

1.7. Press “Done” button in “Feedback List” window.

1.8. Press “Unmount USB” item in “Services” menu.

1.9. Wait for a message “Operation ‘Unmount removable drive’ completed successfully”.

1.10. Disconnect USB flash drive from USB port.

1.11. Press “Close” button.

1.12. Your flash drive contains folder “SendToNavis”.

G.1.5 Sending Feedback Package to Navis

1.1. Copy all required Feedback Packages to USB flash drive (see Section G.1.4, page 305).

1.2. Make sure that USB flash drive contains folder “SendToNavis”.

1.3. Send all files to Navis.

G.1.6 Deleting Feedback Packages

1.1. Switch DP/IJ control computer into “Service Mode” (see Section G.1.1, page 302).

1.2. Press “Feedback” item in “Services” menu.

1.3. In “Feedback List” window:

1.3.1 If you want delete only one particular Feedback Package select it by using arrow buttons for navigation.

NOTE! Deleting is available only for Feedback Packages being copied to USB flash drive (with “Sent” status). If you want to delete particular feedback package copy it to the USB flash drive.

1.3.2 Press “Delete” button.

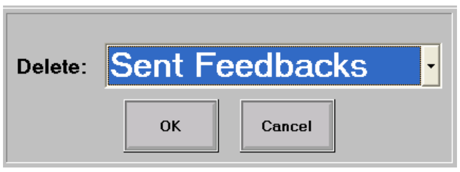


Figure G.7: DPShell. Choice feedbacks to delete

1.3.3 New dialog will suggest you to make choice what do you want to delete (see Figure G.7):
- Sent Feedbacks;
- Selected Feedback.

1.3.4 Select required item and press “OK”. Wait for “Operation ‘Delete feedback’ completed successfully” message will appear.

1.3.5 Press “Close” button.

1.4. Press “Done” button in “Feedback List” window.

G.1.7 DP/IJ Software Update

1.1. Unpack and install an Update Package to USB flash drive (follow individual package instructions).

1.2. Install Update Package from USB flash drive to all DP/IJ control computers for which this package is intended (see Section G.1.8, page 307):

CC — for DP-0 class systems;

CC, IJ — for DP-1;

CCA, CCB, IJ — for DP-2.

1.3. Make sure that correct SW versions are installed on all DP/IJ control computers (see Warning note below).

To obtain information about **NAVIS NavDP 4000** active version, follow steps as in Section G.1.9, page 308.

WARNING!	For DP-2 class systems the same SW version should be installed on both CCA and CCB control computers. Never use **NAVIS NavDP 4000** in case of different versions are active on DP/IJ control computers!

NOTE!	SW versions installed on DP and IJ computers may vary.

1.4. **NAVIS NavDP 4000** is ready to run with updated software.

G.1.8 Installing Update Package on Control Computer

All registered SW updates are logged in the **DPShell** utility (see Figure G.8). All necessary information about the updates is available in “Update & Service” menu item, in the “Description” window.

1.1. Switch DP/IJ control computer into “Service Mode” (see Section G.1.1, page 302).

1.2. Insert USB flash drive with installed Update Package into DP/IJ control computer USB port. Wait for item “Unmount USB” will turn red.

1.3. Press “Update & Service” item in “Services” menu:

- wait for “Available updates List” window will appear (see Figure G.8). This operation may take up to several minutes;
- select required Update Package. Use arrow buttons for navigation.

1.4. Press “Execute” button:

- wait for a message “Operation Update DP-version with package ... completed successfully”;
- press “Close” button.

1.5. Update Package selected in 1.3 item is installed on control computer.

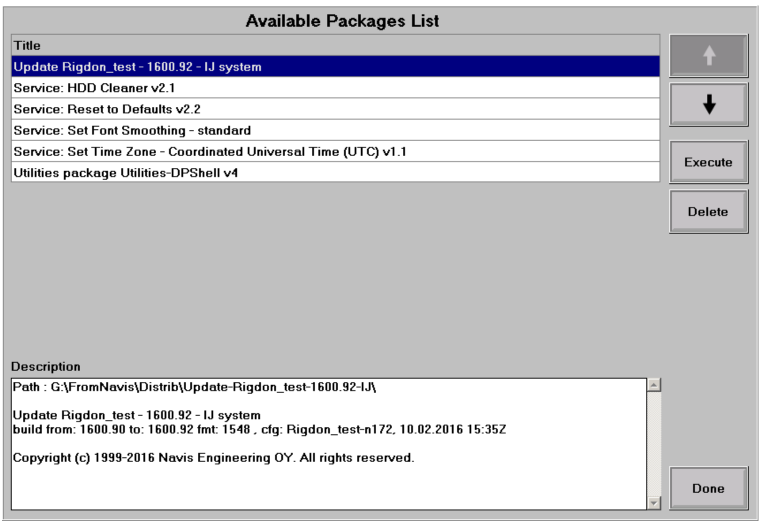


Figure G.8: DPShell. Update package installing

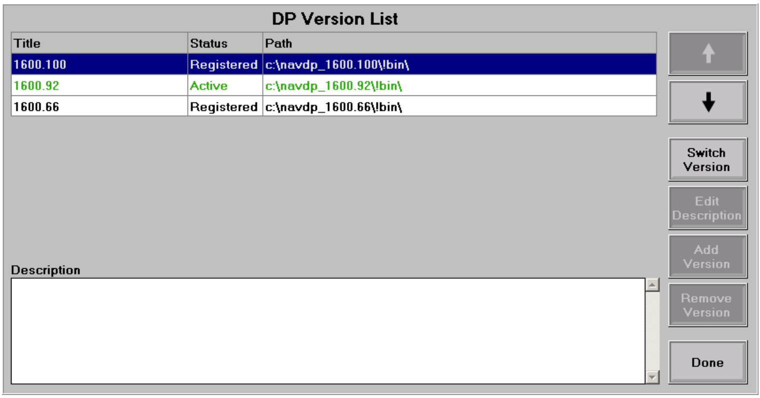


Figure G.9: DPShell. Active version information

G.1.9 Obtaining NAVIS NavDP 4000 Active Version Information

1.1. Switch DP/IJ control computer into "Service Mode" (see Section G.1.1, page 302).

1.2. Press "Switch Version" item in "Services" menu. "DP Version List" will appear (see Figure G.9):

- an active SW version has "Active" status and is marked by green color;
- active version identifier is shown in "Title" column;
- all other installed and registered SW versions have "Registered" statuses.

G.1.10 Switching the Active Version of NAVIS NavDP 4000 on Control Computer

1.1. Switch DP/IJ control computer into "Service Mode" (see Section G.1.1, page 302).

1.2. Make sure that correct SW versions are installed on all DP/IJ control computers (see Warning note of Section G.1.7, page 306).

1.3. Press "Switch Version" item in "Services" menu. "DP Version List" will appear.

1.4. Choose required version to switch on as active (use arrow buttons for navigation).

1.5. Press "Switch Version" button:

- wait for "Operation 'Switch DP-version' completed successfully" message will appear;
- press "Close" button.

1.6. Version selected in 1.4 has an "Active" status (see Figure G.9).

G.1.11 Configuration Menu

The menu provides configuration of the operator station (workstation). The Figure G.10 represents the general view of the menu.

The following settings are available from this menu:

Windows Explorer — switches to the Windows (for service engineers only);

Set computer name — opens the dialog to select both the computer's name and its IP adress (see Figure G.11)* ;

⚠ **WARNING!**	*) A computer's name changing automatically change the computer's IP address!

Set serial number — opens the form for manual input of the computer's serial number (for service engineers only);

Touch screen — calls the Touchscreen calibration utility;

Hide cursor/Show cursor — show/hide cursor switcher;

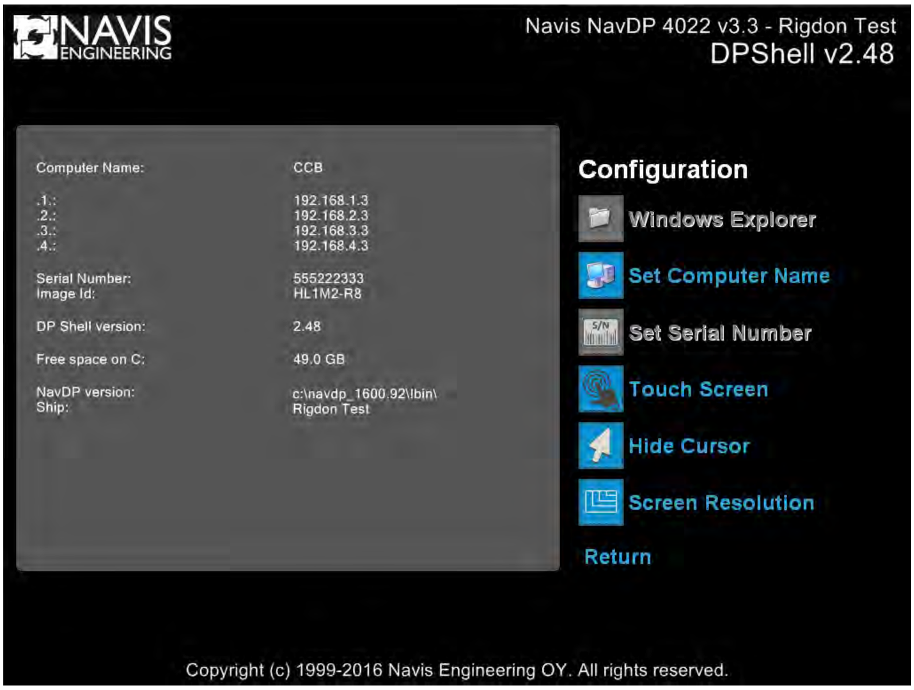


Figure G.10: DPShell. Configuration menu

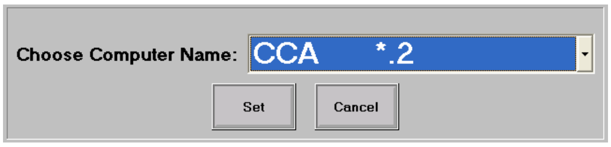


Figure G.11: The computer’s name selection

Screen resolution — calls the dialog to select the screen resolution from the list (see Figure G.12);

Return — back to level up.

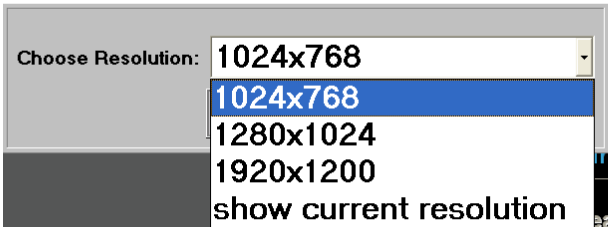


Figure G.12: The screen resolution selection

G.2 Monitorless Configuration

In case the system configuration does not include a touchscreen display the operations are performed via the control panel with LCD (MCP, PCP) (see Section 2.4, page 25):

- Rotary Knob rotation and/or pressing Arrow Buttons are used for navigation through the menu;
- Rotary Knob pressing is used for entering the required menu item.

All popup windows appear on the panel display.

NOTE!	Expression "Press the button/menu item ..." means that you should press the rotary knob on the control panel when the required button/item were selected by the rotary knob rotation or pressing the arrow buttons.

G.2.1 DPShell First Start on the Control Panel of DP/IJ Station

2.1. Power up control system **NAVIS NavDP 4000** on DP/IJ computer (see Section 3.1, page 50).

2.2. Switch the control panel to "Service Mode" to enter **DPShell** utility (see Section 5.12.6, page 99).

2.3. Wait for connection to **DPShell** will appear in the list of panel active connections (for example, "DPShell — CCA").

This operation may take up to several minutes.

2.3.1 Choose the connection to **DPShell** by rotating the rotary knob.

2.3.2 If connection to **DPShell** is not established (the panel status is "Disconnected") restart the control system on DP/IJ computer. The panel is kept in the "Service Mode".

2.4. Wait for **DPShell** Start Screen appearance (see Figure G.13).

2.5. Press "Service" item to enter the service menu before **NAVIS NavDP 4000** automatic start (for more details see Section G.2.2, page 311).

If **NAVIS NavDP 4000** has started automatically shut down the system using a normal shut down procedure (see Section 3.6, page 55) and follow steps from item 2.1.

2.5.1 Use rotary knob rotation or pressing arrow buttons for navigation through the menu (see Section 2.4.11, page 29).

2.5.2 When you select "Service" item press the rotary knob.

2.6. Enter password "16" using a screen keyboard and press "OK" (use knob rotation or arrow buttons for navigation) (see Figure G.14).

2.7. In the opened service menu press "Configuration" item and choose "Bind DPShell to CP" in it.

DPShell will be bound to the control panel on this control station (for more details see Section G.2.12, page 317).

2.8. Leave "Service Mode" on the control panel (see Section 5.12.6, page 99).

2.8.1 **DPShell** Screen will appear on the panel display after a small delay.

2.8.2 If this does not happen, shut down the system using a normal shut down procedure (see Section 3.6, page 55) and follow steps from item 2.1.

G.2.2 Routine Entering the Service Menu on the Control Panel of DP/IJ Station

2.1. Power up control system **NAVIS NavDP 4000** on DP/IJ computer (see Section 3.1, page 50).

2.2. Wait for **DPShell** Start Screen appearance (see Figure G.13).

Figure G.13: DPShell Main menu

This is the screen with the following menu items:

Start DP — **NAVIS NavDP 4000** start. **DPShell** utility will start the system automatically after a delay of:

- 180 seconds — a standard delay for configuration with the control panel (USB flash drive is not connected);
- 600 seconds — in case of connected USB flash drive.

The timer is displayed at the bottom of the Start Screen (see Figure G.13).

Service — DP/IJ computer switching into "Service Mode".

Unmount USB — management of USB flash drive safe removing.
Item "Unmount USB" is displayed in menu if USB flash drive is connected.

NOTE!	USB flash drive should be connected to control computer USB port. The control panel is not equipped with a port for connecting the USB flash drive.

2.3. Make sure that the control panel is in "Operation Mode":

2.3.1 If the control panel is in "Service Mode" leave this mode (see Section 5.12.6, page 99).

2.3.2 If **DPShell** is disconnected from the panel after leaving "Service Mode", follow steps as in Section G.2.1, page 310.

WARNING!	For operation with **NAVIS NavDP 4000** system by using MCP (PCP) panel you should enter **DPShell** in "Operation mode". For this **DPShell** utility should be bound to the control panel by "Bind DPShell to CP" command (see Section G.2.12, page 317).

2.4. Press "Service" item to enter the service menu before **NAVIS NavDP 4000** automatic start.

If **NAVIS NavDP 4000** has started automatically shut down the system using a normal shut down procedure (see Section 3.6, page 55) and follow steps from item 2.1.

2.4.1 Use rotary knob rotation or pressing arrow buttons for navigation through the menu (see Section 2.4.11, page 29).

2.4.2 When you select “Service” item press the rotary knob.

2.5. Enter password “16” using a screen keyboard and press “OK” (use knob rotation or arrow buttons for navigation) (see Figure G.14).

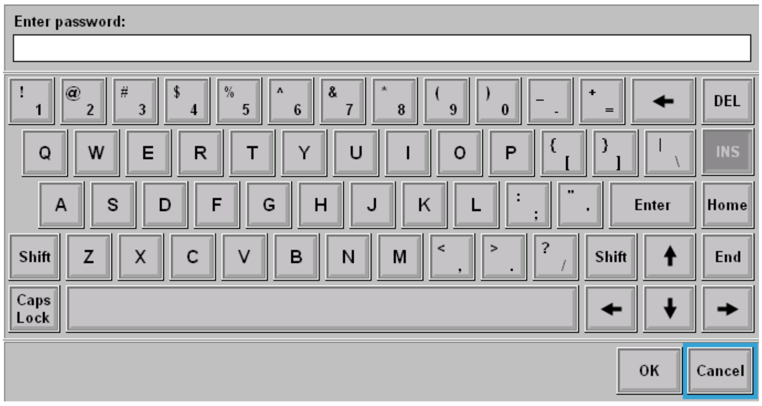


Figure G.14: DPShell. Enter password

If you entered wrong password, “Operation ‘Choose User-Level’ completed with error(s)” message will appear. Press “Close” button and follow steps from item 2.4.

2.6. When you enter a correct password service menu will appear (see Figure G.15).

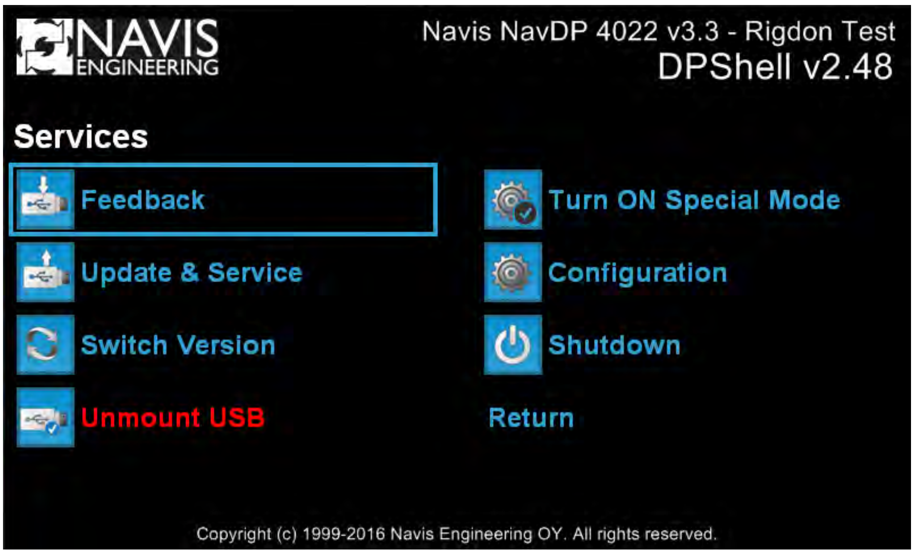


Figure G.15: DPShell Service menu

G.2.3 Leaving the Service Menu on DP/IJ Control Station

2.1. DP/IJ control computer is in service menu (see Figure G.15).

2.2. To leave a service menu:

2.2.1 Close an active window (if any) by pressing “Done” button (use arrow buttons for navigation).

2.2.2 Press “Return” item in menu “Services”.

2.2.3 If “Unmount USB” item is displayed in the start screen press this item for safe removing of the USB flash drive:

– wait for “Operation ‘Unmount removable drive’ completed successfully” message.
– disconnect USB flash drive from USB port.
– press “Close” button.

2.3. To start **NAVIS NavDP 4000** press “Start DP” button (see Section 3.1, page 50).

2.4. To shut down **NAVIS NavDP 4000** use a normal shut down procedure (see Section 3.6, page 55).

G.2.4 Creating Feedback Package

2.1. Switch DP/IJ control computer into “Service Mode” (see Section G.2.2, page 311).

2.2. Press “Feedback” item in “Services” menu.

2.3. In “Feedback List” window press “Create New Feedback” item (use arrow buttons for navigation).

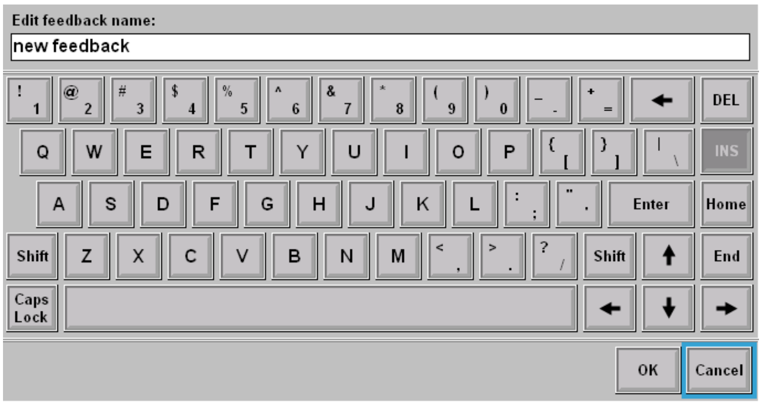


Figure G.16: DPShell. Creating feedback

2.4. In “Edit feedback name” window (see Figure G.16):

2.4.1 Change feedback name using a screen keyboard (default name is “new feedback”).

2.4.2 Press“OK” button.

2.5. Wait for “Operation ‘Add feedback to archive’ completed successfully” message.

2.6. Press “Close” button.

2.7. Next, if feedback package was created successfully **DPShell** suggests you to copy feedbacks to USB flash drive. If you don’t want to copy feedback right now just press “Cancel” button, otherwise you should make sure that USB flash drive is connected and act the same manner as in section G.2.5, page 313, item 2.5.3.

NOTE! “Description” field in “Feedback List” window may contain additional description of the feedback package (for example, “Automatically created Feedback”). Editing of this field is unavailable.

G.2.5 Copying Feedback Package to USB Flash Drive

2.1. Switch DP/IJ control computer into “Service Mode” (see Section G.2.2, page 311).

2.2. Insert USB flash drive into DP/IJ control computer USB port.

2.3. Wait for item “Unmount USB” will turn red.

2.4. Press “Feedback” item in “Services” menu

2.5. In “Feedback List” window:

Figure G.17: DPShell. Choice feedbacks to send

2.5.1 If you want to copy only one particular Feedback Package select it by using arrow buttons for navigation.

2.5.2 Press “Send” button.

2.5.3 New dialog will suggest you to make choice what do you want to copy:

- Not Sent Feedbacks;
- All Feedbacks;
- Selected Feedback.

2.5.4 Select required item and press “OK”. Wait for “Operation ‘Send feedback’ completed successfully” message will appear.

This operation may take up to several minutes.

2.5.5 Press “Close” button (Package status will be changed to “Sent”).

2.6. After copying you can delete sent feedback packages (see Section G.2.7, page 314).

2.7. Press “Done” button in “Feedback List” window (use arrow buttons for navigation).

2.8. Press “Unmount USB” item in “Services” menu.

2.9. Wait for a message “Operation ‘Unmount removable drive’ completed successfully”.

2.10. Disconnect USB flash drive from USB port.

2.11. Press “Close” button.

2.12. Your flash drive contains folder “SendToNavis”.

G.2.6 Sending Feedback Package to Navis

2.1. Copy all required Feedback Packages to USB flash drive (see Section G.2.5, page 313).

2.2. Make sure that USB flash drive contains folder “SendToNavis”.

2.3. Send all files to Navis.

G.2.7 Deleting Feedback Packages

2.1. Switch DP/IJ control computer into “Service Mode” (see Section G.2.2, page 311).

2.2. Press “Feedback” item in “Services” menu.

2.3. In “Feedback List” window:

2.3.1 If you want delete only one particular Feedback Package select it by using arrow buttons for navigation.

> **NOTE!** Deleting is available only for Feedback Packages being copied to USB flash drive (with “Sent” status). If you want to delete particular feedback package copy it to the USB flash drive.

2.3.2 Press “Delete” button.

2.3.3 New dialog will suggest you to make choice what do you want to delete (see Figure G.18):

- Sent Feedbacks;

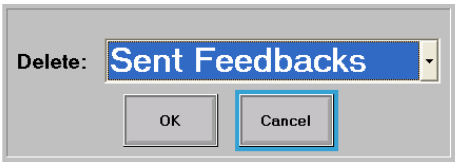


Figure G.18: DPShell. Choice feedbacks to delete

– Selected Feedback.

2.3.4 Select required item by rotary knob rotation and press "OK". Wait for "Operation 'Delete feedback' completed successfully" message will appear.

2.3.5 Press "Close" button.

2.4. Press "Done" button in "Feedback List" window (use arrow buttons for navigation).

G.2.8 DP/IJ Software Update

2.1. Unpack and install an Update Package to USB flash drive (follow individual package instructions).

2.2. Install Update Package from USB flash drive to all DP/IJ control computers for which this package is intended (see Section G.2.9, page 315):

CC — for DP-0 class systems;

CC, IJ — for DP-1;

CCA, CCB, IJ — for DP-2.

2.3. Make sure that correct SW versions are installed on all DP/IJ control computers (see Warning note below).

To obtain information about **NAVIS NavDP 4000** active version, follow steps as in Section G.2.10, page 316.

WARNING! For DP-2 class systems the same SW version should be installed on both CCA and CCB control computers.
Never use **NAVIS NavDP 4000** in case of different versions are active on DP/IJ control computers!

NOTE! SW versions installed on DP and IJ computers may vary.

2.4. **NAVIS NavDP 4000** is ready to run with updated software.

G.2.9 Installing Update Package on Control Computer

All registered SW updates are logged in the **DPShell** utility (see Figure G.19). All necessary information about the updates is available in "Update & Service" menu item, in the "Description" window.

2.1. Switch DP/IJ control computer into "Service Mode" (see Section G.2.2, page 311).

2.2. Insert USB flash drive with installed Update Package into DP/IJ control computer USB port. Wait for item "Unmount USB" will turn red.

2.3. Press "Update & Service" item in "Services" menu:

- wait for "Available updates List" window will appear (see Figure G.19). This operation may take up to several minutes;
- select required Update Package (use rotary knob rotation for navigation).

2.4. Press "Execute" button (use arrow buttons for navigation):

- wait for a message "Operation Update DP-version with package ... completed successfully";
- press "Close" button.

2.5. Update Package selected in 2.3 item is installed on control computer.

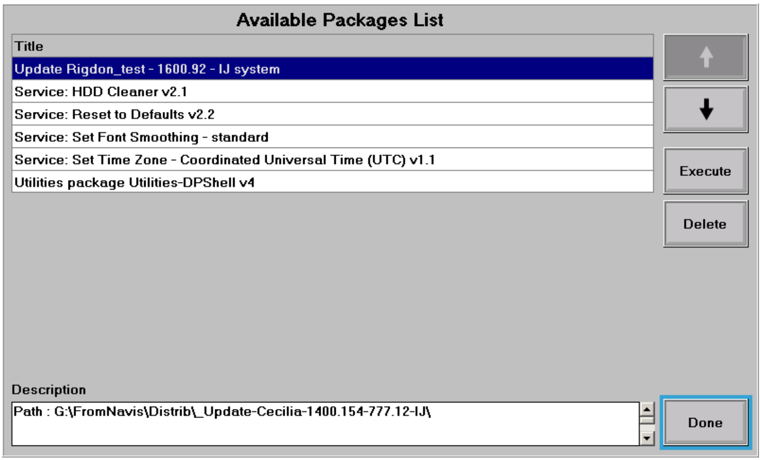


Figure G.19: DPShell. Update package installing

G.2.10 Obtaining NAVIS NavDP 4000 Active Version Information

2.1. Switch DP/IJ control computer into “Service Mode” (see Section G.2.2, page 311).

2.2. Press “Switch Version” item in “Services” menu. “DP Version List” will appear (see Figure G.20):

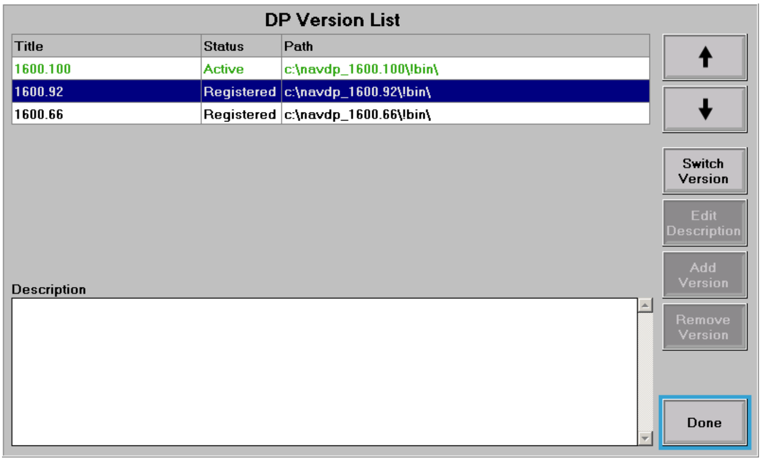


Figure G.20: DPShell. Active version information

- an active SW version has “Active” status and is marked by green color;
- active version identifier is shown in “Title” column;
- all other installed and registered SW versions have “Registered” statuses.

G.2.11 Switching the Active Version of NAVIS NavDP 4000 on Control Computer

2.1. Switch DP/IJ control computer into “Service Mode” (see Section G.2.2, page 311).

2.2. Make sure that correct SW versions are installed on all DP/IJ control computers (see Warning note of Section G.2.8, page 315).

2.3. Press “Switch Version” item in “Services” menu. “DP Version List” will appear.

2.4. Choose required version to switch on as active (use arrow buttons for navigation).

2.5. Press “Switch Version” button:

- wait for “Operation ‘Switch DP-version’ completed successfully” message will appear;
- press “Close” button.

2.6. Version selected in 2.4 has an “Active” status (see Figure G.20).

G.2.12 Configuration Menu

The menu provides configuration of the operator station (workstation). The Figure G.21 represents the general view of the menu.

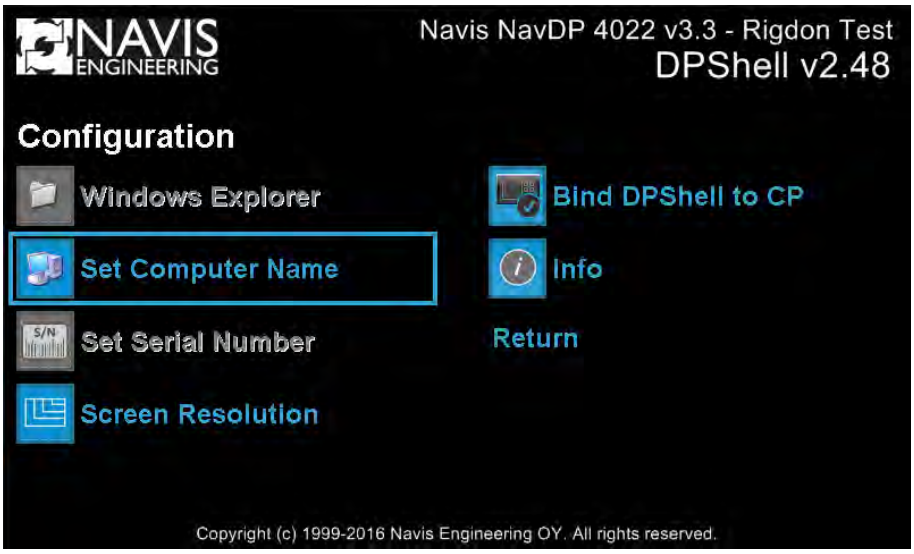


Figure G.21: DPShell. Configuration menu

The following settings are available from this menu:

Windows Explorer — switches to the Windows (for service engineers only);

Set computer name — opens the dialog to select both the computer's name and its IP adress (see Figure G.22)* ;

WARNING!	*) A computer's name changing automatically change the computer's IP address!

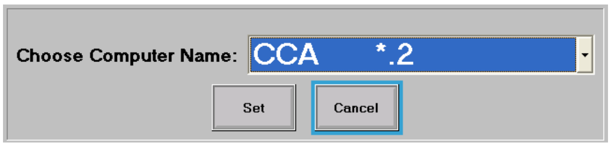


Figure G.22: DPShell. The computer's name selection

Set serial number — opens the form for manual input of the computer's serial number (for service engineers only);

Screen resolution — calls the dialog to select the screen resolution from the list (see Figure G.23);

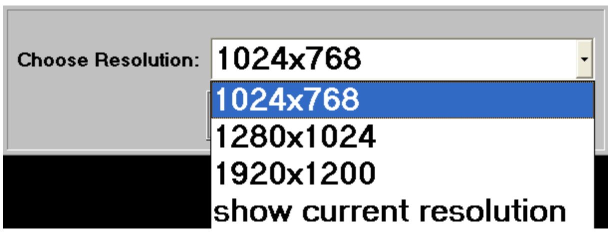


Figure G.23: DPShell. The screen resolution selection

Bind DPShell to CP / Unbind DPShell from CP / Rebind DPShell to CP — manages **DPShell** binding/unbinding/rebinding to the control panel.

Bind DPShell to CP command binds **DPShell** to the control panel on this control station:

– to enter **DPShell** you should not switch the panel into "Service Mode";
– connection to **DPShell** will appear in the list of panel active connections.
This operation may take up to several minutes.

Unbind DPShell from CP command cancels **DPShell** binding to the control panel:

– if you entered **DPShell** utility in "Operation Mode", then "Connection with control panel will be closed, proceed?" message will appear (see Figure G.24);

Figure G.24: Unbind DPShell from CP. Confirmation

– after you press "YES" the connection will be closed. To enter **DPShell** next time you should switch the control panel into "Service Mode" (see Section 5.12.6, page 99).

Rebind DPShell to CP command binds **DPShell** to the control panel as the command "Bind DPShell to CP" does. "Rebind..." means that **DPShell** utility has been already bound to another panel on ths control station.

Info — displays current system information (see Figure G.25).

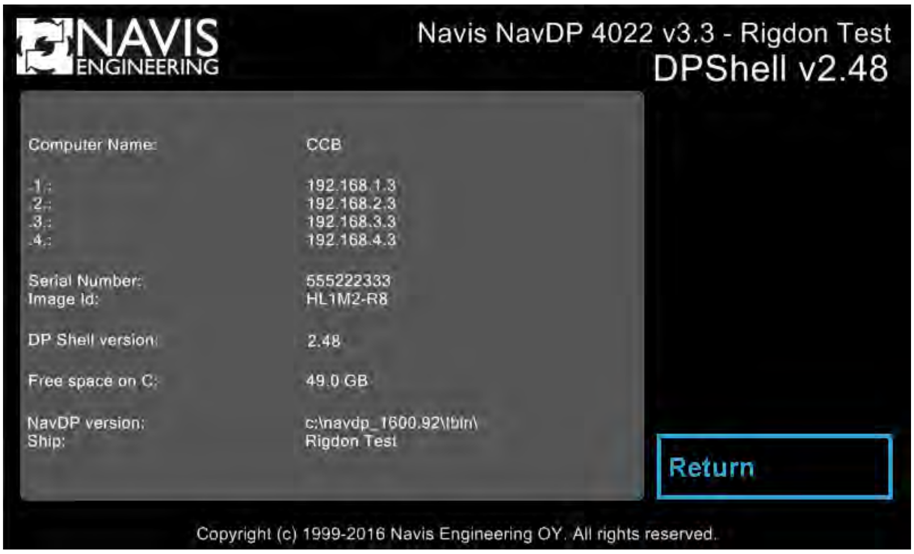


Figure G.25: DPShell. Obtaining System information

Return — back to level up.

Appendix H

Data Logging

H.1 General

The **NAVIS NavDP 4000** system has the following data logging options:

Local logging — data are recorded to the local file storage on the operator station;

Advanced network logging — data are recorded to additional Data Logger Station (DLS).

H.1.1 Local Data Logging

Local logging is always available regardless of whether additional Data Logger Station (DLS) is installed or not.

Local logging is turned on/off by DP Operator.

The data are stored to the local storage (local disk or additional HDD). If DLS is installed, local recorder duplicates data recording to DLS.

H.1.2 Advanced Network Data Logging

Network Data logging provides:

- recording of data up to one month;
- centralized data collection from all control stations (DP and IJ);
- data viewing and analysis on DLS by means of Data Logger Analyzer (see Section H.4, page 332) or data saving for remote analysis;
- data export to the external device (USB flash drive);
- data printing.

Data Logger Station supports several (from one to four) Ethernet connections with DP and IJ stations.

The data record starts just after the system is on, regardless of whether local logging is on or off.

The data are stored in DLS.

The DLS monitoring is provided using the table of state placed in the System Monitor window (see figure H.1).

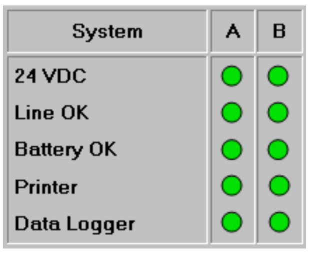


Figure H.1: System Monitor Window. Table of State

H.2 Logging Settings on DP/IJ Stations

Logging parameters are controlled through the Operator Station application / Param View / Logging tab (see figure H.2).

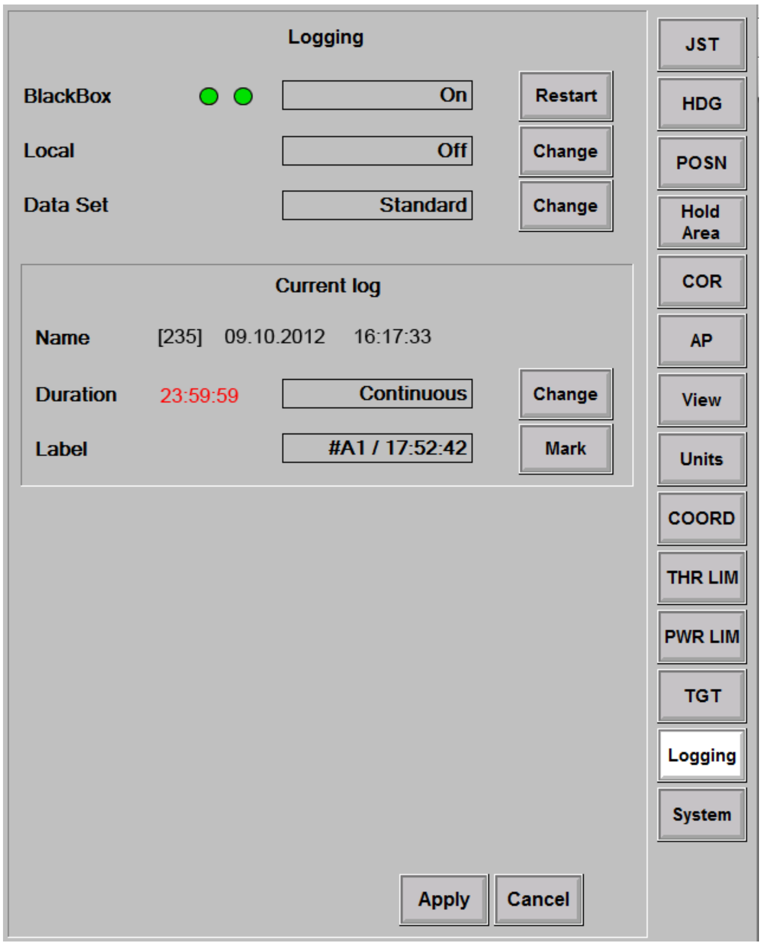


Figure H.2: The Logging Tab

H.2.1 Logging Area

Logging area of the Logging tab contains three strings:

BlackBox/Remote — displays DLS operating mode and its state;

Local — displays local recorder state;

Data Set — displays current data set record mode.

H.2.1.1 DLS Operating Modes

The DLS operates in the following setting modes:

BlackBox — the forced continuous data recording process;

Remote — the ordinary data recording controlled by the operator.

The mode name is displayed at the first line of the tab.
In case the DLS is not installed there is no line at the tab (see figure H.3).
Status indicators (both for A and B DP control stations and for IJ station) in the “BlackBox/Remote” string have the following coding to indicate states of DLS connection/record (excluding the Local recording state):

red — error — the record is on but failed because of disk overflow or no connection;

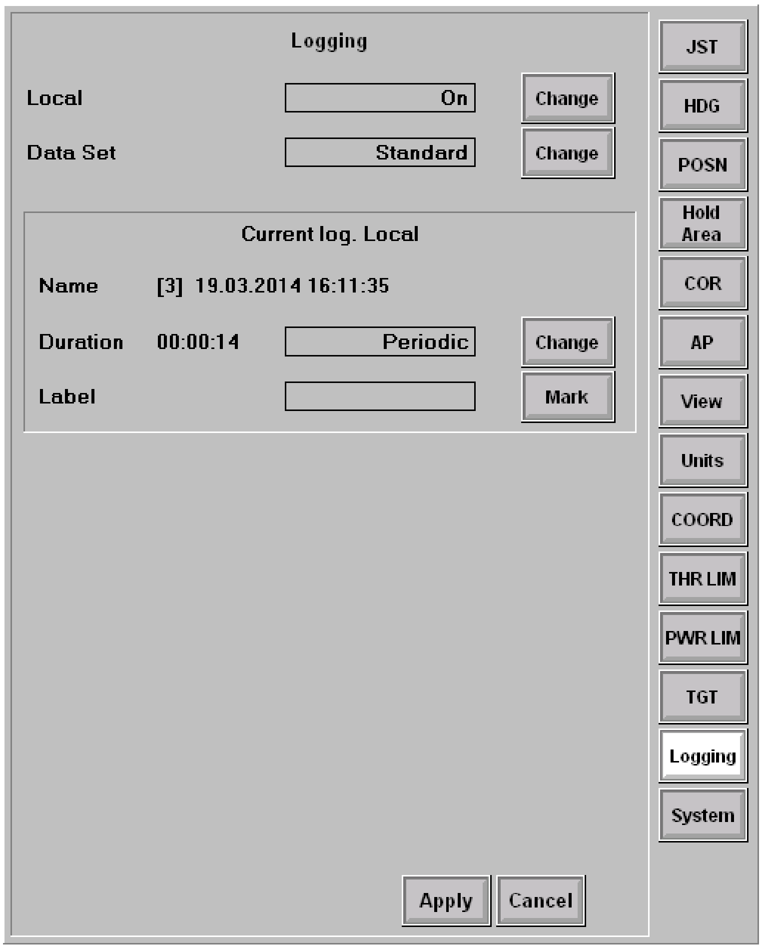


Figure H.3: The Logging Tab in case of DLS is not installed

yellow — warning — connection is ok, the data recording is processed but disk is close to overflow;

green — connection is ok, data recording is processed;

white — connection is ok but data recording process is stopped by the operator (only for "Remote" mode);

grey — the system contains DP (IJ) control station, but the station is not connected.

2.1. The record status is displayed in the entry field in the "BlackBox" mode (see figure H.2):

On — the data are recording (the permanent status);

Restart — the "Restart" softkey has been pressed.

The record is split into intervals. If "Continuous" mode is off, the interval is 1 hour.

> **NOTE!** The interval size is the system setting and cannot be changed by operator.

Therefore a new interval can be started by operator command. To start the new interval:

– press "Restart" softkey. The value of the entry field will be changed to "Restart";
– press "Apply" softkey to approve the command. Then DLS starts a new interval.
If you do not want to start the new interval, press either "Restart" softkey again or "Cancel" softkey to cancel the command. Then DLS continues the current interval.

Restart operation affects all connected DL recorders (both DLS and local recorder).

> **NOTE!** Restart operation is performed only on the selected host — DP (A and B stations) / IJ.

2.2. The mode indication is displayed in the entry field in the "Remote" mode (see figure H.4):

On — the logging is on;

Off — the logging is off.

> **NOTE!** The "Remote" mode is used in case the "BlackBox" option is not available (is not bought).

To change the mode (on — off):

– press "Change" softkey. The value of the entry field will be changed to "On" ("Off");
– press "Apply" softkey to approve the command.
If you do not want to change the status, press either "Change" softkey again or "Cancel" softkey to cancel the command.

The every mode switching forces the system to start a new record interval.

The selected mode ("On"/"Off") persists after **NAVIS NavDP 4000** restarting.

H.2.1.2 Local Logging

The "Local" field contains a status of the local recorder.
There are two local recorder's statuses:

On — local logging is on;

Off — local logging is off.

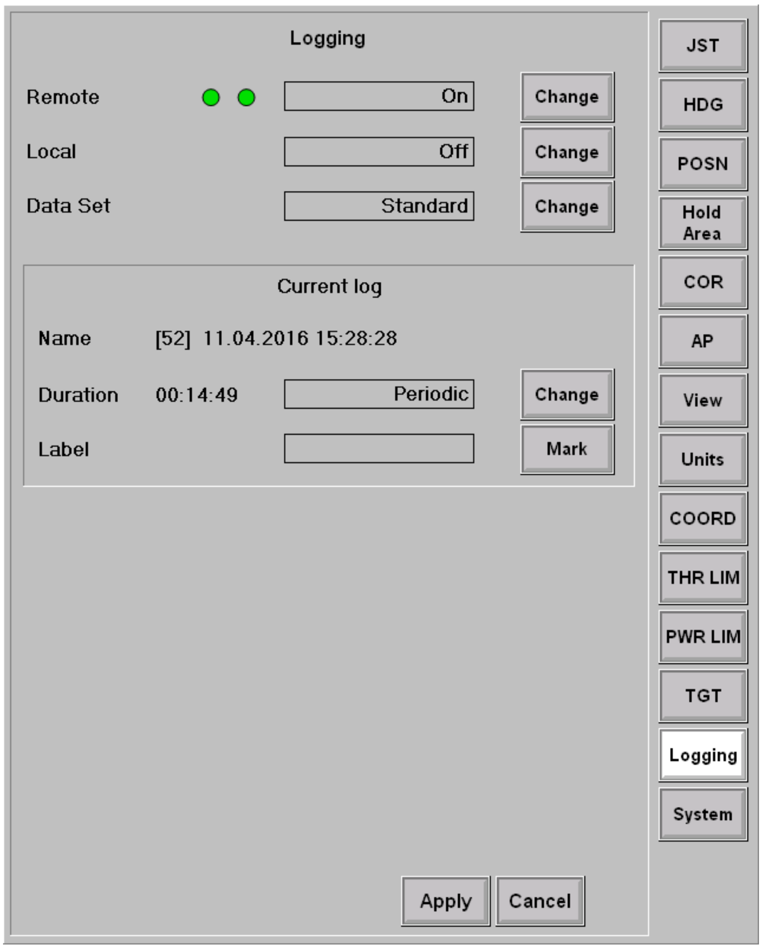


Figure H.4: “Remote” DLS Mode

The default status is “Off”.
To change the status:

– press “Change” softkey. The value of the entry field will be changed to “On” (“Off”);
– press “Apply” softkey to approve the command.
  If you do not want to change the status, press either “Change” softkey again or “Cancel” softkey to cancel the command.

The system starts a new record interval with the every status change.
In case **NAVIS NavDP 4000** system is restarting, the local recorder status depends on DLS availability:

– in case DLS is available, the local recorder status is “Off”.
– in case DLS is unavailable, the status is the same as the one before restarting.

In case DLS records data (local logging is off), symbol is displayed near the vessel name in the Status line (see figure H.5).

Figure H.5: The Status line in case DLS recording is on

In case both recorders (DLS and local recorder) are on, two symbols are displayed near the vessel name in the Status line (see figure H.6).

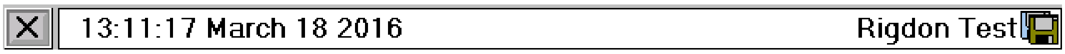


Figure H.6: The Status line in case both DLS and local recording is on

In case DLS is disconnected, red symbol is displayed near the vessel name in the Status line.
In case DLS is not installed and local logging is on, olive symbol is displayed near the vessel name in the Status line.

H.2.1.3 Data Set Record Modes

Data set record mode is displayed in the “Data Set” field.
There are two modes to record data sets:

Standard — an incidents analysis;

Full — a data retrieval to provide remote services.

To change the record mode:

– press “Change” softkey. The value of the entry field will be changed to “Full” (“Standard”);
– press “Apply” softkey to approve the command.
  If you do not want to change the status, press either “Change” softkey again or “Cancel” softkey to cancel the command.

The selected mode persists after **NAVIS NavDP 4000** restarting.

H.2.2 Current Log Area

“Current Log” area of the Logging tab contains information about the current record.
In case the record is off the “Current Log” area is empty.
In case local logging is off, the DLS information is displayed (see figure H.2).
In case the record is performed by both DLS and local recorder, the local recorder information is displayed (see figure H.7).
The area contains three strings:

Name — displays information for the current record;

Duration — displays current record duration and record mode value;

Label — displays current record label (if any).

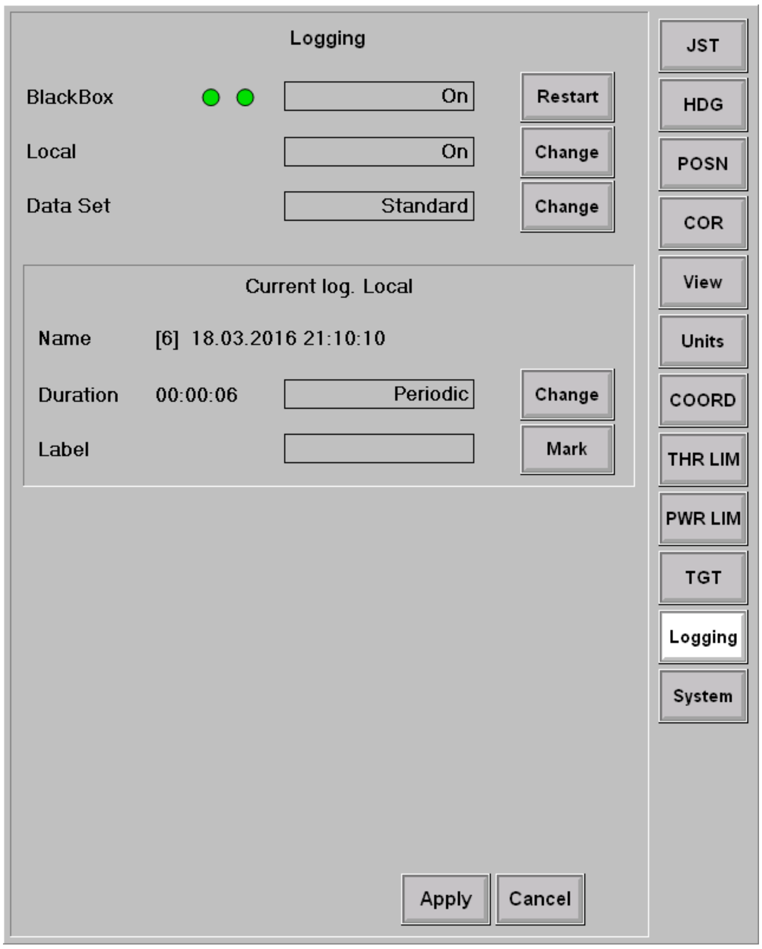


Figure H.7: The Logging Tab. Current Log

H.2.2.1 Current Record Information

"Name" field contains the information for the current record:

- record index, in format [x];
- starting date and time, in format dd.mm.yyyy hh.mm.ss.

> **NOTE!** The time stamp displayed is the current system time at the start of interval. In case the system time is changed by operator the current record data are not changed.

H.2.2.2 Record Modes

The "Duration" string contains the following information:

- current record duration. The value is changing according to the processing;
- record mode.

There are two record modes:

Continuous — a record is not split into intervals;

Periodic — a record is split into intervals.

To change the record mode:

- press "Change" softkey. The value of the entry field will be changed to "Continuous" ("Periodic");
- press "Apply" softkey to approve the command.
  If you do not want to change the status, press either "Change" softkey again or "Cancel" softkey to cancel the command.

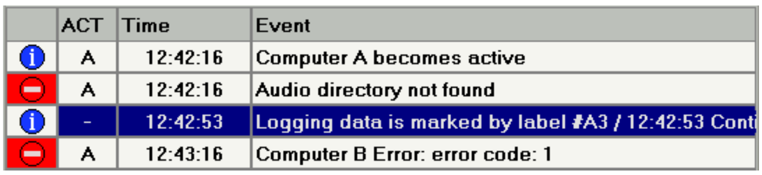
Switching to the "Continuous" mode affects all recorders (both Local recorder and DLS).
The "Continuous" mode is switching automatically to "Periodic" mode in the following cases:

- "Restart" softkey is pressed;
- local logging status is switched between "On" and "Off" (in any direction);
- **NAVIS NavDP 4000** system is restarted.

In case a local control computer is restarted, the "Continuous" mode:

- persists if other control computers have the "Continuous" mode for recording;
- does not persist if there is no computer recording in the "Continuous" mode in the system.

After the "Continuous" mode is off, the interval is labeled with the standard prefix and with the comment "Continuous". The alarm message is generated with label creation (see figure H.8).



	ACT	Time	Event
	A	12:42:16	Computer A becomes active
	A	12:42:16	Audio directory not found
	-	12:42:53	Logging data is marked by label #A3 / 12:42:53 Conti
	A	12:43:16	Computer B Error: error code: 1

Figure H.8: Alarm Message: "Continuous" Label

H.2.2.3 Label

"Label" field displays current record label.
To assign a label:

- press "Mark" softkey. Automatic label will be displayed in the "Label" field;
- press "Apply" softkey to approve the command.
  If you do not want to mark the record, press "Cancel" softkey to cancel the command.

H.2.3 The Overload Protection in the “Continuous” Mode

In case the “Continuous” mode is on, the system generates the following alarm messages:

– the “Duration” values becomes red;
– the one time per an interval (the standard value of interval is 1 hour) the alarm message appears. The message reports that the “Continuous” mode is on and it should be switched off;
– the symbol in the Status line is starting to blink.

The message type depends on the system configuration.
Additionally, there is a maximum record duration restriction. The standard maximum duration is 24 hours.

H.2.4 Disk Space Control

The system is check the available disk space permanently.
When approaching a minimum value (1000 MB by default):

– “Low disk space” alarm is generated;
– status indicators in “BlackBox/Remote” string become yellow.

If the minimum value is reached (1000 MB by default):

– the record is stopped;
– “Logging stopped, disk full” alarm is generated;
– status indicators in “BlackBox/Remote” string become red.

H.2.5 Screenshot

To make a screenshot press twice the CPU console label on the master operator station, located at the bottom side of the screen (see figure H.9).
The screenshot is saved as a file named “Screen_YYYY-MM-DD_HH-MM-SS.bmp” to the “Out” folder.

Figure H.9: CPU Console Label

H.3 Data Logger Console

When Data Logger Station (DLS) is on, LCD displays Data Logger Console Window (see figure H.10).

H.3.1 DL Console Window Areas

DL Console window is divided into three main areas:

– Server area;
– DP System area;
– IJ System area (is similar to DP System area).

3.1. “Server” area contains information concerning the server that collects data and provides performing all operations.

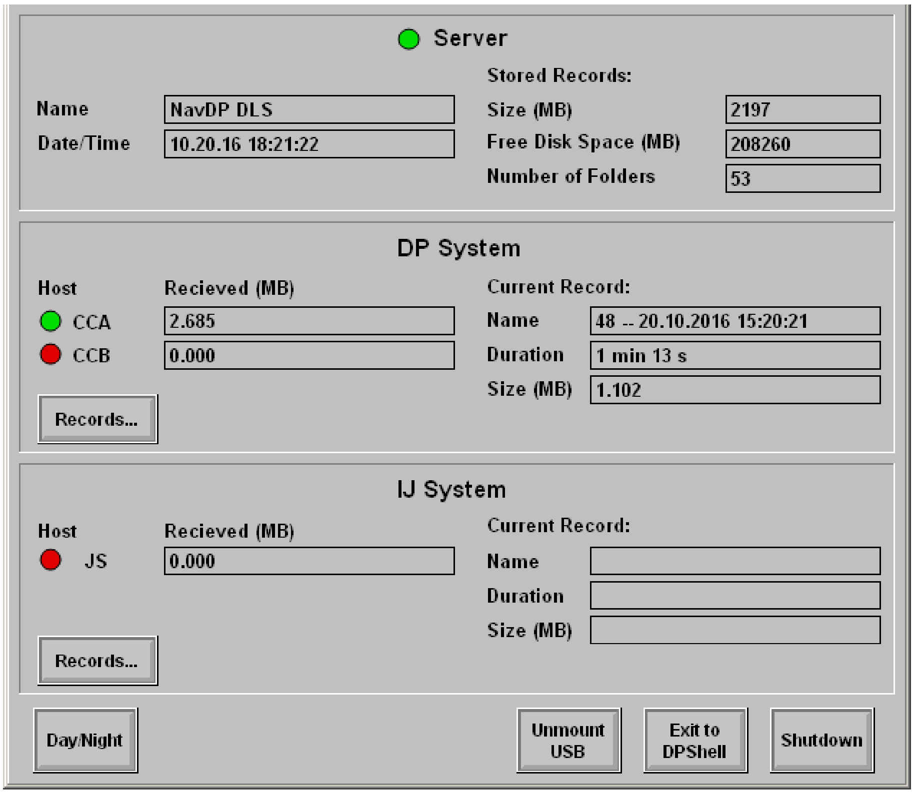


Figure H.10: Data Logger Console Window

Field	**Value**	**Description**
Status indicator	Green	Server connection is ok
	Grey	Server initialization in progress
	Red	No connection
Name	NavDP DLS	Name of the server that collects data from all DP and IJ control stations
Date/Time	mm.dd.yy hh.mm.ss	Current date and time
Stored Records:		
Size (MB)	Whole number	Size of recorded data
Free Disk Space (MB)	Whole number	The remaining space on the disk
Number of Folders	Whole number	Number of created folders with the recorded data

3.2. “DP (IJ) System” area contains information concerning data from the control stations.

Field	**Value**	**Description**
Host indicator	Green	Connection to the control station (CCA, CCB or JS) is ok
	Red	No connection
Received (MB)	x.xxx	Size of data received from the corresponding control station (CCA, CCB or JS)
Current Record:		
Name	Record number — dd.mm.yyyy hh.mm.ss	Name of the current folder in which the data are recorded. The name includes record index, starting date and time
Duration	x min x s	Duration of recording to the current folder
Size (MB)	x.xxx	Size of recorded data

H.3.2 Softkeys

DL Console window contains the following softkeys:

Records... in the **DP System (IJ System)** area calls a window which contains a record list for:

- data export from DP (IJ) control station (see Section H.3.3, page 329);
- data viewing and analyzing (see Section H.4, page 332).

Day/Night is used for switching the palette;

Unmount USB shows status of external flash drive (active — USB flash drive is connected, inactive — disconnected) and is used for safety removing of the USB flash drive;

Exit to DPShell is used for return to **DPShell** utility (see Section G). The logging is stopped;

Shutdown is used for shutting down the Data Logger Station.

H.3.3 Data Export ("Records..." Softkey)

Press "Records..." softkey in the "DP System" area to export data from DP control stations (CCA, CCB). "DP Records" window will appear (see figure H.11).

By default, the window displays list of records from both DP control stations (CCA, CCB).

To display data from one control station (for example, CCA), press softkey with the host name which records should be hidden (for example, CCB) at the top of the window.

Procedure of data export from IJ station and dialog window view are similar to the example specified below.

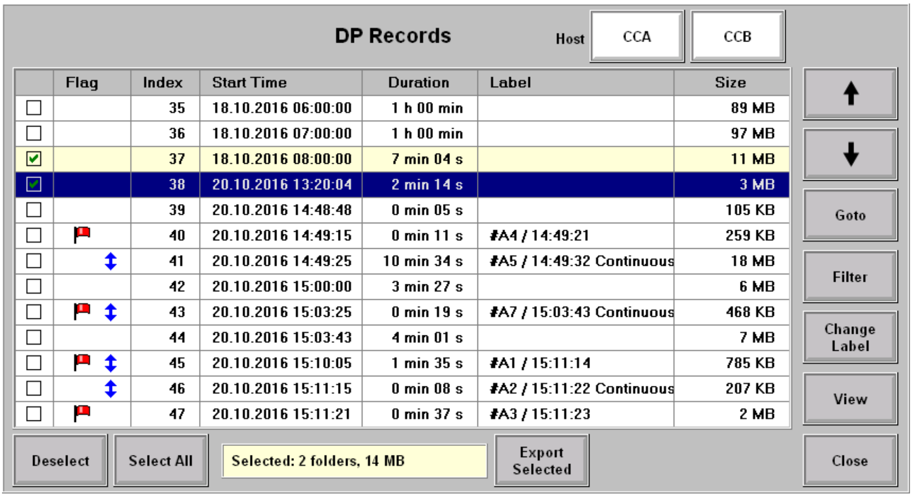


Figure H.11: DP Records Window

H.3.3.1 Record Filtering

You can find out required records for export by using "Goto" softkey or applying a filter.

3.1. To find out particular records perform the following actions:

- press "Goto" softkey and wait for "Enter Date/Time" window will appear (see figure H.12);
- enter required date and time in the opened window and press "OK" softkey;
- records with chosen parameters are selected.

3.2. To filter records according to particular parameters perform the following actions:

- press "Filter" softkey and wait for "Filter Data" window will appear (see figure H.13);
- select required filter parameters (record flag, start/end date and time) in the opened window and press "Apply" softkey;
- records with chosen parameters are displayed.

Figure H.12: Enter Date/Time Window

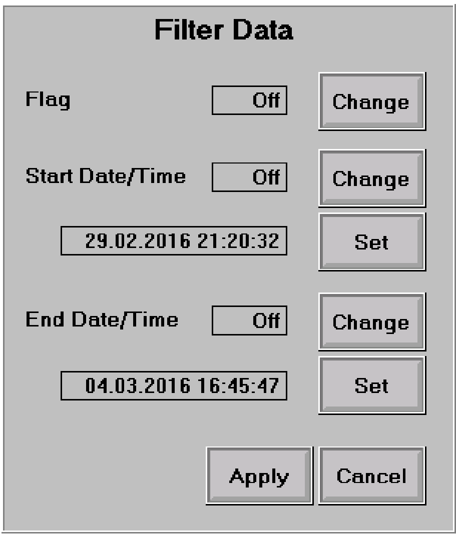


Figure H.13: Filter Data Window

H.3.3.2 Label Change

Automatic labels are assigned to the records on the control stations (see Section H.2, page 320).
To change/assign record label perform the following actions:

- select the record for which you want to change/assign a label (use arrow softkeys for navigation);
- press “Change Label” softkey and wait for a window with a screen keyboard will appear (see figure H.14);
- enter a new label name and press “OK” softkey;
- the label is changed/assigned.

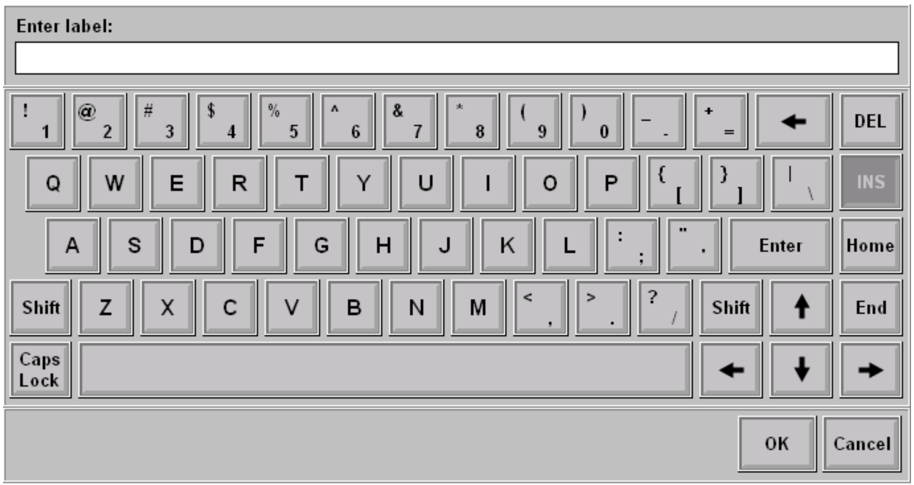


Figure H.14: Change Label Window

H.3.3.3 Record Export

To export records to the external USB flash drive perform the following actions:

3.1. If you want to export a particular record:

- select it by using arrow softkeys for navigation;
- tick the box of the record by using “Select” softkey.

You can select one or more records.

3.2. Insert USB flash drive into DLS computer USB port.

3.3. Press “Export Selected” softkey.
If USB flash drive is connected incorrectly/not connected, “No mounted flash drive found, insert flash drive and try export again” message will appear.

3.4. Select USB flash drive name from the list.

3.5. Wait for “Export finished successfully” message will appear.
This operation may take up to several minutes.

3.6. If the records were exported successfully DL console suggests you to unmount USB flash drive. Press “YES” softkey if you want to unmount USB flash drive right now, otherwise press “NO”.

3.7. Your flash drive contains folder “SendToNavis”.

H.3.3.4 Record Analysis

To analyze data and view charts use Data Logger Analyzer (DLA) (see Section H.4):

- if you want to focus on a particular record, select it by using “Select” softkey;
- press “View” softkey to call DLA.

H.4 Data Logger Analyzer

When you press "View" softkey on DL Console ("DP (IJ) Records" window) Data Logger Analyzer (DLA) window will appear.

H.4.1 DLA Main Window

When DL Analyzer is run LCD displays Main Window (see figure H.15).

If you had selected particular record in the "DP (IJ) Records" window (see figure H.11), before DLA is run it will be focused on this record:

- record duration will be displayed at the bottom side of the screen;
- the record will be selected in the Record table;
- charts will be plotted according to the record duration.

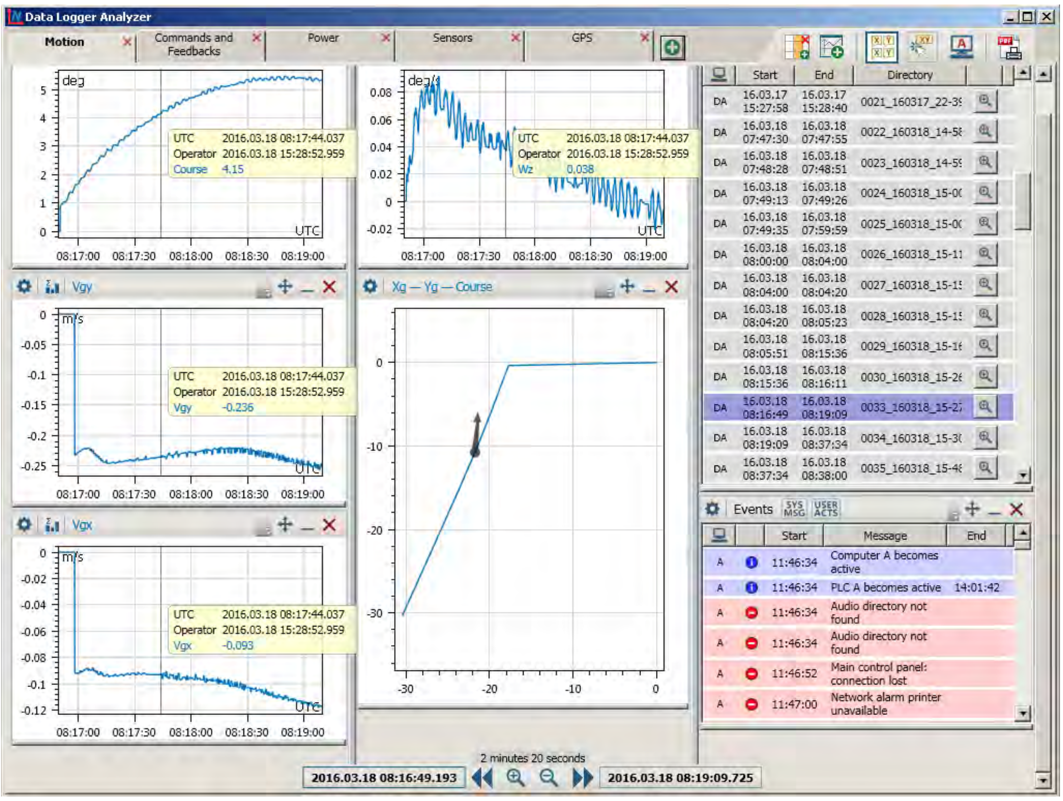


Figure H.15: DL Analyzer Main Window

The following starting tabs are available for DL Analyzer:

- Motion;
- Commands and Feedbacks;
- Power;
- Sensors;
- GPS.

Each starting tab contains a set of default charts and tables.

Set of starting tabs may vary for different vessel configurations.

Full layout list is available by pressing  softkey (see Section H.4.2).

H.4.2 Main Window Softkeys

The main window contains the following softkeys:

 (**Add Page**) softkey is used for addition of a new tab.

Press the softkey and select either layout with default charts and tables from the list or empty one for further addition of charts/tables with custom parameters (see Section H.4.5).

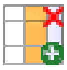
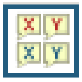
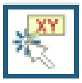
 (**Add/Del/Move columns**) softkey is used for adding, deleting and moving columns (see figure H.16).

Figure H.16: Add/Del/Move columns Window

 (**Add plot/table/...**) softkey is used for addition of charts/tables and setting plot parameters.

 (**Show trackers at all plots simultaneously**) softkey is used for switching tracker view mode at the charts (only at one chart / at all charts simultaneously).

When you press the softkey, additional information (UTC time, operator time, course, etc.) is displayed on all charts simultaneously.

 (**Show tracker only after click**) softkey is used for switching on tracker view mode by click.

When you press the softkey, additional information (UTC time, operator time, course, etc.) is displayed on the chart only after pressing on the touchscreen.

 (**Change data host**) softkey displays data source (DP stations: A and B, IJ station) and is used for the host switching (on active tab).

Data from the selected station is displayed on the charts.

If you want to change data host on other tabs:

- on each tab for which you want to change the data source, press “Change data host” softkey until required host will be displayed, or
- close DLA, choose another host in DL console window and restart DLA by pressing “View” softkey.

> **NOTE!** Both alarm list in the “Event Table” and record list in the “Record Table” are independent of the selected station.

 (**Save/Print Report**) softkey is used for:

- printing of charts and tables;
- report exporting to USB flash drive in PDF format.

To print/export the report:

– go to the tab with charts and tables to be printed/exported as a report;
– press the "Save/Print Report" softkey and wait for "Save/Print Report" window will appear (see figure H.17);
– in the opened window tick the following option parameters, if necessary:

One series per plot — to plot each series on a separate chart (even if the series were grouped on the same chart).
Report example is shown on figure H.18;

Include Event table — to add the Event table.

Figure H.17: Save/Print Report Window

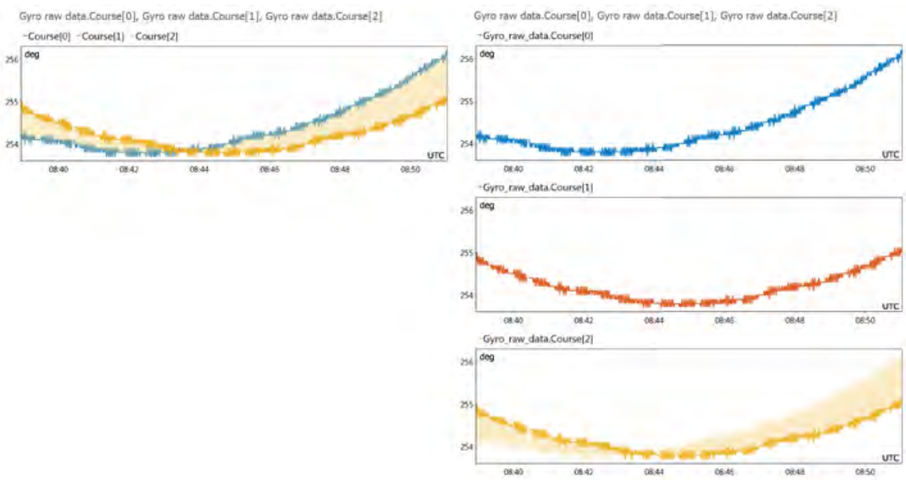


Figure H.18: Report examples. 1: Standard report. 2: Report with "One series per plot" option

4.1. To export report to the USB flash drive:
– Insert USB flash drive into DLS computer USB port.
– Press "Save to USB-disk" item.
If USB flash drive is connected incorrectly / not connected, "No mounted flash drive found, insert flash drive and try export again" message will appear.
– Wait for "Report has been saved at $< path >$" message will appear.
This operation may take up to several minutes.
– Your USB flash drive contains folder "Navis_Reports".

4.2. Press "Print" item to print report. Chosen set of charts and tables will be printed.

Service softkeys located at the bottom side of the screen are used for (see figure H.19):

– chart zooming along the time axis:  — zoom in,  — zoom out;

– motion along the time axis by using arrows: — back, — forward.

Figure H.19: Service Softkeys

Record information is also displayed at the bottom side of the screen.

When particular record is selected, information concerning this record (start/stop time and duration) is displayed.

softkey allows increasing the time range for the analyzed records, but no more than 12 hours.

H.4.3 Operation with Charts

Chart windows contain the following softkeys (may vary for different chart types):

(**Plot/Table Settings**) softkey is used for selecting/changing plot settings:

- press "Plot/Table Settings" softkey and wait for either "Time series plot" or "Position plot" window will appear (it depends on the chart type);
- tick the boxes of required items for the plot (for detailed description of the plot parameter selecting see Section H.4.5, page 337);
- press "OK";
- the chart will be plotted according to selected parameters in the window.

(**Statistic**) softkey is used for displaying min, max, avg and median values.

raw° (**Change angle range**) softkey is used for changing axis angle from 0 to 360^0 (0, 180 or 360^0).

(**Move**) softkey is used for chart moving (up/down) and swapping (left/right) (see Figure H.20).

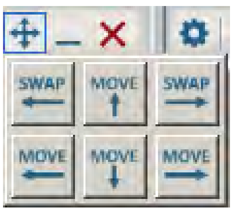


Figure H.20: Move/Swap Softkey

(**Minimize**) softkey is used for minimizing of the chart window.

(**Expand**) softkey is used for expanding of the chart window.

(**Close**) softkey is used for closing of the chart window.

Press the Chart Name to hide/show or remove the chart.

If several charts are plotted in a one window and all the chart names cannot be placed in the line, softkey becomes active. When you press this softkey the other chart names are shown.

H.4.4 Operation with Tables

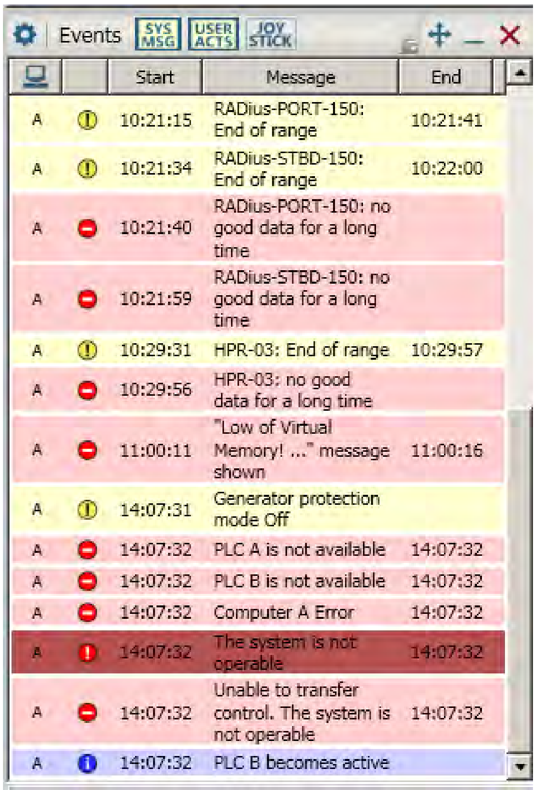
Event and Record tables are displayed on the DLA Main Window, on the "Motion" tab (see figure H.15). These tables are also located on the other layouts in minimized form.

If you want to add Event or Record table to empty layout, press (**Add plot/table/...**) softkey and select required item in the opened window.

4.1. Event table contains statistics of events for the analyzed time:

- event source (station);
- message type (warning, error, info, etc.). It is displayed as a corresponding icon;
- start time;
- message text;
- end time.

An example of Event table is shown in figure H.21.



		Start	Message	End
A		10:21:15	RADius-PORT-150: End of range	10:21:41
A		10:21:34	RADius-STBD-150: End of range	10:22:00
A		10:21:40	RADius-PORT-150: no good data for a long time	
A		10:21:59	RADius-STBD-150: no good data for a long time	
A		10:29:31	HPR-03: End of range	10:29:57
A		10:29:56	HPR-03: no good data for a long time	
A		11:00:11	"Low of Virtual Memory! ..." message shown	11:00:16
A		14:07:31	Generator protection mode Off	
A		14:07:32	PLC A is not available	14:07:32
A		14:07:32	PLC B is not available	14:07:32
A		14:07:32	Computer A Error	14:07:32
A		14:07:32	The system is not operable	14:07:32
A		14:07:32	Unable to transfer control. The system is not operable	14:07:32
A		14:07:32	PLC B becomes active	

Figure H.21: Event Table

Event table window contains the following softkeys:

(**Plot/Table Settings**) softkey is used for adding of a table;

SYS MSG shows system messages (hidden by default);

USER ACTS shows operator actions (hidden by default);

JOYSTICK shows joystick moving (if available, hidden by default);

(**Move**) softkey is used for table moving (up/down) and swapping (left/right) (see figure H.20);

(**Minimize**) softkey is used for minimizing of the table window;

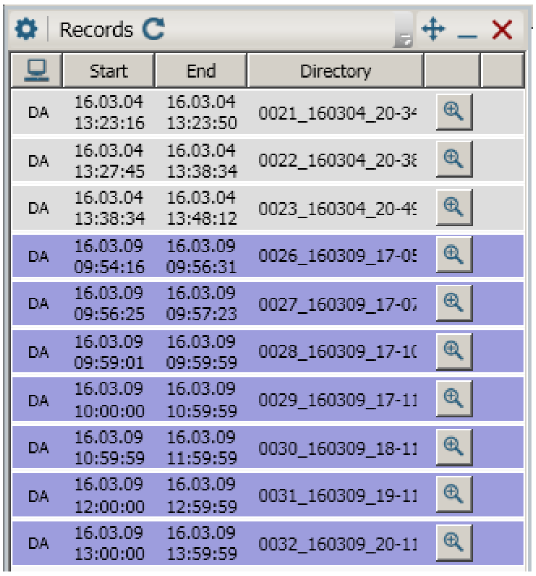
(**Expand**) softkey is used for expanding of the table window;

(**Close**) softkey is used for closing of the table window.

4.2. Record table contains statistics of the records imported from DL Station:

- date and time of the record start;
- date and time of the record end;
- directory name.

An example of Record table is shown in figure H.22.



	Start	End	Directory	
DA	16.03.04 13:23:16	16.03.04 13:23:50	0021_160304_20-3	
DA	16.03.04 13:27:45	16.03.04 13:38:34	0022_160304_20-3	
DA	16.03.04 13:38:34	16.03.04 13:48:12	0023_160304_20-4	
DA	16.03.09 09:54:16	16.03.09 09:56:31	0026_160309_17-0	
DA	16.03.09 09:56:25	16.03.09 09:57:23	0027_160309_17-0	
DA	16.03.09 09:59:01	16.03.09 09:59:59	0028_160309_17-1	
DA	16.03.09 10:00:00	16.03.09 10:59:59	0029_160309_17-1	
DA	16.03.09 10:59:59	16.03.09 11:59:59	0030_160309_18-1	
DA	16.03.09 12:00:00	16.03.09 12:59:59	0031_160309_19-1	
DA	16.03.09 13:00:00	16.03.09 13:59:59	0032_160309_20-1	

Figure H.22: Record Table

Record table window contains the following softkeys:

(**Plot/Table Settings**) softkey is used for adding of a table;

(**Update table**) softkey updates table data;

(**Move**) softkey is used for table moving (up/down) and swapping (left/right) (see figure H.20);

(**Minimize**) softkey is used for minimizing of the table window;

(**Expand**) softkey is used for expanding of the table window;

(**Close**) softkey is used for closing of the table window.

Press softkey to select particular record. The charts will be scaled according to the record duration.

H.4.5 Addition of Tables and Custom Charts

(**Add plot/table/...**) softkey is used for addition of charts/tables and setting plot parameters.
Go to tab to which new chart/table will be added. You can also select empty tab.
Press “Add plot/table/...” softkey and in the opened window select required chart or table:

- Time series plot;
- Position plot;
- Event table (is included in the default set of charts and tables);
- Record table (is included in the default set of charts and tables).

4.1. When you select “Time series plot” item a window in which data and sensor parameters are selected for the charts will appear (see figure H.23).

In the opened window:

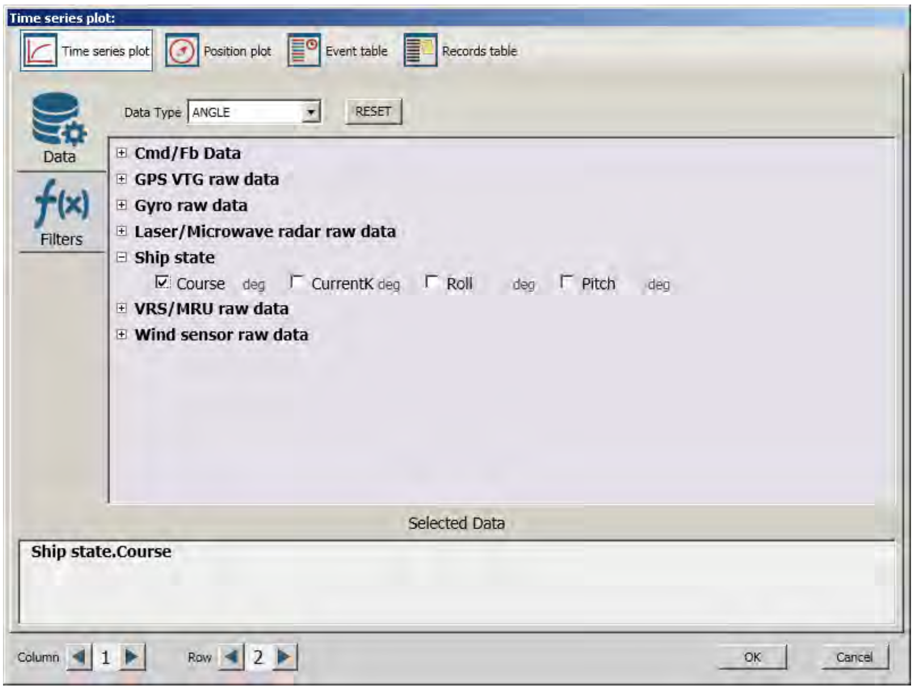


Figure H.23: Time Series Plot

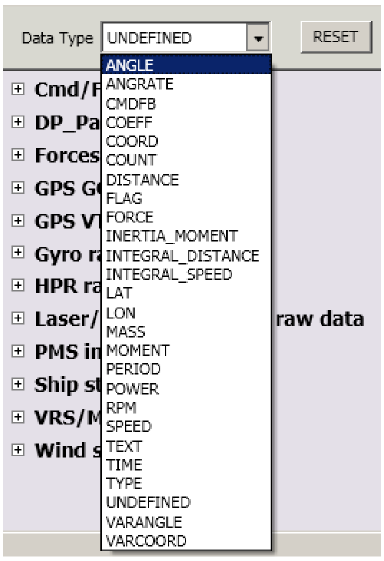


Figure H.24: Time Series Plot. Data Type

- select parameters relating to data properties (angle, moment, speed, etc) from “Data Type” list (see figure H.24):
  “Reset” softkey returns default value “Undefined”. A full list of sensor parameters is displayed in “Selected data” window;
- select required sensor parameters (see figure H.23) according to selected data parameters.
  The charts will be plotted according to both types of selected parameters (data and sensors);
- select column and row numbers to which the selected chart will be added (use arrows at the bottom side of the window for navigation);
- press “OK” softkey;
- chart with selected parameters will appear in the selected column and row.

4.2. When you select “Position plot” item a window in which position parameters are selected for the charts will appear (see figure H.25).

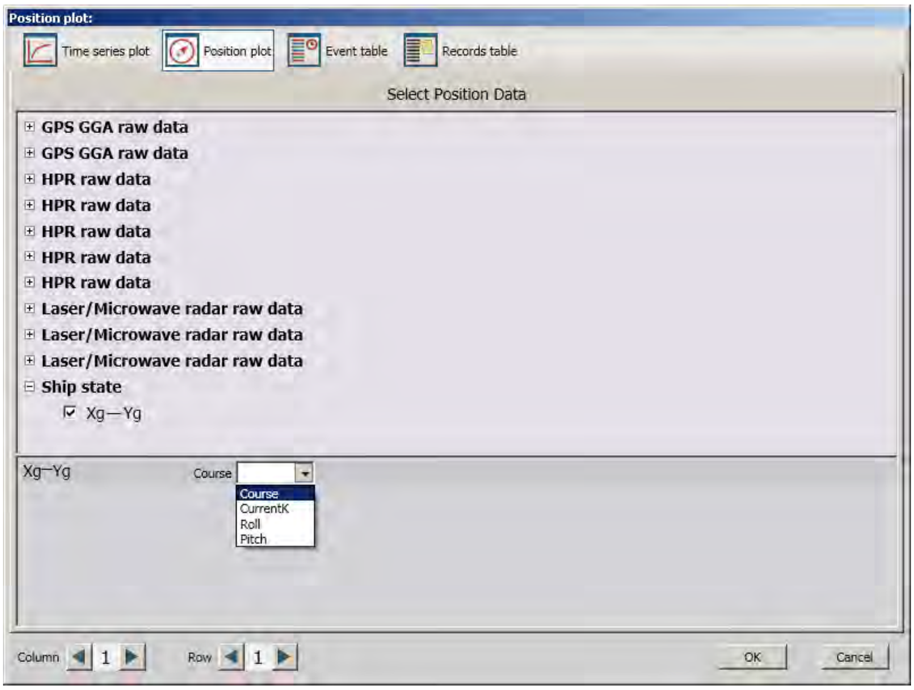


Figure H.25: Position Plot

In the opened window:

- select required position parameters;
- select one of additional parameters from the list to be displayed on the chart (course, roll, pitch, etc).
  Additional parameters are available not for all position parameters;
- select column and row numbers to which the selected chart will be added (use arrows at the bottom side of the window for navigation);
- press “OK” softkey;
- chart with selected parameters will appear in the selected column and row.

Press either “Event table” or “Record table” item and “OK” softkey to add the required table (see Section H.4.4).

H.5 Logging to External VDR

NAVIS NavDP 4000 system allows data transmission to the external VDR.
The data include information such as: position, speed, angles, alarms, etc.
The message contains the following mandatory configurable parameters:

- Talker Identifier (Talker ID) - the first 2 or 4 characters following the “$”:
  - 2 characters for standard NMEA-messages;
  - 4 characters for proprietary messages (with first letter “P”).

- Message Type – the next 3 characters (according to NMEA standard).
- Sending from only Master station (default value) or from both stations (Master & Slave).
- Transmission interval (is configured according to external requirements, the default value is 1.0 sec).
  This parameter is used for all message types, excluding Alarm messages (ALA, ALR). In this case the message will be sent when the alarm is generated.

Some messages additionally contain special parameters. For example, Alarm messages contain intervals for sending a complete alarm list with specifying its status.

Other message fields depend on message type and operation/control modes.

Detailed description of VDR message fields see in Appendix D.3, page 291.

Appendix I

Services

Service tools are intended for troubleshooting **NAVIS NavDP 4000**. These functions are for advanced users.

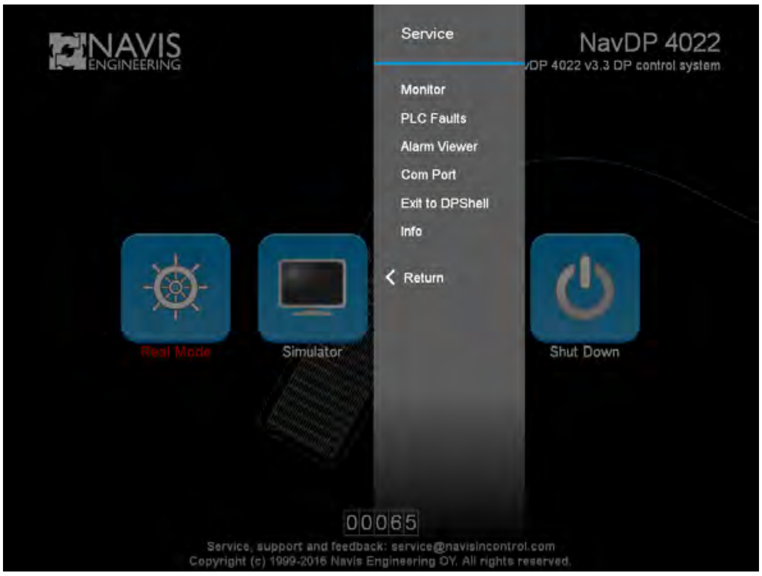


Figure I.1: Starter Service menu

I.1 Signal Monitor Utitity

Signal Monitor utitity (**Monitor** menu item) is only for service engineers now. It is used for the system calibration during dock and sea trials. This utility is password-protected.

I.2 PLC Faults Utitity

This utitity (**PLC Faults** menu item) provides to clear PLC Fault Table or disable PLC faults temporary.

I.3 Alarm Viewer

Alarm Viewer utitity (**Alarm Viewer** menu item) is indended for alarm history analysis.
See Section 4, page 57 for details.

I.4 COM Ports Monitor Utitity

If a control system is switched on, select **Services** on the Main Screen, then **COM Ports** to start the COM Input/Output viewer. COM Ports submenu is used for evaluating of real state signals from sensors and of ports numbers correspondence on CC and PLC.

COM Ports submenu looks as shown in Figure I.2.

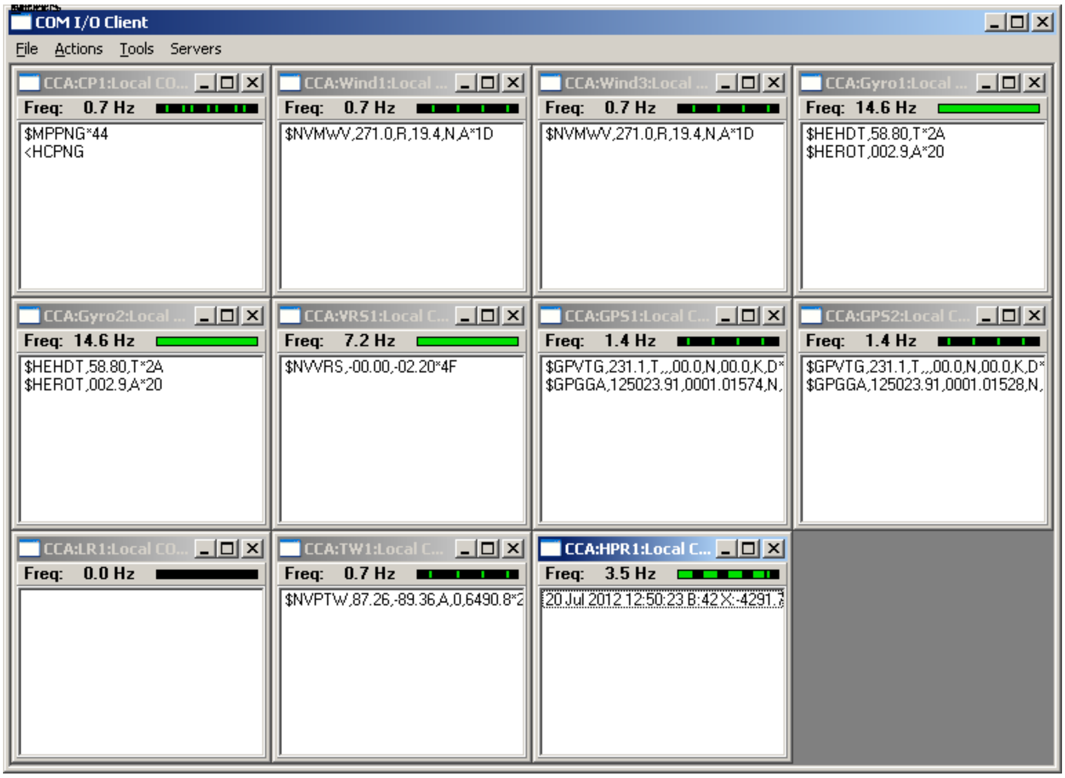


Figure I.2: COM Ports submenu

Select **Servers** to choose viewed control computer. If there are two control computers, you can choose both. The main window displays all sensors connected to a selected computer.

Select **Actions** to change mode of choosen sensor's info representation. Actions submenu contains following strings: Output, Only NMEA, One Line, BaudRate: value, Dump. You can change the Baud Rate value of choosen sensor by select value from dropdown list. For starting of dumping select the Dump from Actions submenu.

Select **Tools** if you want to apply actions for all sensors. Tools submenu contains:

Disable Output and Enable Output — options for enabling and disabling output for all sensors respectively;

Start Dump and Stop Dump — are for launching dumping for all sensors too. However, you can disable dumping for every sensors from Actions submenu;

Start DataReq and Stop DataReq — are used if sensor sends data on request.

Refresh servers — is used for renew servers list.

Select **Files - Exit** to exit from COM Ports viewer to Services menu.

I.5 Touch Screen Calibration

If Touch Screen behavior does not match with your expectations, perform the calibration procedure.

In DPShell Screen hold your touch for 6 second or select **Service**, then **Configuration**, then **Touch Screen**. The white field of Touch Screen Calibration dialogue will appear. Touch several marks on the screen as they appear. If Control Unit has multiple monitors they will be configured one by one.

Calibration will be terminate, if there is no pressing within 10 seconds.

Appendix J

Error Codes

J.1 General

Error Codes are for developers only. In case an error occurs, please inform developers. Critcial system error alarm contains PLC and CC codes.

Following alarms contains codes:

Alarm	Error codes
Computer Error	**CA**
Computer A Error	**CA**
Computer B Error	**CB**
AP Fault — Switch To Manual Steering	**CA:CB:PA:PB**
The system is not operable	**CA:CB:PA:PB**. For non-redundant CC: **CA:0:PA:PB** For non-redundant PLC: **CA:CB:PA:0** For non-redundant PLC and CC: **CA:0:PA:0**

where

CA	CCA error code
CB	CCB error code
PA	PLCA error code
PB	PLCB error code

J.2 CC Error codes

Error flag is bitwise OR of the following bit-flags:

Bit Value	Description
0x001	No connection with another CC (redundant CC only)
0x002	Combined flag: No data from any PLC or master PLC from slave CC
0x004	No data from any PLC
0x008	No data from master PLC (slave CC only)
0x010	No 24(12)VDC
0x020	Combined flag: No active control panel (redundant CC) or no working WS (multi-WS system) or CPU error flag (trainer simulator only)
0x040	No active control panel (redundant CC only)
0x080	there is no working WS (multi-WS system)
0x100	CPU error flag from instructor station (trainer simulator only)

J.3 PLC Error codes

Error flag is bitwise OR of the following bit-flags:

Bit Value	Description
0x001	Combined flag: read/write error
0x002	Error read data from PLC
0x004	Error write data to Master PLC
0x008	PLC fault table is not empty
0x010	No data from Genius buses

J.4 Examples

The system is not operable: code 0:1:0:0	no connection with CCB, alarm on CCA
The system is not operable: code 6:0:7:0	No data from any PLC, read and write error
Computer A Error: Code 1	No connection with CCB
Computer B Error: Code 1	No connection with CCA
Computer A Error: Code 6	No active control panel
The system is not operable: code 6:1:3:0	No active control panel, Error read data from PLC

Appendix K

The Trend View Diagrams List

NOTE! The lists of Items depends on the vessel configuration

K.1 Data Classes

Class	Comment
Power	Generator and Thruster Powers
THR CMD FB	Thrusters, Propellers, Rudders Commands and Feedbacks
Forces	Forces and Moments
Sensors	Sensors data (Raw and Processed)
REF Systems	REF Systems data (Raw and Processed)

K.2 Data Groups and Items

K.2.1 Power

Group	Unit	Items	Comment
Generator Powers	Power units*	G1..GN	Generator power
Diesel Powers	Power units*	D1..DN	Diesel power
Propeller Powers	Power units*	P1..PN	Propeller power (consumed)
Thruster Powers	Power units*	T1..TN	Thruster power (consumed)
GEN Breakers	ON/OFF		Generator breakers state
THR Breakers	ON/OFF		Thruster breakers state
Propeller Breakers	ON/OFF		Propeller breakers state

K.2.2 Thruster Commands and Feedbacks

Group	Unit	Items	Comment
Thrust	%	C1, C2,...CN F1, F2..FN	Propeller and Thruster Thrust Commands and Feedbacks in %
Angle	^{o}	C1, C2,...CN F1, F2..FN	Rudder and Thruster Angle Commands and Feedbacks in ^{o}
RPM	rpm	C1, C2,...CN F1, F2..FN	Propeller and Thruster RPM Commands and Feedbacks
Pitch	–	C1, C2,...CN F1, F2..FN	Propeller and Thruster (CPP) Commands and Feedbacks

K.2.3 Forces

Group	Unit	Items	Comment
X-Force	force units*	C, A, D (Command, Actual, Disturbance)	Bollard pull estimated x-force
Y-Force	force units*	C, A, D (Command, Actual, Disturbance)	Bollard pull estimated y-force
Z-Moment	force units*	C, A, D (Command, Actual, Disturbance)	Bollard pull estimated z-moment
%-Force	%	XC, XA, XD YC, YA, YD MC, MA, MD	Relative forces and z-moments

K.2.4 Sensors Data

Group	Unit	Items	Comment
Gyro Heading	^{o}	1..N, P	Gyro Heading raw and processed (filter output)
Gyro Yaw Rate	$^o/min$	1..N, P	Gyro Yaw Rate raw and processed (filter output)
Wind Speed	Wind speed units*	1..N, P	Wind Speed raw and processed (filter output)
Wind Direction	^{o}	1..N, P	Wind direction raw and processed (filter output)
VRS Roll	^{o}	1..N, P	VRS/MRU roll raw and processed (filter output)
VRS Pitch	^{o}	1..N, P	VRS/MRU pitch raw and processed (filter output)
LOG Vx	Velocity units*	1..N, P	LOG x-velocity raw and processed (filter output)
LOG Vy	Velocity units*	1..N, P	LOG x-velocity raw and processed (filter output)
LS Draft	Distance units*	1..N, P, U	LS draft raw, processed (filter output) and used
LS Displacement	Tons	1..N, P, U	LS displacement raw, processed (filter output) and used
LS Loading	Tons	1..N, P, U	LS loading raw, processed (filter output) and used

K.2.5 REF Systems Data

Group	Unit	Items	Comment
REF X	Distance units*	G, H, L, T, P (GPS, HPR, LR, TW, Processed)	Ref-systems x-coordinate raw and processed (filter output)
REF Y	Distance units*	G, H, L, T, P (GPS, HPR, LR, TW, Processed)	Ref-systems y-coordinate raw and processed (filter output)
DGPS LAT	Geo	1..N, P	GPS latitude raw and Processed (filter output)
DGPS LON	Geo	1..N, P	GPS longitude raw and Processed (filter output)
LR Bearing	^{o}	1..N, P	Laser Radar / MW Radar raw bearing and processed (filter output)
LR Range	Distance units*	1..N, P	Laser Radar / MW Radar range raw and processed (filter output)
TW Alpha	^{o}	1..N, P	Taut Wire α angle raw and processed (filter output)

TW Beta	^{o}	1..N, P	Taut Wire β angle raw and processed (filter output)
TW Length	Distance units*	1..N, P	Taut Wire length raw and processed (filter output)
HPR X	Distance units*	1..N, P	HPR X-coordinate raw and processed (filter output)
HPR Y	Distance units*	1..N, P	HPR Y-coordinate raw and processed (filter output)

* — units are operator defined in Param window