SIMRAD

R2009 / R3016

Operation manual

English

Software version: 18.3.3



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Preface

Disclaimer

⚠ Warning: Refer to important safety information in the product documentation and review all warnings, limitations, and disclaimers before using this product.

This product is not a substitute for proper training and prudent seamanship. It is the owner's sole responsibility to install and use the equipment in a manner that will not cause accidents, personal injury or property damage. The user of this product is solely responsible for observing maritime safety practices.

Navigational features that appear in this document are not a substitute for proper training and prudent seamanship. They do not replace a human navigator and SHOULD NOT be relied on as a sole or primary source of navigation. It is the operator's sole responsibility to use more than one navigational methods to ensure the route suggested by the system is safe.

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This statement, any instruction manuals, user guides and other information relating to the product (Documentation) may be translated to, or has been translated from, another language (Translation). In the event of any conflict between any Translation of the Documentation, the English language version of the Documentation will be the official version of the Documentation.

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Warranty

The warranty card is supplied as a separate document.

In case of any queries, refer to the brand website of your display or system:

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Compliance statements

Regulatory compliance

Navico Group declares under its sole responsibility that the R2009/R3016 complies with the requirements of:

- the EU directive 2014/30/EU (Electromagnetic Compatibility) - **CE**

All compliance documents are available on the product's section on the following website:

www.navico-commercial.com

United Kingdom

Hereby, Navico Group declares that the radio equipment complies with UKCA under The Radio Equipment Regulations 2016. The relevant Declaration of conformity is available in the product's section at the following website:

- www.navico-commercial.com

Australia

This product complies with ACMA according to Radiocommunications Labelling (Electromagnetic Compatibility) Notice 2017.

New Zealand

This product complies with RSM according to Radiocommunications (EMC Standards) Notice 2019.

FCC Warning statement

⚠ Warning: The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

About this manual

This manual is a reference guide for operating, installing and configuring the software for the R2009 Control unit.

➔ ***Note:*** This manual does not cover installation of the various antennas that can be used in these radar systems.

In addition to this manual the following documents are available for the R2009 Control unit:

- R2009/R3016 Quick Guide
- R2009/S2009 Mounting template

Important text conventions

Important text that requires special attention from the reader is emphasized as follows:

➔ ***Note:*** Used to draw the reader's attention to a comment or some important information.

⚠ Warning: Used when it is necessary to warn personnel that they should proceed carefully to prevent risk of injury and/or damage to equipment/ personnel.

Intended audience

This manual is written for system operators and installers. It assumes that the user has basic knowledge of radars, navigation, nautical terminology and practices.

Viewing the manual on the screen

The PDF viewer included in the unit makes it possible to read the manuals and other PDF files on the screen. The manuals can be read from a card inserted in the card reader or copied to the unit's internal memory.

The PDF file is opened from the File manager, refer to *"Files"* on page 65.

Use the keys to maneuver in the PDF file as described below:

- Scroll pages
  Use the rotary knob.
- Zoom in/out
  Use the **+** and **-** keys.
- Maneuver on a page that is larger than the display area
  Use the arrow keys.
- Exit the PDF viewer
  Use the Exit key.

Safety precautions

Safety precautions described in this section are applicable to the radar system. They are general safety precautions that are not related to any specific procedure, and they might therefore not appear elsewhere in this manual. They are recommended precautions that personnel must understand and apply during operation and maintenance of the system.

You are obliged to read these operating instructions prior to operation, and to adhere to the operating instructions in order to prevent possible danger. Prevention of danger includes that operator personnel are trained and authorized for safe operation of the equipment. We assume no liability for damage due to improper operation which could have been prevented.

The system must only be operated by persons who have passed the relevant mandatory training on the respective systems and applications. Only reading these operating instructions cannot replace such training. Persons authorized to operate, maintain and troubleshoot the system are instructed and trained by Simrad. Persons operating or servicing this radar system must be familiar with the general safety regulations and specific safety systems, and they must have passed all required training. They must have read the relevant operating instructions and manuals before starting to work.

Have these operating instructions always at hand on all relevant locations, and ensure that copies are available to all operators. Operating personnel must at all times follow all safety regulations.

During normal operation, the unit can be quickly disconnected from the main power line by turning OFF the relevant circuit breaker located on the electric switchboard.

Do not replace components or make adjustments inside the unit when the voltage supply is turned ON. Always remove power and discharge to ground a circuit before touching it. Under no circumstances should any person initiate servicing or repairing the unit except in the presence of a qualified person.

Ensure unobstructed access to all operator panels, controls, and relevant switchgear cabinets in order to enable instant response to alarms.

Whenever it is necessary to disconnect the waveguide from a radar transmitter for maintenance purpose, the transmitter output should be terminated with a matched load. If this is not possible, care should be taken. Do not stand in front of an open-ended waveguide from which power is being radiated.

→ ***Note:*** Main power is always present on the terminal board unless the main break from the power distribution panel of the vessel is turned off.

> ⚠ Warning: Never look down a waveguide from which power is being radiated!

Warnings

High voltage

Radar equipment includes high voltage that can cause injury or loss of life. Danger exists only when the units are opened, exposing internal circuits, as when servicing the equipment.

This radar has been carefully designed to protect personnel from possible injury from high voltages. Although every effort has been made to eliminate danger to personnel, no responsibility is accepted for any injury or loss of life suffered in connection with this equipment.

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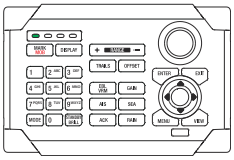
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1 Introduction

R2009 and R3016 Radar control units

The R2009 and R3016 are dedicated radar control units with integrated 9-inch portrait and 16-inch widescreen display. The units are compatible with a range of Simrad® radar solutions, including Halo® Pulse Compression, and HD Digital radars.



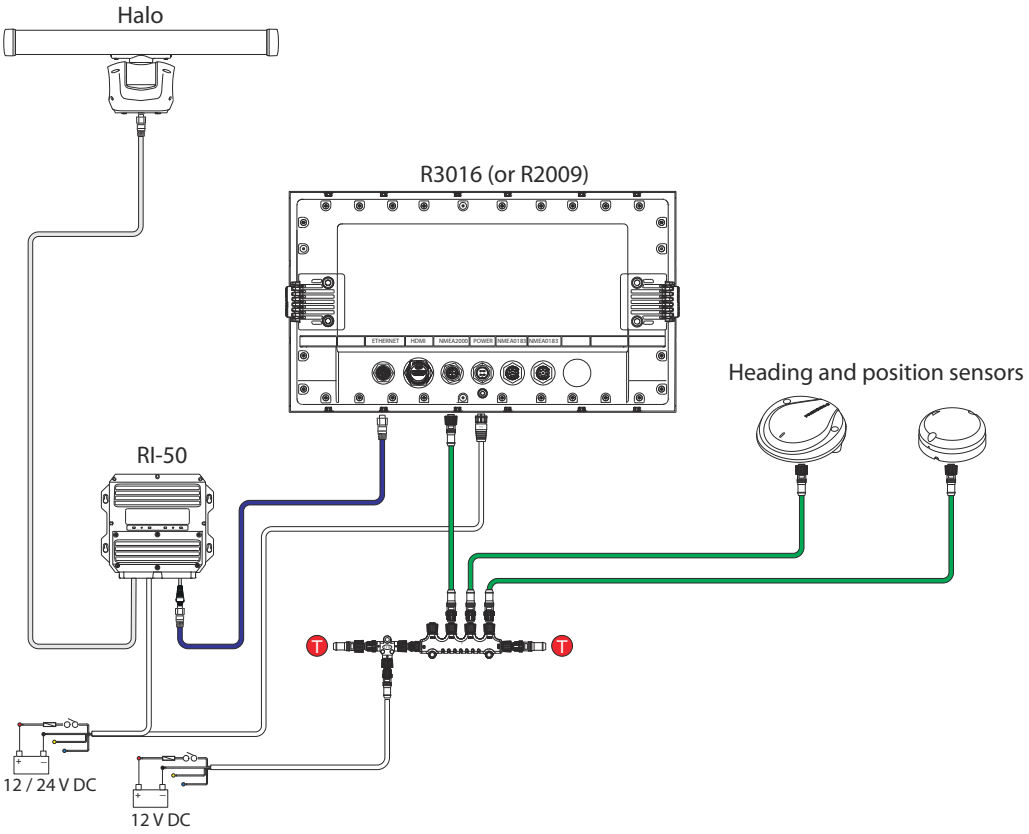
O2000 Controller

The optional O2000 Controller can be used to remotely operate up to 4 radar control units.

Separate documentation is delivered for the O2000 Controller.

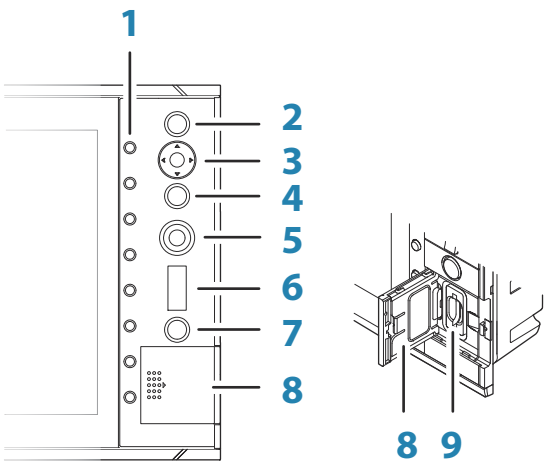
System diagram

The illustration is an example of a basic system installation, including one control unit, a radar antenna, a heading sensor and a position sensor.



2 The user interface

Front panel and keys



1 **Softkeys**
Press a key once to access options for the corresponding function.

2 **Enter (ENT) key**
With no menu or cursor not active: no function.
With cursor active on PPI: press to acquire a selected target, press and hold to display options for managing targets.
Menu and pop-up operation: press to select an option or activate/deactivate an option.

3 **Arrow keys**
With no menu active: press to move the cursor on the radar PPI.
Menu operation: press to move through menu items and to adjust a value.

4 **Exit (EXIT) key**
With no menu or cursor not active: no function.
With cursor active on PPI: press to remove cursor.
Menu operation: press to return to previous menu level or to exit a dialog.

5 **Rotary knob**
With no menu active: behavior depending on operational mode.
Menu operation: rotate to scroll through menu items and to adjust values, press to select or to save settings.

6 **Range (RANGE) key**
Press the **+** or the **-** indication to increase or decrease the radar range.

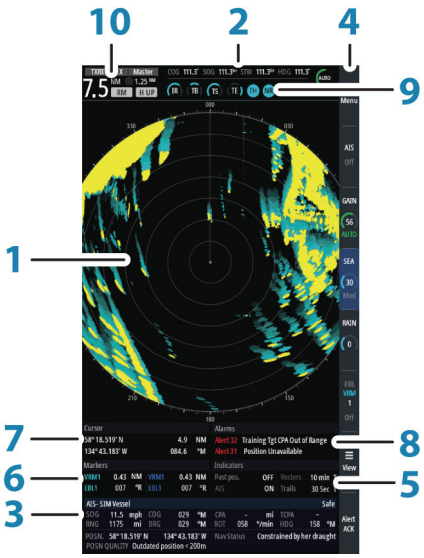
7 **Standby/Brilliance (STANDBY/BRILL) key**
Press once to display the Brilliance/Standby pop-up, press again to toggle between Standby and Transmit mode.
Press and hold to switch the radar system on/off.

8 **Card reader door**

9 **SD card reader**

Main panel

The main panel is divided into predefined areas as shown in the figure below.



A **Plan Position Indicator (PPI)**
Radar video area where all tracking and navigation options are performed.

B **Own ship information**
Stabilization mode indicator, picture freeze indicator and gauges showing primary and secondary sensors.

C **Target panel**
Detailed information about selected targets and AIS targets.

D **Softkey bar**
Reference for softkey functions.

E **Target indicators**
Overview of target indicator settings.

F **Markers**
Details for active VRM and EBL markers.

G **Cursor information**
Range and bearing from the vessel to the cursor position. Also including position information if a position source is available.

H **Alerts panel**
List of all active alerts.

I **Signal indicators**
Gauges for signal processing and indicators for radar functions.

J **System information**
Range, mode and pulse details.



PPI symbols

Range rings and heading line symbols can be turned on and off individually from the PPI symbols sub menu.

The **Overlay graphic off** menu option turns off all graphics overlaid on the radar PPI, showing only the video signal.

→ ***Note:*** The **Heading line off** and **Overlay graphic off** menu options are mono stable, meaning that you need to press and hold the **ENT** key or the right arrow key to temporarily remove the relevant symbols from the panel. The graphics are invisible as long as the key is pressed, and will turn on again when the key is released.

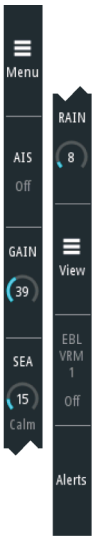
Picture freeze indicator



The Own ship information area includes a picture freeze indicator (A). The small dot blinks at an interval of 1 second to show that the screen is alive and that information from sensors are updated.

If the picture freezes the unit needs to be restarted.

Softkeys



When a softkey is pressed, the function for the selected softkey becomes available.

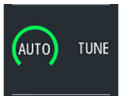
The softkey bar is always displayed on the panel.

More details about the softkey functionality are available in the separate sections describing the functions later in this manual.

→ ***Note:*** The **TUNE/View** softkey depends on the currently active radar scanner.



Halo, 3G, 4G

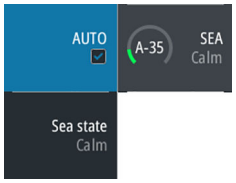


HD Pulse scanners

→ ***Note:*** When the softkey is used for the **TUNE** function, the view option is available in the main menu.

Softkey pop-ups

If you press the **GAIN**, **SEA**, **TUNE** and **EBL/VRM** softkey twice, their corresponding pop-up is displayed.



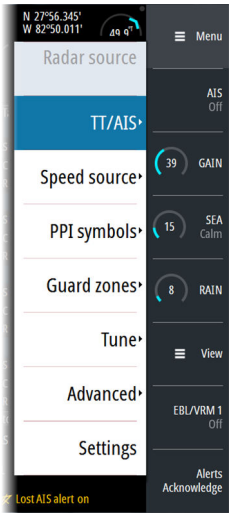
If a pop-up has more than one option, you select the options by using the arrow keys.

You remove the pop-up and revert to the softkey's main function by re-pressing the softkey or by pressing the **Exit** key.

The menu system

The menu system consists of the main menu with sub menus. The main menu gives access to the Settings dialogs.

If a menu is inactive for 10 seconds the menu will automatically close.

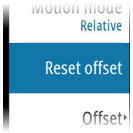


Main menu and sub menus

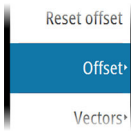
You access the Main menu by pressing the Menu softkey.

- Use the up and down arrow keys or turn the rotary knob to move up and down in a menu
- Press the **ENT** key, the right arrow key or the rotary knob to access a sub menu, to toggle options and to confirm a selection
- Press the **EXIT** key or the left arrow key to return to previous menu level and then exit the menu system

A selected menu item is indicated with a blue background. If a sub-menu is available this is indicated with a right arrow after the text.



Selected menu item

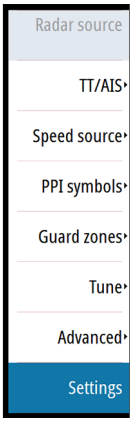


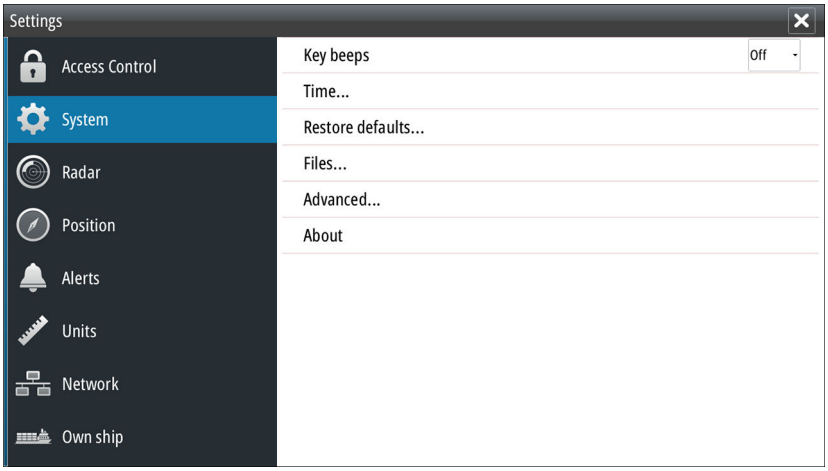
Sub-menu indication

Settings dialogs

The various Settings dialogs provide access to system settings and for vessel specific settings.

You access the Settings dialogs from the Main menu.

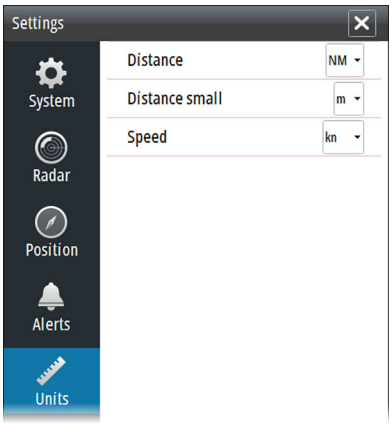




There is no time-out for the Settings dialogs. A dialog remains open until it is manually closed.

Measurements units

You can change the measurement units from the Units Settings dialog.



➔ ***Note:*** Measurements units can only be changed when the connected antenna is in standby.

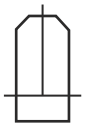
Own vessel symbol

At large range scales, the indication of antenna position, the CCRP and own vessel are the same, and indicated as an own ship minimized symbol.

At small range scales, the vessel's actual size (defined in the commissioning of the radar system) is indicated. If the antenna position deviates from the CCRP this will be shown on the image.



Vessel symbol at large range scale

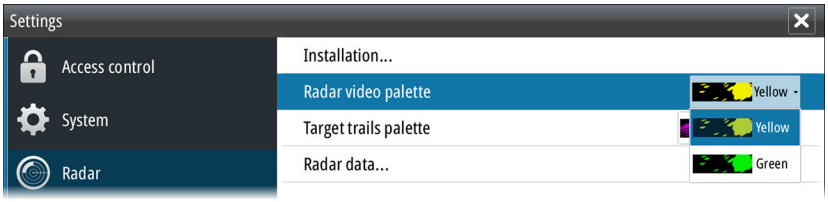


Vessel symbol at small range scale

Radar palettes

Different palettes are available for the radar video and for the target trails.

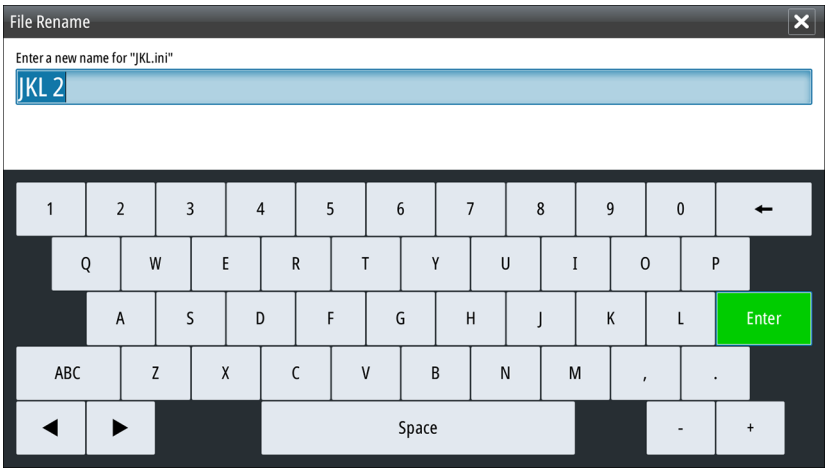
You select the palettes from the Radar Settings dialog.



On-screen keyboard

A numeric or alphanumeric virtual keyboard is displayed when required to enter user information in dialogs.

- Select a virtual key by using the arrow keys followed by the **Enter** key to confirm the selection
- Complete the entry and close the dialog by selecting the **Enter** virtual key



If the virtual keyboard is inactive for 10 seconds it will automatically close.

You remove the virtual keyboard without entering information by pressing the **Exit** key.

Screen capture

Simultaneously press the **ENT** and **Power/Brilliance** keys to take a screen capture. Screen captures are saved to internal memory.

To view files, refer to *"Files"* on page 65.

3 Basic operation

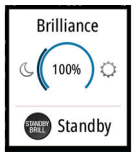
Turning the system on and off

The system is switched ON by pressing the **STANDBY/BRILL** key on the control unit.

Press and hold the **STANDBY/BRILL** key for 5 seconds to turn the control unit and the radar antenna off.

→ ***Note:*** The R2009 Control unit can be wired and configured for power control. If the unit is configured as a power slave, the unit will turn on and off when the power master is turned on and off. Refer to *"Power Control"* on page 65.

Adjusting display brightness



At first start-up the display brilliance is set to 100%. When the unit is restarted the brilliance is automatically set to the level it was prior to switching the unit off.

The brilliance is adjusted from the Brilliance/Standby pop-up.

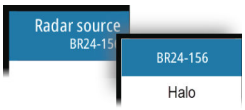
- Display the pop-up by pressing the **STANDBY/BRILL** key, then adjust the display brilliance by turning the rotary knob.

The system includes a Day and a Night color palette, optimized for day and night light conditions. When the brilliance is set to 40% or lower, the system switches to use the night palette.

- With the pop-open, you switch between Day and Night palette by pressing the left (40%) or right (100%) arrow keys.

You remove the pop-up from the panel by pressing the **EXIT** key.

Selecting radar source



More than one antenna can be connected to the radar control unit.

You select active antenna from the main menu.

Switching between Transmit and Standby mode

You toggle between Transmit and Standby mode by short presses on the **STANDBY/BRILL** key when the Brilliance/Standby pop-up is displayed.

Adjusting the radar range

You increase or decrease the range by one step by pressing the **+** and **-** icons on the **Range** key.

The radar range is shown in the upper left corner of the radar panel.

There is a direct link between the range scale and the operation mode of the specific selected transceiver. For more information refer to the radar transceiver's technical documentation.

Using the cursor

The cursor can be used to measure a distance, to define various radar map elements, and to acquire and select targets within the PPI area.

The cursor is by default not active after power on.

- You activate the cursor and display the cursor icon by pressing one of the Arrow keys
- You move the cursor within the PPI area by pressing one of the Arrow keys
- You deactivate the cursor and remove the cursor icon from the PPI by pressing the **EXIT** key

→ ***Note:*** The cursor cannot be activated, deactivated or moved when a menu or a Settings dialog is open.



When the cursor is active on the radar PPI, the cursor information area will show range and bearing from the vessel to the cursor position. If the system is connected to a position source (i.e. EPFS), the cursor information area includes the geographic position of the cursor.

When the cursor is active the **ENT** key is used for managing targets.

Target tracking

When the cursor is active, you can use the **ENT** key for acquiring radar targets.

- Press the **ENT** key once to acquire the target at cursor position without displaying the Cursor ENTER menu
- Press and hold the **ENT** key to display the Cursor ENTER menu.

The items in the Cursor ENTER menu depends on if a target is positioned at the cursor position, the type of target, and the status of the target.



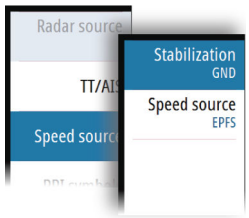
No target at cursor position



Target at cursor position

See more details about Radar targets and AIS target in *"Managing targets"* on page 28.

Selecting speed source and stabilization mode



Speed information can be obtained from different speed sources connected to the system.

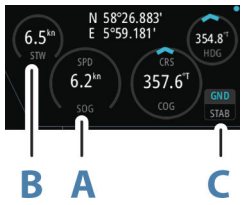
You can at any time switch the preferred primary speed source to any of the available speed sensors from the Speed source menu.

The stabilization mode depends on selected speed source, and the system will automatically switch to the available stabilization mode when you switch speed source.

The table shows stabilization modes available for each speed source type. Any restrictions for a source are detailed under each speed source description in the following sections.

Speed source	Stabilization mode available	Restrictions
Speed LOG (Single axis)	Sea	None
Speed LOG (Dual axis)	Sea and Ground (depending on the transducer)	None
EPFS	Ground	None
Manual	Sea	Yes
Auto drift *	Ground	Yes

* This feature is optional. Refer to *"Activating optional features"* on page 50 for more details.



Primary speed source (**A**), secondary speed source (**B**) and stabilization mode (**C**) are shown in the Own ship information panel.

Speed LOG

The speed LOG can be Single or Dual axis input, either water track or bottom track. Therefore the stabilization mode available can be either Sea or Ground depending on the sensor in use.

→ ***Note:*** The speed through water measured close to the hull is affected by the tide and by the current, so from time to time it will differ significantly from speed over the ground. A Speed Log measuring speed through water may in specific cases be affected by poor conditions due to e.g. air or ice below the sensor. If the sensor measures only the

longitudinal component of the speed, the transversal ship component is unknown to the radar.

EPFS

The EPFS provides true speed and true course over ground.

Manual speed

When this option is selected you can manually enter speed, drift and set (heading).

→ ***Note:*** Manual speed is not available if AIS is turned ON.

Auto drift

→ ***Note:*** This feature is optional. Refer to *"Activating optional features"* on page 50 for more details.

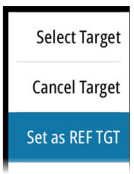
When this option is selected the system uses a stationary tracked target as speed reference for calculating own ship speed. The function is used when no speed sensors are available.

→ ***Note:*** The Auto drift option is only available if the AIS function is OFF and if a target is set as reference.

⚠ Warning: The echo used as reference must be a stationary target. Otherwise all speed calculated will not be true, but only relative to the reference target. It is wrong to select a ship that is anchored as a reference; no alarm will be signaled when the ship starts to move and all the calculated true speed will change to erroneous values. The reference echoes should never be used to calculate relative speed. This data is not following a speed change with adequate accuracy for an anti-collision system.

⚠ Warning: When the reference target is lost, a warning is raised and the speed source will automatically be switched to LOG. If the LOG is working on water track, the speed mode will become sea stabilized and the user will be notified in case of a change of stabilization. The loss of a reference target may have a major impact on the accuracy of the results for true speed and true course of the target, and own speed precision will be degraded.

Selecting the reference target



R 18

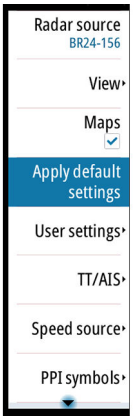
A reference target must be selected before the speed source can be set to Auto drift.

Use the following process to select a reference target:

1. Position the cursor over the preferred target, then press the **ENT** key to display the **Cursor ENTER** menu
2. Activate the Set reference target option

The reference target is labelled with an **R** to identify it as a reference.

Applying default control settings



The default control settings allows for quickly setting the system back to a known state.

From this state you can adjust the settings to suit different conditions. You can save up to 5 user defined control settings in the system. Refer *"Customizing radar control settings"* on page 50.

You return from a User setting to default control settings from the Main menu.

4 Adjusting the radar image

You may improve the radar image by adjusting the gain, by filtering out unwanted echoes due to sea clutter, rain or other weather conditions, and by tuning the sensitivity of the radar receiver.

➔ ***Note:*** Tuning is only available for HD radar sensors.

➔ ***Note:*** The radar image settings do not affect the AIS targets.

Sea and rain clutter could be present at the same time and further degradation in detection performance will be experienced. As sea clutter is related to short range and rain clutter is usually present in a longer range, rain clutter settings can be adjusted without affecting the echoes in the sea clutter area.

> ⚠ Warning: If the precipitation is located over the ship position, the adjustment of rain clutter will affect the presentation of near echoes. Long pulses should not be used in heavy rain as the range will decrease significantly. Maximum range detection of target is slightly affected with moderate rain and short pulse, but becomes only 30% with heavy rain. On long pulses the range decreases to unacceptable 30% with moderate rain to 10% with heavy rain. The X-Band will be useful only for near range detection, using only the short pulse.



Some functions include both a manual and an automatic mode. It is recommended to use the manual mode only if the automatic mode doesn't provide satisfactory results.

The radar image is controlled by dedicated softkeys as described in the next sections.

➔ ***Note:*** It is recommended to turn Trails OFF when you adjust the radar image as trails might hinder the proper video adjustment feedback.

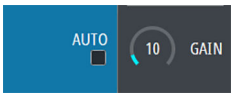
Gain

The Gain option controls the sensitivity of the radar receiver. A higher gain makes the radar more sensitive to radar echoes, allowing it to display weaker targets. If the gain is set too high, the image might be cluttered with background noise.

➔ ***Note:*** The Gain control shall not be used to clean the picture from sea or rain clutter.

The value of the Gain should be set so that the background noise is just visible on the radar panel.

At start-up of the system, the Gain is 80% in order to receive the optimum noise level.



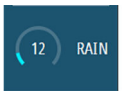
Gain has a manual and an automatic mode.

You adjust the gain by using the **GAIN** softkey:

- Press the softkey once to activate the function, then turn the rotary knob to manually adjust the setting
- Press and hold the softkey to turn on/off the automatic option
- Press the softkey twice to display the Gain pop-up, then press the **ENT** key to turn on/off the automatic option

Rain anti-clutter

Rain anti-clutter is used to reduce the effect of rain, snow or other weather conditions on the radar image. When you increase the value, the sensitivity of the long distance field clutter caused by rain is reduced. The value should not be increased too much as this may filter out real targets.



Rain anti-clutter has no automatic mode.

You adjust the rain anti-clutter by using the **RAIN** softkey:

- Press the softkey once to activate the function, then turn the rotary knob to manually adjust the setting.

Sea anti-clutter

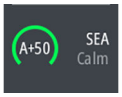
The Sea anti-clutter option is used to filter the effect of random echo returns from waves or rough water near the vessel. When you increase the value, the sensitivity of the near field clutter caused by waves is reduced. If the value is increased too much, both sea clutter and targets will disappear from the display and targets around own ship may not show potentially dangerous targets.

> ⚠ Warning: At increasing levels of sea clutter, some targets cannot be detected even by means of the Sea anti-clutter filtering, since buoys or other small objects are producing echoes of a level lower than the ones coming from waves.

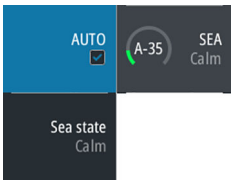
The value of the Sea anti-clutter should be set so that the clutter is seen as small dots, and small targets will become distinguishable around the ship.

Sea anti-clutter has a manual mode and automatic mode(s), and the system includes predefined settings for Calm, Moderate and Rough sea state conditions.

The Sea anti-clutter automatic options are scanner dependent:



You adjust the sea clutter by using the **SEA** softkey:



- Press the softkey once to activate the function, then turn the rotary knob to fine tune the setting
- Press the softkey twice to display the Sea pop-up, then:
  - press the **ENT** key or the rotary knob to toggle between manual and automatic modes
  - use the arrow keys to select the Sea state option, then press the **ENT** key or the rotary knob to toggle through the predefined sea state conditions (Calm, Moderate and Rough)

Tune

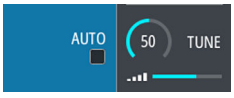
→ ***Note:*** Tuning is only required for HD radar sensors.

You can tune the radar receiver to have maximum target returns on the screen.

Tuning has a manual and an automatic mode.

In automatic tuning mode, the transceiver performs a tuning of the receiver when the range scale changes.

Manual tuning should only be used if the automatic tuning fails. The tuning should not be performed earlier than 10 minutes after the radar has been switched on. Manual tuning is best done by a long pulse setting (range set to 24 NM), and by using a high level of gain. In this condition, adjust the tuning control to obtain the maximum signal strength.



You adjust the tuning by using the **TUNE** softkey:

- Press the softkey once to activate the function, then turn the rotary knob to manually adjust the setting
- Press and hold the softkey to turn on/off the automatic option
- Press the softkey twice to display the Tune pop-up, then press the **ENT** key, the right arrow key or the rotary knob to turn on/off the automatic option

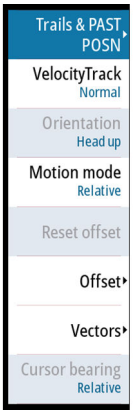
5

Radar view options

Several radar view options are available from the View sub menu.

The View sub menu is activated by pressing the **View** softkey and available when the system is connected to Halo, 3G and 4G radar scanners, or from the menu when connected to HD Pulse scanners.

→ ***Note:*** Motion mode and Reset Offset are disabled at max zoom range (72 NM). The functions are enabled again when zooming down one level.



Target trails and past position

You select how the radar targets are displayed on the radar image in the trails and past position submenu. See *"Display settings for radar targets"* on page 29.

VelocityTrack

This option is available for radar antennas that have Doppler coloring functionality.

This is an unlock feature, refer to *"Feature unlock"* on page 24.

→ ***Note:*** When VelocityTrack is enabled antenna rotation speed may be reduced.

Doppler coloring is a navigation aid to distinguish moving targets approaching or diverging from your vessel. The radar indicates if a target is approaching or diverging from your vessel when both these conditions are true:

- The target's relative speed is greater than the VelocityTrack speed threshold.
- The target is not geo-stationary (e.g. land or a marker buoy).

The following options are available:

- Off - turns off Doppler coloring
- Normal - approaching targets and diverging targets are colored.
- Approaching targets - only approaching targets are colored

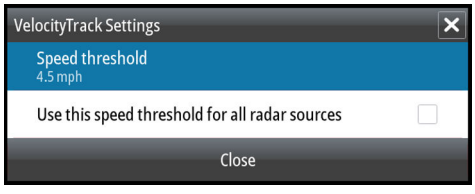
The color of approaching and diverging targets depends on the palette used:

- Diverging targets are blue colored on all radar image palettes.
- Approaching target colors on radar image palettes:
  - Black/Red palette - Yellow
  - White/Red palette - Yellow
  - Black/Green palette - Red
  - Black/Yellow palette - Red

VelocityTrack settings

Use this dialog to set speed thresholds of targets to be colored.

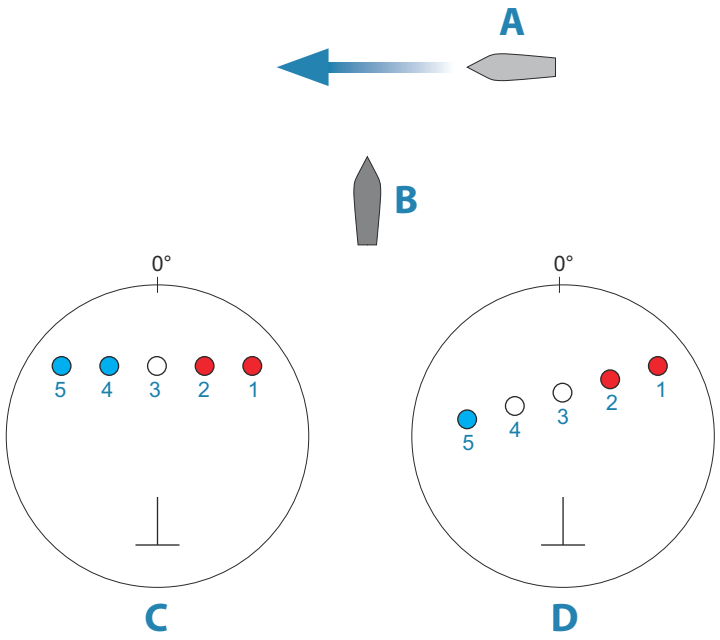
The speed threshold can be defined to apply for the radar source of the selected radar panel only, or to all radar sources connected to the system. The setting is only applied to those radars powered and connected at the time the setting is made. If the all radar sources option is selected, newly connected radars will use the specified values automatically.



VelocityTrack examples

Approaching and diverging moving targets can be indicated as neutral (not colored) in some circumstances. The navigator should be aware of these situations to safely use the VelocityTrack feature as an aid for collision avoidance.

Examples of how VelocityTrack behaves in 2 navigation scenarios is illustrated below. The illustrations show a target (**A**) crossing own vessel's (**B**) path.



The examples show the target movement (1-5) over 5 radar scans with the radar in relative motion mode.

In example **C**, own vessel COG is 0°, and speed is 0 knots.

In example **D**, own vessel COG is 0°, and speed is 10 knots.

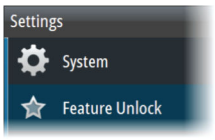
In both examples, the target COG is 270°, and the speed is 20 knots.

The colors in the example are according to the colors used for black/green and black/yellow radar palettes:

- Red, indicating the target is on an approaching path to own vessel. It's relative speed at that point is greater than the VelocityTrack speed threshold.
- Not colored, indicating it is temporarily neutral because it's relative speed at that point is less than the VelocityTrack speed threshold.
- Blue, indicating the target is diverging away from own vessel and it's relative speed at that point is greater than the VelocityTrack speed threshold.

Feature unlock

Features can be unlocked by entering the feature unlock code.



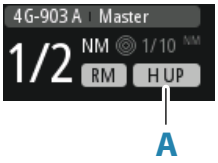
→ ***Note:*** The Feature Unlock option is only available if your unit supports a locked feature.

Select the Feature Unlock option in the Settings dialog and then the feature you want to unlock. Follow the instructions to purchase and enter the feature unlock code.

After a feature unlock code is entered in the unit, the feature is available for use.

Radar orientation

Selected radar orientation is shown in the System information panel (A).



Head-up

In head-up mode, the heading line on the PPI is oriented on the 0° on the bearing scale and towards the top of the screen. The radar image is displayed relative to own ship, and when the ship turns the radar image rotates.

→ ***Note:*** Head-up is only available in relative motion mode, and it is the only orientation mode available if the radar is not connected to a heading source.

North up

In North up mode the 0° indication on the PPI represents north. The heading line on the PPI is oriented according to own ship heading obtained from the gyro compass. When the ship turns the heading line changes its direction according to the ship's heading, while the radar image remains stabilized.

The North up orientation is not available if no heading source is connected to the radar. If heading data is lost, the system will automatically switch to Head-up orientation.

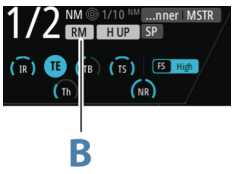
Course up

In Course up mode, the top of the bearing scale indicates the ship's true course measured from north at the time Course up was activated. When the ship turns the bearing scale remains fixed, while the heading line rotates with the ship's yawing and course change.

The Course up orientation is reset by re-selecting the Course up mode.

Radar motion mode

Selected radar motion mode is shown in the System information panel (B).



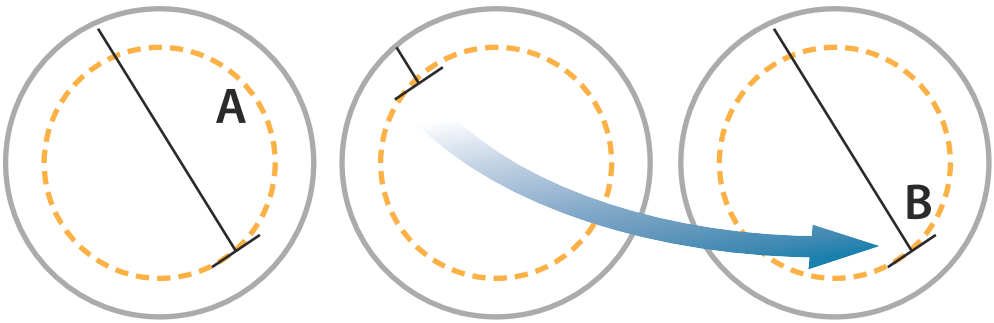
Relative motion

In Relative motion your vessel remains in a fixed location on the Radar PPI, and all other objects move relative to your position.

You select the position of the fixed location as described in *"Offsetting the PPI center"* on page 26.

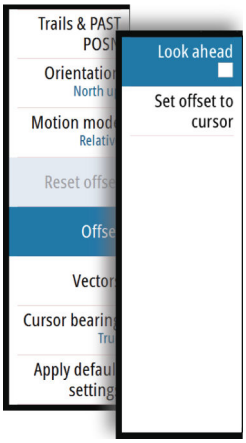
True motion

In true motion your vessel and all moving targets move across the Radar PPI as you travel. All stationary objects remain in a fixed position. When the vessel's symbol reaches 75% of the PPI radius (**A**), the radar image is redrawn with the vessel symbol re-positioned (**B**) 180° opposite the current heading bearing.



When true motion is selected, the true motion reset option is available from the menu. This allows for manually resetting the radar image and vessel symbol to its starting position.

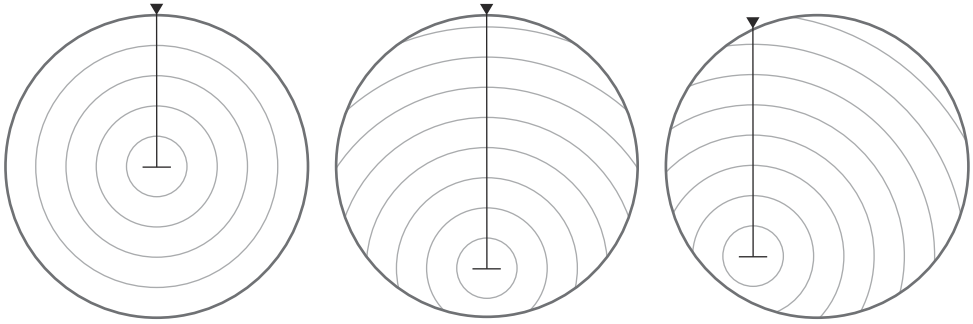
→ ***Note:*** True motion is only available when the PPI is in either north up or course up orientation mode.



Offsetting the PPI center

You can set the antenna position origin to different location on the radar PPI. The options described in the next sections are available.

→ ***Note:*** Offsetting the PPI center is allowed only in Relative motion.



PPI center: Center *PPI center: Look Ahead* *PPI Center: Offset*

You return the antenna center to PPI center by using the **Reset offset** option in the View menu.



→ ***Note:*** The bearing scale is according to the Consistent Common Reference Point (CCRP), while the offset sets the radar antenna position on the PPI. The maximum off-centering allowed is 75% of the radius at the current range. This may result in the CCRP being outside of the bearing scale. In such cases the measurements are still taken by the CCRP and the bearing scale is compressed accordingly.

Center

The Center option resets the antenna position to the center of the PPI.

Look ahead

The Look ahead option is used to maximize the view ahead of the vessel. When selected the PPI center is placed at 70% of the radius of the PPI, 180° opposite the top of the display.

→ ***Note:*** Look ahead is only available for Heading Up radar orientation.

Offset to cursor position

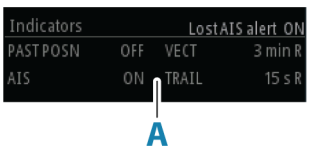
This option allows you to use the cursor for selecting the antenna center. When the option is selected the PPI center is immediately moved to the cursor position.

Vectors

A target vector indicates the expected target movement within a defined time. The vectors are computed by multiplying the target speed with the set time value.

You can select to show target vectors with true or relative speed, and you can set the length of the vector. The length represents the vessel movement within the given time period.

Vector settings are shown in the Target indicators panel (**A**).



→ ***Note:*** True speed indication is not possible if there is a Gyro or Speed source failure. If the vectors are in true presentation and one of the sensors (gyro or speed log) fails, the presentation is automatically switched to relative.

Cursor bearings

You can select to show the cursor bearings as true or relative to own vessel.

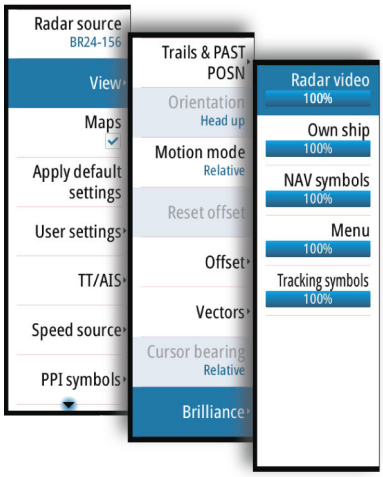
➔ ***Note:*** True can only be selected when a gyro is available.

Setting the brilliance for individual panel items

➔ ***Note:*** This feature is optional. Refer to *"Activating optional features"* on page 50 for more details.

The brilliance can be set individually for the various panel items.

The brilliance is adjusted from the Brilliance sub-menu.



6 Target tracking

Radar targets and AIS targets are used to estimate the relative speed and direction, and the system can alert the user about potentially dangerous targets and loss of communication with an AIS target.

Managing targets

When the cursor is active, you can use the **ENT** key for acquiring radar targets and for activating AIS targets.

- Press the **ENT** key once to acquire the target at cursor position without displaying the Cursor ENTER menu
- Press and hold the **ENT** key to display the Cursor ENTER menu.

The items in the Cursor ENTER menu depends on if a target is positioned at the cursor position, the type of target, and the status of the target.

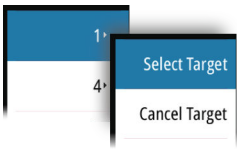
If more than one target is located at cursor position, the menu will show reference number for radar targets and ship names for AIS targets.



No target at cursor position



One target at cursor position



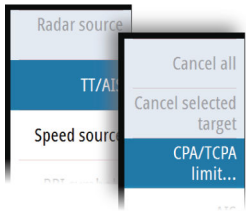
Two radar targets at cursor position

Selecting and de-selecting targets

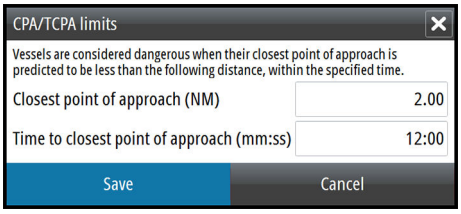
AIS targets and tracked radar targets can be selected, but only one target can be selected at a time. When a target is selected the target symbol will change to selected target, and the Targets panel will show detailed information for the target.

You de-select a target and remove the detailed target information in the Target Panel by selecting the deselect target option in the Cursor ENTER menu.

Defining dangerous vessels



You can use the CPA (Closest point of approach) and TCPA (Time to closest point of approach) values to define when a target should be considered as dangerous. When a radar or AIS target comes within the distance for CPA or within the time limit for TCPA, the symbol changes to the Dangerous target symbol.



Radar targets

Any radar echo can be acquired and tracked.

Acquiring radar targets

The acquire target option is used for acquiring any targets within the radar range.

To start tracking a radar target, move the cursor to the target and then either:

- Press the **ENT** key once to acquire the selected target without displaying the Cursor ENTER menu
- Press and hold the **ENT** key to display the Cursor ENTER menu, then select the **Acquire target** menu option

There might be a delay after having selected the target before the system received stable target data:

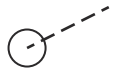
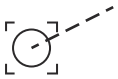
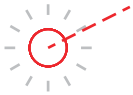
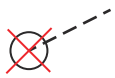
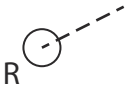
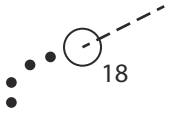
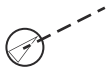
- After 1 minute the symbol will show a trend vector, and speed and course of the trend will be shown in the Target panel
- After 3 minutes the symbol will become steady, and all the data fields of selected targets will be available. The target symbol will change to tracked radar target symbol

The above time references represent worst case situations. In a stable situation the radar target information is available immediately.

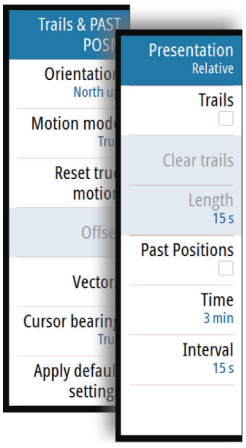
➔ ***Note:*** The CPA/TCPA anti-collision functions will be enabled for tracked radar targets.

Radar target symbols

The following symbols are used for radar targets in the system:

Symbol	Description
	**Tracked Radar target** with velocity vector
	**Selected Radar target**, indicated with a square (dotted line) around the target symbol
	**Dangerous Radar target**, indicated with bold line and with red color.The symbol flashes until the target alarm is acknowledged by the operator. It remains red until the system no longer defines it as a dangerous target
	**Lost Radar target**, indicated with crossed lines centered on the target symbol. The symbol is located at the last received position from the target
	**Reference target**
	**Radar target** with past position and velocity vector
	**Radar target in acquisition state**, indicated as a broken circle centered at the position of target acquisition
	**Associated target** - using radar data

Display settings for radar targets



You select how the radar targets are displayed on the radar image in the Trails and past position sub menu.

The settings are indicated in the Indicators panel.

Trails and past position presentation mode

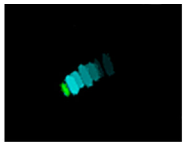
Trails and past position indicators can be displayed as either true or relative to own ship.

Trails and past position indicators are available in both Sea and Ground stabilization modes. See *"Selecting speed source and stabilization mode"* on page 18.

Target trails

A target trail indicates the target movement by leaving an afterglow, gradually reducing the intensity over time.

Target trails show where a target used to be, and the function is useful for quickly assessing the movement of targets relative to your own vessel.



You can set the length of the trails. The length represents the time it takes for the trails to fade out.

The **Clear trails** option clears target trails from your radar panel temporarily. The trails start to build up again unless you switch the function off.



Showing a target's past positions

The **Past positions** option is used to visualize the previous positions of a tracked target or an activated AIS target.

The **Time** defines the length of time for which each target's past positions should be displayed on the PPI. The **Interval** defines the distance between each past position indicator.

⚠ Warning: Trails build-up starts when exiting from the standby condition. Trails or past position length will be reached only after the selected time duration.

Possible target tracking errors

Some factors can generate tracking errors or make the radar image difficult to read, and therefore reduce target detection capability:

- Sea, rain, snow and low clouds returns
- Radar Interference
- Sidelobe echoes
- Blind sectors
- Low signal to noise ratio and signal to clutter ratio

⚠ Warning: The speed and course of a radar target are obtained by consecutive measurements of the echo position. The data is then filtered to reach the required precision. This means, that every abrupt change of speed and direction will be recognized with a certain delay to reach absolute certainty that the target is moving in a different way. The confirmation delay is about five scans and after that some additional time is needed to reach the same data precision as from before the maneuver.

Sea, rain, snow and low clouds returns

Radar echoes in sea, rain or weather clutter areas may be masked by the clutter. The effects of such errors appear as continuous big changes of the target course and speed vectors. Sometimes the symbol of a target that has been acquired at high speed can slip away from the real target position after a certain time, and this might generate the lost target alarm.

These errors can be avoided or at least minimized by proper manual adjustments of sea and rain controls, or by selecting the automatic control option. For more details, see *"Adjusting the radar image"* on page 21.

Radar interference

Other radars operating in the same frequency band can generate interference. Normally this is seen on the radar screen as a series of spirals. When the interference falls on the tracked target, it can cause a deformation of the size of the echo, and consequently a small error in the target's course and speed values.

Adjustment option is available in the Advanced menu. See *"Rejecting radar interference"* on page 52.

Sidelobe echoes

Radar antennas have a radiation pattern consisting of a main lobe and several very small sidelobes. Most of the energy transmitted by the radar is radiated and received back on the main lobe, and a very small part on the sidelobes. This has no effect in case of distant or small targets, but the returns from a large target at short range (less than 3 NM) can generate, on both sides of the main echo and at the same range, arcs or series of small echoes. These

effects, when they are an extension of the main echo, can cause momentary errors for the tracking, and course and speed values given by the tracking can become unstable.

The problem can usually be eliminated or strongly reduced by an accurate adjustment of the Sea control. Refer *"Sea anti-clutter"* on page 22.

Blind sectors

Funnels, masts or other obstructions (when located near the radar antenna) may cause blind or shadow sectors, where the target visibility may be completely lost or strongly reduced. Targets remaining in these sectors for a long time (more than 10 antenna revolutions) will be considered lost, and the lost target alert will be triggered.

Low signal to noise ratio and signal to clutter ratio

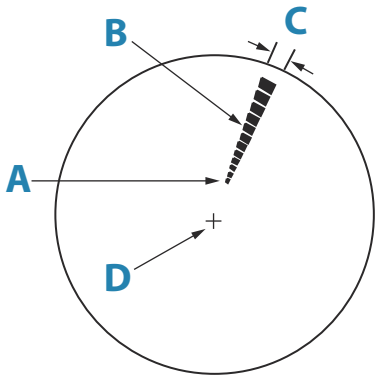
In situations where the signal to noise or the signal to clutter ratio of the radar echoes is low (small vessels in heavy sea or rain clutter, or big vessels close to the radar horizon), target detection is poor and the tracking will not detect the target at each antenna revolution. This will cause errors in the tracking, and it can range from missed information and up to complete loss of the target when it is missed for 10 consecutive antenna revolutions.

Radar SART

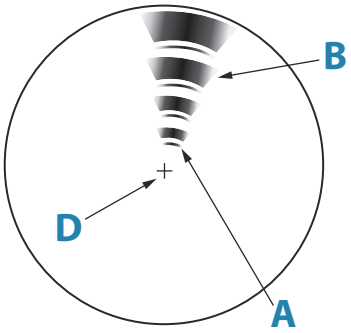
A SART (Search And Rescue Transponder) is used for emergencies. These devices may be either a radar-SART, or a GPS-based AIS-SART.

The radar-SART is used to locate a survival craft or distressed vessel by creating a series of dots on the radar PPI. The range for detection of a radar-SART is normally about 8 NM, and its signal may be triggered by any X-Band radar.

As the radar-SART is very near, side lobes from the radar antenna may show the responses as a series of concentric arcs or rings. This effect can be removed by using the Sea anti-clutter control. It is useful to observe the side lobes as they might be easier to detect in clutter conditions, and they will confirm that the radar-SART is very close to own ship.



Radar-SART far from own vessel (range: 24 NM)



Radar-SART close to own vessel (range: 3 NM)

Recommended settings for radar-SART detection

To best detect a radar-SART signal, adjust the settings as follows:

- Set the range scale between 6 and 24 NM
  - The spacing between responses is too small to be distinguished at higher scales (0.64 NM)
  - The length of the radar-SART response (12 dots) may be extended to 9.5 NM beyond the position of the radar-SART, and it is necessary to see more than one response dot to distinguish the radar-SART from other responses
- Set the sea clutter control to manual mode and adjust it to minimum
  - A high value could remove the SART response

→ ***Note:*** With a minimum value for SEA anti-clutter ships inside the clutter range may not be visible to the radar.
If the sea clutter is strong when the SEA anti-clutter control set to minimum, the first few dots of the radar-SART response might not be detectable. In such conditions the

position of the radar-SART may be estimated by using the EBL/VRM off center function and measure 9.5 nautical miles from the farthest dot back towards own ship.

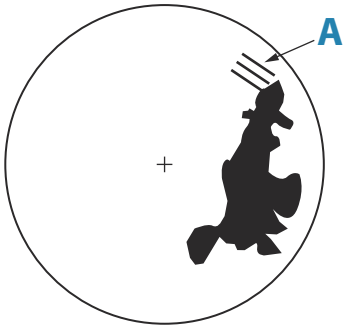
- Set the rain anti-clutter control to manual mode, and adjust as required to avoid rain clutter
  - The setting does not affect the radar-SART detection
- Set the gain control to manual mode, and adjust is to see some noise dots in the background
  - Normal gain setting for long range detection can usually be used (around 80% of max range)
- Turn OFF target boost. See *"Target boost"* on page 53
  - The shape and dimension of the radar-SART dots could be affected by this setting.

⚠ Warning: The operator should take care when using the radar with these settings. The detuned radar will not be able to see and track targets as it will when it is tuned, and the anti-collision functions may no longer be working. The tuning should be returned to normal as soon as possible.

Racons

A racon (radar beacon) is a radar transponder commonly used to mark maritime navigational hazards.

A racon responds to a received radar pulse by transmitting an identifiable mark back to the radar. The displayed response has a length on the radar display corresponding to a few nautical miles, encoded as a morse character beginning with a dash for identification. The inherent delay in the racon causes the displayed response to appear behind the echo from the structure on which the racon is mounted (**A**).



Racons and their identifying marks are normally indicated on marine charts. Their purpose can change with the country they are used in. Generally they are used to:

- Identify aids to navigation, both seaborne (buoys) and land-based (lighthouses)
- Identify landfall or positions on inconspicuous coastlines
- Indicate navigable spans under bridges
- Identify offshore oil platforms and similar structures
- Identify and warn of environmentally-sensitive areas (such as coral reefs)

In some countries they are also used to:

- Mark new and uncharted hazards (these should use the Morse identifier "D")
- Identify center and turning points
- Leading line racons

Racons installed on buoys are usually active for 20 seconds, and then off for the next 20 seconds.

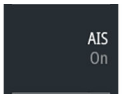
Recommended settings for racon detection

The racon response could be degraded by rain and sea anti-clutter control, and by interference suppression. Turning off of the above mentioned settings should improve the

racon visibility on the PPI. The detection range of a racon may also be reduced if the radar receiver is not tuned.

AIS targets

If a compatible AIS receiver is connected to the radar system, any targets detected by these devices can be displayed and tracked. You can set alarms to notify you if an AIS target gets too close or if the target is lost.



The system can display up to 120 targets, of which a maximum of 20 can be activated.

An alert is triggered if the number of AIS targets exceeds 95% of the maximum system limitation and when the maximum capacity is reached.

When the total AIS capacity is reached, additional AIS targets will be visualized following a range based priority logic. Only the target closest to the own vessel will be visualized. If you try to activate more than 20 AIS targets you will be warned by a message that no more activations are allowed.

By default, all AIS targets are shown on the panel if an AIS device is connected to the system and the AIS function turned ON. You can select to filter AIS targets as described in *"AIS target filtering"* on page 35.

The AIS function is available when:

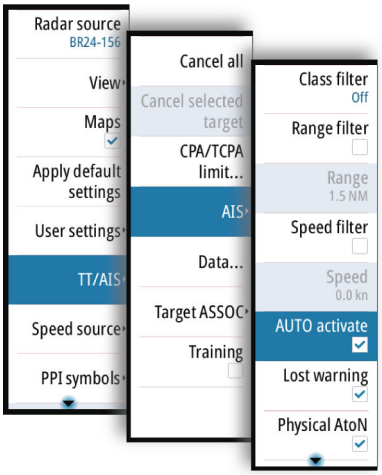
- AIS data is available through the serial line
- Gyro compass heading is available. If gyro heading is lost the AIS function is automatically switched OFF
- EPFS valid position is available

Sleeping AIS targets

All received AIS targets are initially presented in sleeping status. A sleeping target does not show vectors and heading lines, but only a small icon pointing in the direction of the target's heading.

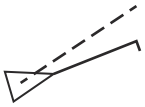
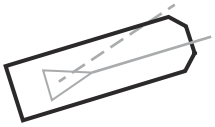
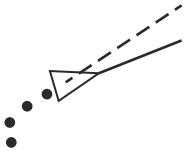
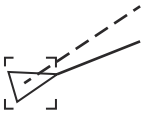
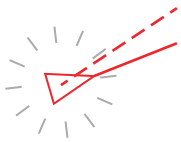
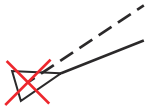
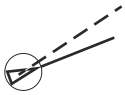
You can manually switch a sleeping target to an activated target. An activated AIS target shows a larger icon, and it has an associated vector, heading line and a turning indicator if available. Activated AIS targets are always processed against CPA/TCPA limits, and are defined as dangerous target if the CPA/TCPA limits are exceeded.

You can enable the system to automatically switch a sleeping target to an activated target when the CPA or TCPA is lower than the set minimum safe value. In this situation the AIS target is automatically defined as a dangerous target.



AIS target symbols

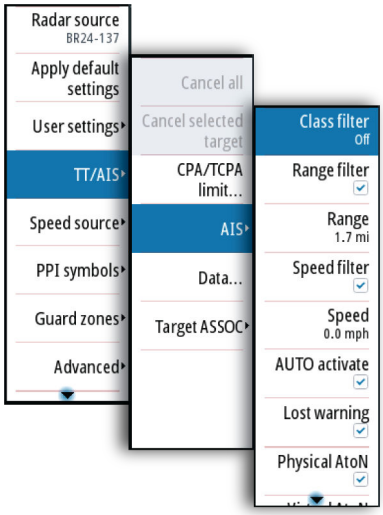
The following icons are used for AIS targets in the system:

Symbol	Description
	**Sleeping AIS target**, aligned with received heading information or with COG information if heading is not available
	**AIS target** with heading line and SOG/COG (dotted line), and with indicated turn direction
	**AIS target** with true scaled outlines
	**AIS target** with past track
	**Selected AIS target**, indicated with a square (dotted line) around the target symbol
	**Dangerous AIS target** indicated with bold line and with red color. The symbol flashes until the target alarm is acknowledged by the operator
	**Lost AIS target**, indicated with crossed lines centered on the target symbol. The symbol is located at the last received position from the target
	**Associated target** - using AIS data
	**AIS SART** (AIS Search And Rescue Transmitter)
	**AIS Base station**
	**Real AtoN** (Aids To Navigation)
	**Virtual AtoN**

For a complete list of AIS and AtoN symbols, refer to *"Target symbols"* on page 89.

→ ***Note:*** A symbol is drawn with a dotted line if the collision avoidance cannot be calculated.

AIS target filtering



By default, all AIS targets are shown on the panel if an AIS device is connected to the system and the AIS function turned ON.

Activated AIS targets are labeled with the same ID as shown for the AIS target in the Target panel. This label can be turned ON and OFF from the AIS sub menu.

You can select to filter the icons based on range and target speed from the AIS sub menu.

It is possible to refine further the filtering by applying the filters only to Class A or Class B vessels. From the same AIS sub menu you can select to not display AIS data reports.

AIS and radar target association

When an echo with its AIS symbol on top is being acquired for tracking, the system can detect that the two symbols represent the same target with the target association function. When the function is activated, the radar target and the AIS target are associated. You select whether to use source data from the AIS target or from the tracked radar target.



Associated targets - using AIS data



Associated targets - using radar data

This function is useful for reducing the number of AIS symbols and radar targets on the PPI. Too many targets could clutter the screen and result in dangerous situations. The function also compensates for a possible failure in one of the two targets, e.g. if the radar tracked target falls behind an island, the system keeps tracking and visualizing the AIS target.

→ ***Note:*** The tracked radar target continues to be analyzed by the system when the target association is active.

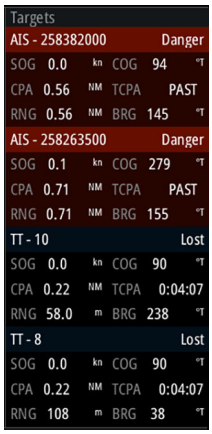
Displaying target information

The Target panel

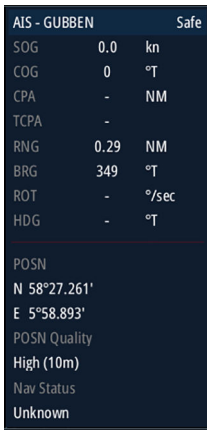
By default the Target panel displays basic information about four targets.

The panel displays both tracked radar targets and AIS targets. The targets listed are prioritised by CPA, TCPA, Range.

When you select a radar or an AIS target, the Target panel changes to show detailed information for the selected target. This information remains in the Target panel until the target is de-selected.

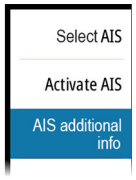


Target panel - no targets selected

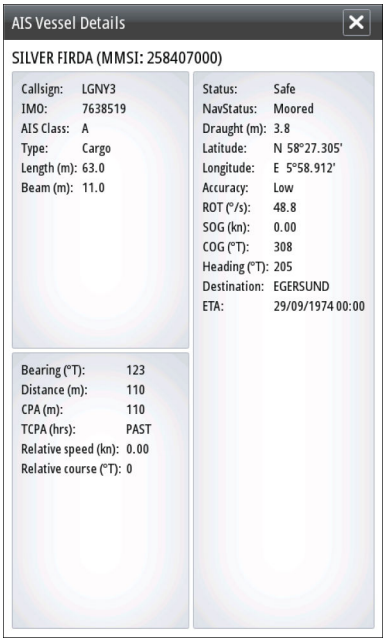


Target panel - AIS target selected

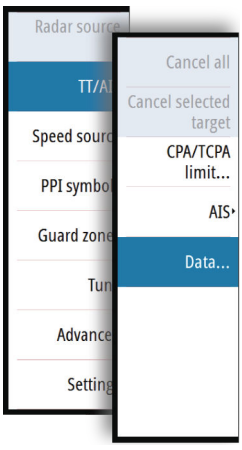
AIS vessel details dialog



Detailed information about an AIS target is available by pressing the **ENTER** key when the cursor is over an AIS target.

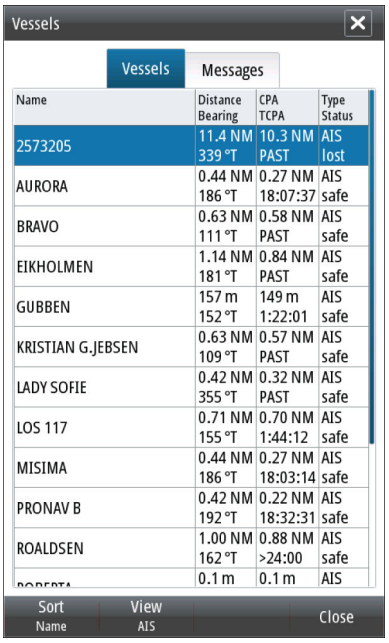


The Vessels dialog



The Vessels dialog displays a list of all tracked targets. The dialog is activated from the TT/AIS menu or by pressing and holding the AIS softkey.

This dialog lists targets by distance to own vessel, but allows for sorting the targets based on target name. The dialog also lists received AIS messages.


Vessels
Vessels
Messages
Name
Distance Bearing
CPA TCPA
Type Status
2573205
11.4 NM 339 °T
10.3 NM PAST
AIS lost
AURORA
0.44 NM 186 °T
0.27 NM 18:07:37
AIS safe
BRAVO
0.63 NM 111 °T
0.58 NM PAST
AIS safe
EIKHOLMEN
1.14 NM 181 °T
0.84 NM PAST
AIS safe
GUBBEN
157 m 152 °T
149 m 1:22:01
AIS safe
KRISTIAN G.JEBSEN
0.63 NM 109 °T
0.57 NM PAST
AIS safe
LADY SOFIE
0.42 NM 355 °T
0.32 NM PAST
AIS safe
LOS 117
0.71 NM 155 °T
0.70 NM 1:44:12
AIS safe
MISIMA
0.44 NM 186 °T
0.27 NM 18:03:14
AIS safe
PRONAV B
0.42 NM 192 °T
0.22 NM 18:32:31
AIS safe
ROALDSEN
1.00 NM 162 °T
0.88 NM >24:00
AIS safe
0.1 m
0.1 m
AIS
Sort Name
View AIS
Close

7 Navigation tools

Guard zones

The Guard zone function is used to warn the user about objects inside a specified zone ahead or around your vessel.

You can define two guard zones with individual settings.

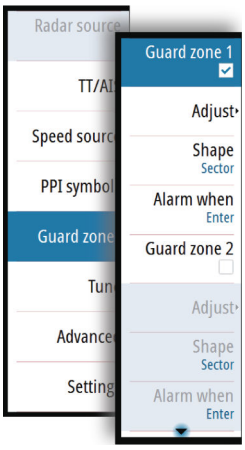
When a guard zone is activated the following happens:

- Any radar echo and AIS target received near the same position for 3 consecutive scans are automatically acquired
- The target symbol changes to indicate a dangerous target
- An alert text is displayed in the Alert panel

The alert indications remain as long as the target is within the guard zone.

You turn the guard zones on/off and manage the guard zone settings from the Guard zone sub menu.

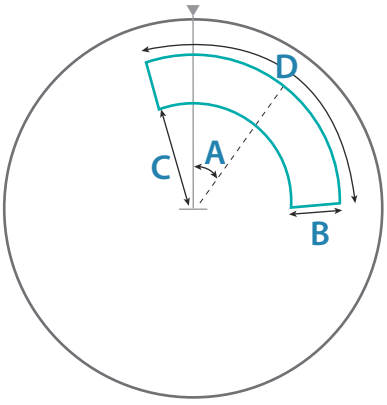
Defining a guard zone



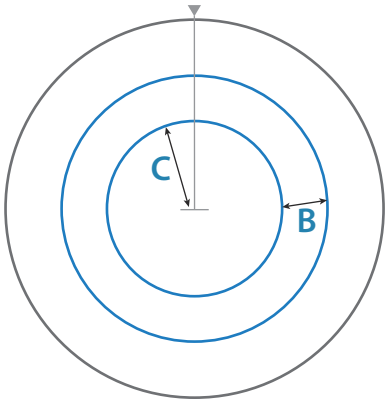
1. Turn on the guard zone you want to define
2. Select the shape for the zone
   - The adjustment options depends on the guard zone shape
3. Select **Adjust** to define the setting for the guard zone:
   - **A**: Bearing, relative to vessel heading
   - **B**: Depth
   - **C**: Range, relative to vessel center
   - **D**: Width
4. Set the value by turning the rotary knob, then press the rotary knob or the **ENT** key to save the value and move focus to the next adjustment icon



5. Press the **EXIT** key to return to the radar image

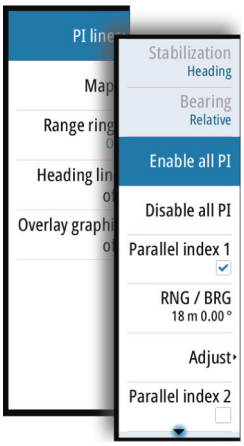


Shape: Sector



Shape: Circle

Parallel index lines



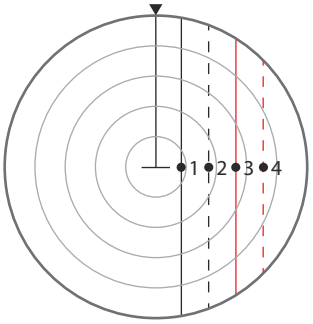
Parallel Index (PI) lines are used to visualize a distance to own vessel, other vessels or to land objects. Two index lines can be used to indicate a corridor - typically used to visualize an area you want to maneuver within.

The PI lines can be defined with north or heading stabilization, and with true or relative bearing.

- North stabilization: the line direction is maintained with respect to north
- Heading stabilization: the line rotates with the vessel heading
- True bearings: the parallel index bearing is measured from the geographical north
- Relative bearings: the parallel index bearing is measured from the heading line

You can define four PI lines in the system, and they are identified with different color and style:

- PI1: Grey solid line
- PI2: Grey dotted line
- PI3: Orange solid line
- PI4: Orange dotted line



You can turn each PI line on and off individually, and the position, bearing and truncating can be set for each line.



Each PI line can be reset to be parallel to own ship's heading from the main menu.

Adjusting a PI line

Each PI line's range and bearing are shown in PI lines submenu.

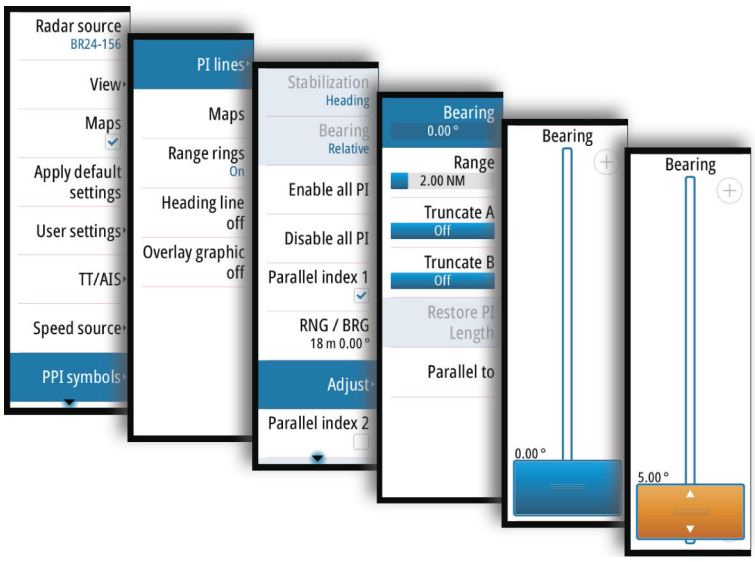


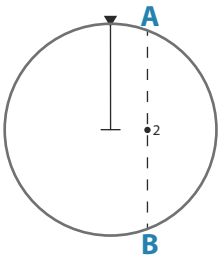
You can adjust the line's settings from the selected line's **Adjust** menu option. The options described in the next sections are available.

Adjusting range and bearing

1. Select the **Range** or **Bearing** menu options
   - A blue slider bar is displayed
2. Press the **ENT** key or the rotary knob to activate the slider bar
   - The slider bar turns yellow to indicate that it is active
3. Turn the rotary knob or use the up/down arrow keys to increase or decrease the slider bar value
   - The change is immediately committed and shown on the image
4. Press the **EXIT** key or the right arrow key to leave the edit mode

→ ***Note:*** Max range for a bearing line is 12 NM.

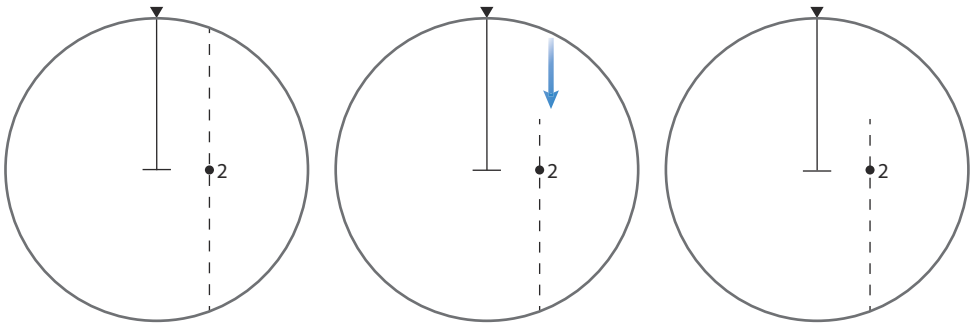




Truncating a PI line

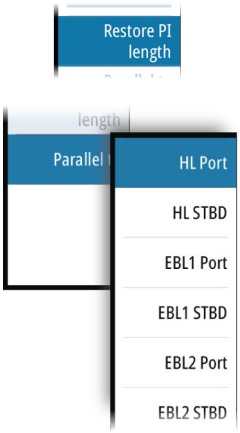
You can use the **Truncate** menu option to extend or reduce an existing PI line. The end points of the line (**A** and **B**) are adjusted individually.

1. Select the truncate A or B option in the menu.
   - A blue slider bar is displayed
2. Press the **ENT** key or the rotary knob to activate the slider bar
   - The slider bar turns yellow to indicate that it is active
3. Turn the rotary knob to extend or reduce the line
4. Press the **EXIT** key to confirm the selection



Function activated *End point adjusted* *Line truncated*

A line remains truncated until the restore length option is selected from the menu.



PI line alignment

A PI line can be parallel to port or starboard of the heading line, or to the port or starboard side of an EBL.

- If the Stabilization is set to Heading, the PI line rotates as the vessel heading change
- Parallel to EBL is a way to quickly set the bearing of a PI line parallel to the EBL in use. The line does not rotate if the EBL later is changed.

EBL/VRM markers

The EBL/VRM markers are a basic tool for collision avoidance. They are used to mark any fixed or moving radar target, and to measure distances between two objects.

The EBL/VRM markers are by default positioned at the center of the vessel. It is, however, possible to offset the reference point to any selected position on the radar image to measure the distance between two objects on the PPI, or to fix the marker to a target.

Two different EBL/VRMs can be placed on the radar image. They are identified as dashed rings/lines with different colors to be able to discriminate them from each other and from the fixed range rings:

- EBM/VRM1 is cyan
- EBL/VRM2 is blue

The EBL presentation can be defined with true or relative presentation:

- True motion: the reference is geographic (e.g. a coastal line or current own vessel position)
- Relative motion: the EBL follows a moving reference (own vessel or a moving target)

The markers' line width indicates whether the marker is in edit mode (bold lines) or at a fixed position (thin lines).



EBL/VRM1 OFF, function not active

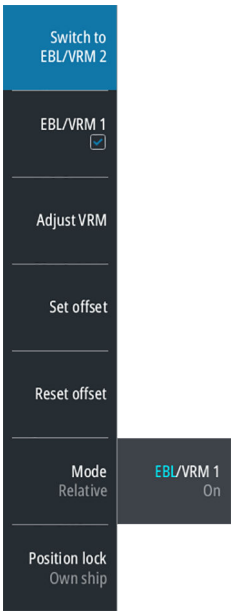


EBL/VRM1 ON, EBL adjustable by rotary knob



EBL/VRM1 ON, VRM adjustable by rotary knob

The EBL/VRM pop-up



You display the EBL/VRM pop-up by pressing the **EBL/VRM** softkey twice, or by re-pressing the softkey when the function is active.

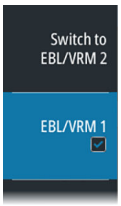
The content of the pop-up depends on status of the active EBL/VRM. The example shows the pop-up when active EBL/VRM is offset.

The adjustable parameter is indicated with blue text in the softkey.

From the pop-up you can:

- switch between active EBL/VRM 1 and EBL/VRM 2 marker
- turn on and off displaying of the active marker
- switch between adjusting EBL and VRM for the active marker. You can also switch between adjustable parameter by pressing the rotary knob
- set EBL presentation (True or Relative)
- set offset for active marker
- reset an offset marker to vessel position
- select whether the EBL/VRM should be locked to own vessel or to the geographical position

Turning the EBL/VRM markers on and off



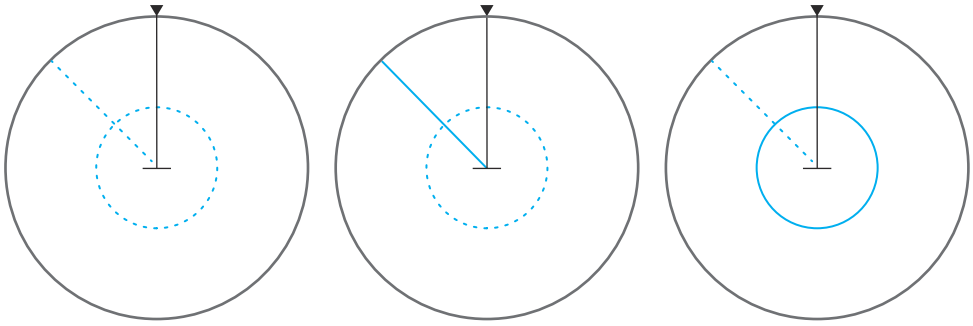
Both EBL/VRM markers are by system startup turned off.

- Turn ON the selected EBL/VRM by pressing the EBL/VRM softkey once
- Switch between EBL/VRM 1 and EBL/VRM 2 in the function's pop-up
- Turn OFF the selected EBL/VRM by pressing the **EXIT** key. Repress the **EXIT** key to turn off the second marker if this is on.
- Leave the EBL/VRM function with the marker ON by pressing one of the other softkeys

You can also turn the EBL/VRM marker on and off from the function's pop-up.

Adjusting the EBL/VRM marker

The marker's line width indicates whether the marker is in edit mode or at a fixed position. When in edit mode the adjustable parameter is bold.



EBL/VRM1 ON, function not in edit mode

EBL/VRM1 ON, EBL adjustable by rotary knob

EBL/VRM1 ON, VRM adjustable by rotary knob

When an EBL/VRM marker is in edit mode, the following options are available for adjusting the marker:

- Use the arrow keys to move the EBL/VRM intersection
- Turn the rotary knob to adjust the adjustable parameter (bold line and blue text in softkey)
- Press the rotary knob to switch between adjusting EBL and VRM

Offsetting the EBL/VRM marker



1. Press the EBL/VRM softkey twice to display the pop-up
2. Select the **Set offset** option
   - The pop-up closes, and the cursor is positioned in the EBL/VRM center
3. Use the arrow keys to move the EBL/VRM center, then select one of the following options:
   - press the **ENT** key to fix the marker to the selected position, then use the arrow keys to move the EBL/VRM intersection
   - turn the rotary knob to adjust the EBL
   - press the rotary knob to toggle between EBL and VRM, then turn the rotary knob or use the arrow keys to adjust the item that is editable

You remove the EBL/VRM marker from the radar image by pressing the **EXIT** key.

Measuring range and bearing

Different options are available for measuring the position, speed, course, distance and bearing of radar echoes.

- Cursor position
- Range rings and bearing scale
- EBL (Electronic Bearing Lines) and VRM (Variable Range Markers)

It is important to minimize the range to obtain the best precision for the measurement. In most cases you can use a higher range if you position the PPI in one of the off-center modes. Refer *"Offsetting the PPI center"* on page 26.

→ ***Note:*** Every measurement made with cursor or EBL/VRM is always referred to the Consistent Common Reference Point (CCRP).

Using the cursor

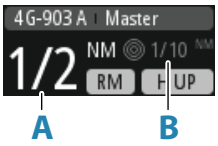


When you position the cursor over an echo, the cursor information area will show range and bearing from the vessel to the cursor position.

This measuring option gives a fast and precise measurement of distance to a target.

Range rings and bearing scale

Range rings and bearing scale is used to measure distance when a fast measurement is required. This measuring option gives only an approximate distance and speed of a target.

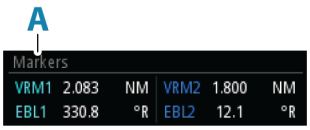


The range scale (**A**) and the distance between two adjacent range rings (**B**) are shown in the System Information are on the radar image.

The range scales, the related distance between the range rings and number of rings are:

Range (NM)	Distance between the range rings (NM)	Number of range rings
1/8	1/40	5
1/4	1/20	5
1/2	1/10	5
3/4	1/4	3
1.5	1/4	6
3	1/2	6
6	1	6
12	2	6
24	4	6
36	6	6
48	8	6
64	16	4
72	12	6

Measuring by using EBL/VRM markers



The Electronic Bearing Line (EBL) and Variable Range Marker (VRM) allows quick measurements of range and bearing from own vessel to a target, or between two targets on the PPI. Bearing and range are shown in the Markers panel (**A**).

Measuring distance from own vessel

1. Press the EBL/VRM softkey to turn the selected EBL/VRM marker on
2. Repress the EBL/VRM softkey to display the pop-up if you need to:
   - Select the EBL presentation (True or Relative)
   - Reposition the marker to vessel position (if the center of the selected EBL/VRM is offset)
3. Use the arrow keys or turn the rotary knob to position the EBL/VRM on the second measuring point

Measuring distance between two objects

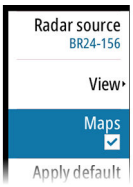
1. Press the EBL/VRM softkey twice
   - The selected EBL/VRM marker is turned on and the pop-up displayed
2. Select the EBL presentation (True or Relative)
3. Select the **Set offset** option
4. Use the arrow keys to reposition the EBL/VRM marker's center on the object from where you want to measure the distance
5. Press the **ENT** key to confirm the position

- The cursor will automatically be moved from the marker's center to the EBL/VRM intersection

6. Use the arrow keys or turn the rotary knob to move the EBL/VRM to the second measuring point
   - Range and bearing from the EBL/VRM marker's center to cursor position is now displayed in the Markers panel

You can reset the EBL/VRM marker's center to vessel position by selecting the **Reset offset** option in the EBL/VRM pop-up.

8



Maps

Maps are graphical navigation tools, composed of lines and symbols that can be added to a radar image. Maps are used to help the operator to increase the definition of the coast, restricted or dangerous areas.

You can have up to 32 maps in the system, and each map may consist of 120 linear segments and 32 symbols.

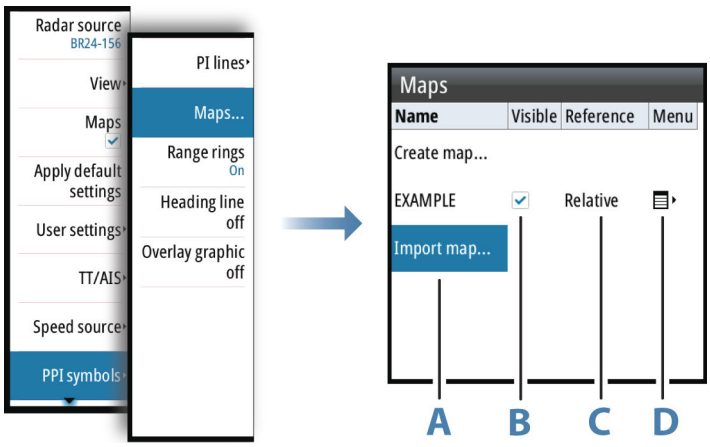
→ ***Note:*** The **Maps** option must be enabled in the main menu to be able to work with maps.

Compatible maps created on other units can be imported to your system, and maps saved on your system can be copied to an SD card and used on other radar units. Refer *"Importing and exporting maps"* on page 49.

Any maps created on a unit, together with imported maps, are retained in the unit's non-volatile memory (My files\Maps). The maps are available in the unit after a restart.

The Maps dialog

The Maps dialog shows all maps loaded into the unit's non-volatile memory.



From the Maps dialog you can:

- import stored map files from the unit's internal file system or from an SD card (**A**)
- select which maps that are displayed (**B**)
- set a map's reference (**C**)
- display the Maps pop-up from where you can create new maps, edit, save, export and delete a map (**D**)

Map references

The system includes the follow map types:

- Relative maps, which follows the position and equals the heading of own ship. All relative map coordinates are stored as distances from own ship
- Geographic maps. The coordinates for this type of maps are stored as geographic positions, and its elements are always drawn in the same absolute position.

When a map is saved the system automatically calculates both relative and the geographic details for all map items. When you switch reference the change is immediately committed without having to save the map.

→ ***Note:*** Relative maps cannot be created or imported if log or gyro is unavailable or failing.

→ ***Note:*** Geographic maps cannot be created or imported if EPFS (Electronic Position Fixing System) or Gyro is unavailable or failing. A geographic map cannot be displayed if the ship is too far from the area of the map.

Map colors and symbols

Lines and map symbols can be presented in white, grey, magenta, red, green, yellow or cyan color.

The following map symbols are available:

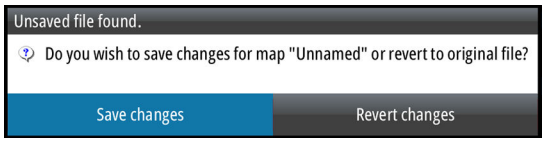
Symbol	Description	Symbol	Description	Symbol	Description
	Buoy North		Area Caution		Arrow W
	Buoy South		Area Depth		Arrow NW
	Buoy East		Area Empty		Sign Call
	Buoy West		Area Ufo		Sign Reminder
	Buoy Lateral Port		Arrow N		Nato 1
	Buoy Lateral Stbd		Arrow NE		Nato 2
	Buoy Special		Arrow E		Nato 3
	Buoy Danger		Arrow SE		Nato 4
	Buoy Safe		Arrow S		Nato 5
	Buoy Unknown		Arrow SW		Nato 6

Creating a new map

The steps below details how to create map lines. Symbols are added by using the same procedure.

1. Activate the Maps dialog and select the **Create map** option
   - A new map (Unnamed) is listed in the Maps dialog
2. Select the new map, and press the **ENT** key or the rotary knob to display the virtual keyboard for entering a unique map name
3. When the name is confirmed, activate the visibility for the new map, and select the **Reference** option
4. Select the Menu icon and press the **ENT** key or the rotary knob to display the Maps pop-up menu.
5. Select the **Edit** option
   - The pop-up menu is closed
6. Use the arrow keys to move the cursor to the first position of the new line
7. Press the **ENT** key to display the pop-up menu again
8. If required, select line style and line color. Press the right arrow key to return to the pop-up menu
9. Select the **Add line** option to position the first line point at the cursor position
10. Move the cursor to the second point of the line
    - A line is now drawn from the first line point to the cursor
11. Press the **ENT** key to display the pop-up menu again, then select the **Add point** option
    - A new point is added at cursor position

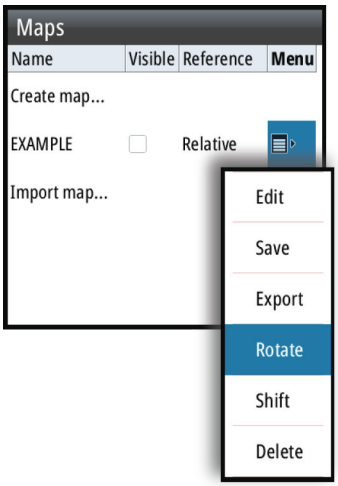
12. Continue as described in item 10 and 11 to add additional line points
13. Select **Finish adding** when all line points are defined
14. Press the **EXIT** key to leave the edit mode, then confirm or reject the changes to the map



Modifying a map

Any map listed in the Maps dialog can be edited, also maps that are under construction.

- Highlight a map and press the **ENT** key or the rotary knob to change the map's name
- Toggle on/off the visibility of a map by ticking on/off the visibility checkbox
- Highlight the Reference and press the **ENT** key or the rotary knob to toggle between relative and geographic reference
- Highlight the menu option and press the **ENT** key or the rotary knob to display the Maps pop-up menu



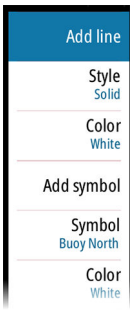
The following options are available in the Maps pop-up menu:

Edit	Creates new and edits existing map details. Refer *"Edit map details"* on page 47
Save	Saves the map in the **My files\Maps** folder on the unit
Export	Exports the map to an SD card or to a selected folder on the unit
Rotate	Rotates the map
Shift	Shifts the map location
Delete	Deletes the map from the Maps dialog and from the **My files\Maps** folder on the unit

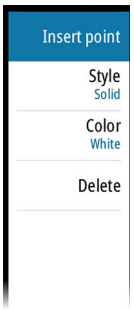
Press the **EXIT** key to finish editing, rotating or shifting the map, then confirm or reject the changes.

Edit map details

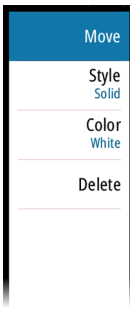
The edit options depend on where the cursor is positioned:



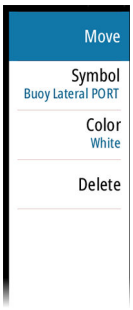
No maps at cursor position



Map line at cursor position



Vertex at cursor position

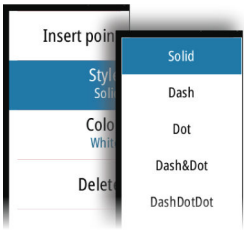


Symbol at cursor position

The example describes how to insert a new point on a line and then move this point to a new position.

1. Select the map you want to edit, then select the **Edit** option from the Maps pop-up menu
2. Move the cursor to the map line where you want to add a new point, then press the **ENT** key
   - The pop-up menu will now show options for a new point
3. Select the **Insert point** option, and confirm by pressing the **ENT** key
   - A new point is now inserted at cursor position
4. Without moving the cursor, re-press **ENT** key to display the options for the new point
5. Select the **Move** option, and confirm by pressing the **ENT** key
   - The selected point is now anchored to the cursor
6. Use the arrow keys to move the cursor to the point's new position

- For moving a symbol or a vertex, position the cursor over a symbol or vertex (step 2), then proceed as described in step 5-6.

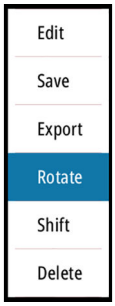


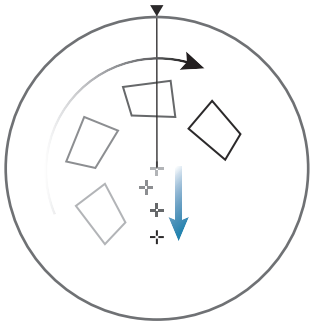
- For changing the line type, symbol or color for a map line or symbol, position the cursor over the line or symbol (step 2), then select the options from the Style, Symbol or Color dropdown lists.

Press the **EXIT** key to leave the edit mode, then confirm or reject the changes to the map

Rotating the map

1. Select the map you want to edit, then select the **Rotate** option in the Maps pop-up menu
   - The selected map is now anchored to the cursor
2. Use the arrow keys to rotate the map around the vessel's position
3. Press the **EXIT** key to leave the edit mode, then confirm or reject the changes to the map

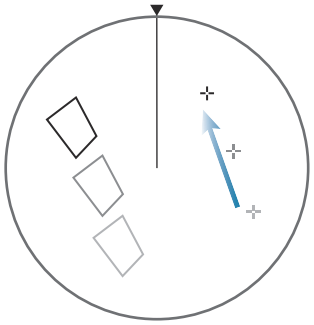




Shifting a map's position

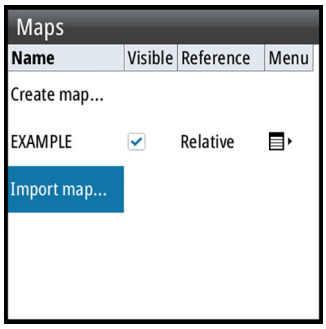
1. Select the map you want to edit, then select the **Shift** option in the Maps pop-up menu
   - The selected map is now anchored to the cursor
2. Use the arrow keys to move the map to the new position
3. Press the **EXIT** key to leave the edit mode, then confirm or reject the changes to the map





Importing and exporting maps

You import a map from within the Maps dialog. Imported maps are added to the units' non-volatile memory, and the maps are added to the list of loaded maps.



Maps listed in the Maps dialog can be used on other compatible radar units. The map files are exported individually from the Maps pop-up menu. Map files can also be copied to an SD-card from the Files management system (Settings\System). See more details about File management system in the separate Commissioning and Maintenance manual.

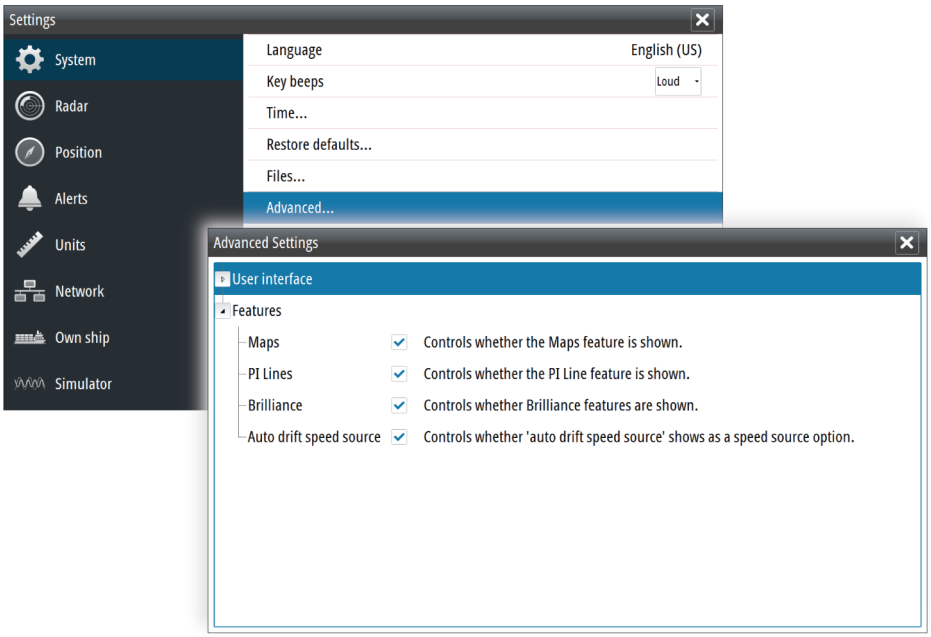
9 Customizing radar settings

Activating optional features

Some features are optional in the R3016.

These features are disabled by default.

You can turn these features on and off from the **Advanced Settings** menu.

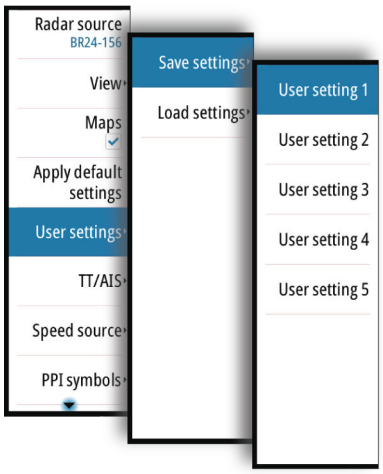


When a feature is disabled the option is removed from the menu.

Customizing radar control settings

You can save up to 5 user defined control settings in the system. The function is used for defining various conditions and user preferences.

The user settings are saved and recalled from the User settings menu.



You recall default control settings from the Main menu. Refer *"Applying default control settings"* on page 20.

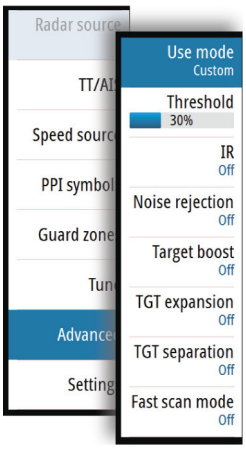
The following functions are included when you save a user setting:

Function	Default setting
Band	*X-band*
Gain, Rain and Sea	Automatic
Tuning	Automatic
Range	6 NM
Fixed range rings	Off
VRMs	One VRM on at 0.25 NM
EBLs	*Off or last settings*
Parallel index lines	Off or last settings
Display mode of PPI	True motion, north up
Stabilization Sea/Ground	Ground (SOG, COG)
Off-centering	Look ahead
Target trails	On, 6 minutes (same as vector)
Past position	Off
Radar target tracking	Continued
Vector mode	Relative
Vector time	6 minutes
Graphical AIS reported target display	On
Radar and AIS target function	Association On
Operational alarms (except collision warnings)	Off
Collision warning	On (limits CPS 2 NM, TCPA 12 minutes)
Display of maps, navigation lines and routes	Last settings

10 Advanced radar options

The Advanced menu allows for adjusting radar control settings.

→ ***Note:*** **Use mode** is only available with Halo radar antenna.



Use modes

Use modes are available with preset control settings for different environments. The following modes are available:

- **Custom** - All radar controls can be adjusted and will be retained after a mode change or radar power cycle. Radar defaults are set for general purpose use.
- **Harbor** - The radar settings are optimized for areas such as busy waterways and large man-made structures where good target discrimination and rapid image updates are needed.
- **Offshore** - The radar settings are optimized for offshore sea conditions and making isolated targets larger and easy to see.
- **Weather** - The radar settings are optimized for best detection and presentation of rain clutter. Image update rate is slowed and color depth is increased.
- **Bird** - The radar settings are optimized for best detection of birds. The radar is set up for maximum sensitivity. This mode is not recommended for use in congested harbor environments.

Not all controls are adjustable in each mode. The following table shows preset controls and adjustability for each control.

	Custom	Harbor	Offshore	Weather	Bird
Noise rejection	Adjustable	Medium	High	Medium	High
Threshold	Adjustable	30%	30%	0%	0%
Target Expansion	Adjustable	Low	Medium	Off	Off
Interference Reject	Adjustable	Adjustable	Adjustable	Adjustable	Adjustable
Target Separation	Adjustable	Medium	Off	Off	Off
Fast scan	Adjustable	High	High	Off	Off

Radar threshold

The threshold sets required signal strength for the lowest radar signals. Radar returns below this limit are filtered and are not displayed.

Default value: 30%.

Rejecting radar interference

Interference could be caused by radar signals from other radar units operating in the same frequency band.

A high setting reduces the interference from other radars.

In order not to miss weak targets, the interference rejection should be set to low when no interference exists.

Noise rejection

The Noise Rejection control sets the amount of noise filtering applied by the radar. Target sensitivity is increased at longer ranges when this control is set to Low or High, but does cause some loss of target discrimination.

Target boost

The target boost control increases pulse length or reduces radar bandwidth to make targets appear larger in range and increase radar sensitivity.

Target expansion

Target expansion increases the length of targets in range, making them easier to see.

Target separation

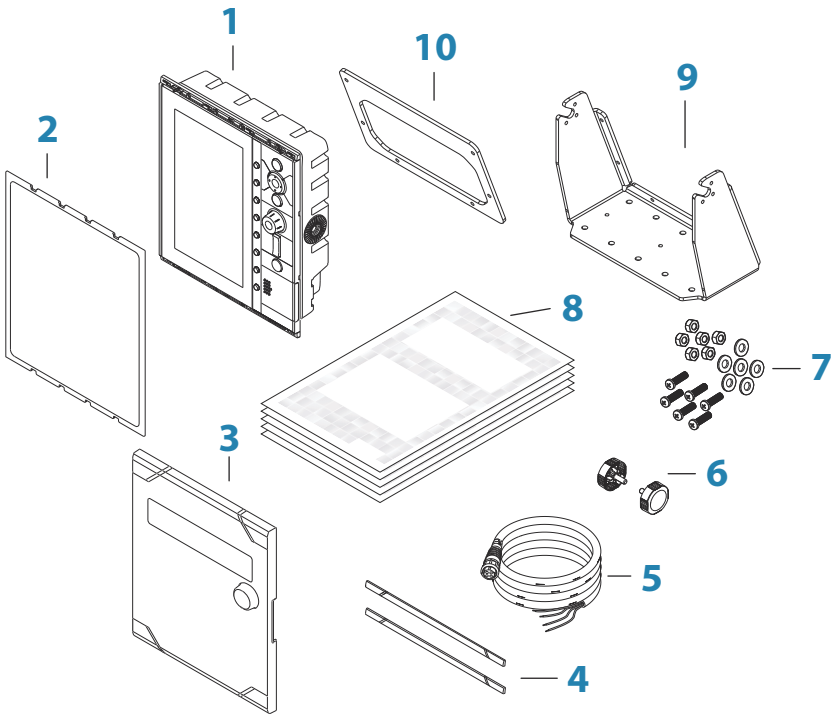
The **Target separation** control allows you to control the target discrimination of the radar (separation between objects is more prominent).

Fast scan

Sets the speed of the radar antenna rotation (from 20 RPM in standard mode to 36 RPM in Fast scan mode). This option gives faster target updates.

11 Installation

Box contents



1	Control unit
2	Panel mounting gasket
3	Sun cover
4	Bezels
5	Power cable
6	Knobs
7	Fixing screws
8	Documentation pack
9	U-brackets
10	U-bracket straps

Mounting location

Choose the mounting locations carefully before you drill or cut.

For overall width and height requirements, refer to *"Dimensional drawings"* on page 96.

Do not mount any part where it can be used as a hand hold, where it might be submerged, or where it will interfere with the operation, launching, or retrieving of the boat.

The unit should be mounted so that the operator can easily use the controls and clearly see the screen.

The R2009 control unit has a high-contrast screen and is viewable in direct sunlight, therefore this unit can be installed at both inside and outside locations.

Check that it is possible to route cables to the intended mounting location.

Leave sufficient clearance to connect all relevant cables.

Before cutting a hole in a panel, make sure that there are no hidden electrical wires or other parts behind the panel.

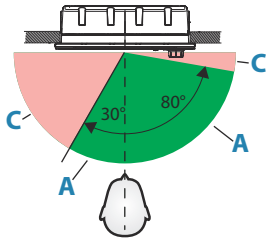
Ensure that any holes cut are in a safe position and will not weaken the boat's structure. If in doubt, consult a qualified boat builder, or marine electronics installer.

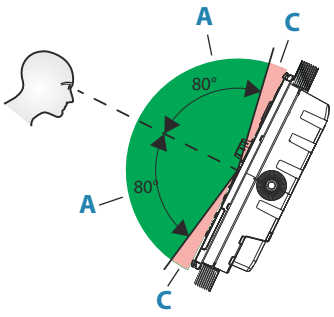
➔ ***Note:*** Where flush mounted, the enclosure should be dry and well ventilated. In small enclosures, it may be required to fit forced cooling.

⚠ Warning: Inadequate ventilation and subsequent overheating of the unit may cause unreliable operation and reduced service life. Exposing the unit to conditions that exceeds the specifications could invalidate your warranty. – refer to *"Technical specifications"* on page 87.

Viewing angle

The viewing angle influences the viewability of the monitor. The recommended viewing angles relative to perpendicular are shown in the illustrations below.





A Optimum viewing angle

B Good viewing angle

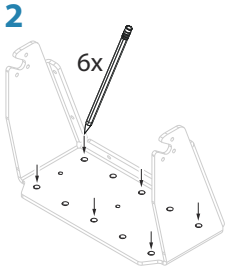
C Poor viewing angle or obstructed view

➔ ***Note:*** Installations requiring better left hand visibility on the 9" unit can optimize the display for viewing from the left. Refer to *"View from left"* on page 72.

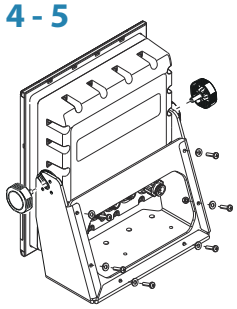
U-bracket mounting

1. Place the bracket in the desired mounting location. Ensure that the chosen location has enough height to accommodate the unit fitted in the bracket, and allows tilting of the unit. In addition, adequate space is required on both sides to allow tightening and loosening of the knobs.
2. Mark the screw locations using the bracket as a template, and drill pilot holes. Use fasteners suited to the mounting surface material. If the material is too thin for self-tappers, reinforce it, or mount the bracket with machine screws and large washers. Use only 304 or 316 stainless steel fasteners.
3. Screw down the bracket.
4. Mount the unit to the bracket using the knobs. Hand tighten only. The ratchet teeth in the bracket and display case ensure a positive grip and prevent the unit changing from the desired angle.
5. Fix the bracket straps.

2



4 - 5



Panel mounting

The screws and gasket used for panel mounting are included in the box. For mounting instructions, refer to the mounting template.

12 Wiring

Guidelines

Don't:

- make sharp cable bends
- run cables in a way that allows water to flow down into the connectors
- run the data cables adjacent to radar, transmitter, or large/high current carrying cables or high frequency signal cables
- run cables so they interfere with mechanical systems
- run cables over sharp edges or burrs

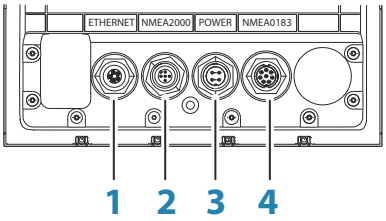
Do this:

- make drip and service loops
- use cable-tie on all cables to keep them secure
- solder/crimp and insulate all wiring connections if extending or shortening the cables. Extending cables should be done with suitable crimp connectors or solder and heat shrink. Protect joints from water, humidity and otherwise corrosive environments
- leave enough space for connecting and disconnecting cables

⚠ Warning: Before starting the installation, be sure to turn electrical power off. If power is left on or turned on during the installation, fire, electrical shock, or other serious injury may occur. Be sure that the voltage of the power supply is compatible with the unit.

⚠ Warning: The positive supply wire (red) should always be connected to (+) DC with a fuse or a circuit breaker.

Rear connections



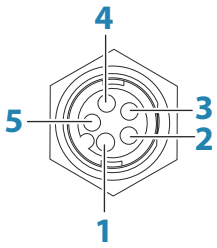
1 Ethernet, 5-pin

2 NMEA 2000®, 5-pin

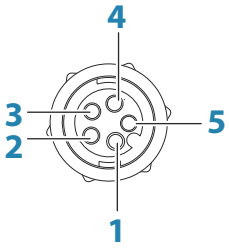
3 Power, 4-pin

4 NMEA 0183®

Ethernet connector details



Unit socket (female)

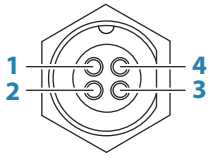


Cable plug (male)

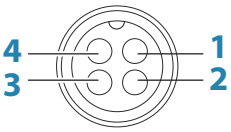
Key	Purpose	Color
1	Transmit positive TX+	Blue/White
2	Transmit negative TX-	Blue
3	Receive positive RX+	Orange/White
4	Receive negative RX-	Orange
5	Shield	Bare

R2009 Power connector details

Power connector details



Unit socket (male)



Cable plug (female)

Pin number	Purpose	Color
1	DC negative	Black
2	(Not used)	Blue
3	Power control	Yellow
4		Red

Power control connection

The yellow wire in the power cable can be used to control how the unit is turned on and off.

Power controlled by power key

The unit will turn on/off when the power key on the unit is pressed.

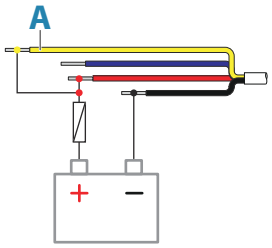
Leave the yellow power control wire disconnected and tape or heat-shrink the end to prevent shorting.

Power control by supply power

The unit will turn on/off without using the power key when power is applied/removed.

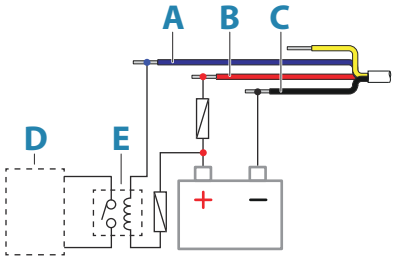
Connect the yellow wire to the red wire after the fuse.

→ ***Note:*** The unit cannot be powered down by power button, but can be put in to standby mode (the screen backlight turns off).



Key	Purpose	Color
A	Power control wire, connected to supply power	Yellow

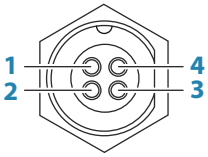
External alarm



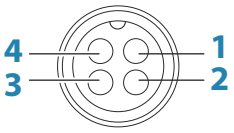
Key	Purpose	Color
A	External alarm output (N/C isolated contact)	Blue
B	Positive DC supply	Red
C	Negative DC supply	Black
D	Alert Management System	
E	24 V Relay (NO/NC dependant on AMS requirements)	

R3016 Power connector details

Power connector details



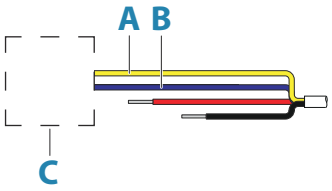
Unit socket (male)



Cable plug (female)

Pin	Purpose	Color
1	DC negative	Black
2	External alarm output (N/C isolated contact)	Blue
3	External alarm output negative return	Yellow
4		Red

External alarm

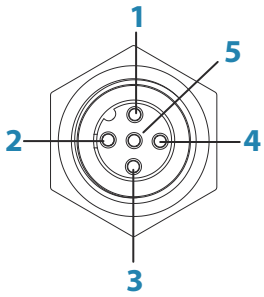


Key	Purpose	Color
A	External alarm output negative return	Yellow
B	External alarm output (N/C isolated contact)	Blue
C	Alert management system	

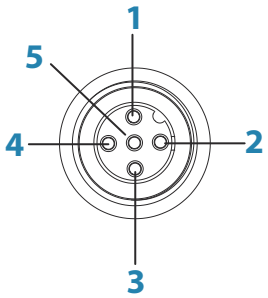
NMEA 2000 backbone

NMEA 2000 device connection

The NMEA 2000 data port allows the receiving and sharing of a multitude of data from various sources.



Unit socket (male)



Cable plug (female)

Key	Purpose	Color
1	Shield	Drain
2	NET-S (+12 V DC)	Red
3	NET-C (DC negative)	Black
4	NET-H	White
5	NET-L	Blue

Planning and installing a network backbone

The backbone needs to run between the locations of all products to be installed - typically in a bow to stern layout - and be no further than 6 m from a device to be connected.

Choose from the following components to make up the backbone:

- Micro-C cables: 0.6 m (2 ft), 1.8 m (6 ft), 4.5 m (15 ft), and 7.6 m (25 ft) cables.
- T-connector or 4-way connector. Used to connect a drop cable to the backbone.
- Micro-C power cable. Connect to the backbone at a position that is central to the network load using a T-connector or 4-way connector.

Power the network

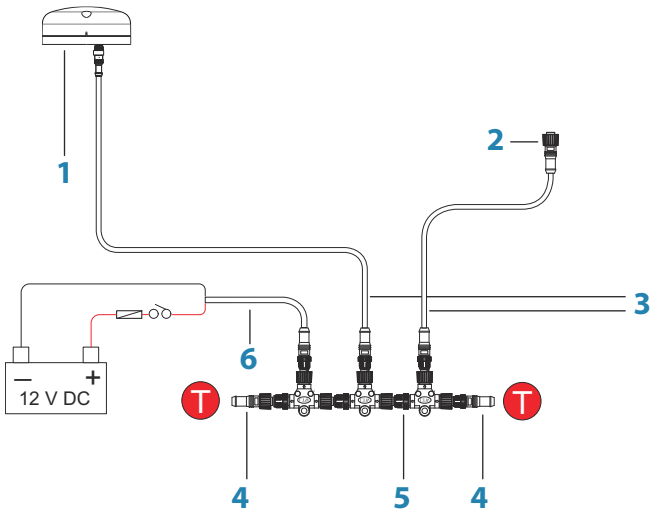
Connect power at any location in the backbone for smaller systems.

For larger systems introduce power at a central point in the backbone to ***balance*** the voltage drop of the network.

➔ ***Note:*** If joining to an existing NMEA 2000® network that already has its own power supply, do not make another power connection elsewhere in the network, and ensure the existing network is not powered by 24 V DC.

➔ ***Note:*** Do not connect the NMEA 2000® power cable to the same terminals as the engine start batteries, autopilot computer, bow thruster or other high current devices.

The following drawing demonstrates a typical small network. The backbone is made up of directly interconnected T-connectors.



1 NMEA 2000® device
2 Connector to unit
3 Drop-cable, should not exceed 6 m (20 ft)
4 Terminators
5 Backbone
6 Power cable

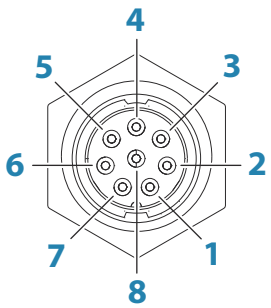
NMEA 0183

The NMEA 0183 serial port provides input (Listeners) and outputs (Talkers) for the various IEC 61162 interfaced sensors. The port uses the NMEA 0183 (serial balanced) standard, and can be configured in the software for different baud rates up to 38,400 baud.

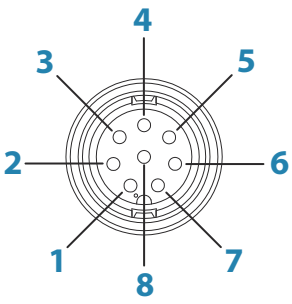
For configuring of the ports, refer to *"Serial ports"* on page 68.

NMEA 0183 serial cable

Cable labelled: 032-0080-08. Spare part number: 000-11247-001.



Unit socket (male)



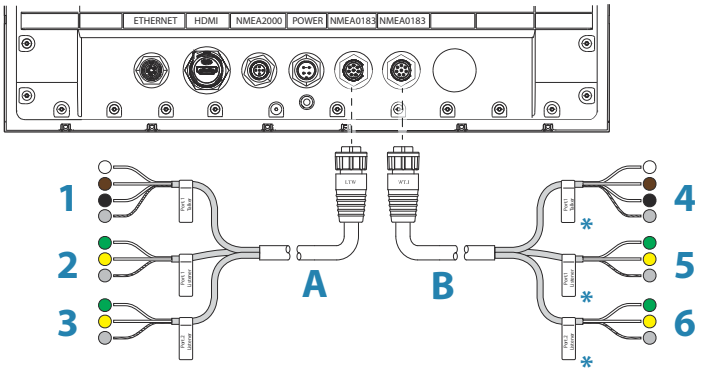
Cable plug (female)

Key	Port	Purpose	Color
1	Port 2	Listener B (Rx+)	Brown/White
2	Port 2	Listener A (Rx-)	Brown
3	Port 2	Talker B (Tx+)	Green/White
4	Port 2	Talker A (Tx-)	Green
5	Port 1	Talker B (Tx+)	Orange/White
6	Port 1	Talker A (Tx-)	Orange
7	Port 1	Listener A (Rx-)	Blue/White
8	Port 1	Listener B (Rx+)	Blue

NMEA 0183 High speed serial cable

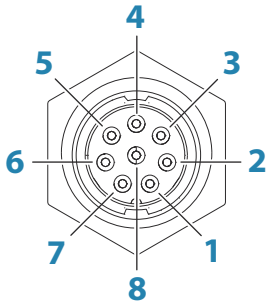
→ ***Note:*** R3016 only.

Cable labelled: 032-0101-081. Spare part number: 000-12393-001.

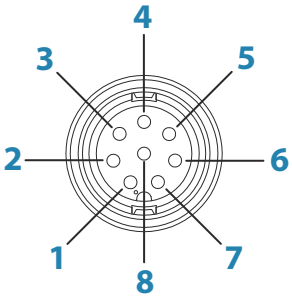


Key	Description
A	Serial 1
B	Serial 2
1	Port 1 (talker)
2	Port 1 (listener)
3	Port 2 (listener)
4	Port 3 (talker)
5	Port 3 (listener)
6	Port 4 (listener)

* Serial 2 cable is identical to Serial 1 cable. Therefore Serial 2 cable wires labelled as Port 1 denote Port 3, and wires labelled as Port 2 denote Port 4.



Unit socket (male)



Cable plug (female)

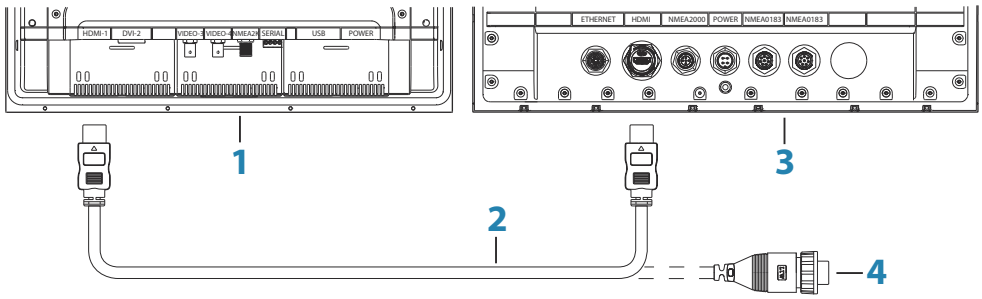
Key	Left socket	Right socket	Purpose	Color
N/A	Port 2 and Port 4		Shield	Bare wire
1	Port 2	Port 4	Listener B (Rx+)	Green
2	Port 2	Port 4	Listener A (Rx-)	Yellow
3	Port 1	Port 3	Shield	Bare wire
4	Port 1	Port 3	Common	Black
5	Port 1	Port 3	Talker B (Tx+)	Brown
6	Port 1	Port 3	Talker A (Tx-)	White
N/A	Port 1 and Port 3		Shield	Bare wire
7	Port 1	Port 3	Listener A (Rx-)	Yellow
8	Port 1	Port 3	Listener B (Rx+)	Green

Talkers and Listeners

Do not connect multiple devices outputting data (Talkers) on to any serial input (RX) of the unit. The RS422 protocol is not intended for this type of connection, and data will be corrupted if more than one device transmits simultaneously. The output (TX) however may drive multiple receivers (Listeners). The number of receivers is finite, and depends on the receiving hardware. Typically three devices is possible.

Connect an external monitor

The R3016 incorporates HDMI technology and has a HDMI output which can be connected to an external monitor to replicate video at a remote location. Video is at a resolution of 1366 x 768, a connected monitor should support same resolution or be able to scale.



1 MO series monitor

2 HDMI cable

3 R3016

4 HDMI cable - waterproof connector (use in exposed installations)

→ ***Note:*** While the HDMI standard does not state maximum cable length, signal may be compromised on long runs. Only use Navico or other high quality HDMI certified cables. 3rd party cables should be tested before installation. On runs over 10m it may be required to add an HDMI amplifier or use HDMI-CAT6 adaptors.

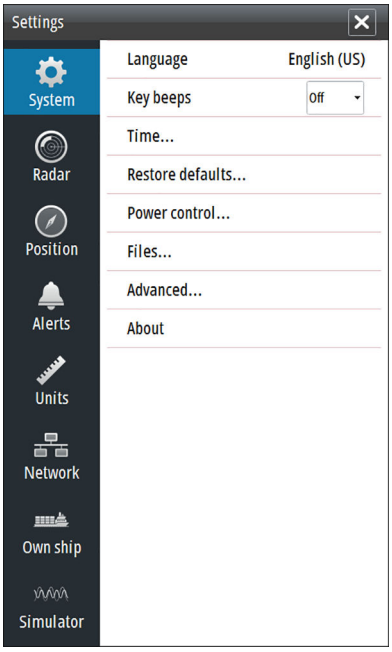
→ ***Note:*** Some HDMI TV displays may apply over-scan, which will in effect crop the image possibly causing loss of important content. Check the display manual for an option to disable over-scan or adjust scaling

13 Software setup

Prior to use, the radar system requires a number of settings be configured in order for the system to perform as expected.

Access to the required dialogs for commissioning are found in the **Settings** dialog, accessed from the main menu.

The settings dialogs consist of numerous parameters that will seldom require adjustment beyond initial setup. All settings are stored in non-volatile memory. Most are intended to be configured by the technician commissioning the system, by the operator at first use, or by a technician after servicing or replacement of system parts.

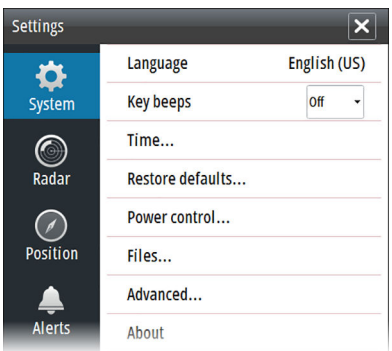


The following areas must all be addressed during commissioning, and should be stepped through one at a time. Refer to the detailed sections for further information.

1. General system settings. Refer *"System settings"* on page 64
2. Setting up external sensors. Refer *"Network settings"* on page 65
3. Radar Settings. Refer *"Radar settings"* on page 69
4. Own vessel charachteristics. Refer *"Own ship"* on page 73

System settings

Use the system settings dialog to set basic settings as described below. Some settings can require a reboot of the system.



Language

Controls the language used on this unit for panels, menus, and dialogs. Changing the language causes the unit to restart.

Key beeps

Controls the loudness of the beep sound when a key is pressed.

Default setting: Loud

Time

Controls the local time zone offset, and the format of the time and date.

Restore defaults

Allows you to select which settings are to be restored to their original factory settings.

Power Control

➔ ***Note:*** This option is available for R2009 Control units only.

Used for defining the R2009 Control unit as a power slave.

This setting is only applicable if the yellow wire is connected to ignition or to a stand-alone switch that applies 12 V/24 V.

➔ ***Note:*** You cannot use the **STANDBY/BRILLIANCE** key to power down a unit that is set to power slave. The unit is powered off when the power master is powered down, or when the system power is removed.

Files

File management system, used to browse the contents of the unit's internal memory and inserted SD card.

Advanced

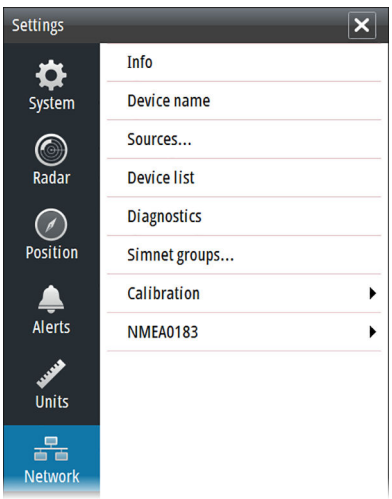
Shows a panel with more advanced settings. Used for setting how your system displays various user interface information. In addition, controls which features are shown in the interface.

About

Displays copyright information, software version, and technical information for this unit.

Network settings

Use the Network settings dialog to setup networks and connect to network devices.



Info

Displays the Ethernet connection status, the unit's IP and MAC addresses.

Device name

Assigning a name is useful in systems using more than one device of the same type and size. When viewing data sources or the device list, the assigned name will append the default product name + virtual device function for easy identification.

Data source selection

Data sources provide live data to the system.

The data may originate from modules internal to the unit (for example internal GPS or sonar), or external modules connected to the NMEA 2000 or via NMEA 0183 if available on the unit.

When a device is connected to more than one source providing the same data, the user can choose the preferred source. Before commencing with source selection make sure all external devices and the NMEA 2000 backbone are connected and are turned on.

Auto select data sources

The Auto select option looks for all sources connected to the unit. If more than one source is available for each data type, selection is made from an internal priority list. This option is suitable for the majority of installations.

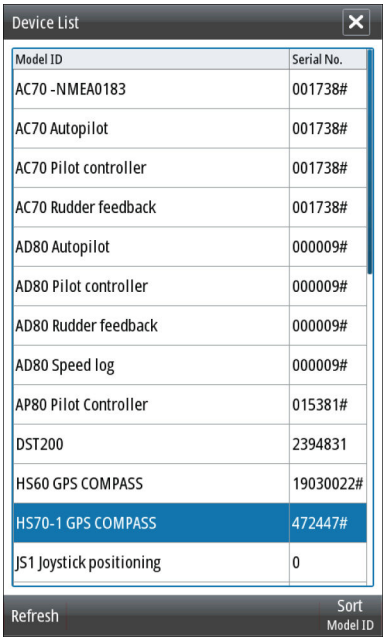
→ ***Note:*** Auto data source selection may already have been selected at first time startup. However, it should be redone if any new devices have been added to the network since.

Advanced data source selection

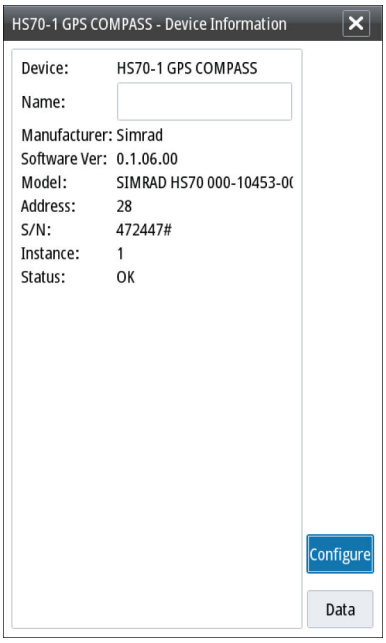
The advanced option allows for you to manually select or unselect data sources. Manual selection is generally only required where there is more than one source for the same data, and the 'Auto select' selected source is not the one desired.

Device list

The Device list shows the devices that provide data. This may include a module inside the unit, or any external NMEA 2000 device.



Selecting a device in this list will bring up additional details and actions.



All devices allow allocation of an instance number in the **Configure** option. Set unique instance numbers on any identical devices on the network to allow for the unit to distinguish between them. The **Data** option shows all data being output by the device.

Some devices will show additional options specific to the device.

→ ***Note:*** Setting the instance number on a 3rd party product is typically not possible.

Diagnostics

The NMEA 2000 tab on the diagnostics page can provide information useful for identifying an issue with the network.

→ ***Note:*** The following information may not always indicate an issue that can be simply resolved with minor adjustment to network layout or connected devices and their activity on the network. However, Rx and Tx errors are most likely indicating issues with the physical network, which may be resolved by correcting termination, reducing backbone or drop lengths, or reducing the number of network nodes (devices).

Bus state

Simply indicates whether the bus is powered, but not necessarily connected to any data sources. However, if bus shows as **off**, but power is present along with an increasing error count, it is possible that termination or cable topology is incorrect.

Rx Overflows

The unit received too many messages for its buffer before the application could read them.

Rx Overruns

The unit contained too many messages for its buffer before the driver could read them.

Rx/Tx Errors

These two numbers increase when there are error messages, and decrease when messages are received successfully. These (unlike the other values) are not a cumulative count. Under normal operation these should be at 0. Values around 96 upwards indicate a heavily error prone network. If these numbers go too high for a given device, it will automatically drop off the bus.

Rx/Tx Messages

Shows actual traffic in and out of device.

Bus Load

A high value here indicates network is near full capacity. Some devices automatically adjust rate of transmission, if network traffic is heavy.

Fast Packet Errors

Cumulative counter of any fast packet error. This could be a missed frame, or a frame out of sequence etc. NMEA 2000 PGNs are made of up to 32 frames. The entire message will be discarded when a frame is missed.

➔ ***Note:*** Rx and Tx Errors often indicate an issue with the physical network, which may be resolved by correcting termination, reducing backbone or drop lengths, or reducing the number of network nodes (devices).

Reset counters

Resets all counters in the NMEA 2000 tab of the Diagnostics dialog to zero. The counters start recounting immediately.

SimNet Groups

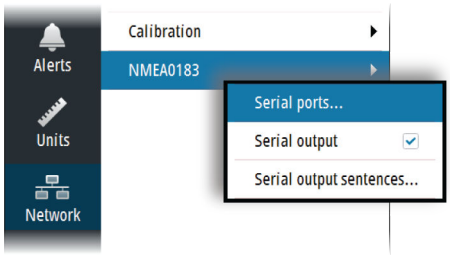
The SimNet Group function is used to control parameter settings, either globally or in groups of units. The function is used on larger vessels where several SimNet units are connected to the network. By assigning several units to the same group, a parameter update on one unit will have the same effect on the rest of the group members.

Calibration

An offset (positive or negative) can be applied to correct inaccuracies in boat speed, sea temp, air temp, barometric pressure, and depth sourced from NMEA 2000 devices.

NMEA 0183 setup

The NMEA 0183 port must be set to suit the speed of connected devices, and can be configured to output only the sentences required by listening devices.



Serial ports

Specifies the baud rate for port for the devices connected to the NMEA 0183. The baud rate should be set to correspond with devices connected to the NMEA 0183 input and output.

Serial Output

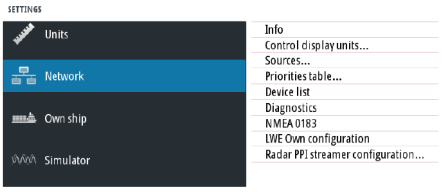
Selection determines whether the data is output via Tx lines, and will enable editing of the output sentences list.

Serial Output Sentences

This list allows control over which sentences need to be transmitted to other devices from the NMEA 0183 port. Due to the limited bandwidth of NMEA 0183 it is desirable to only enable the data that is required. The less sentences that are selected, the higher the output rate of the enabled sentences.

Commonly used sentences are enabled by default.

Radar settings



Expanded PPI

With this option selected the radar video outside the bearing scale is also visible.

Radar installation dialog

The content of the radar Installation dialog depends on the radar antenna connected to the system as per the table below.

All options are described in the next sections.

Option	Halo 20	Halo 20+	Halo 24	Halo 2000/ 3000
Radar source	x	x	x	x
Radar status	x	x	x	x
Antenna setup	x	x	x	x
Adjust range offset				
Adjust bearing alignment	x	x	x	x
Sector blanking	x	x	x	x
Sidelobe suppression	x	x	x	x
Tune				
Adjust local interference rejection	x	x	x	x
Adjust open array park angle				x
Halo light		x	x	x
Reset radar to factory defaults	x	x	x	x

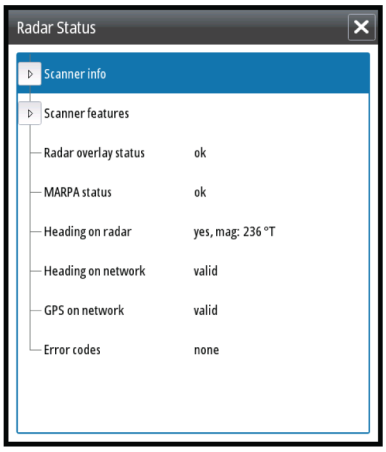
Radar source

More than one antenna can be connected to the radar control unit.

Use this option to select the antenna that is to be configured.

Radar status

Primarily for information and to assist with fault finding.



Antenna setup

Used for setting the position, height and span of the antenna.

The approximate position of the antenna on the vessel must be set in order to correctly position the vessel outline when viewing close range settings. The PPI will be centered on the icon representing the position of the antenna.

The antenna height is the height of the antenna above the water line, when vessel is carrying a typical load. It is very important to set the antenna height correctly as this will affect the sea clutter function.

The antenna span is the total length of the antenna.

Adjust range offset

The radar sweep should commence at your vessel (a radar range of zero). You may need to adjust the radar range offset to achieve this. If this is set incorrectly, a large dark circle in the center of the sweep might occur. You might notice straight objects such as straight sea walls or piers having curves or an indentation. Objects close to your vessel may appear "pulled in" or "pushed out".

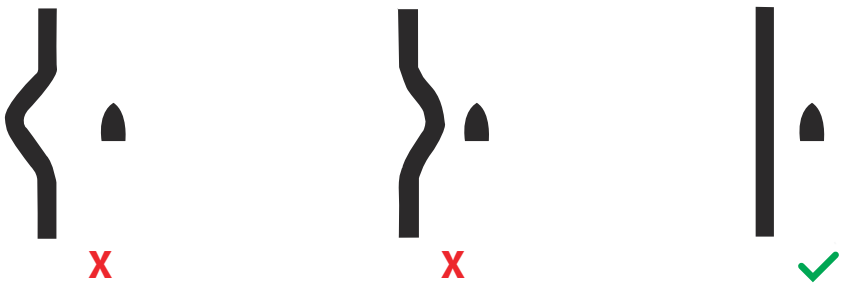


Adjust the range offset as below when the vessel is about 45 to 90 m (50 to 100 yards) from a straight-walled jetty or similar feature that produces a straight line echo on the display.

- Point the boat towards the jetty
- Adjust the gain setting until a reasonably good image of the jetty echo is displayed

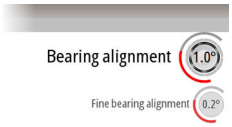
With the Range offset dialog open:

- Turn the rotary knob to adjust the range offset to make the jetty echo appear as a straight line on the display
- Press the **ENT** key to save the settings



Adjust bearing alignment

This is to align the heading marker on the screen with the center line of the vessel. This setting compensates for any slight misalignment of the up-mast transceiver during installation. Misalignment that is not corrected for will compromise target tracking and can result in dangerous misinterpretation of potential navigation hazards.



Point the vessel towards a stationary isolated object. Then with the Bearing alignment dialog open:

- Press the rotary knob to switch focus between coarse and fine bearing alignment
- Turn the rotary knob to adjust the bearing alignment so that the heading line touches the end of the selected stationary object
- Press the **ENT** key to save the settings and close the Bearing alignment dialog

Sector blanking

To assure passenger safety from radiation and if the radar is installed in close proximity to a mast or structure, that could cause unwanted reflections or interference to appear on the radar image, use the sector blanking feature to stop the radar from transmitting in a defined direction, over a variable sector size. Up to four sectors can be set up.

→ ***Note:*** Sectors are setup relative to the heading line of the radar. The bearing of the sector is measured from the front of the vessel to the center line of the sector.

Sidelobe suppression

Occasionally false target returns can occur adjacent to strong target returns such as large ships or container ports. This occurs because not all of the transmitted radar energy can be focused into a single beam by the radar antenna, a small amount energy is transmitted in other directions. This energy is referred to as sidelobe energy and occurs in all radar systems.

The returns caused by sidelobes tend to appear as arcs.

When the radar is mounted where there are metallic objects near the radar, sidelobe energy increases because the beam focus is degraded.



The increased sidelobe returns can be eliminated using the Sidelobe suppression option. With dialog open:

- Press the rotary knob to switch focus between the manual and auto adjustment icons
- Turn the rotary knob to adjust the value of the active icon

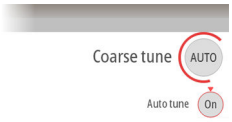
Use the following procedure to adjust the sidelobe suppression:

1. Set the radar range to between 1/2 nm to 1 nm and the Sidelobe suppression value to Auto
2. Take the vessel to a location where sidelobe returns are likely to be seen. Typically this would be near a large ship, container port, or metal bridge
3. Traverse the area until the strongest sidelobe returns are seen
4. Change Auto sidelobe suppression to OFF then select and adjust the sidelobe suppression control until the sidelobe returns are just eliminated. You may need to monitor 5-10 radar sweeps to be sure they have been eliminated
5. Traverse the area again and readjust if sidelobes returns still occur
6. Press the **ENT** key to save the settings and leave the Sidelobe suppression dialog

Tuning

The Tuning options are used to do initial tuning of the radar system and to adjust the radar when a new magnetron has been fitted.

The tuning should be performed in an area with large and identifiable targets within range, and the value should be adjusted until the best reflection is obtained.



With the Tune dialog open:

- Press the rotary knob to switch focus between the manual and auto adjustment icons
- Turn the rotary knob to adjust the value of the active icon

Local interference rejection

Interference from some onboard sources can interfere with the radar. One symptom of this could be a large target on the screen that remains in the same relative bearing even if the vessel changes direction.

Open array park angle

The park angle is the final resting position of the antenna relative to the heading line of the radar when the radar is set to standby. The antenna will stop rotating at the desired offset.

Halo light

Controls the levels of the Halo Radar pedestal blue accent lighting. There are four levels possible for the lighting. The accent lighting can only be adjusted when the radar is in standby mode.

→ ***Note:*** The blue accent pedestal lighting might not be approved for use in your boating location. Check your local boating regulations before turning the blue accent lights ON.

Reset radar to factory defaults

Clears all user and installer settings applied to radar, and restores ex-factory settings. Use with caution, taking note of current settings first, especially those set by the operator if radar has already been in active service.

Radar palettes

Different palettes are available for the radar video and for the target trails.

→ ***Note:*** The palette color does only affect day colors. Night colors are automatically selected when the brilliance are adjusted to 80% or lower.

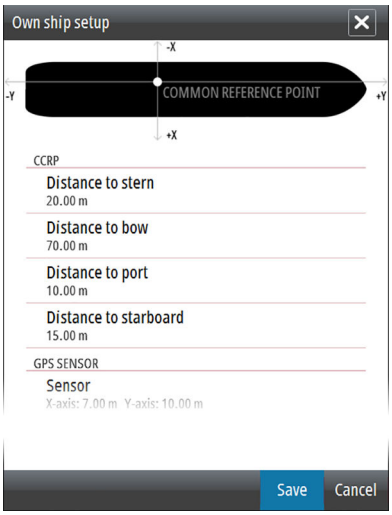
View from left

Used for optimizing the display for viewing from the left. See *"Viewing angle"* on page 55.

Own ship

Own ship setup

This dialog is used for defining the CCRP and GPS sensors position.



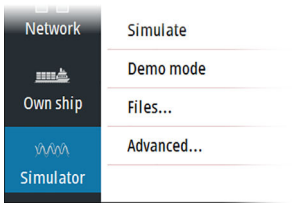
- CCRP
  - Sets the approximate location for the common reference point. This is the ship's bridge and location of the radar operator. With the radar antenna position also defined, the radar can calculate the bearing and distance of radar targets relative to the CCRP.
- GPS Sensor
  - Sets the approximate location for the primary GPS position sensor. This is relevant to correct positioning of AIS targets on the PPI.

MMSI

Set the vessel's own MMSI number. This prevents the vessel being identified as an AIS target on own display.

14 Simulator

The simulation feature lets you see how the unit works in a stationary position and without being connected to sensors or other devices.



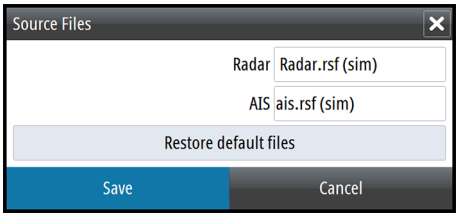
Demo mode

In this mode the unit automatically runs through the main features of the product; it changes pages automatically, adjusts settings, opens menus, etc.

→ ***Note:*** Demo mode is designed for retail/showroom demonstrations.

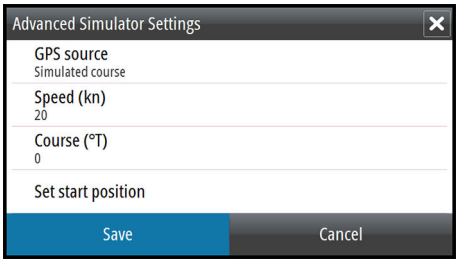
Simulator source files

You can select which data files are used by the simulator. A set of source files is included in your system, and you can import files by using a card inserted into the card reader. You can also use your own recorded log data files in the simulator.



Advanced simulator settings

The Advanced simulator settings allows for manually controlling the simulator.



GPS source

Selects where the GPS data is generated from.

Speed and Course

Used for manually entering values when GPS source is set to Simulated course. Otherwise, GPS data including speed and course come from the selected source file.

Set start position

Allows you to enter coordinates as a starting position.

→ ***Note:*** This option is only available when the GPS source is set to Simulated course.

15 Maintenance

Preventive maintenance

The unit does not contain any field serviceable components. Therefore, the operator is required to perform only a very limited amount of preventative maintenance.

It is recommended that you always fit the supplied protective sun cover when the unit is not in use.

Cleaning the display unit

A proper cleaning cloth should be used to clean the screen, where possible. Use plenty of water to dissolve and take away salt remains. Crystalized salt may scratch the coating if using a damp cloth. Apply minimal pressure to the screen.

Where marks on the screen cannot be removed by the cloth alone, use a 50/50 mixture of warm water and isopropyl alcohol to clean the screen. Avoid any contact with solvents (acetone, mineral turpentine, etc.), or ammonia based cleaning products, as they may damage the anti-glare layer or plastic bezel.

To prevent UV damage to the plastic bezel, it is recommended that the sun cover be fitted when the unit is not in use for an extended period.

Cleaning the media port door

Clean the media port door regularly to avoid salt crystallization on the surface, causing water to leak into the card slot.

Checking the keys

Make sure that no keys are stuck in the down position. If one is stuck, wiggle the key to free it back to normal.

Checking the connectors

The connectors should be checked by visual inspection only.

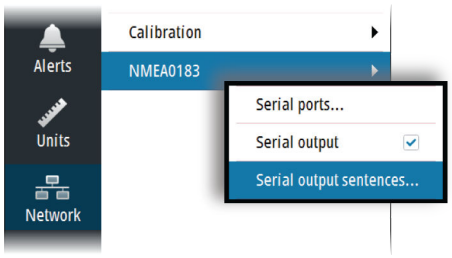
Push the connector plugs into the connector. If the connector plugs are equipped with a lock, ensure that it is in the correct position.

NMEA Data logging

All serial output sentences sent over the NMEA TCP connection are logged to an internal file. You can export and review this file for service and fault finding purposes.

The maximum file size is predefined. If you have added several other files to the system (file recordings, music, pictures, PDF files), this may reduce the allowed file size for the log file.

The system logs as much data as possible within the file size limitation, and then it starts overwriting the oldest data.



Exporting the log file

The log file can be exported from the files dialog.

When you select the Log database you are prompted to select a destination folder and filename. Once accepted, the log file is written to the chosen location.

Software upgrades

The latest software is available for download from our website,
www.navico-commercial.com

Before initiating an update to the unit itself, be sure to back up any potentially valuable user data. Refer to *"Backing up your system data"* on page 76.

Backing up your system data

It is recommended to regularly copy your system settings files as part of your back-up routine. The files can be copied to a card inserted in the card reader. Refer to *"Files"* on page 65.

16 The alert system

The system will continuously check for danger situations and system faults while running.

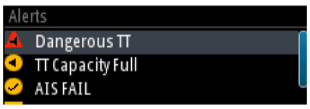
Type of alerts

There are 3 alert types in the system:

- **Alarms**: This is the system's highest priority alert, activated when situation occurs that might result in collision, or for conditions that critically effect the capability or performance of the system. An alarm is accompanied by an audible signal (3 short signals repeated every 7 seconds), and the alarm icon is flashing until the alarm is acknowledged.
- **Warnings**: This is alerts of lower priority, announcing conditions that could result in unwanted system response or eventual failure if no action is taken. A warning is accompanied by an audible signal (2 short signals repeated every 2.5 minute), and the warning icon is flashing until the warning is acknowledged.
- **Cautions**: This is information about danger and caution objects that requires attention. Caution alerts have no audible signal.

Alert notifications

When an alert is triggered, the alert appears in the Alerts panel.



The alerts are displayed in a sorted order. The sort order is first by state (i.e. not acknowledged before rectified before acknowledged), then severity (i.e. alarm before caution), then age.

Alarms and Warnings have different states:

- Active - not acknowledged, not silenced
- Active - not acknowledged, silenced
- Active - acknowledged
- Active - responsibility transferred to another work station
- Rectified - not acknowledged

When an alert has been both rectified and acknowledged, it will disappear from the Alerts panel.

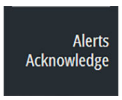
Cautions cannot be acknowledged, and they disappear from the alert list when the condition is rectified.

The table below shows alert icon and behavior depending on alert state.

Alert type	Icon	State	Indication
Alarm		Active - not acknowledged, not silenced	• Flashing symbol and descriptive text • Audible signal
		Active - acknowledged	• Steady symbol and descriptive text • No audible signal
		Rectified - not acknowledged	• Flashing symbol and descriptive text • No audible signal

Alert type	Icon	State	Indication
Warning		Active - not acknowledged, not silenced	• Flashing symbol and descriptive text • Audible signal
		Active - not acknowledged, silenced	• Flashing symbol and descriptive text • No audible signal
		Active - acknowledged	• Steady symbol and descriptive text • No audible signal
		Active - responsibility transferred	• Steady symbol and descriptive text • No audible signal
		Rectified - not acknowledged	• Flashing symbol and descriptive text • No audible signal
Caution		Active	• Steady symbol and descriptive text • No audible signal

Acknowledging alerts



The **Alerts** softkey is labelled **Alerts Acknowledge** if there is an un-acknowledged alarm or warning in the system.

Acknowledge the most recent alert by pressing the **Alerts** softkey. The cursor is then automatically moved to the Alerts panel, and you can use the arrow keys to move up and down in the list of alerts.

- Repeat pressing this softkey to continue to acknowledge alerts from the top of the Alerts panel.
- Press the Exit key to exit the Alerts panel.

When an Alarm or Warning is acknowledged, the alert icon stops flashing and changes to the acknowledged icon. The siren continues to sound if there are remaining unacknowledged alarms or warnings, otherwise it is muted.

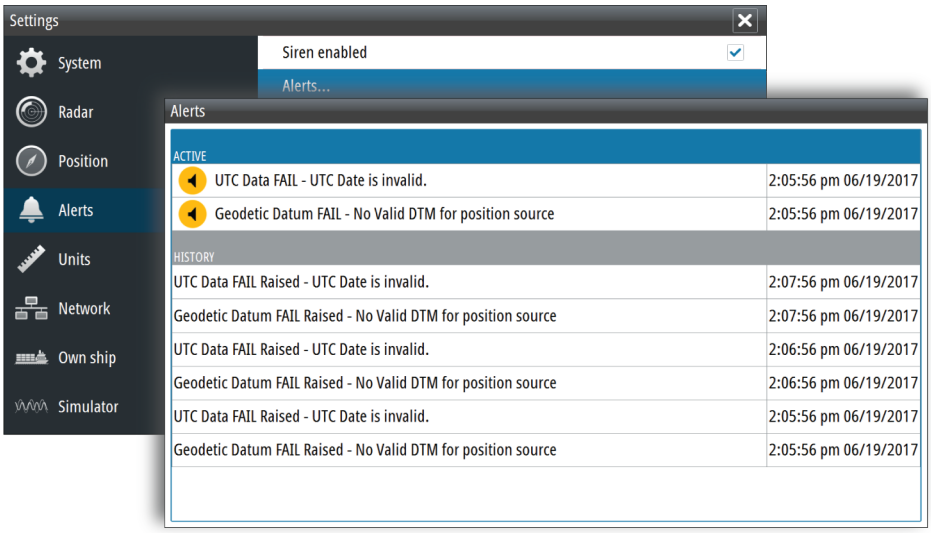
The acknowledged alert is not moved to its new position in the sort order until there has been 2 seconds without any alerts being acknowledged.

All alerts remain in the Alerts panel until the reason for the alert is rectified.

The Alerts dialog

The Alerts dialog includes a list of active alerts together with a historic listing of the last 100 alert state changes. Entries are added to the history whenever an alert is raised, acknowledged, rectified or cleared.

All alerts in the Alerts dialog include a time stamp.



Alphabetic alarm listing

Alert type abbreviations:

- C: Caution
- W: Warning
- A: Alarm

Alert text	Description	Type	Category
AIS Capacity 95%	AIS target processing/displaying is about to be exceeded.	C	B
AIS Capacity Full	AIS capacity exceeded.	W	A
AIS FAIL	AIS failure	W	B
	Not used AIS failure	C	B
AIS TGT in GZ	AIS Target in Guard zone	W	A
AIS TGT Lost: #	AIS target # is lost	W	A
BAM HBT Lost	BAM Heartbeat lost	C	B
Dangerous AIS TGT	CPA or TCPA values of an activated AIS target less than set limits	A	A
Dangerous TT	CPA or TCPA values of a tracked target less than set limits	A	A
EPFS FAIL	Not used position source failure	C	B
	Position source failure	W	B
Geodetic Datum FAIL	Geodetic Datum failure	W	B
GYRO FAIL	Gyro failure	W	B
	Not used gyro failure	C	B
Heading Line FAIL	Heading line failure	W	B
Magnetron EOL	Magnetron end of life reached	C	B
POSN Invalid	Position invalid	W	B
POSN Unavailable	Position unavailable	W	B
Radar Antenna FAIL	Radar antenna failure	W	B
RADAR FAIL	Radar TXRX failure	W	B

Alert text	Description	Type	Cate-gory
REF TGT Lost	Reference target lost	W	A
SOG FAIL	Speed Over Ground failure	W	B
Speed LOG FAIL	Not used speed LOG failure	C	B
	Speed LOG failure	W	B
SPD Long. Axis FAIL	Speed longitudinal axis data failure	W	B
SPD Tran. Axis FAIL	Speed transversal axis data failure	W	B
STW FAIL	Speed Through Water failure	W	B
TGT in GZ	Tracked target # within the vessel's guard zone	W	A
Train TGT CPA FAIL	Training target CPA out of range	W	A
Train TGT TCPA FAIL	Training target TCPA out of range	W	A
Trigger FAIL	Trigger failure	W	B
TT Capacity 95%	Tracked target processing/displaying is about to be exceeded	C	B
TT Capacity Full	Tracked target capacity exceeded	W	A
TT Lost: #	Tracked target # is lost	W	A
UTC Data FAIL	UTC data failure	W	B
Radar Video FAIL	Radar video failure	W	B

Operating modes fallback

The following table shows possible failure categories, and which operations that are allowed or not allowed when the failure occurs.

Failure	Possible alert	Fallback arrangement	Function Inhibited
Heading failure	GYRO FAIL	Automatic switch to relative motion head-up mode	• AIS • Acquiring/Tracking Radar Targets
Speed through water failure	Speed LOG FAIL STW FAIL	Possible to set Manual speed	• AIS
Course and speed over ground failure	Speed LOG FAIL SOG FAIL EPFS speed FAIL	Automatic switch to relative motion, relative vectors and sea stabilization	• True vectors
Position input failure	POSN Invalid POSN Unavailable		• AIS
Radar video input failure	RADAR FAIL	Possible to display target information based on AIS data	
AIS input failure	AIS FAIL		• AIS

17 Terms and abbreviations

ACK	Acknowledge
ACQ	Acquire
AZ	Acquisition Zone
ADJ	Adjust, Adjustment
ALT	Altitude
AIS	Automatic Identification System
AM	Amplitude Modulation
ANCH	Anchor Watch
ANT	Antenna
AP	Autopilot
APR	April
ARPA	Automatic Radar Plotting Aid
AUD	Audible
AUTO	Automatic
AZ	Acquisition Zone
AZI	Azimuth Indicator
BCR	Bow Crossing Range
BCT	Bow Crossing Time
BKGND	Background
BRG	Bearing
BRILL	Display Brilliance
BWW	Bearing Waypoint To Waypoint
C UP	Course Up
CCRP	Consistent Common Reference Point
CENT	Centre
CNCL	Cancel
COG	Course Over Ground
CONT	Contrast
CPA	Closest Point Of Approach
CPU	Central Processing Unit
CRS	Course
CTS	Course To Steer
CURS	Cursor
DAY/NT	Day/Night
DECR	Decrease
DEG	Degrees
DEL	Delete
DGPS	Differential Gps
DISP	Display
DIST	Distance
DPTH	Depth
DR	Dead Reckoning
DSC	Digital Selective Calling

DW	Deep Water
EBL	Electronic Bearing Line
ECDIS	Electronic Chart Display And Information System
ECS	Electronic Chart System
EGNOS	European Geo-Stationary Navigational Overlay System
ENCSOG	Automatic Navigational Chart
EP	Estimated Position
EPFS	Electronic Position Fixing System
EPIRB	Emergency Position Indicating Radio Beacon
EQUIP	Equipment
ERBL	Automatic Range And Bearing Line
ETA	Estimated Time Of Arrival
ETD	Estimated Time Of Departure
EZ	Exclusion Zone
FK	User Function Key
FMCW	Frequency Modulated Continuous Wave
FS	Fast Scan
FWD	Forward
GAS	Grounding Avoidance System
GEOG	Geographic
GLONASS	Global Orbiting Navigation Satellite System
GMDSS	Global Maritime Distress And Safety System
GND TRK	Ground Track
GNDSTAB	Ground Stabilized
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GZ	Guard Zone
H UP	Head Up
HDG	Heading
HL	Heading Line
HR	Hours
I/O	Input/Output
IBS	Integrated Bridge System
ID	Identification
IN	Input
INIT	Initialization
INS	Integrated Navigation System
IR	Interference Rejection
IRCS	Integrated Radio Communication System
ISW	Interswitch
Km	Kilometer
KN	Knots
LBL	Label
LIM	Limit
LOST TGT	Lost Target

LP	Long Pulse
m	Meters
MIN	Minimum
MIN	Minutes
MKR	Marker
MOB	Man Over Board
MP	Medium Pulse
MSTR	Master
N UP	North Up
NAV	Navigation
NC	Normally Closed
NLT	Not Less Than
NM	Nautical Mile
NMT	Not More Than
NR	Noise Rejection
NUC	Not Under Command
OFF CENT	Off Centre
OFFTRK	Off Track
OS	Own Ship
OUT	Output
PAD	Predicted Area Of Danger
PAST POSN	Past Position
PCB	Printed Circuit Board
PI	Parallel Index Line
PL	Pulse Length
PM	Performance Monitor
POSN	Position
PPC	Predicted Point Of Collision
PRF	Pulse Repetition Frequency
PWR	PWR
R BRG	Relative Bearing
R CRS	Relative Course
R VECT	Relative Vector
RAD	Radius
RAIN	Anti Clutter Rain
RCDS	Raster Chart Display System
REF	Echo Reference
REF SOG	Echo Reference Speed
REL or R	Relative
RM	Relative Motion
RM (R)	Relative Motion (Relative Trails)
RM (T)	Relative Motion (True Trails)
RNC	Raster Navigational Chart
RNG	Range
ROT	Rate Of Turn

RR	Range Rings
RTE	Route
RX	Receiver
SAF CON	Safety Contour
SAR	Search And Rescue
SC/SC	Scan To Scan
SDME	Speed and Distance Measuring Equipment
SEA	Anti Clutter Sea
SEL	Select
SENC	System Electronic Navigational Chart
SNR	Signal To Noise Ratio
SOG	Speed Over Ground
SP	Short Pulse
SPD	Speed
SRNC	System Raster Navigational
STAB	Stabilized
STBD	Starboard
STBY	Standby
STW	Speed Through Water
T BRG	True Bearing
T CRS	True Course
T SPD	True Speed
T VECT	True Vector
TB	Target Boost
TCPA	Time To Closest Point Of Approach
TE	Target Expand
TGT	Target
Tgt exp	Target expansion
Th	Target threshold
TM	True Motion
TPR	Transponder
TRIAL	Trial Maneuver
TRIG	Trigger Pulse
TRK	Track
TRKG	Tracking
Tracking	Time To Go
TS	Target separation
TWOL	Time To Wheel Over Line
TX	Transmit, Transmitter
TX/RX	Transceiver
UPS	Uninterruptible Power Supply
VRM	Variable Range Marker
VTS	Vessel Traffic Services
WOL	Wheel Over Line
WOP	Wheel Over Point

18 Spare parts and accessories

The most up-to-date list of spare parts and accessories is available at the product site on www.navico-commercial.com

R2009 Options and accessories

Item	Part number
O2000 Control unit	000-12189-001
Micro-C T-connector	000-0119-79
NMEA 2000 Cable, 1.8 m (6 ft)	000-0127-53
NMEA 2000 Cable, 4.6 m (15 ft)	000-0119-86
NMEA 2000 Power cable	000-0119-75
NEP-2 Network expansion	000-10029-001

R2009 Spare parts and service packs

Item	Part number
O2000 Control unit	151-10369-001
R2009 Control unit	151-10366-001
Sun cover	000-12413-001
Front case service pack	000-12398-001
Keypad radar kit	000-12401-001
SD service pack	000-12402-001
Case re-assembly kit	000-12403-001
SD door kit	000-12407-001
Dash mounting pack	000-12409-001
Bracket mounting pack	000-12411-001
NMEA 0183 serial cable, 2 m (6.6 ft)	000-11247-001
Power cable	000-00128-001

R3016 Options and accessories

Item	Part number
O2000 Control unit	000-12189-001
HDMI-DVI cable, 1.5 m (5 ft)	000-12427-001
Micro-C T-connector	000-0119-79
NMEA 2000 Cable, 1.8 m (6 ft)	000-0127-53
NMEA 2000 Cable, 4.6 m (15 ft)	000-0119-86
NMEA 2000 Power cable	000-0119-75
NEP-2 Network expansion	000-10029-001

R3016 Spare parts and service packs

Item	Part number
O2000 Control unit	151-10369-001
R3016 Control unit	151-10368-001
Sun cover	000-12414-001
Front case service pack	000-12399-001
Keypad radar kit	000-12401-001
SD service pack	000-12402-001
Case re-assembly kit	000-12404-001
SD door kit	000-12408-001
Dash mounting pack	000-12410-001
Bracket mounting pack	000-12412-001
High speed NMEA 0183 serial cable, 2 m (6.6 ft)	000-12393-001
Power cable	000-00128-001

19 Technical specifications

The most up-to-date specifications list is available at:
www.navico-commercial.com

Overview

Display size	
R2009	9-inch portrait
Screen brightness	
R2009	≤1200 cd/m^2
Networking capability	
R2009	2 x NMEA 0183, 1x NMEA 2000, 1x Ethernet
Video integration	
R2009	None

Display

Display resolution	
R2009	480 x 800
Display type	
R2009	9-inch LED-backlit Colour TFT LCD

Technical/environmental

Operating temperature	-15°C to +55°C / 5°F to 131°F
Waterproof standard/ rating	IPX6 and IPX7
Specified standards	• IEC/EN60945 → ***Note:*** Refer to the product website for the latest information about product compliance.
Dimensions	Refer to *"Dimensional drawings"* on page 96
Weight	
R2009	1.95 kg / 4.3 lb

Power

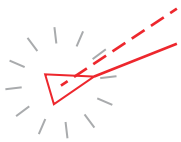
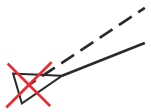
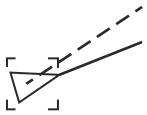
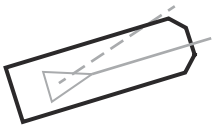
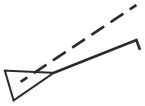
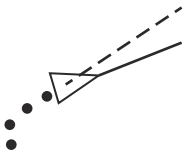
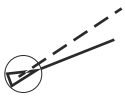
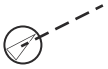
Supply voltage	12-24 V DC
Power consumption	
R2009	11 W

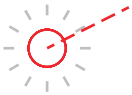
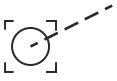
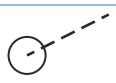
Compass safe distance

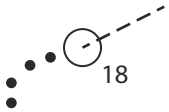
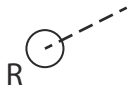
	Safe distance to the standard magnetic compass	**Safe distance to the steering magnetic compass**
R2009 Control unit	0.34 m	0.25 m

20 Target symbols

This section lists the target symbols used in this system.

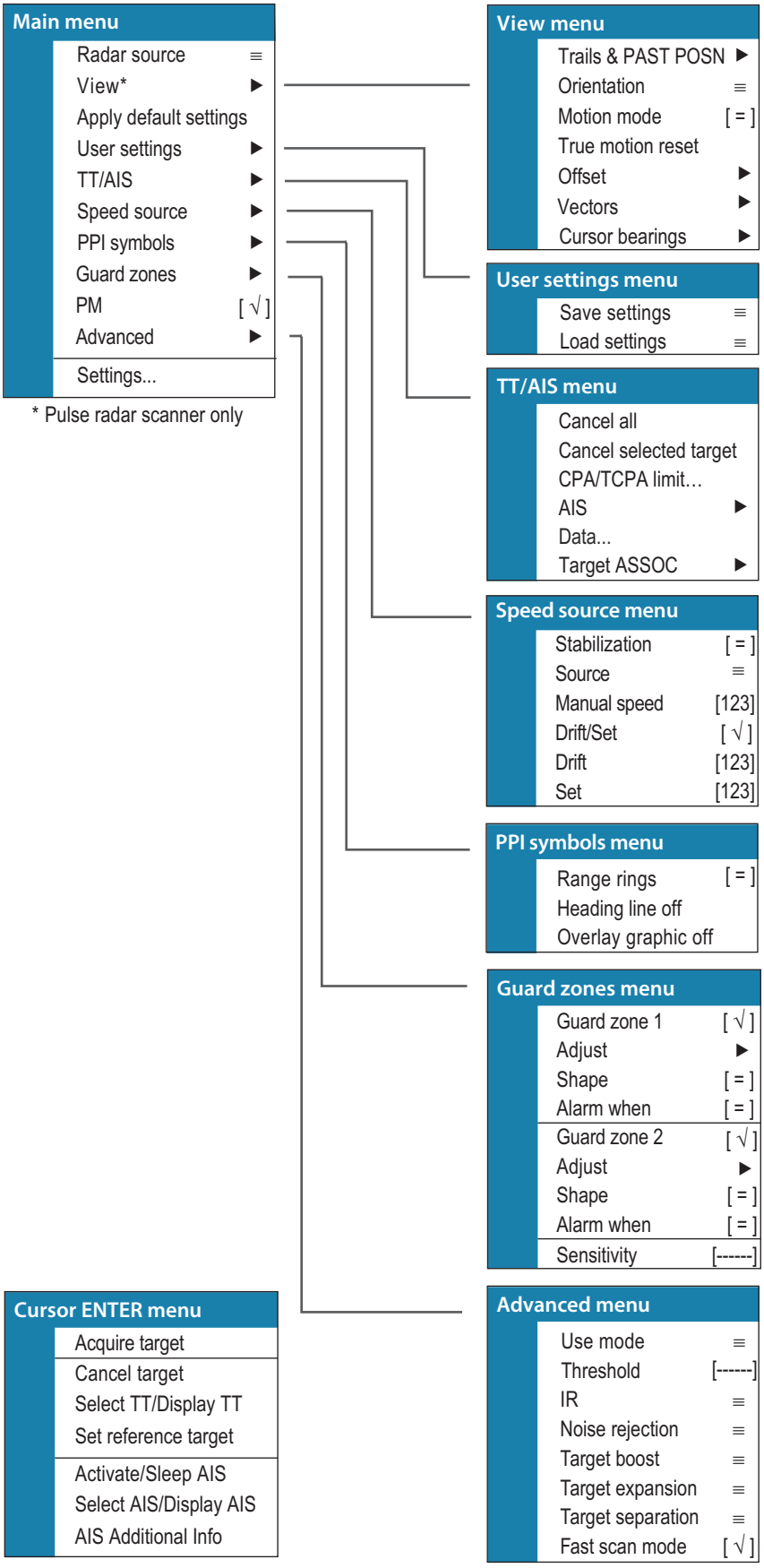
Symbol	Description
	**AIS Base station**
	**AIS SAR aircraft**
	**AIS SAR vessel**
	**AIS SART** (AIS Search And Rescue Transmitter)
	**AIS target - Dangerous**, indicated with bold line and with red color.The symbol flashes until the target alarm is acknowledged by the operator
	**AIS target - Lost**, indicated with crossed lines centered on the target symbol. The symbol is located at the last received position from the target
	**AIS target - Selected**, indicated with a square (dotted line) around the target symbol
	**AIS target** - **Sleeping**, aligned with received heading information or with COG information if heading is not available
	**AIS target, activated - True scaled outlines**
	**AIS target** with heading line and SOG/COG (dotted line), and with indicated turn direction
	**AIS target** with heading line, SOG/COG (dotted line) and past track
	**Associated target** - using AIS data
	**Associated target** - using radar data
	**Physical AIS AtoN**,basic shape (AIS aids to navigation)
	**Physical AIS AtoN - East cardinal mark**
	**Physical AIS AtoN - Emergency wreck mark**

Symbol	Description
	**Physical AIS AtoN - Isolated danger**
	**Physical AIS AtoN - North cardinal mark**
	**Physical AIS AtoN - Off position**
	**Physical AIS AtoN - Port hand mark**
	**Physical AIS AtoN - Racon failure**
	**Physical AIS AtoN - Racon**
	**Physical AIS AtoN - Safe water**
	**Physical AIS AtoN - South cardinal mark**
	**Physical AIS AtoN - Special mark**
	**Physical AIS AtoN - Starboard hand mark**
	**Physical AIS AtoN - Unlit** (failure of lights)
	**Physical AIS AtoN - West cardinal mark**
	**Radar target** - **Dangerous**,indicated with bold line and with red color.The symbol flashes until the target alarm is acknowledged by the operator. It remains red until the system no longer defines it as a dangerous target
	**Radar target - in acquisition state**, indicated as a broken circle centered at the position of target acquisition
	**Radar target** - **Lost**, indicated with crossed lines centered on the target symbol. The symbol is located at the last received position from the target
	**Radar target - Selected**, indicated with a square (dotted line) around the target symbol
	**Radar target - Tracked**, with velocity vector

Symbol	Description
	**Radar target** with past position and velocity vector
	**Reference target**
	**Signal station**
	**Virtual AIS AtoN**,basic shape
	**Virtual AIS AtoN - East cardinal mark**
	**Virtual AIS AtoN - Emergency wrek mark**
	**Virtual AIS AtoN - Isolated danger**
	**Virtual AIS AtoN - North cardinal mark**
	**Virtual AIS AtoN - Port hand mark**
	**Virtual AIS AtoN - Safe water**
	**Virtual AIS AtoN - South cardinal mark**
	**Virtual AIS AtoN - Special mark**
	**Virtual AIS AtoN - Starboard hand mark**
	**Virtual AIS AtoN - West cardinal mark**
	**Virtual AIS AtoN Missing**

21 Menu tree

The illustration below shows the main menu and the first level sub menus.



22 Supported data

→ ***Note:*** NMEA 0183 and NMEA 2000 data output requires the connection of relevant sensors.

NMEA 0183 sentences

Sentence	Description	In	Out
DBT	Depth Below Transducer	x	x
DPT	Depth	x	x
DSC	Digital Selective Calling Information	x	
DSE	Expanded Digital Selective Calling	x	
DTM	Datum reference	x	
GGA	Global positioning system (GPS) fix data	x	x
GLC	Geographic Position - Loran C		x
GLL	Geographic position- latitude and longitude	x	x
GNS	GNSS fix data	x	
GSA	GNSS DOP and Active Satellites	x	x
GSV	GNSS Satellites in view	x	x
HDG	Heading - Deviation & Variation	x	x
HDM	Heading - Magnetic	x	
HDT	Heading - True	x	
MOB	Man Over Board	x	
MTW	Water Temperature	x	x
MWD	Wind Direction and Speed	x	x
MWV	Wind Speed and Angle	x	x
OSD	Own ship data		x
RMC	Recommended Minimum Specific GNSS Data	x	
RSD	Radar system data		x
RTE	Routes	x	
THS	True heading and status	x	
TLB	Target label		x
TLL	Target Latitude & Longitude		x
TTD	Tracked target data		x
TTM	Tracked target message		x
VBW	Dual ground/water speed	x	
VDM	AIS VHF data-link message	x	
VDO	AIS VHF data-link own vessel report	x	
VHW	Water speed and heading	x	x
VLW	Distance traveled through water	x	x
VTG	Course over ground and ground speed	x	x
WPL	Waypoint Location	x	
XDR	Cross Track Error - Dead Reckoning	x	x
ZDA	Time and date	x	x

NMEA 2000 compliant PGN List

NMEA 2000 PGN (receive)

59392	ISO Acknowledgement
59904	ISO Request
60928	ISO Address Claim
126208	ISO Command Group Function
126992	System Time
126996	Product Info
127237	Heading/Track Control
127245	Rudder
127250	Vessel Heading
127251	Rate of Turn
127257	Attitude
127258	Magnetic Variation
127488	Engine Parameters, Rapid Update
127489	Engine Parameters, Dynamic
127493	Transmission Parameters, Dynamic
127503	AC input status
127504	AC Output Status
127505	Fluid Level
127506	DC Detailed Status
127507	Charger Status
127508	Battery Status
127509	Inverter Status
128259	Speed, Water referenced
128267	Water Depth
128275	Distance Log
129025	Position, Rapid Update
129026	COG & SOG, Rapid Update
129029	GNSS Position Data
129033	Time & Date
129038	AIS Class A Position Report
129039	AIS Class B Position Report
129040	AIS Class B Extended Position Report
129041	AIS aids to Navigation
129283	Cross Track Error
129284	Navigation Data
129539	GNSS DOPs
129540	AIS Class B Extended Position Report
129794	AIS aids to Navigation
129801	Cross Track Error
129283	Cross Track Error
129284	Navigation Data
129539	GNSS DOPs

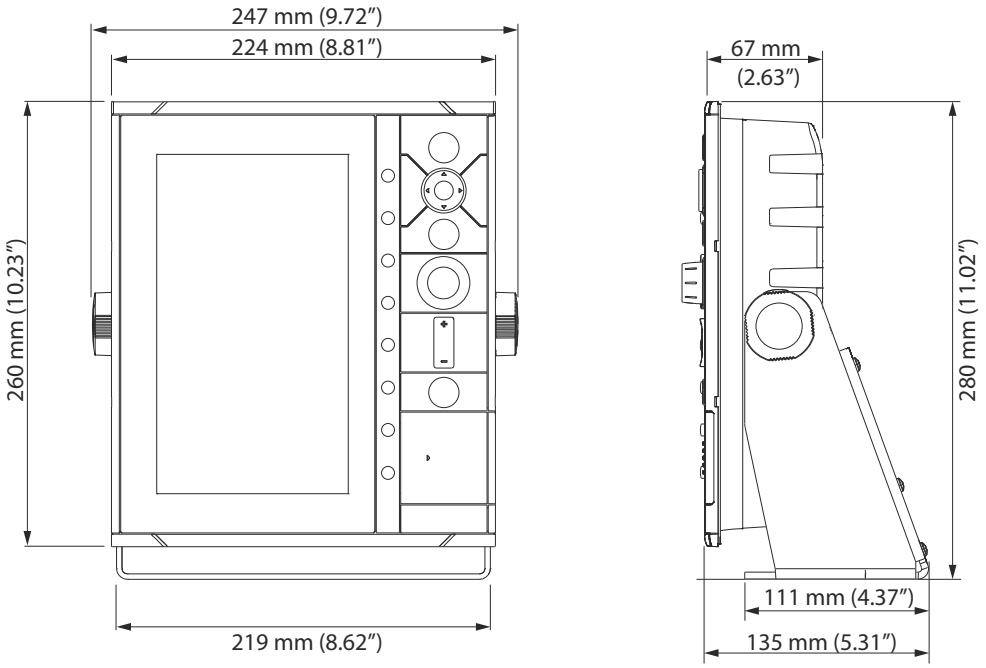
129540	GNSS Sats in View
129793	AIS UTC & Date Report
129794	AIS Class A Static and Voyage Related Data
129798	AIS SAR Aircraft Position Report
129801	AIS Addressed Safety Related Message
129802	AIS Safety Related Broadcast Message
129808	DSC Call Information
129809	AIS Class B "CS" Static Data Report, Part A
129810	AIS Class B "CS" Static Data Report, Part B
130074	Route and WP Service - WP List - WP Name & Position
130306	Wind Data
130310	Environmental Parameters
130311	Environmental Parameters
130312	Temperature
130313	Humidity
130314	Actual Pressure
130576	Small Craft Status
130577	Direction Data
130578	Vessel Speed Components

NMEA 2000 PGN (transmit)

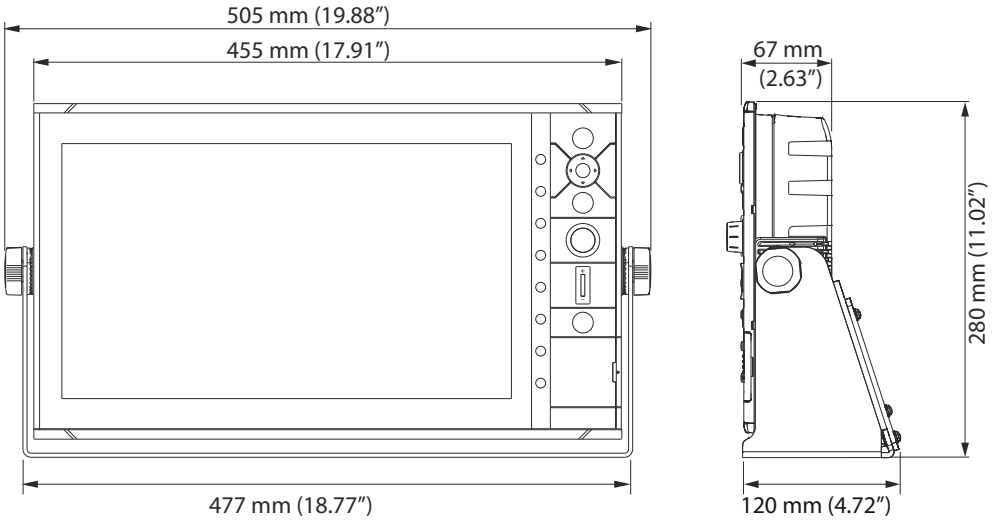
126208	ISO Command Group Function
126992	System Time
126996	Product Info
127237	Heading/Track Control
127250	Vessel Heading
127258	Magnetic Variation
128259	Speed, Water referenced
128267	Water Depth
128275	Distance Log
129025	Position, Rapid Update
129026	COG & SOG, Rapid Update
129029	GNSS Position Data
129283	Cross Track Error
129284	Navigation Data
129285	Route/Waypoint Data
129539	GNSS DOPs
129540	GNSS Sats in View
130074	Route and WP Service - WP List - WP Name & Position
130306	Wind Data
130310	Environmental Parameters
130311	Environmental Parameters
130312	Temperature
130577	Direction Data

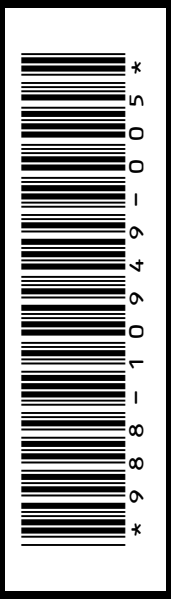
23 Dimensional drawings

R2009 Control unit



R3016 Control unit





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