KODEN

OPERATION MANUAL

SOLID-STATE RADAR

KRS Series

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KRS Series Operation Manual
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When part of the document needs to be revised, the document has advanced revision number.
The document No. is indicated at the lower right side on the cover and at the left or right side of the footer region of each page.

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CHAPTER 1: HEALTH & SAFETY

Warnings and cautions

Note:

The warnings and cautions detailed in this document apply to the operation of the equipment. For warnings and cautions related to installation and maintenance, please refer to the relevant Installation manual. For a list of applicable documents, refer to: **p.14 — Product documentation**

Aid to navigation

The equipment detailed in this document comply with relevant SOLAS regulations and are provided as an aid to navigation. The equipment should be used in accordance with the SOLAS regulations.

Safety warnings

Warning: Product operation

This product must be operated in accordance with the Operation manual provided. Failure to do so could result in personal injury, damage to your vessel and/or poor product performance.

Warning: Radar rotation

Some settings will power up the Radar scanner causing the antenna to rotate. Ensure that all personnel are clear of the Radar scanner before the Radar scanner is powered up.

Warning: Radio Frequency (RF) radiation hazard

The Radar scanner transmits electromagnetic energy at microwave frequencies which can be harmful, particularly to the eyes. Do NOT look at the scanner from close range. Ensure personnel are clear of the scanner when it is powered on.

Radio Frequency (RF) transmissions can affect cardiac pacemakers and cause damage or cause irregularities in their operation. Any users of such devices should be aware and understand the risks prior to exposure.

Important:

For safety reasons, the Radar must be installed above head height, out of range of personnel.

Transmitted power density levels (from center of rotation)

Installers must ensure that the Radar is installed in a location that adequately protects crew members and the general public from Radar antenna transmissions. Transmitted power density is based on the antenna gain, and the distance to the antenna.

The following table lists the calculated minimum compliance boundary (in meters) for *transmitted power density levels* (rounded up to the nearest 0.1 m):

Worker / Occupational / Crew	General Public
0.3 m which is < Swept Volume (0.975 m)	0.5 m which is < Swept Volume (0.975 m)

Range within which the power density exceeds the following:

Antenna	10W/m^2	50W/m^2	100W/m^2
Rotating	0.5 m < Swept Volume (0.975 m)	0.3 m < Swept Volume (0.975 m)	A power density level of 100W/m^2 does not occur at any point.

Warning: Day mode brightness warning

Switching from Night mode to Day mode instantly increases the display brightness to maximum. This will impact the operator's night vision, due to the relative brightness of Day mode in night time conditions.

Product warnings

Warning: Anti virus protection

The system does not include protection against computer viruses. Before inserting any memory device ensure it is free from computer viruses by scanning the device with a suitable anti virus application with up to date virus definitions.

Caution: Servicing, maintenance and repair

Servicing, maintenance and repair of this equipment can only be carried out by Koden Electronics Co., Ltd. authorized engineers. Unauthorized servicing, maintenance and repair of the equipment will invalidate product warranty and require re-commissioning of the equipment.

Regulatory notices

Radar licensing

Installation and operation of this Radar may be subject to individual licensing of the equipment, operator or vessel.

In many countries, the licensing for the use of Radar equipment is included in the **Ship Station license** and **Operator's license** issued for VHF radios. However, even if you already have a Ship Station license and Operator's license for a VHF radio, **some countries may require a separate license for Radar equipment use.**

Important:

It is your responsibility to determine whether a license is required in your area before operating this equipment.

For a list of license issuing authorities, refer to:

p.119 — Licensing issuing authorities

Open source license agreements

This product is subject to certain open source license agreements. For more information, contact Koden dealer or Koden.

Approval certificates

For more information, contact Koden dealer or Koden.

Disclaimer

Koden does not warrant that this product is error-free or that it is compatible with products manufactured by any person or entity other than Koden.

Koden is not responsible for damages or injuries caused by your use or inability to use the product, by the interaction of the product with products manufactured by others, or by errors in information utilized by the product supplied by third parties.

Third-party hardware, such as converters, adapters, routers, switches, Access Points etc., provided by third parties, may be made available directly to you by other companies or individuals under separate terms and conditions, including separate fees and charges. Koden Electronics Co., Ltd. or its affiliates have not tested or screened the third-party hardware. Koden has no control over, and is not responsible for:

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Warranty registration

This registration must be completed in full to receive the warranty from Koden Distributor/Dealer or Koden Electronics Co., Ltd.
It is important that you register your product to receive full warranty benefits. Your unit package includes a bar code label indicating the serial number of the unit. You should retain the bar code label indicating the serial number of the unit.

Technical accuracy

To the best of our knowledge, the information in this document was correct at the time it was produced. However, Koden cannot accept liability for any inaccuracies or omissions it may contain. In addition, our policy of continuous product improvement may change specifications without notice. As a result, Koden cannot accept liability for any differences between the product and this document. Please check the Koden website to ensure you have the most up-to-date version(s) of the documentation for your product.

Publication copyright

CHAPTER 2: DOCUMENT INFORMATION

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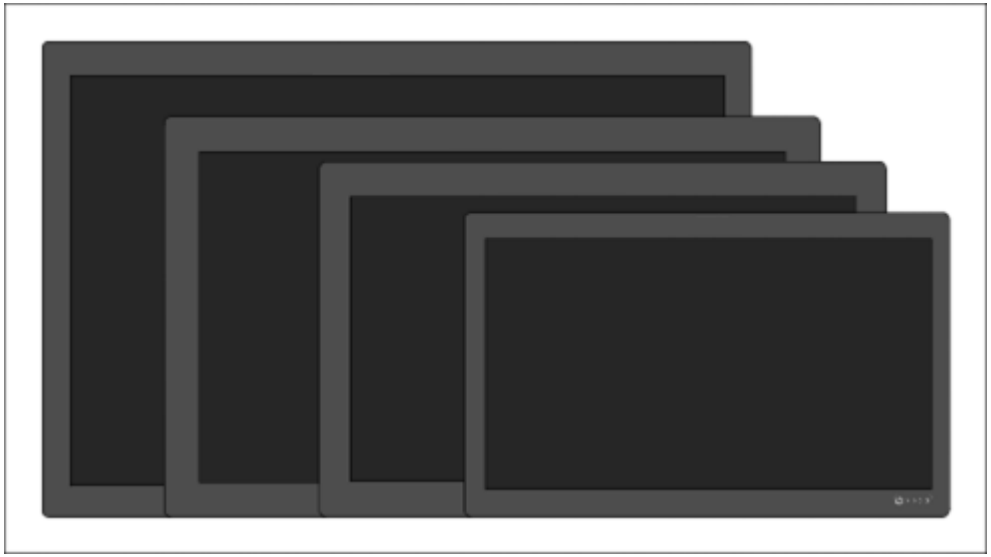
*Card reader: option

2.1 Applicable products

This document is applicable to the following products:

Navigation displays



- KRS 16” Radar System, part number: KRS-1611P
- KRS 19” Radar System, part number: KRS-1911P
- KRS 22” Radar System, part number: KRS-1211P
- KRS 24” Radar System, part number: KRS-1411P

Including peripherals such as: External alarm buzzer, External card reader* and USB Trackball.

2.2 Product documentation

The following documentation is applicable to your product:

Applicable documents

- KRS Radar Operation manual (This document).
- KRS Radar Installation manual.

This and other Koden product documents are available to download in PDF format. For more information, contact Koden dealer or Koden.

2.3 Document conventions

The following conventions are used throughout this document.

Formatting of user interface menus and settings references

References to menus, settings options and physical buttons are formatted using square brackets [ ].

Examples:

- “Select *[Guard Zone]* from the *[Additional features]* menu.
- “Enable the *[AIS]* toggle switch to display AIS targets onscreen.”

- Swipe your finger from left to right across the *[Power swipe] t*ouch control.

Procedures for performing specific tasks using the product's user interface The term "**Select**" is used to refer to the action of:

- *Trackball*— moving the cursor over an item and clicking the left or right button.
- *Touchscreen* — using your finger to select a menu option or item on the screen.

Examples:

- "Select *[Ok]* to confirm your selection."
- "Select the target onscreen."

The term "**Drag**" is used to refer to the action of:

- Trackball — click and hold left or right button and use the ball to move the cursor.
- Touchscreen — using your finger to select an item and then moving your finger in the required direction.

Procedures for navigating menu hierarchies

Menu hierarchies are used in this document to provide a quick summary on how to access a particular function or menu option.
References to menu hierarchies are formatted using square brackets [ ] with an arrow > separating each menu setting.

Examples:

- "The CCRP location can be configured from the *[Ownship]* settings menu: *[Standby screen > Settings > Ownship]*."

2.4 Document illustrations and screenshots

Note:

- Whilst care is taken to ensure that the illustrations and screenshots provided in this document portray the latest hardware and software versions available, where differences are purely aesthetic, some illustrations and screenshots may depict an older version of hardware or software.
- The navigation and/or sensor data shown in screenshots may be simulated data and therefore may not reflect real world conditions.

CHAPTER 3: PRODUCT AND SYSTEM OVERVIEW

CHAPTER CONTENTS

*Card reader: option

3.1 KRS radar system overview

The Koden KRS radar system comprises of a Radar display with an integrated processor, an RSB-111P Radar scanner, a Data Collection Unit (DCU) and display peripherals.

The Koden KRS radar system is currently compliant for Cat 3 and Cat 2 ships / craft.

The following table provides a summary of the categories and basic differential capabilities for each category of SOLAS shipborne radar equipment.

Size of ship/craft	CAT 3 <500gt	CAT 2 500gt to <10000gt HSC <10000 gt	CAT 1 10000gt	KRS capability
Minimum operational display area diameter	180 mm (7.09 in)	250 mm (9.84 in)	320 mm (12.60 in)	-
Auto acquisition of targets	-	-	Yes	Yes
Minimum acquired radar target capacity	20	30	40	100
Minimum activated AIS target capacity (simultaneously displayed)	20	30	40	4,000
Minimum sleeping AIS target capacity (simultaneously displayed)	100	150	200	4,000
Trial manoeuvre	-	-	Yes	Yes

Range and bearing discrimination

- MSC.192/5.5.1: In line with regulations, the radar system is capable of displaying two point targets on the same bearing, separated by 40 m (131.23 ft) in range, as two distinct objects.
- MSC.192/5.5.2: In line with regulations, the radar system is capable of displaying two point targets on the same range, separated by 2.5° in bearing, as two distinct targets.

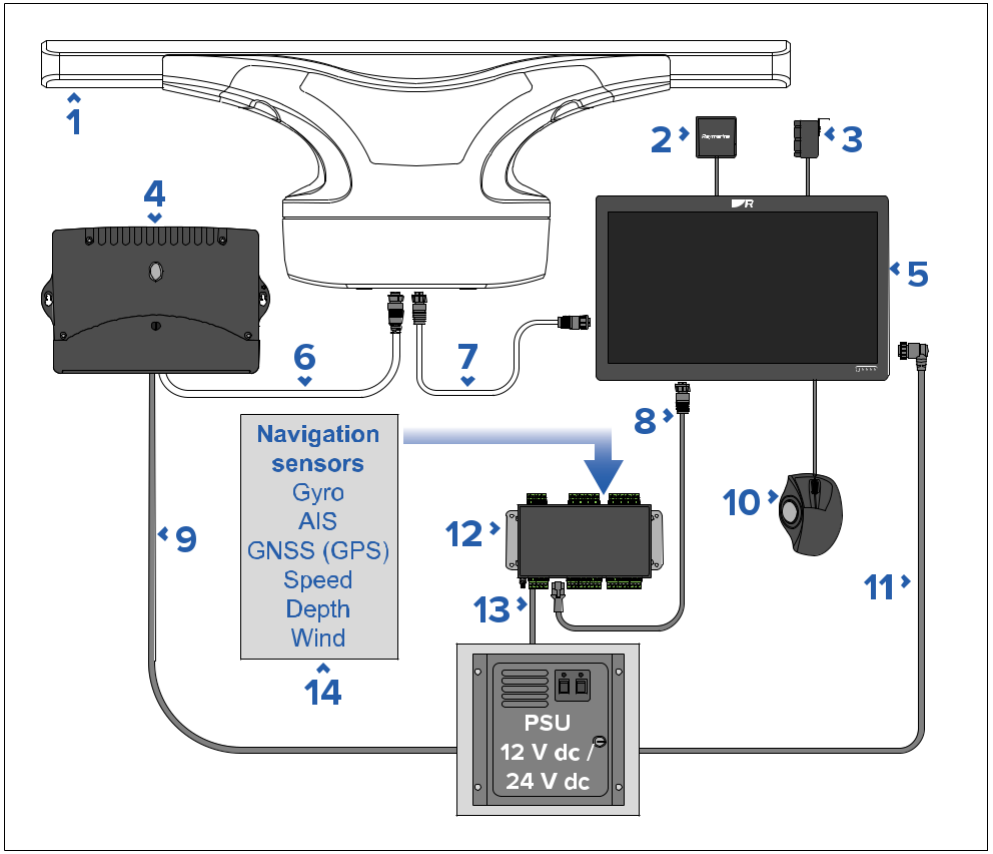
Minimum range

The minimum range of Koden approved sensors installed in accordance with MSC.922/5.3.1.2 shall be less than 40 m (131.23 ft).

System

The KRS Radar system should be set up as follows:

System example



System hardware

1. **RSB-111P Radar Scanner with 6 ft antenna** — Detects targets by transmitting microwaves and generating a picture on the Radar display using the microwaves reflected from the objects.
2. **External card reader*** — The external card reader* is used to backup and restore user data and settings.
3. **Alarm buzzer** — The alarm buzzer is used to provide an audible alert of a situation requiring the user's attention. The alarm buzzer is mandatory for the KRS radar system, as the Radar display does not include a built-in buzzer.
4. **VCM100** — The Radar scanner's Voltage Control Module (VCM) provides power to the Radar scanner.
5. **KRS Radar Display** — A display that shows the Radar image and data from externally connected devices, to provide situational and navigational awareness.
6. **Radar power cable** — Connects the Radar scanner to the VCM100.
7. **Radar data cable** — Transfers data from the Radar scanner to the Radar display.
8. **RJ45 cable** — Transfers data from the DCU to the Radar display.
9. **VCM power cable** — Connects the VCM to the power supply (cable NOT supplied).
10. **KRS Trackball** — Used to control the Radar display and interact with its user interface.
11. **Display power cable** — The cable is used to power the Radar display.
12. **KRS DCU (Data Collection Unit)** — Collects data transmitted by externally connected devices and transmits the data over Ethernet, so that it can be shown on the Radar display.
13. **DCU power cable** — A cable is required to power the DCU and is NOT supplied.
14. **NMEA 0183 External sensors** — External sensors are connected to the DCU's NMEA 0183 inputs.

Note:

The power cables for the VCM100 and DCU are not supplied with the system. All other components and cables are supplied when ordering a KRS Radar System.

Screen resolutions

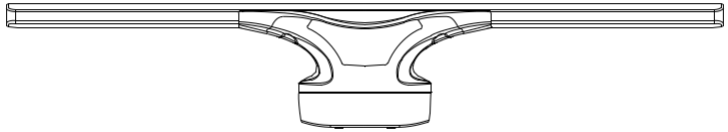
KRS Radar display screen resolutions:

Display	Screen resolution
16"	1920 x 1080
19"	1920 x 1080

Display	Screen resolution
22”	1920 x 1080
24”	1920 x 1200

3.2 Approved Radar scanners

The following Radar scanners are approved for use with the KRS Radar display:



- RSB-111P radar scanner with 6 ft antenna.

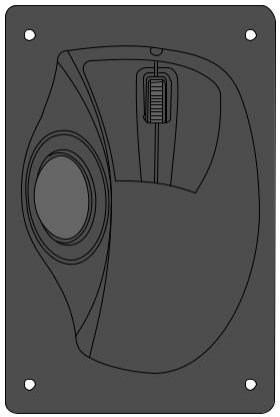
Radar target acquisition data source requirements

Radar target acquisition requires external devices that transmit relevant data to be available on your system
The following data sources are required:

Data type	Example data source
COG (Course Over Ground)	GPS or GNSS receiver.
SOG (Speed Over Ground)	GPS or GNSS receiver.
THS / HDT (True Heading)	Compass or Autopilot sensor providing fast heading data. (The gyro compass or equivalent heading sensor must have an update rate that is adequate for the ship’s rate of turn. In general for non-high speed craft, the update rate should be a minimum of 10 Hz.).

3.3 KRS Trackball

The following Trackball is recommended for controlling the Radar display.



- KRS USB trackball (part number: A80788).

3.4 Additional components

The following additional devices are required to provide data to the system:

- A gyro-compass or transmitting heading device (THD)
- A speed and distance measuring equipment (SDME)
- An electronic position fixing system (EPFS)
- An automatic identification system (AIS); or
- Other sensors or networks providing equivalent information acceptable to the IMO (e.g.: an INS).

CHAPTER 4: SOFTWARE DETAILS

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4.1 Display software

This document is applicable to the following software:

Software name	Software version
KRS-Series Radar Display	v2.0

Important:

Running any software other than that supplied with the display will invalidate the product warranty.

4.2 Performing a software update

From time to time software updates will be available which will improve available features and functionality. Software update will be provided by Koden or an authorized dealer.

The current display software version is shown on the standby screen.

For software information, contact Koden dealer or Koden.

CHAPTER 5: SUPERIORuperior FEATURES

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5.1 Superior features introduction

Details of the superior features and improvements that have been included in the latest release of the KRS-Series Radar Display operating system are detailed here.
These details also appear inline in the relevant chapters of the ***KRS-Series Radar*** *Operation manual*. You may need to refer to these chapters to understand the full context of a feature.

5.2 Operational Display Area (ODA)

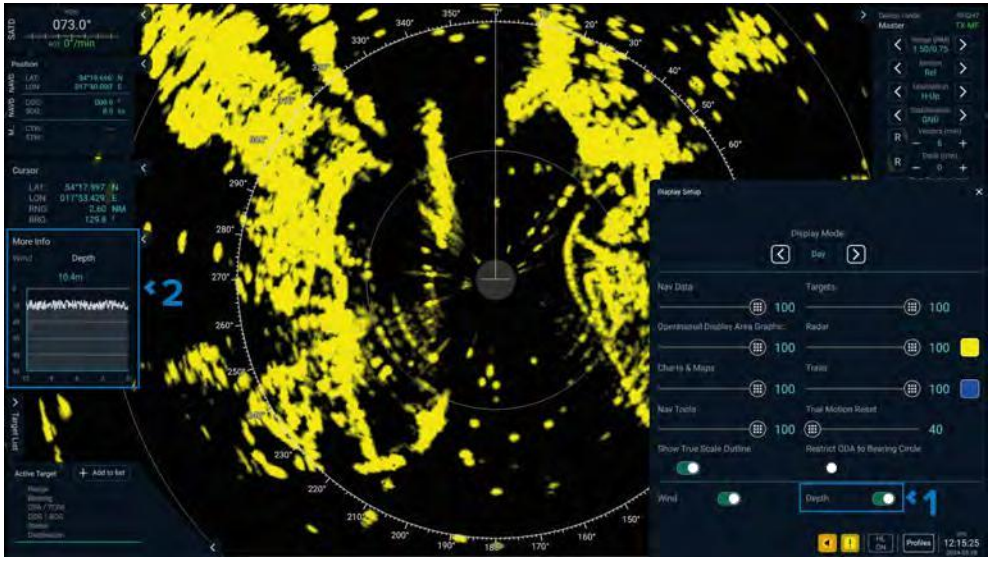
By default, the Operational Display Area (ODA) will cover the entire screen. If desired, the ODA can be restricted to the bearing scale circle.
Use the *[Restrict ODA to bearing circle]* toggle switch located in the *[Display setup]* menu to enable and disable the ODA restriction.

1. **Disabled** —The ODA will fill the available screen.
2. **Enabled** — The ODA will be restricted to the bearing scale circle.

5.3 Depth data

Depth data from a connected external device can be displayed onscreen.

Enable the *[Depth]* toggle switch located in the *[Display setup] m*enu to view *[Depth] d*ata onscreen.
Current depth and a depth history chart will be displayed on the left side of the Radar screen.



1. *[Depth]* toggle switch.
2. *[More info]* box showing Depth data.

If both *[Wind]* data and *[Depth]* data are enabled, you can switch between data by selecting either *[Wind]* or *[Depth]* from the *[More info]* box.

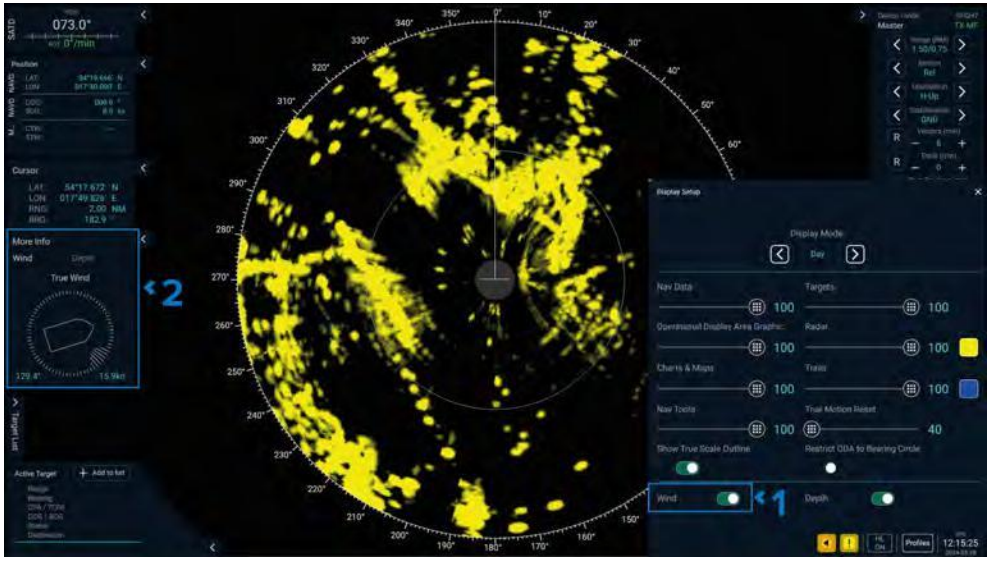
The *[More Info]* box is automatically hidden when the *[Targets List]* is displayed.

5.4 Wind data

Wind data from a connected external device can be displayed onscreen.

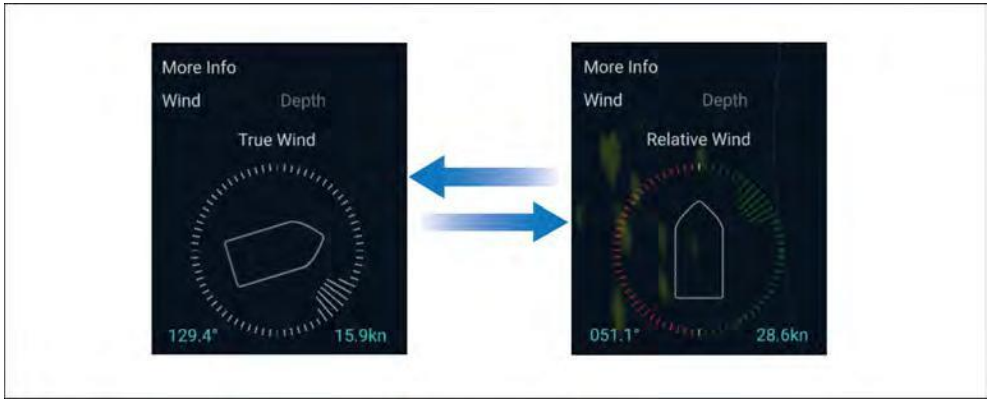
Enable the *[Wind]* toggle switch located in the *[Display setup]* menu to view *[Wind]* data onscreen.

Current wind speed and direction will be displayed on the left side of the Radar screen.



If both Wind data and Depth data are enabled, you can switch between data by selecting either *[Wind]* or *[Depth]* from the *[More info]* box.

True / Relative wind



To switch to *[Relative wind]* data, long-press on the *[True Wind]* label . A further long-press switches back to the display of *[True Wind]* data.

The *[More Info]* box is automatically hidden when the *[Targets List]* is displayed.

5.5 Standby screen overview

After the display has started up, the standby screen is shown.

1. *[Radar screen]*— Select to display the Radar screen.
2. *[File management]*— Select to browse files on internal and external memory.
3. *[Backup]*— Select to initiate a settings and user data backup.
4. *[Display details]*— Identifies the display model and software version. Select and hold the model name to initiate a software update.
5. *[Export system logs]*— Select to save system logs to a memory card.
6. *[Settings]*— Select to open the password-restricted settings menu.

5.6 Cursor details

The cursor is used to select objects and setting options.

The location of the cursor's position in relation to your vessel is displayed in the cursor box located on the left side of the screen.
Cursor position measurements / range scales are always referenced to the CCRP.
The following location details are provided:

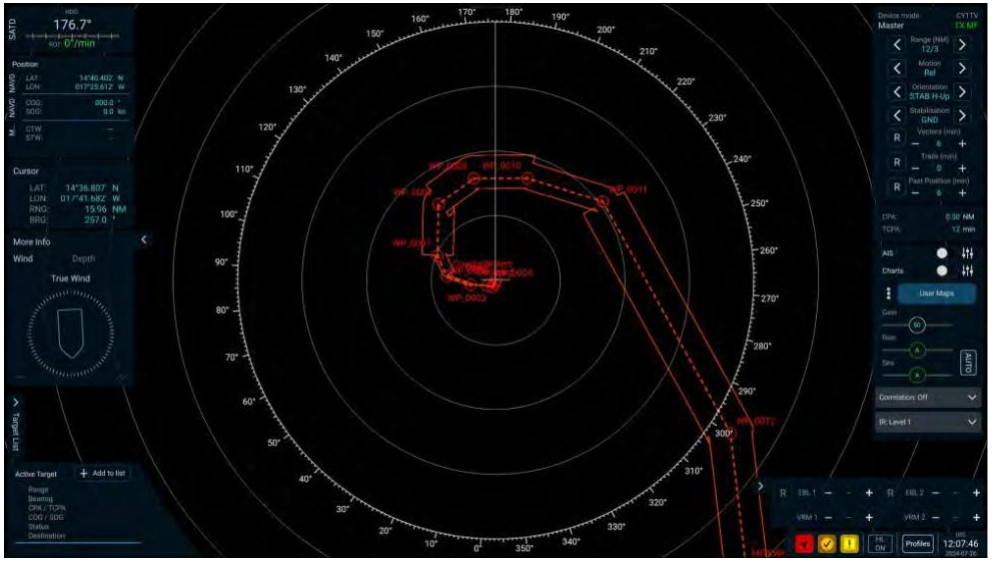
- *[LAT]* Latitude / *[TTG]* time To Go.
- *[LON]* Longitude / *[ETA]* estimated Time of Arrival.
- *[RNG]* (Range from ownship in NM or km).
- *[BNG]* (Bearing from ownship)

1. Latitude and Longitude.
2. TTG and ETA.

A long-press on *[LAT]* or *[LON]* will switch the data display to *[TTG]* and *[ETA]*; *[RNG]* will also switch to km (Kilometers).
A long-press on *[TTG]* or *[ETA]* will switch the data display back to *[LAT]*and *[LON]*, and revert *[RNG]* to NM (Nautical Miles).
When *[LAT]* and *[LON]* are displayed, a long-press on *[RNG]* will switch the display of the unit of measurement for the cursor and VRM ranges between NM and km.

5.7 Route Manager

The Route Manager can be used to import routes from a memory card to the display's internal memory.
The display can import routes in the Route plan exchange format (RTZ), and can also receive routes automatically when transmitted using RTE and RMB telegrams.



The routes on the memory card must be located in a folder named “KRS Routes”, located in the root directory of the memory card.
The *[Route Manager]* is accessed from the *[Additional Features]* menu located on the right side of the screen.

Importing a route

RTZ routes can be imported from a memory card using the Route Manager.

1. Select the relevant external memory card slot.
   A list of routes in the “KRS Routes” folder will be displayed.

Note:

The route files must be in the “KRS Routes” folder.

2. Select the route that you want to import.
3. Select *[Import]*.
4. Select *[Load]*.

Enabling automatic receipt of routes

The display can be configured to automatically receive routes sent using RTE and RMB Telegrams.

1. Select *[Routes]* from the *[Additional Features]* menu.
2. If required, enable the *[Load RTE Route Automatically]* toggle switch.
3. If required, enable the *[Load RMB Route Automatically]* toggle switch.

Routes sent by a connected external device will be automatically received by the display.

CHAPTER 6: GETTING STARTED

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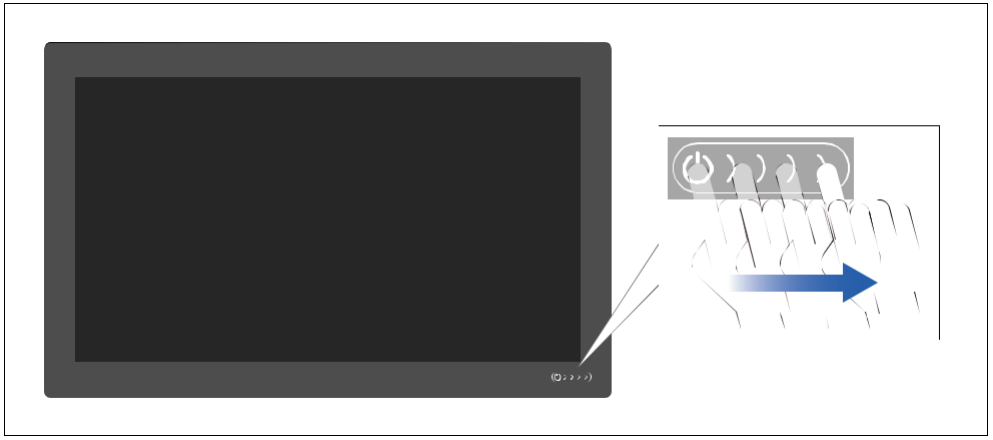
6.1 Switch on / off

Switching on the display

When the display is powered but in standby, the *[Power swipe]* touch control will be illuminated.
To switch on the display:



1. Swipe your finger from left to right across the *[Power swipe]* touch control. The display will boot up.

Switching the display to standby

When the display is switched on, follow the steps below to put the display into standby (switch off).

1. Swipe your finger from left to right across the *[Power swipe]* touch control. The *[Shortcut Menu]* is displayed.
2. Select and hold the *[Turn OFF]* power symbol until the screen switches off.

Note:

When the display is in standby, it may still draw a small amount of power from the battery. If this is a concern, unplug the power supply or switch off at the breaker.

Removing power

If you wish to ensure that the display is not consuming any power, then it must be switched off at the breaker or the power cable must be unplugged. When the breaker is switched back on or the cable is reconnected, the display will resume in the same power state that it was in when it was switched off.

6.2 Controls

Display controls

The navigation display includes a touchscreen and a touch controlled power swipe area.

1. *[Power swipe]* touch control — Swipe your finger from left to right across the *[Power swipe]* touch control to switch on the display. When switched on, swipe again to open the *[Shortcut Menu]*.

Trackball controls

- The trackball is used to move the cursor around the screen.

- Left click selects an item.
- Right click selects an item.
- The middle scroll wheel can be used to range in and out. The scroll wheel is also used to scroll through the *[Additional features]* menu.

Keyboard shortcuts

The function ‘F’ keys on the optional KRS keyboard are used for specific shortcuts.

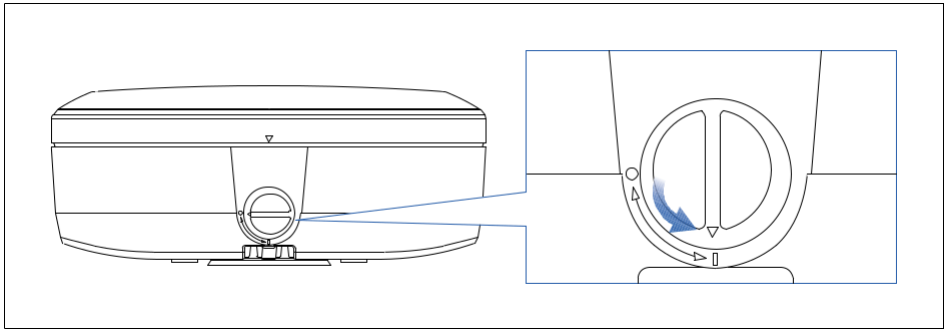
- *[F1]*— Radar Transmit *[TX]* standby *[STBY]*.
- *[F2]*— Acknowledge alarms.
- *[F3]*— Enable and disable display of *[AIS]* targets.
- *[F4]*— Chart On/Off.
- *[F5]*— Temporary Suppression *[HL Off]*, whilst pressed.
- *[F6]*— Open or close the *[Shortcut menu]*.
- *[F7]*— *[Take Screenshot]*.
- *[F8]*— *[Acquire]* at cursor location.
- *[F9]*— *[Radar offset]* reset.
- *[F10–F12]*— Undefined.

6.3 Initial power on test

Once all cables have been connected, it is important to perform an initial power on test in order to confirm correct operation.

Ensure that all cables have been correctly and securely connected to both the radar and the navigation display (which should initially be powered OFF):

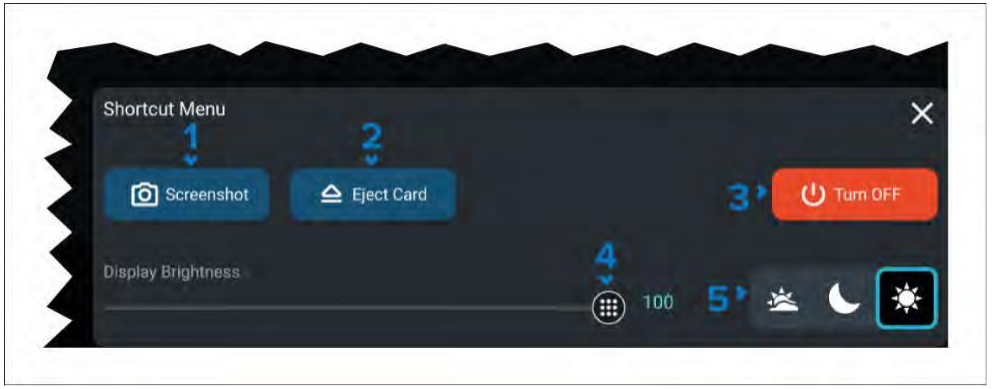
1. Turn the Radar’s **Power/Safety** switch to set it to ON (i.e. the switch should be in the 6 o’clock position).



2. Power on the navigation display.
   The Radar scanner should enter *Standby* mode. The status LED located in the cable duct below the pedestal’s **Power/Safety** switch should start flashing *Green* once every 30 seconds. If the LED is not lit, the Radar is NOT receiving power, OR it is powered and is in *Sleep* mode.
3. If necessary, adjust the brightness navigation display, before proceeding with a Radar test using the navigation display’s *[Radar]*application.

6.4 Power swipe shortcut menu

Swiping from left to right over the *[Power swipe]* touch control (located in the bottom right corner of the display) will open the *[Shortcut Menu]*.



1. *[Screenshot]*— Select to save an image of the screen to a memory card.
2. *[Eject Card]*— Select to safely remove a memory card from the card reader*.

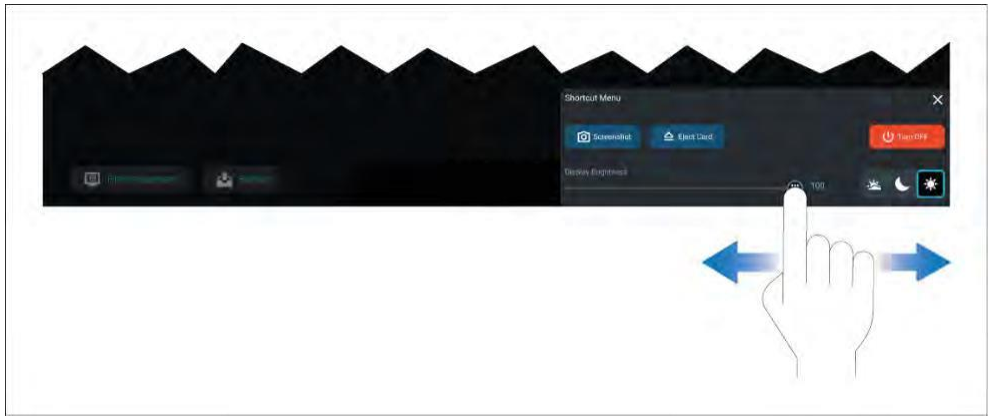
3. *[Turn OFF]*— Select and hold to power down the display.
4. *[Display Brightness]*— Adjusts the display's brightness.
5. *[Day, Dusk & Night modes]*— Change the display mode.

6.5 Removing a memory card or USB stick

Memory cards and USB memory sticks must be removed ("ejected") safely in order to prevent potential corruption and loss of data.

1. Open the card reader door.
2. Open the *[Shortcut Menu]* by swiping your finger from left to right on the *[Power swipe]* touch control.
3. Select *[Eject Card]*.
4. Select the slot containing the card/USB device you want to remove.
5. *To eject a card*: push the memory card forward into its slot until you hear the audible click of the spring mechanism. The card will be ejected from the slot.
6. *To remove a USB stick*: gently pull the USB stick from the card reader slot.

6.6 Adjusting brightness



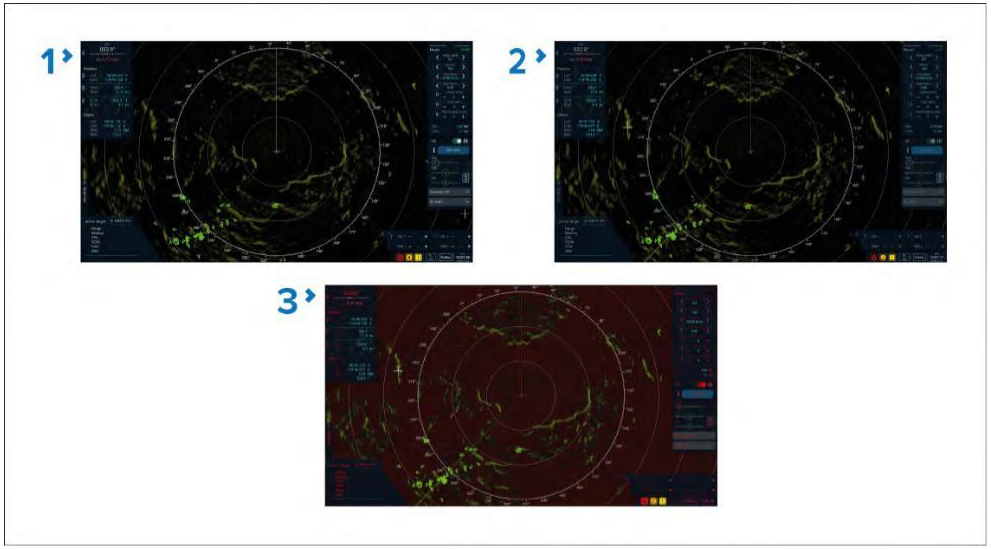
With the *[Shortcut Menu]* displayed:

1. Use your finger to move the *[Display brightness]*control along the slider bar to adjust the brightness level.

When the *[Shortcut Menu]* is displayed, you can also use the *[Power swipe]* touch control to increase the brightness level in increments.

6.7 Display modes

Display modes are available that optimize the screen for either *[Day]*, *[Dusk]* or *[Night]*running.



1. *Day (default)*— Max brightness and standard user interface color scheme.
2. *Dusk*— 50% brightness and changes the user interface color scheme for optimum viewing at dusk.
3. *Night*— 25% brightness and changes the user interface color scheme for optimum viewing at night

The display mode can be set from the *[Display Settings] m*enu which is accessed by selecting *[DISP SET]* from the *[Additional features]* menu on the right side of the screen. The display mode can also be set from the *[Shortcut Menu]*, which can be accessed by swiping your finger from left to right across the *[Power swipe]* touch control.

Changing display mode

The display mode is changed from the *[Shortcut Menu]*, which can be accessed by swiping your finger from left to right across the *[Power swipe]* touch control.

Select the relevant icon to change display mode:

1. *[Dusk mode]*.
2. *[Night mode]*.
3. *[Day mode]*.

Warning: Day mode brightness warning

Switching from Night mode to Day mode instantly increases the display brightness to maximum. This will impact the operator's night vision, due to the relative brightness of Day mode in night time conditions.

6.8 Standby screen overview

After the display has started up, the standby screen is shown.

1. *[Radar screen]*— Select to display the Radar screen.
2. *[File management]*— Select to browse files on internal and external memory.
3. *[Backup]*— Select to initiate a settings and user data backup.
4. *[Display details]*— Identifies the display model and software version. Select and hold the model name to initiate a software update.
5. *[Export system logs]*— Select to save system logs to a memory card.
6. *[Settings]*— Select to open the password-restricted settings menu.

6.9 Settings menu

Operator access to the *[Settings]* menu is not permitted.

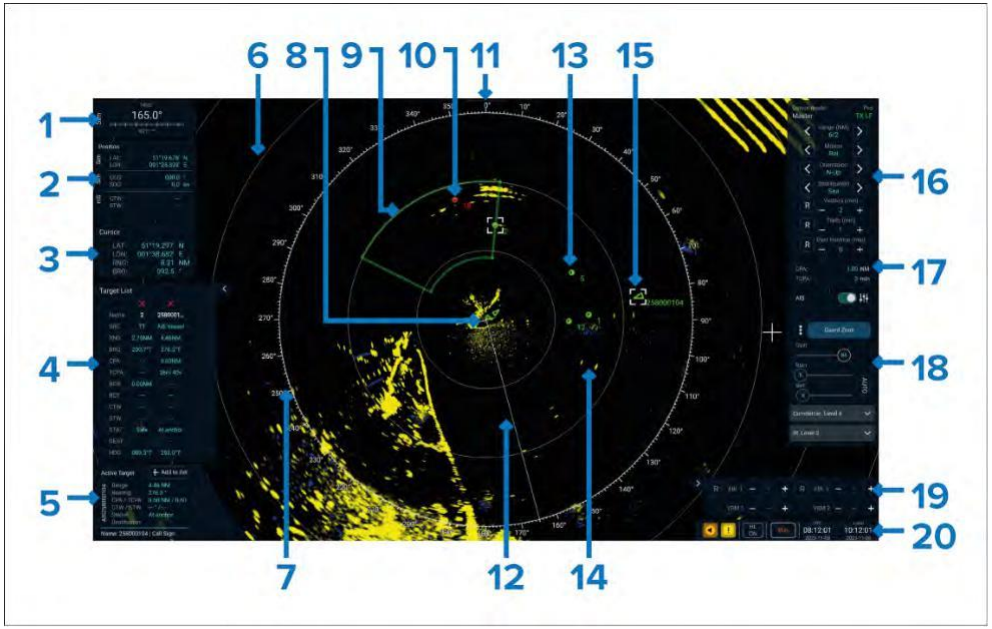
Note:

System configuration is performed via the *[Settings]* menu. Access is only granted to officially trained, authorized engineers.

For further details, refer to the Installation manual.

6.10 Radar display overview

The Radar display shows a visualization of the echoes received from a connected Radar scanner. The Radar display is a navigation aid used to help enhance collision and situational awareness, by enabling target position, distance and speed to be tracked in relation to your vessel. The Radar display is designed to provide all necessary information and controls onscreen.



1. **Heading** — The heading box displays HDG (Heading) and ROT (Rate of Turn).
2. **Position** — The position box displays the following own vessel data:
   - LAT (Latitude) and LON (Longitude).
   - COG (Course Over Ground) / SOG (Speed Over Ground). COG and SOG is displayed if *[GND]* (Ground) stabilization has been selected.
   - CTW (Course Through Water) / STW (Speed Through Water).

   The position box can be collapsed and expanded using the Up / Down arrow.
3. **Cursor** — The cursor box displays the following cursor position data:
   - LAT (Latitude) and LON (Longitude).
   - RNG (Range) and BNG (Bearing).
4. **Target List** — Selecting the arrow will display the list of all targets that have been added to the list.
5. **Active Target** — The active target box provides details for the active (currently selected) target. The following details will be displayed:
   - Range & Bearing.
   - CPA (Closest Point of Approach) & TCPA (Time to Closest Point of Approach).
   - CTW (Course Through Water) / STW (Speed Through Water).

   Selecting *[Add to list]* will add a selected target to the Target List.
6. **Range rings** — Evenly spaced concentric circles help determine distances.
7. **Bearing scale** — Bearing indicator.
8. **Ownship position** — Indicates own vessel position in relation to the radar targets.
9. **Guard zone** — The green outline is the guard zone area, an alert will be raised if a target enters this zone.
10. **Dangerous target** — Dangerous targets appear red.
11. **Pull down menu bar** — Pull down the bar to access the *[Pull down] m*enu.
12. **Heading line** — Points in the direction of travel on the bearing scale.
13. **Tracked Radar target** — Symbols are used to represent Radar targets.
14. **Radar returns / echoes** — Possible targets e.g.: vessels.
15. **Selected target** — Targets which have been selected or added to the Target List will have a white dashed target box around their target symbol.
16. **Display Controls** — Provides options for how the radar data is presented onscreen.
17. **CPA** — Allows you to specify the distance and time used for CPA and TCPA calculations.

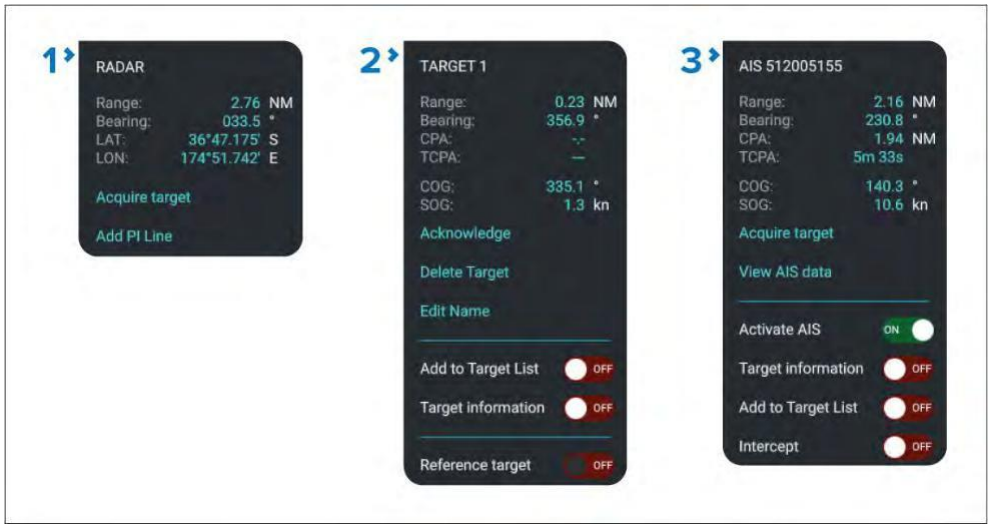
18. **Radar Controls** — Enable and disable AIS targets overlay on the Radar screen. Select additional features and adjust signal processing controls.
19. **EBL / VRM** — Configure EBLs and VRMs.
20. **Alerts and time** — View active alerts and current date and time. Access the *[Profiles] m*enu, show / hide UI elements, and center the vessel position onscreen.

Context menus

Context-sensitive information and options are available via context menus, which are displayed by selecting and holding on an area or item onscreen. The following context menus are available:

- *[Radar]*context menu — For details see below.
- *[Acquired target]* context menu — For details see below.
- *[AIS target]* context menu — For details see below.
- *[EBL]* context menu — For details refer to: **p.58 — EBL context menu**
- *[VRM]* context menu — For details refer to: **p.83 — VRM context menu**
- *[MOB]* context menu — For details refer to: **p.63 — Man Over Board MOB)**
- *[PI Line]* context menu— For details refer to: **p.66 — PI Line context menu**

Example context menus



1. **Radar context menu** — When a location/radar echo is selected the *[Radar]*context menu is displayed. The *[Radar]* target context menu includes the following information and options:
   - Information: Range, Bearing from ownship and Latitude and Longitude of the cursor position.
   - *[Acquire target]*— Acquire and track the target.
   - *[Add PI Line]*— Add a parallel index line at cursor location.
2. **Radar target context menu** — When an acquired radar target is selected, the *[Radar target]* context menu is displayed. The *[Radar target]* context menu includes the following information and options:
   - Information: Range, Bearing from ownship, CPA, TCPA, COG and SOG.
   - *[Acknowledge]*— Acknowledge a dangerous target alert. Only shown if target is dangerous or lost.
   - *[Delete target]*— Remove an acquired radar target from target tracking.
   - *[Edit name]*— Rename the target.
   - *[Add to Target List]*— Add the target to the Target List.
   - *[Target Information]*— Displays Range, Bearing, COG and SOG onscreen next to the target.
   - *[Reference Target]*— Add acquired target as a reference target.
3. **AIS target context menu** — When an AIS target is selected, the *[AIS target]*context menu is displayed. The *[AIS target]*context menu includes the following information and options:
   - Information: Range, Bearing from ownship, CPA, TCPA, COG and SOG.
   - *[Acknowledge]*— Acknowledge a dangerous target alert. Only shown if target is dangerous or lost.
   - *[Acquire target]*— Acquire the AIS target as a tracked radar target.
   - *[View AIS Data]*— Display the AIS data that is being transmitted by the AIS target.
   - *[Activate AIS]*— Switching this setting *Off* changes an activated target into a sleeping target. Switching the setting *On* changes a sleeping target into an activated target.
   - *[Target Information]*— Displays Range, Bearing, COG and SOG onscreen next to the target.

- *[Add to Target List]*— Add the target to the Target List.
- *[Intercept]*— Perform a target interception.

Fine adjustments

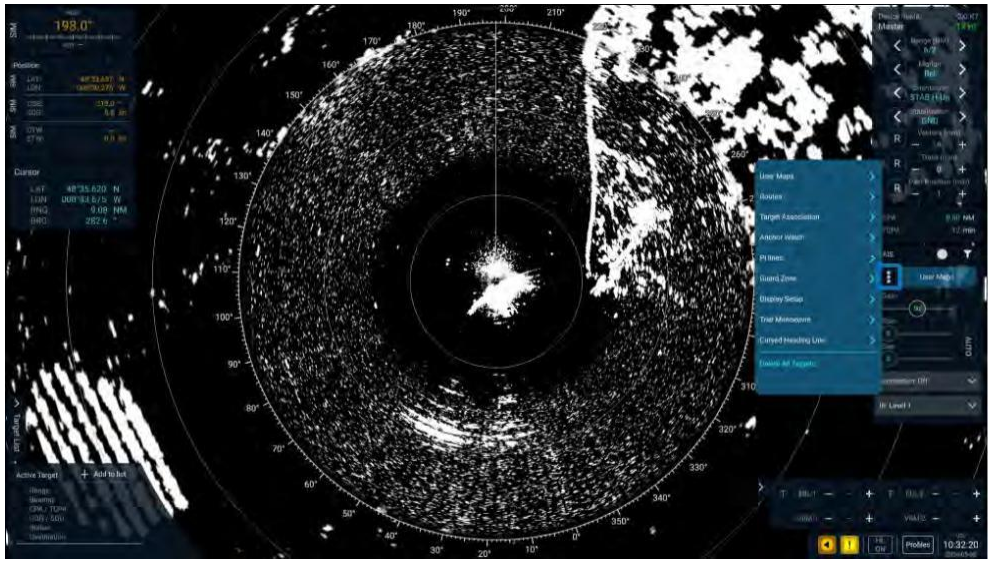
Fine adjustments can be made to control values.

Place the cursor over the value and use the Trackball middle scroll wheel to make adjustments.
The following settings can be adjusted using the scroll wheel.

1. *[Vector]*, *[Trails]*and *[Past Position]* controls.
2. *[CPA]* and *[TCPA]* controls.
3. *[Gain]*, *[Rain]*and *[Sea]* controls.
4. *[EBL]* and *[VRM]* controls.
5. *[Curved Heading Line]* slider controls.
6. *[Trial Manoeuvre]* slider controls.

Additional features menu

Additional features are available by selecting the *[Additional features]* menu icon (three dots) located on the right side of the screen.
Selecting the *[Additional features]* icon will open the *[Additional features]* menu. Selecting an option from the *[Additional features]* menu will open the menu for that feature.
A shortcut to the last opened additional feature is available to the right of the *[Additional features]* menu icon.



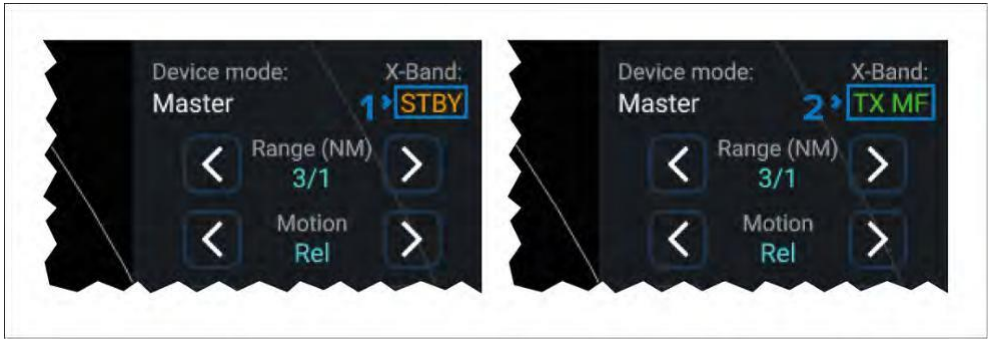
The following additional features are available:

Feature	More information
[User Maps]	**p.77 — User maps**
[Routes]	**p.25 — Route Manager**
[Target Association]	**p.72 — Target Association**
[Anchor Watch]	**p.41 — Anchor Watch**
[PI lines]	**p.65 — Parallel Index Lines**
[Guard Zone]	**p.61 — Guard zones**
[Display Setup]	**p.57 — Display Setup**

Feature	More information
[Trial Manoeuvre]	**p.77 — Trial Manoeuvre**
[Curved Heading Line]	**p.48 — Curved Heading Line (CHL)**

6.11 Radar transmit and standby

The Radar scanner can be set to transmit mode or put into standby from the Radar status located in the top right corner of the screen.



1. Select *[STBY]* to start the Radar scanner transmitting.
2. Select *[TX LF]*, *[TX MF]* or *[TX HF]* to put the Radar scanner into Standby.

6.12 Selecting a Radar scanner

On systems with 2 Radar scanners, you can select which Radar scanner is used to display the Radar image onscreen, or, you can enable and disable the Radar simulator from the Radar selection options.

With the Radar screen displayed:

1. Select the current selected Radar located in the top right corner of the screen.
2. Select the drop down arrow in the *[Radar]* field of the *[Radar Sensor]* menu.
3. Select the desired Radar scanner from the drop down list.

The Radar screen will change to display the data transmitted from the selected Radar scanner.

6.13 Returning to the Standby screen

From the Radar screen, follow the steps below to return to the Standby screen.

1. Drag down the *[Pull down]* menu bar.
2. Select the *[Standby]* screen icon.

CHAPTER 7: A TO N OPERATOR'S INSTRUCTIONS

CHAPTER CONTENTS

7.1 Acquire mode

Acquire mode enables radar target acquisition to be initiated each time the screen is selected/clicked. When the screen is selected/clicked the system will try to acquire a target at that location.

Acquire mode can be enabled by selecting the *[ACQ]* button from the *[Pull down]* menu.

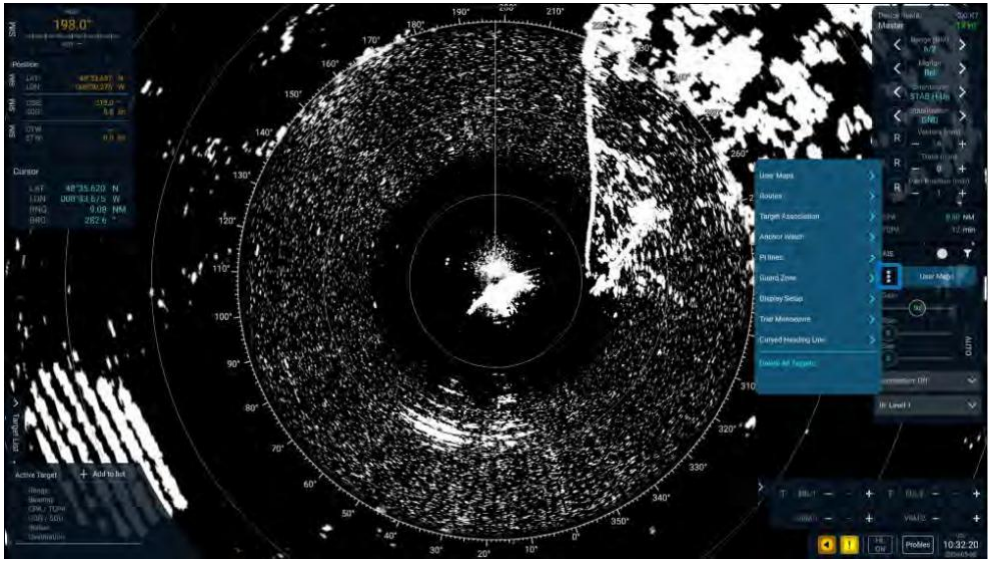
When enabled, the *[ACQ]* button text will turn blue.

7.2 Additional features menu

Additional features are available by selecting the *[Additional features]* menu icon (three dots) located on the right side of the screen.

Selecting the *[Additional features]* icon will open the *[Additional features]* menu. Selecting an option from the *[Additional features]* menu will open the menu for that feature.

A shortcut to the last opened additional feature is available to the right of the *[Additional features]* menu icon.



The following additional features are available:

Feature	More information
[User Maps]	**p.77 — User maps**
[Routes]	**p.25 — Route Manager**
[Target Association]	**p.72 — Target Association**
[Anchor Watch]	**p.41 — Anchor Watch**
[PI lines]	**p.65 — Parallel Index Lines**
[Guard Zone]	**p.61 — Guard zones**
[Display Setup]	**p.57 — Display Setup**
[Trial Manoeuvre]	**p.77 — Trial Manoeuvre**
[Curved Heading Line]	**p.48 — Curved Heading Line (CHL)**

7.3 AIS targets

With compatible AIS hardware connected to your display, AIS targets can be displayed and tracked.

With the *[AIS]* toggle enabled, vessels transmitting AIS data which are in range of your vessel will be shown onscreen using AIS symbols.

Note:

- Not all vessels may be equipped with AIS.
- The accuracy of AIS data is dependent on the accuracy of each ship's navigation systems.
- AIS-equipped vessels can disable transmission of AIS data, meaning they will not appear as AIS targets onscreen.

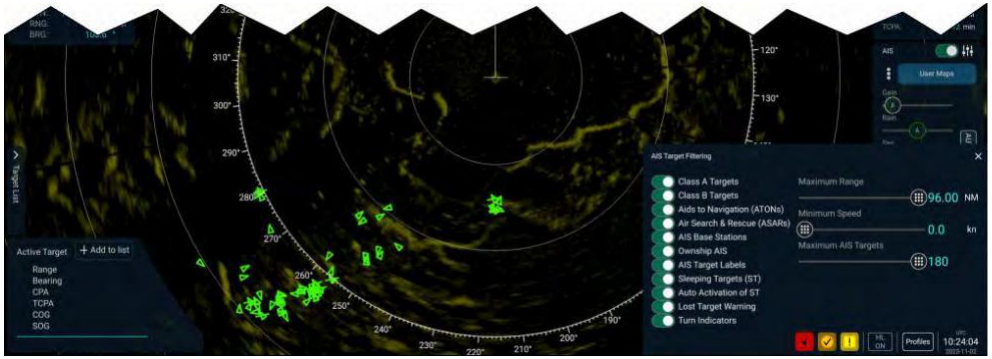
The system can show up to 4,000 AIS targets simultaneously. Where more than 4,000 AIS targets are present, only the **closest** 4,000 AIS targets will be shown. The system will continue to process up to 6,000 AIS targets.

AIS targets are represented using triangle symbols. The color and appearance of a target identifies its status. Target symbols will be orientated to the target's reported heading (or COG, if heading is not reported). If no heading or COG is reported, the target symbol will be orientated toward the top of the screen.

For further details and examples of AIS target symbols, refer to:
p.98 — AIS target symbols

AIS Target Filtering

The AIS targets can be filtered to show only targets which meet certain criteria.
Select the *[Options] i*con located to the right of the *[AIS]* toggle switch to display AIS filtering options.



The available AIS filters are:

- *[Class A Targets]* — Show/hide Class A AIS targets.
- *[Class B Targets]* — Show/hide Class B AIS targets.
- *[Aids to Navigation (AtoNs)]*— Show/hide physical and virtual AtoNs.
- *[Air Search & Rescue (ASARs)]*— Show/hide Air Search & Rescue targets.
- *[AIS Base Stations]*— Show/hide AIS base stations.
- *[Ownship AIS]*— Enable/Disable display of ownship AIS data in the target data area. The displayed data is the data transmitted to other vessels.
- *[AIS Target Labels]*— Show/hide AIS target names labels.
- *[Sleeping Targets (ST)]*— Show/hide AIS targets that are sleeping (i.e.: not activated).
- *[Auto Activation of ST]*— Enable/disable automatic activation of sleeping AIS targets which become dangerous i.e.: the target violates the configured *[CPA]* and *[TCPA]* limits.

Note:

With *[Auto Activation of ST]* enabled, manoeuvring through areas with numerous moored AIS targets will cause multiple sleeping targets to auto activate. This effect can be reduced by decreasing *[CPA]* and *[TCPA]* limits, however this may adversely impact safe and timely acquisition of genuine targets.

- *[Lost Target Warning]*— Enable and disable the AIS lost target alarm.
- *[Turn Indicators]*— Enable and disable display of turn indicators for AIS targets.
- *[Maximum Range]*— Specify the maximum range at which AIS targets are displayed.
- *[Minimum Speed]*— Specify the minimum speed a target must be travelling to be displayed onscreen (AIS targets travelling below this speed will not be displayed).
- *[Maximum AIS Targets]*— Specify the maximum number of AIS targets to be shown onscreen. When more targets are present than the selected number, only the closest targets will be shown. The maximum AIS targets that can be displayed simultaneously is 4,000.

When an AIS filter is active the *[Options]* icon is changed to signify that not all targets may be displayed.

Note:

Dangerous targets will be shown and activated automatically regardless of AIS filter settings.

AIS target capacity warnings

Warnings will be displayed when the display is nearing its AIS capacity and when the number of AIS targets has exceeded maximum capacity.

- When the number of sleeping and activated AIS targets being displayed reaches 95% of the maximum capacity, a warning is triggered noting: ‘ *AIS: Targets nearing capacity*’.
- When the number of sleeping and activated AIS targets being displayed exceeds maximum capacity, a warning is triggered noting: ‘ *AIS target capacity exceeded*’. New AIS targets that come into ownship’s AIS range will continue to be processed.

When the target capacity has been exceeded, any new targets that are deemed to be of ‘greater importance’ will replace targets that are of ‘less importance’; target importance levels can be configured using the AIS filters, CPA, TCPA etc.
Using the *[Maximum AIS Targets]* slider has no effect on the capacity warnings.

AIS target activation

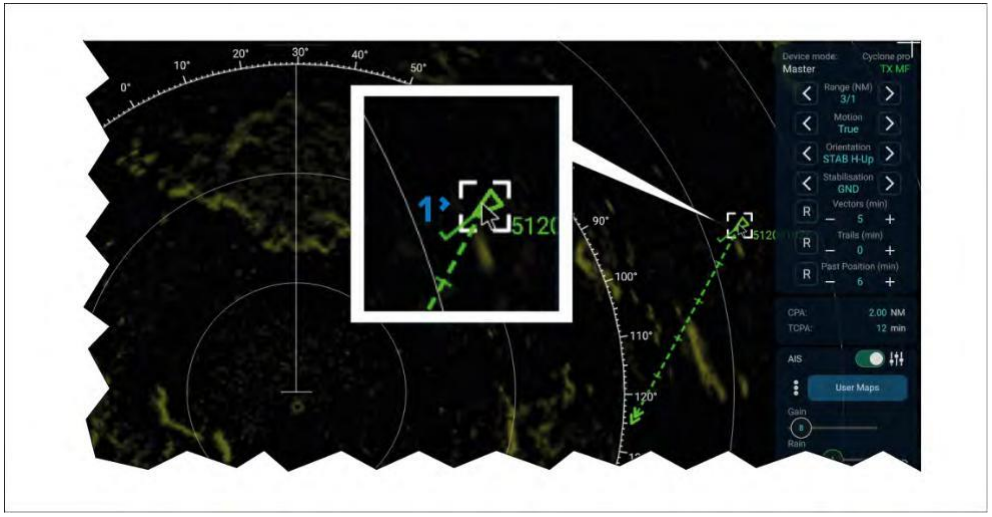
By default new AIS targets that appear onscreen will be sleeping (not activated).
AIS targets can be activated:

- Manually by selecting the target onscreen.
- Automatically when they are received, by enabling the *[Auto Activation of ST]* toggle switch in the *[AIS Target Filtering]* menu.
- Automatically when they enter an active guard zone.

AIS targets can be deactivated by double clicking on the target or by switching off the *[Activate AIS]* toggle switch from the *[AIS target]* context menu.

Selecting and activating an AIS target quickly

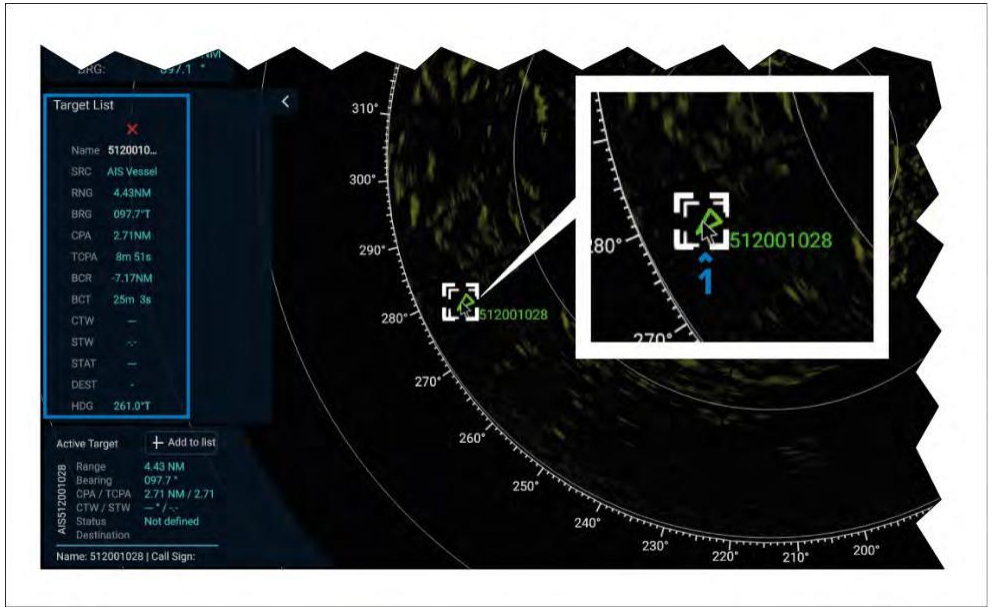
AIS targets can be selected and sleeping AIS targets can be activated.



1. Left click an AIS target to select it. If the target is sleeping, left clicking will also activate the target.

Adding an AIS target to the target list

Activated AIS targets can be added to the Target List.



1. Double click on an activated target to add it to the Target List.

Sleeping an AIS target

Activated AIS targets can be put back into a sleeping state.

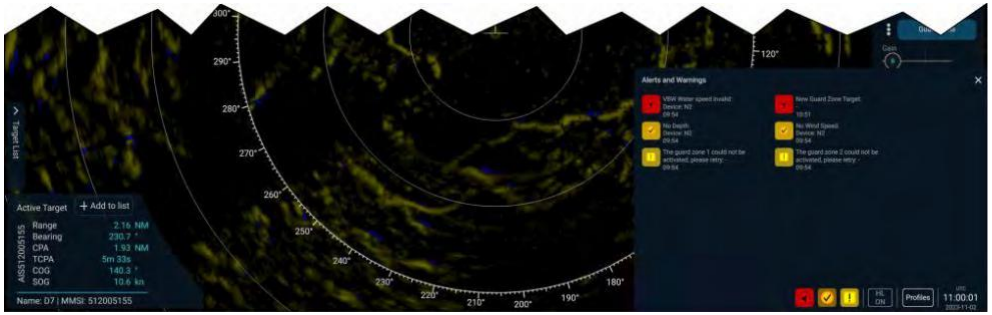
1. Double click an AIS target that is in the Target List to place it back in a sleeping state.
2. For targets not in the Target List: Double click to add to the Target List and then double click again to put the target in a sleeping state.

7.4 Alerts

Icons are used to notify when an alert condition is triggered or is active. The icons will appear in the alert notification area, located on the bottom right of the screen. Selecting the notification area will expand the area enabling alert details to be viewed.

Alerts are prioritized in descending order as follows:

1. Alarm.
2. Warning.
3. Caution.



Important:

Audible beeps for alarms and warnings, depending on equipment, may require an external buzzer to be connected. Without an external buzzer, no audible beeps will be heard and you may not be navigating in accordance with *Type Approval* requirements.

Alarms

Alarms have the highest priority. Red icons with a triangle in the center are used to signify alarms.

Alarms are accompanied by 3 audible beeps which repeat every 7 seconds.

Alarm icons

1. A flashing alarm icon with a loudspeaker symbol signifies an unacknowledged active alarm.
2. A flashing alarm icon featuring a loudspeaker symbol with a diagonal line through it, signifies an alarm that has been silenced but is still active.
3. An alarm icon with an exclamation mark symbol signifies an acknowledged alert that is still active. Acknowledged alerts will remain in the notification area until the alarm condition is rectified.
4. An alarm icon with a symbol showing an arrow pointing right signifies a transferred responsibility alert.
5. A flashing alarm icon with a tick mark symbol signifies an unacknowledged alert where the alarm condition has been rectified.

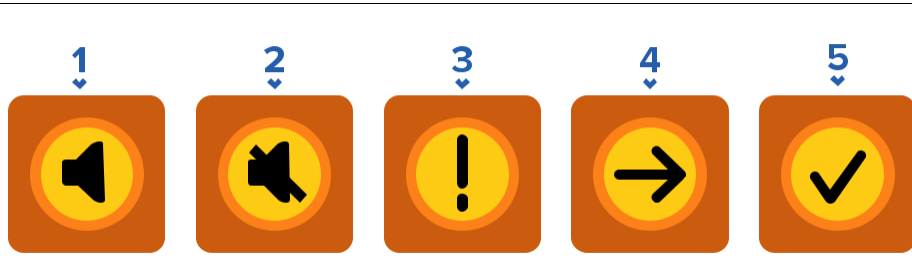
Selecting an alarm notification will acknowledge it.

Warnings

Orange icons with a circle in the center are used to signify warnings.

Warnings are accompanied by 2 audible beeps when the warning is first triggered. Warning beeps are not repeated.

Warning icons



1. A flashing warning icon with a loudspeaker symbol signifies an unacknowledged active warning.
2. A flashing warning icon featuring a loudspeaker symbol with a diagonal line through it, signifies a warning that has been silenced but is still active.
3. A warning icon with an exclamation mark symbol signifies an acknowledged warning that is still active. Acknowledged warnings will remain in the notification area until the warning condition is rectified.
4. A warning icon with a symbol showing an arrow pointing right signifies a transferred responsibility warning.
5. A flashing warning icon with a tick mark symbol signifies an unacknowledged warning where the warning condition has been rectified.

Selecting a warning notification will acknowledge it.

If Warnings are not acknowledged and remain active, they will be escalated to an Alarm after 60 seconds.

Cautions

A Yellow icon with a square in the center and an exclamation mark is used to signify a caution.

Caution icon

Caution notifications will clear once the item that triggered it is cleared.

Alerts can be configured from the *[Alarm Settings]* menu: *[Standby screen > Settings > Alarm Settings]*.

More information

Alert configuration details can be found in the KRS *Installation manual*.

7.5 Anchor Watch

The Anchor watch feature monitors current vessel position and speed against specified criteria to determine if the anchor is dragging.

If your vessel's speed exceeds the speed specified in the *[Risk of dragging]* alert threshold, the 'Anchor dragging' alarm is triggered.

If the distance between your vessel's current position and its position when Anchor watch was enabled exceeds the distance specified in the *[Swing Circle Diameter]* the 'Anchor watch limit exceeded' warning is triggered.

Anchor watch consists of an anchor dragging alarm which is based on ownship speed and a specified risk of dragging speed and a static swing circle that is placed when the anchor is dropped.

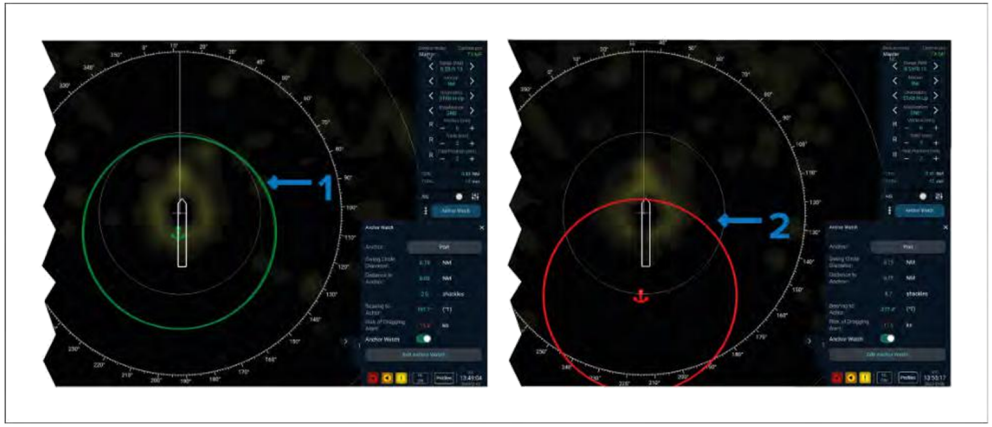
Anchor(s) and ownship CCRP must be configured to enable the anchor watch feature.

The Risk of dragging threshold is configured from the *[Alarm settings]*: *[Standby screen > Settings > Alarm Settings > Anchor Watch > [Risk of dragging]]*.

To configure the Anchor watch settings, select *[Anchor watch]* from the *[Additional features]* menu located on the right side of the screen.

The Anchor watch settings are as follows:

- *[Anchor]*— Select one of the configured anchors.
- *[Swing circle diameter]*— Select the value to adjust the size of the swing circle.
- *[Distance to Anchor]*— Distance between current vessel position and the location where the anchor was dropped.
- *[Bearing to Anchor]*— Bearing to the location where the anchor was dropped.
- *[Risk of Dragging alert]*— Current vessel speed. The value will be colored green if vessel speed is *below*the *[Risk of dragging]* threshold, and red if vessel speed is *above*the threshold.
- *[Anchor watch]*— Enable and disable *[Anchor watch]*.



1. When enabled, an anchor symbol and circle which represents the specified Swing circle diameter is displayed at ownship position. The center position of the swing circle is determined by the selected anchor's position, as specified in the *[CCRP]* settings menu.
2. If any part of your vessel crosses the swing circle, the *[Anchor watch limit exceeded]* warning is triggered and the anchor symbol and swing circle will be colored red.

For details on configuring anchor positions, refer to the KRS *Installation manual*.

7.6 Beacon mode

Beacon mode is used to improve the detection of Radar based emergency beacons. Radar based emergency beacons produce a series of dots on the radar screen which provides an indication of range and bearing.

Note:

- Beacon mode is only available for supported radar scanners.
- Beacon mode should not be used for normal navigation.

Beacon mode is enabled by selecting *[BEACON]* from the *[Pull down]* menu.

When Beacon mode is enabled:

- The display will switch to single display.
- All ENH level will be switched off.
- The radar range will be set to 4 NM.
- The *[BEACON]* button text will turn blue.
- '**BEACON**' is displayed in place of the *[Correlation]* and *[IR]* values to indicate that Beacon mode is active.

As a beacon is approached, the series of dots will turn into arcs or concentric rings. The *[Sea]* anti clutter control can be used to reduce these.

Limitations:

- The *[Rain]*anti clutter control should not be used when detecting beacons as this may reduce of suppress the beacon responses.

Selecting the *[BCM]* icon again will deactivate Beacon mode.

When Beacon mode is deactivated the display will revert to its previous settings.

7.7 Bearing scale

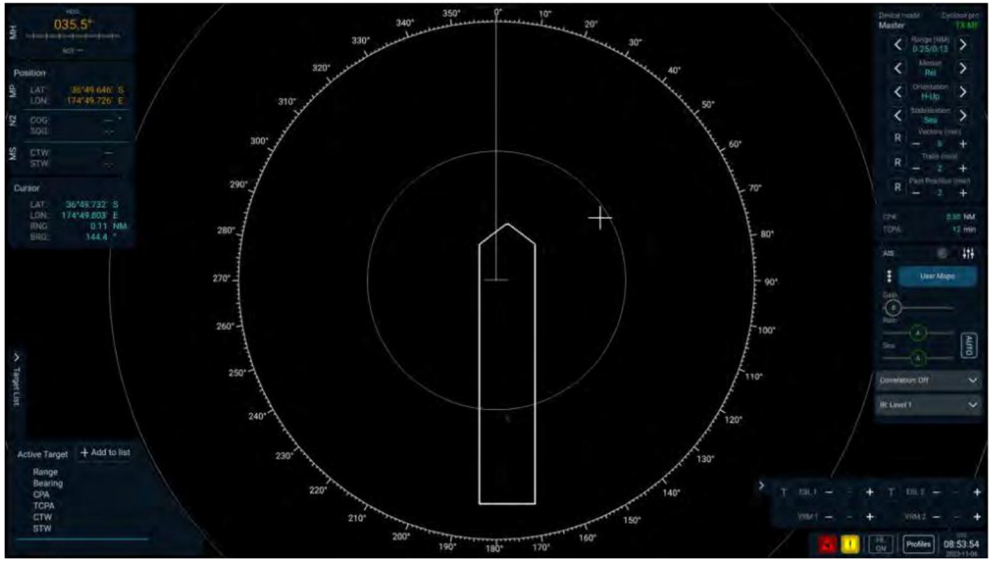
The bearing scale provides an indication of bearing. The bearing scale is permanently displayed at the centre of the screen and is the largest full ring.

The bearing scale is displayed at the distance specified in the range control (e.g.: 6/2 means the bearing scale radius is 6 NM and the range rings are spaced every 2 NM).

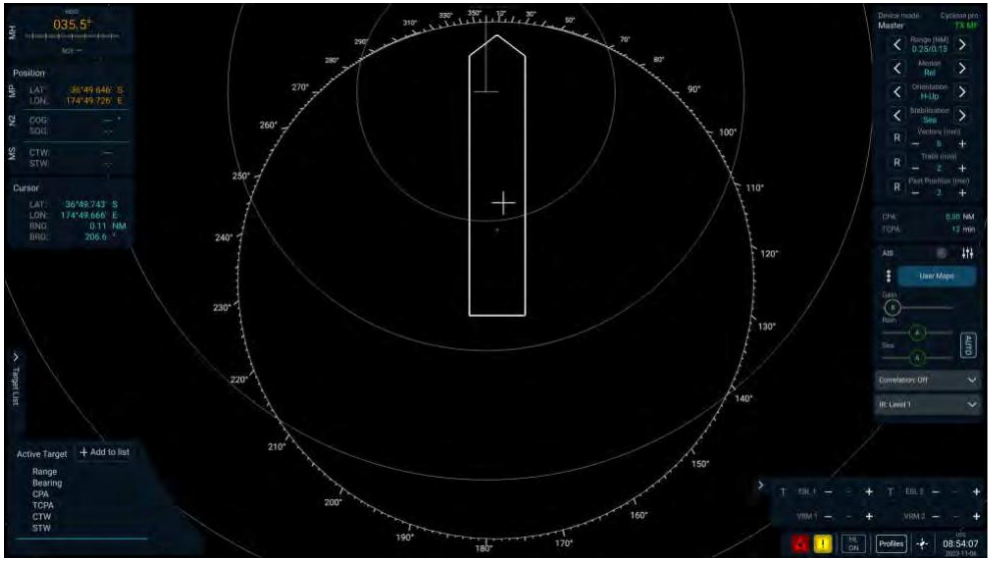
When the Radar screen is centred, the CCRP is usually located at the centre of the bearing scale

On larger vessels, that also have a large offset between CCRP and Radar antenna positions it is possible, at shorter ranges for the CCRP to be outside of the Radar presentation area.

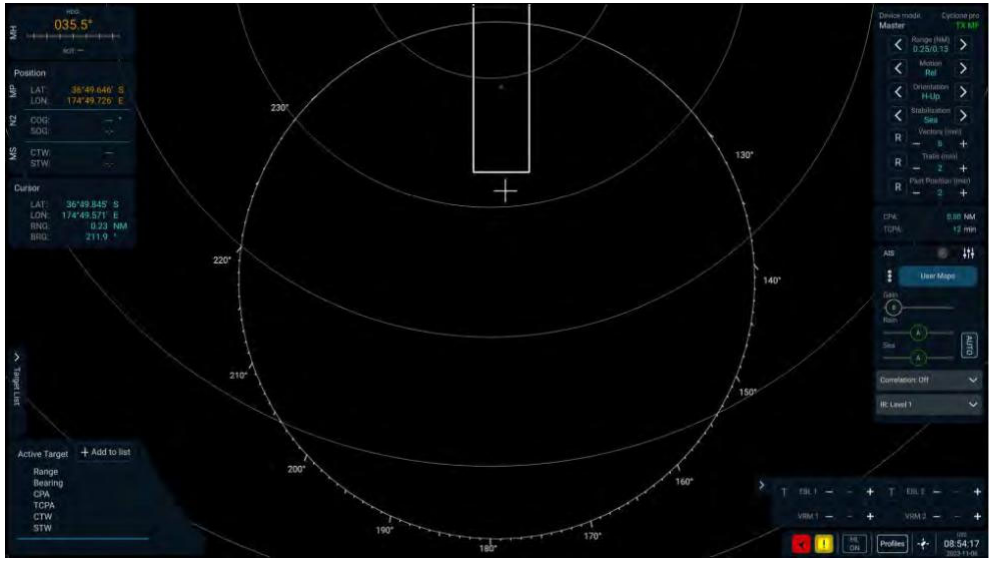
In the following examples the CCRP is forward and the Radar antenna position is aft.



In this example, the CCRP is displayed within the radar presentation area but slightly offset from centre. The bearing scale changes so that the bearing markers point towards the CCRP.



The CCRP is nearing the limits of the radar presentation area. The bearing scale continues to change with the bearing markers pointing towards the CCRP.



The CCRP is outside of the radar presentation area. All forward bearing scales are blank, bearing markers aft of the vessel point towards the CCRP.

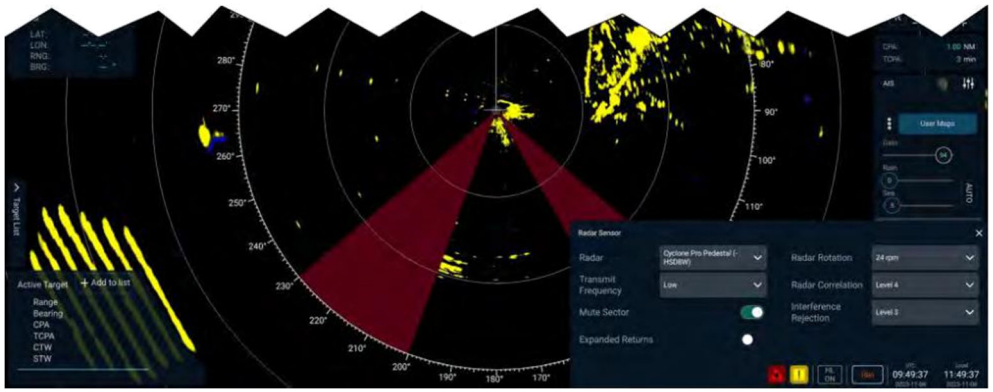
7.8 Blank/Mute Sectors

Enabling blank sectors

If blank sectors have been configured, they can be enabled and disabled from the *[Radar Sensor]* menu.

Note:

Blank sector must be configured from the password restricted *[Radar Settings]* menu before they can be displayed onscreen using the *[Mute Sector]* toggle switch.



1. Select the Radar name heading located on the top right of the screen. The *[Radar Sensor]* menu is displayed.
2. Enable the *[Mute sector]* toggle switch.

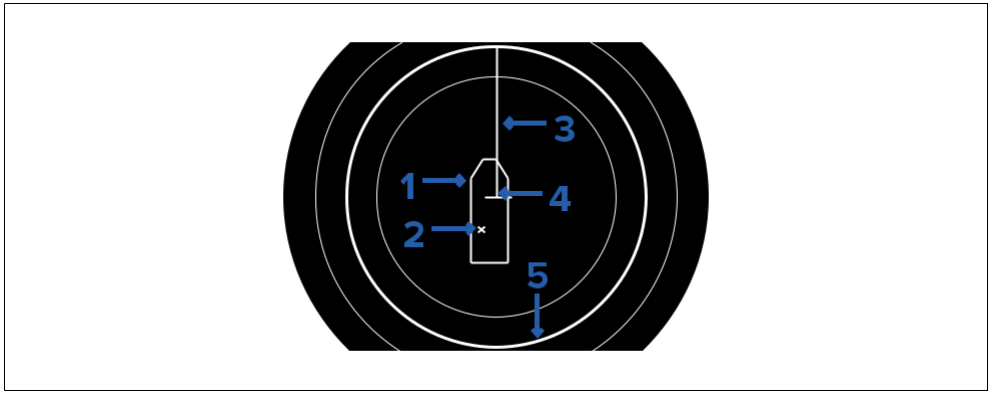
The configured blank sectors will be displayed onscreen.

7.9 CCRP

The Consistent Common Reference Point (CCRP) is a specified location on ownship from which all horizontal measurements are referenced. E.g.: range, bearing, relative course, relative speed, closest point of approach (CPA) and time to closest point of approach (TCPA).

Measurements are not referenced to the Radar antenna's position, except where specifically selected and clearly indicated; e.g.: Bow Crossing Range (BCR) and Bow Crossing Time (BCT).

When the Radar screen is centred, the CCRP is usually located at the centre of the bearing scale. The Radar image is always centered around the Radar antenna's location. (this is more evident for larger ships when using a short range scale).



1. Ownship.
2. Radar location.
3. Heading line.
4. CCRP location.
5. Bearing scale.

Note:

The CCRP's and Radar scanner's location must be configured before using the system for navigation.

7.10 Collision avoidance

The Radar image, features and controls are used to improve awareness of the potential for collision.

The radar image shows returns from surface objects/radar echoes, which may be potential targets. However, the radar image will also show returns from clutter and noise, such as sea clutter and rain. It is important to ensure that the *[Gain]*, *[Sea]*and *[Rain]* (signal processing) controls are adjusted appropriately to reduce the clutter and noise so that target tracking operates efficiently.

Radar targets generate trails. Relative trails provide an initial indication of a collision threat, if the target is pointing towards ownship and the range is decreasing. However, constant monitoring and comparison, with for instance an EBL, is required to establish if the target poses a potential or actual threat.

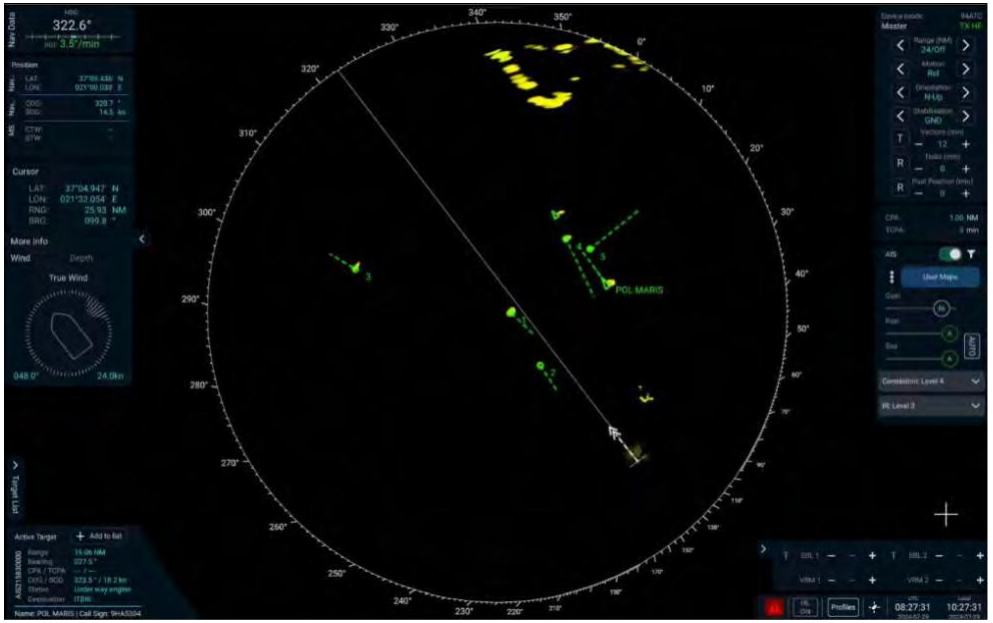
Radar targets which are of interest can be acquired and tracked using the target tracking process.

Past position performs a similar function to trails, however whereas radar targets automatically develop trails, reported AIS targets can only use Past position vectors to indicate historical movements.
For further details on collision avoidance features, refer to:

- **p.54 — Trails**
- **p.55 — Past position**
- **p.37 — AIS targets**
- **p.74 — Tracked Radar targets (ARPA)**

Target tracking

Radar targets and AIS targets can be tracked.



Tracked Radar (ARPA) targets

The Radar target tracking feature complies with and exceeds the IMO requirements for Target Tracking. Target Tracking allows the tracking of up to 100 surface targets with relative speeds of up to 150 knots.
Targets can be manually acquired in the range of 0.1 to 80 nautical miles.
Targets can be automatically acquired when they enter specified guard zones, in the range of 0.5 to 24 nautical miles.
Acquired targets are tracked automatically in the range 0.1 to 24 nautical miles.
The Target Tracking feature is designed to minimize the effects of error sources on tracking accuracy and also minimizes target swap. However, as with all tracking systems, error sources, such as excessive clutter or poor signal to noise ratio will have a detrimental effect on accuracy.

Tracked AIS targets

The automatic Identification System (AIS) feature complies with and exceeds the IMO requirements for an Automatic Identification System aid.
The system can process up to 6,000 AIS targets and display up to 4,000 AIS targets simultaneously as sleeping or activated targets, based on user set filters.
AIS targets can be activated by manual selection, automatically or automatically when they enter specified guard zones. The guard zones are common to both AIS targets and tracked Radar targets.
A benefit of AIS is that AIS targets are visible in adverse weather conditions and provide an earlier indication of a target movement.

Note:

- Not all surface objects/vessels may be equipped with AIS.
- The accuracy of AIS data is dependent on the accuracy of each ships navigation systems.
- AIS equipped vessels can disable transmission of AIS data.

The AIS system has two major classifications, Class A for large ships providing a full set of data and Class B for small craft, which provide a subset of data.
AIS compliments the target tracking feature to support radar in an anti-collision role.
While the user functionality of Radar target tracking and AIS is very similar, there are important differences.
Target tracking systems are subject to error sources that do not apply to AIS, for example:

- Low Signal-to-Noise ratio - Targets may appear to fade on the screen. The target track may indicate a weak target alert, and in extreme cases, lose

the target. Other echoes or clutter appearing in the tacking window may result in target swap or cause vector instability.

- Side Lobes/Reflections - Ownship structures within the Radar antenna beam or presence of other large targets, can generate false targets or elongated targets. This may result in tracking errors and could give false indications of CPA. Reference targets affected by reflections may become unreliable and it is advised that multiple reference targets are used to reduce error.
- Ownship pitch and roll.

Target tracking and AIS functions

A summary of target tracking features is shown below:

Function	Definition
Target Acquisition (ARPA only)	Surface Targets with relative speeds of up to 150 knots can be tracked. Up to 100 targets may be acquired either manually, using the cursor, or automatically using guard zones.
Tracking (ARPA only)	Acquired radar visible targets are automatically tracked up to a range of 24 NM; vectors are generated which indicate the course and speed of the target. All acquired targets may be labelled, and data on the true target course, true speed, range, and bearing, BCR / BCT, CPA and TCPA may be shown for selected targets.
Target Activation (AIS only)	Targets can be presented out to a range of 96 NM. Up to 4,000 (simultaneously displayed) AIS targets may be activated, either manually using the cursor, or automatically using guard zones.
Guard Zones	Guard zones are available, all of which are variable. When a target, which has not previously been acquired, enters a guard zone, an alert is generated. Target Tracking automatically acquires a radar target and activates an AIS target.
Target History	The Trails and Past Position controls provide a presentation of track history.
Reference Target (ARPA only)	Tracked (radar) targets may be designated as Reference targets and used for manual stabilization.
CPA/TCPA Limit	The limits define the time and Closest Point of Approach (CPA) of a target; violation of both CPA and TCPA triggers the COLLISION WARNING alert. The target must violate both parameters to trigger the alert. TCPA limit may be varied between 0 and 60 min, in one minute increments. CPA limit may be varied between 0.0 and 6.0 NM, in increments of 0.1 NM. The default values are 12 minutes and 2.0 NM.
Trial Manoeuvre	Simulates the intended change of course or speed to assess planned action in advance, either for navigational purposes or when a potential collision situation exists.
Lost Target (ARPA)	If a target is not seen for 20 consecutive scans, and the target is of interest, a *Lost Target* message is displayed in the alert box, and a lost target symbol is drawn at the last known position of the target. To cancel the alert and delete the Lost Target symbol, either acknowledge the alert or the Lost Target symbol.
Lost Target (AIS)	If no data is received from the target for a specified period, and if the target is of interest, a *Lost Target* message is shown in the alert box, and a lost target symbol is drawn at the last known position of the target. Note that the specified period depends on speed and navigational status of the AIS target. To cancel the alert and delete the Lost Target symbol, either acknowledge the alert or the Lost Target symbol.

Function	Definition
Tracking Overload (ARPA)	An alert indicates when the Tracking capacity is nearing, or has exceeded, 150 targets. An alert is also produced following the attempted acquisition of the 151st target. Tracking another target requires one or more currently-tracked targets to be removed from tracking.
AIS Capacity	An alert indicates when the AIS capacity is nearing or has exceeded 4,000 (simultaneously displayed) targets.

Note:

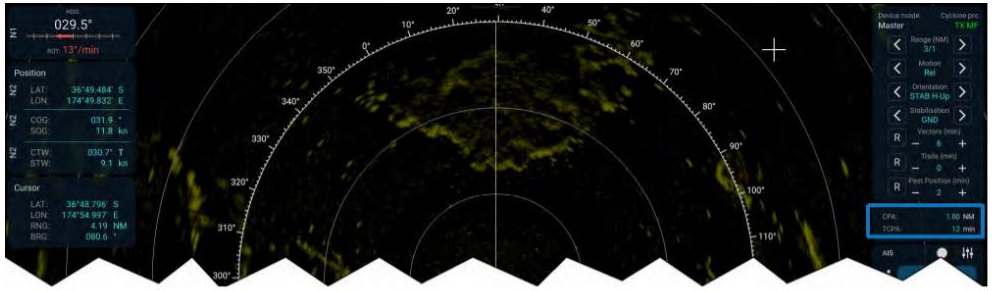
- For Target Tracking, when using the manual speed input method, the user MUST adjust the speed input manually every time the ownship speed changes.
- In order for AIS reception to be available, GPS position (preferably GGA), valid heading and non-manual log must be available.
- Target tracking / collision avoidance is not possible without a valid source of COG and SOG.

7.11 CPA and TCPA

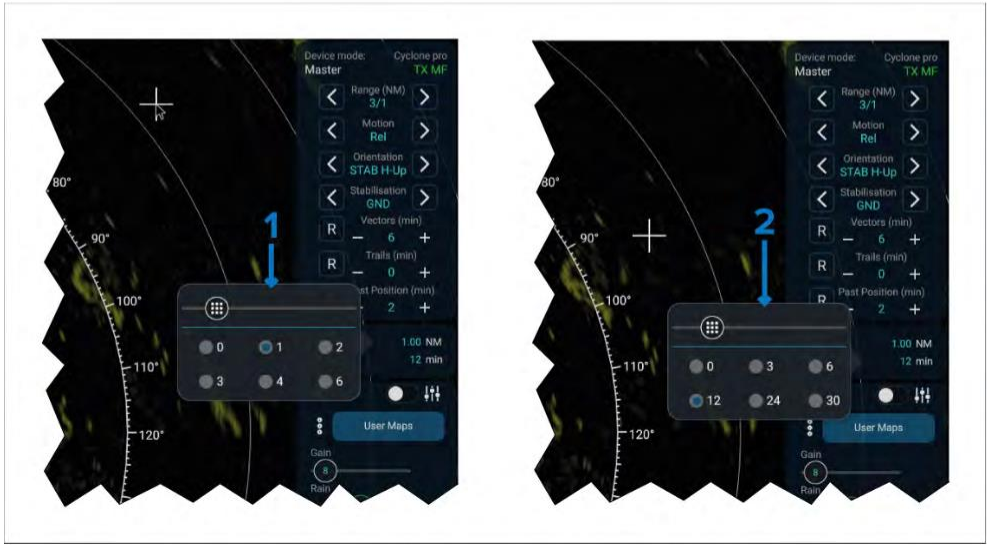
CPA (Closest Point of Approach) and TCPA (Time to Closest Point of Approach) are used to identify targets which are dangerous as they are a potential collision threat. AIS targets and tracked Radar targets are dangerous if they will cross your path within the distance and time specified in the *[CPA]* and *[TCPA]* settings.

The Dangerous target alarm (collision warning alarm) can only be turned off if the target is no longer being tracked or the alarm condition is no longer present.

*[CPA]*and *[TCPA]* settings are located on the right side of the screen.



Selecting the current value will open the options menu.



1. *[CPA]* settings.
2. *[TCPA]* settings.

Select an option or use the slider control to adjust the value.

7.12 Cursor details

The cursor is used to select objects and setting options.

The location of the cursor's position in relation to your vessel is displayed in the cursor box located on the left side of the screen.

Cursor position measurements / range scales are always referenced to the CCRP.

The following location details are provided:

- *[LAT]*Latitude / *[TTG]* time To Go.
- *[LON]*Longitude / *[ETA]* estimated Time of Arrival.
- *[RNG]*(Range from ownship in NM or km).
- *[BNG]*(Bearing from ownship)

1. Latitude and Longitude.
2. TTG and ETA.

A long-press on *[LAT]* or *[LON]* will switch the data display to *[TTG]*and *[ETA]*; *[RNG]*will also switch to km (Kilometers).

A long-press on *[TTG]* or *[ETA]* will switch the data display back to *[LAT]*and *[LON]*, and revert *[RNG]* to NM (Nautical Miles).

When *[LAT]*and *[LON]* are displayed, a long-press on *[RNG]* will switch the display of the unit of measurement for the cursor and VRM ranges between NM and km.

7.13 Curved Heading Line (CHL)

The CHL feature is a path prediction tool which projects a curved heading line from your vessel. The CHL is based on the *[Course]*, *[Radius]/ [ROT]* (rate of turn), *[Speed]* and *[Delay]* specified in the *[Curved Heading Line]* settings.

The *[Curved Heading Line]* settings are located in the *[Additional features]* menu on the right side of the screen.

Enable the *[Curved Heading Line]*using the toggle switch.

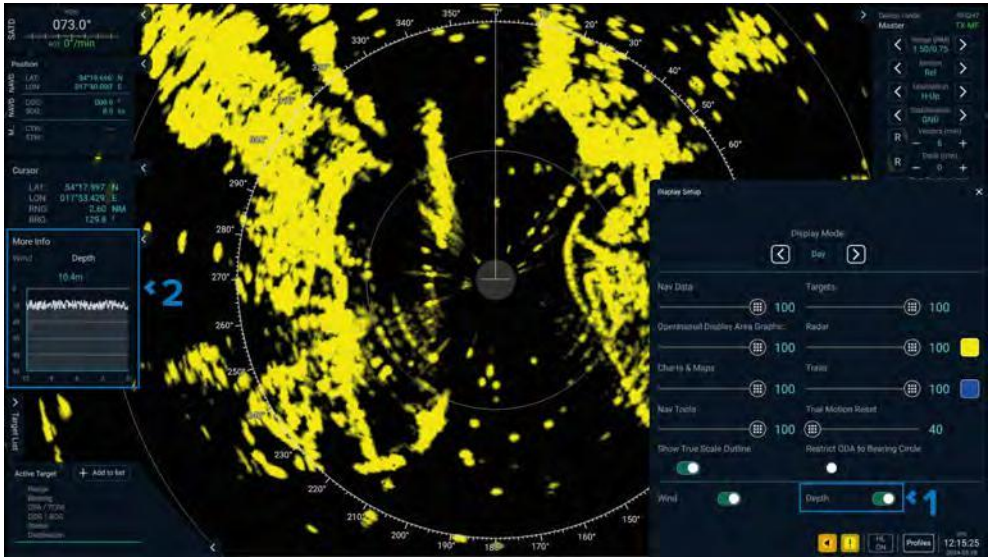
Configure the CHL settings using the *[Course]*, *[Radius]* / *[ROT]*, *[Speed]* and *[Delay]* options. Selecting the *[Radius]* setting title will switch the setting to *[ROT]* (Rate of Turn). Selecting the *[ROT]* setting title will switch the setting back to *[Radius]*.

The CHL can also be adjusted onscreen as follows:

1. Select and hold on the first circle and drag to adjust the *[Delay]*.
2. Select and hold on the second circle and drag to adjust the *[Radius] / [ROT]*
3. Select and hold on the line after the second circle and drag to adjust the *[Course]*.

7.14 Depth data

Depth data from a connected external device can be displayed onscreen.
Enable the *[Depth]* toggle switch located in the *[Display setup]* menu to view *[Depth]* data onscreen.
Current depth and a depth history chart will be displayed on the left side of the Radar screen.



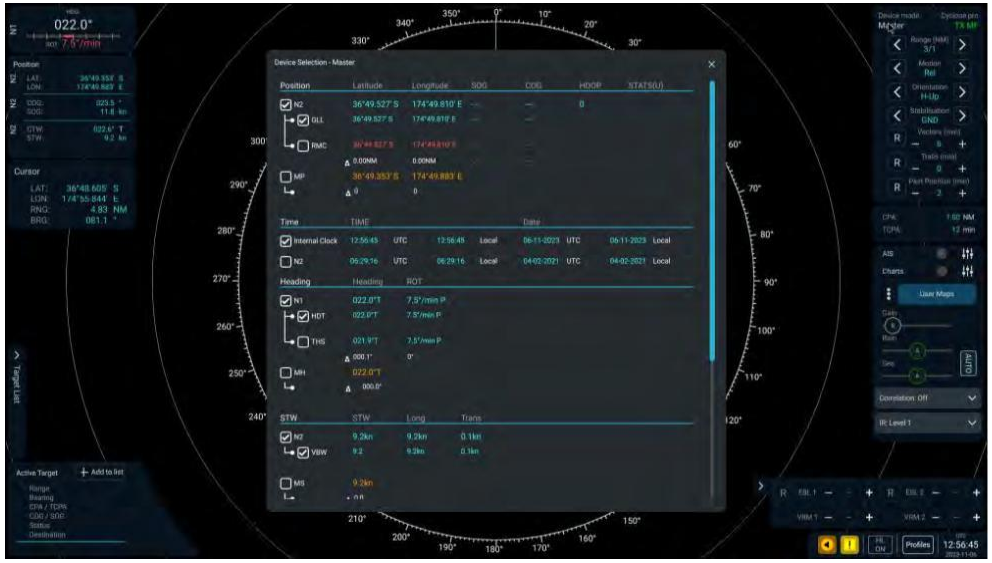
1. *[Depth]* toggle switch.
2. *[More info]* box showing Depth data.

If both *[Wind]* data and *[Depth]* data are enabled, you can switch between data by selecting either *[Wind]* or *[Depth]* from the *[More info]* box.
The *[More Info]* box is automatically hidden when the *[Targets List]* is displayed.

7.15 Device selection

Selecting a sensor name in the position details area located on the left side of the screen opens the *[Device Selection]* menu.
The *[Device Selection]* menu provides current data values of connected devices and the delta value between 2 devices transmitting the same data type.

Tick the box next to the relevant sensor data to use as the active data source.



Data values

- Blue values indicate the device is performing as expected.
- Orange values are used to indicate a manual device's values.
- Red values indicate that the data/device is no longer available.

Delta values

- White values indicates a viable option.
- Red values indicate that the delta is too significant.

Sensor failure

In the event of a sensor failure, an alarm will be triggered and the system will automatically switch to use the next valid device for the data.
The priority order shall be:

1. Next valid sensor.
2. Reference target, if one has been selected.
3. Manual device.

7.16 Display controls

Display controls are located in the box located on the top right of the screen.

The following controls are available:

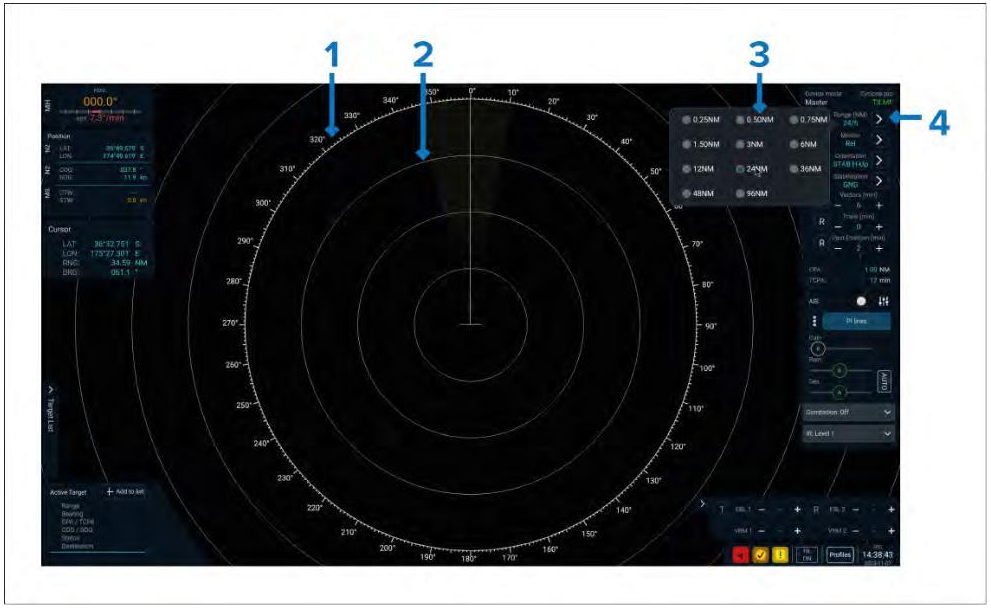
- *[Device mode]*— Selecting and holding on *[Master]*will take a screenshot and save it to a memory card.
- *[X-Band]*/ Radar name — Selecting *[X-Band]* the Radar name located in the top right corner of the screen will open the *[Radar Sensor]* menu. Selecting *[TX LF]* / *[TX MF]* / *[TX HF]* will put the Radar into standby mode.
  Selecting *[STBY]*will start the Radar scanner transmitting.
- *[Range (NM)]*— Identifies the current range scale and provides *[Range scale]*options.
- *[Motion]*— Use to switch between *Rel* (relative) and *True* motion mode.
- *[Orientation]*— Use to switch orientation modes.
- *[Stabilization]*— Use to switch stabilization modes.
- *[Vectors (min)]*— Use to specify vector length (in minutes).
- *[Trails (min)]*— Use to specify length of trails (in minutes).
- *[Past Position (min)]*— Use to specify length of past position vectors (in minutes).

The motion mode for Vectors, Trails and Past position can be set using the icons located to the left of the controls. Selecting *[R]* (relative) will switch to *[T]* true. selecting *[T]* true will switch to *[R]* (relative).

Radar range

Range rings (evenly spaced concentric circles) are displayed on the screen and are centered on the CCRP. Range rings enable you to easily estimate the distance between two points on the Radar screen.

Use the scroll wheel or pinch to zoom touch gesture to range in and out. Alternatively use the *[Range]* settings in the Display controls area located in the top right of the screen.



1. **Bearing scale** — The bearing scale is drawn at the selected display range scale.
2. **Range rings** — Evenly spaced concentric circles.
3. **Range options** — Selecting the Current range will display the available range options. Selecting an option will change the onscreen range.
4. **Range** — Identifies the display range (distance between your vessel, when the vessel is centered, and the bearing scale), and also the spacing between range rings (e.g.: 24/4 means the display range is 24 NM and the spacing between each range ring is 4 NM). You can use the *[Left]* and *[Right]* arrows to cycle through the range options.

The following ranges are available:

Display range	Ring spacing
0.25 NM	0.13 NM
0.50 NM	0.25 NM
0.75 NM	0.25 NM
1.50 NM	0.50 NM
3 NM	1 NM

Display range	Ring spacing
6 NM	2 NM
12 NM	3 NM
24 NM	4 NM
48 NM	8 NM
96 NM	12 NM

Note:

- Selecting the current range value will open range options.
- Selecting and holding on the range value will turn range rings on/off.

Switching range rings on or off

The range rings can be switched on or off.

1. Long press on the current range to turn range rings off.
2. Long press on the current range to turn range rings back on.

Motion

The Radar screen can be set to Relative motion or True motion.

The *[Motion]* mode setting is available from the Display controls area located in the top right of the screen.

[Rel] **(Relative) motion**

In relative motion mode, the position of ownship remains fixed and Radar image moves relative to your position.

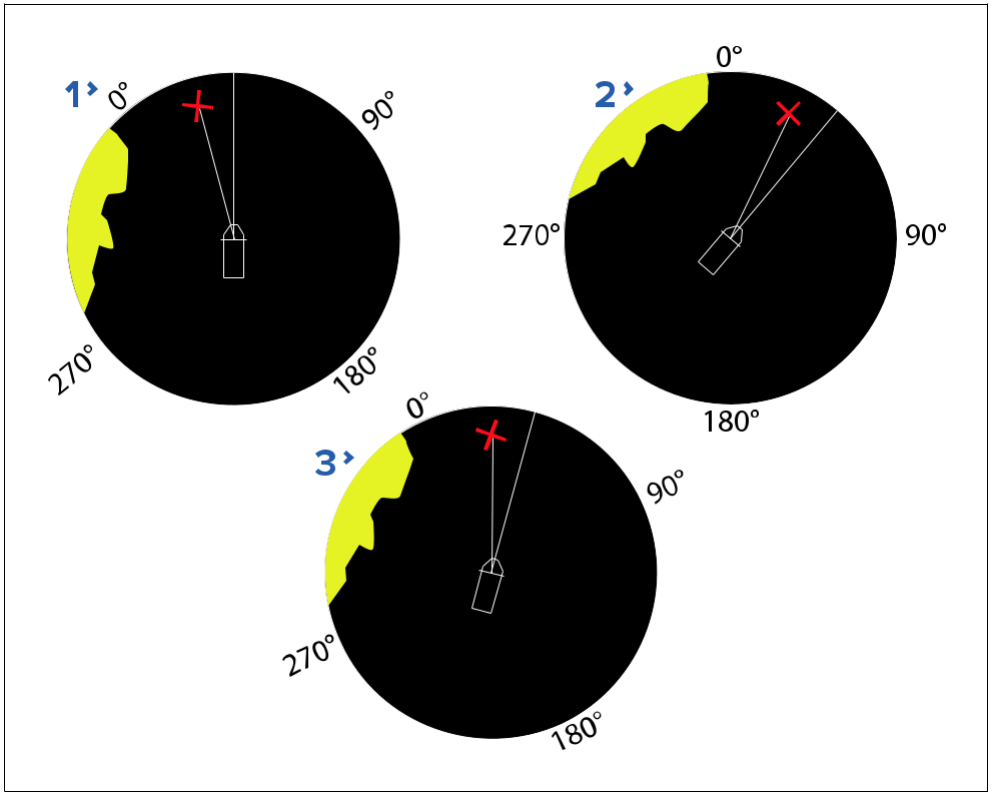
[True] **motion**

In true motion mode, stationary Radar targets remain fixed and moving targets, including ownship move in true perspective to each other and to landmasses. As your vessel's position reaches the edge of the screen, the image is redrawn to reveal the area ahead.

Orientation

The *[Orientation]* setting determines how the Radar screen is orientated in relation to your vessel's direction of travel.

The *[Orientation]* setting is available in the Radar control area. located on the top right of the screen. The following options are available:



1. *[H-Up]* **(Head Up) /** *[STAB H-up]* **(Stabilized Head-Up):**
   - *[STAB H-up]* **(Stabilized Head-Up):** This mode uses the selected Gyro with the Bearing Scale representing the True bearing. The top of the screen points to the visual view from the bridge, in the direction of ownship heading. As heading changes the radar image rotates accordingly. *[STAB H-Up]* mode is activated by selecting and holding on *[H-up]* orientation.
   - *[H-Up]* **(Head-Up):** The top of the screen points to the visual view from the bridge. In this mode the bearing scale represents the Relative bearing. AIS targets, Radar targets (ARPA) and User maps will be disabled. As your heading changes the radar image rotates accordingly. *[H-Up]* mode is activated by selecting and holding on *[STAB H-up]* orientation, or if no Gyro is available.
2. *[N-Up]* **(North Up):** The top of the screen points towards north and as your vessel's heading changes the ownship symbol and heading line rotates accordingly.
3. *[C-Up]* **(Course-Up):** The top of the screen points towards your destination and as your vessel's heading changes the ownship symbol and heading line rotates accordingly. Selecting and holding *[C-Up]* will reset the orientation (e.g.: when following a route, after turning towards the next waypoint select and hold so that the new waypoint is orientated towards the top of the screen.

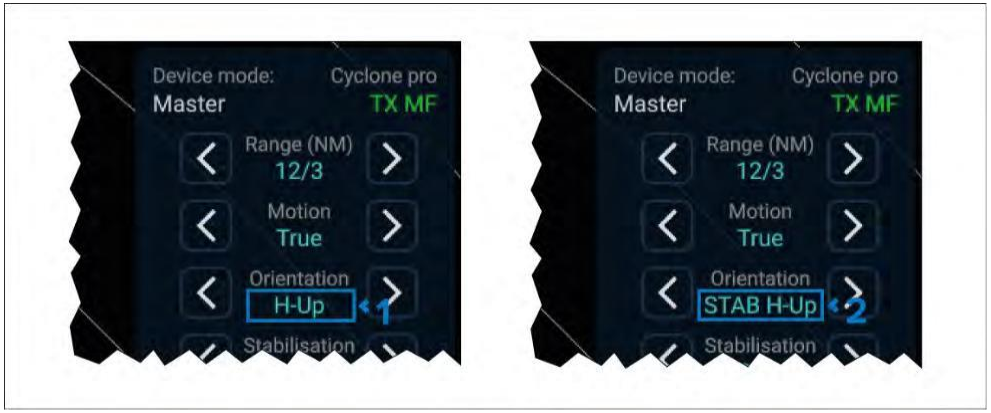
Note:

- If no gyro compass is connected *[H-Up]* will be the only available mode.
- If heading data is lost/becomes unavailable in *[N-Up]*, *[C-Up]* or *[STAB H-Up]* modes then the Radar screen will switch to *[H-Up]* mode.

Re-enabling Stabilized Head-up

If the display loses its heading, the *[Orientation]* mode will switch to *[H-Up]* mode. Once heading is restored, *[STAB H-Up]* (Stabilized H-Up) should be re-enabled.

Follow the steps below to re-enable *[STAB H-Up]* mode.



1. Long press on *[H-Up]* orientation mode, located on the right side of the screen to re-enable *[STAB H-Up]*.
2. Long press on *[STAB H-Up]* to revert the display back to *[H-Up]* mode.

Stabilization

The *[Stabilization]* setting determines the reference source used for velocity.
Velocity can be either ground stabilized or water stabilized.
The *[Stabilization]* setting is available in the Display controls area, located on the top right of the screen. The following options are available:

*[GND]***(Ground) stabilization**

Ground stabilization uses Speed Over Ground (SOG) and Course Over Ground (COG) from a source such as a Electronic Position Fixing System (EPFS), Speed and Distance Measuring Equipment (SDME), GNSS (GPS) receiver or use of a tracked reference target.
Without ground-referenced speed and course, stationary targets would appear to drift at a rate and direction opposite to the tide.
Ownship Course Over Ground (COG) and Speed over Ground (SOG) may also be calculated from a dual axis log input.
Ground stabilization is useful when you need to know your ownship and other ships course and speed in relation to land, buoys and beacons etc.

[Sea] **stabilization**

Sea stabilization uses Speed Through Water (STW) and Course Through Water from a source such as an SDME or speed transducer.

Note:

A single axis log cannot detect the effect of leeway. Sea stabilization is affected by tide and wind, the effect of ownship's structure, and will vary in different locations.

Vectors

Vector lines show the predicted future path and velocity of a target. The length of the vector line shows where the target is predicted to be when the time specified in the *[Vector]* settings has elapsed. Perpendicular lines are placed along the vector line at regular time intervals.
The vectors time period setting is located in the Display controls area on the right side of the screen.
The time period for vectors can be adjusted by:

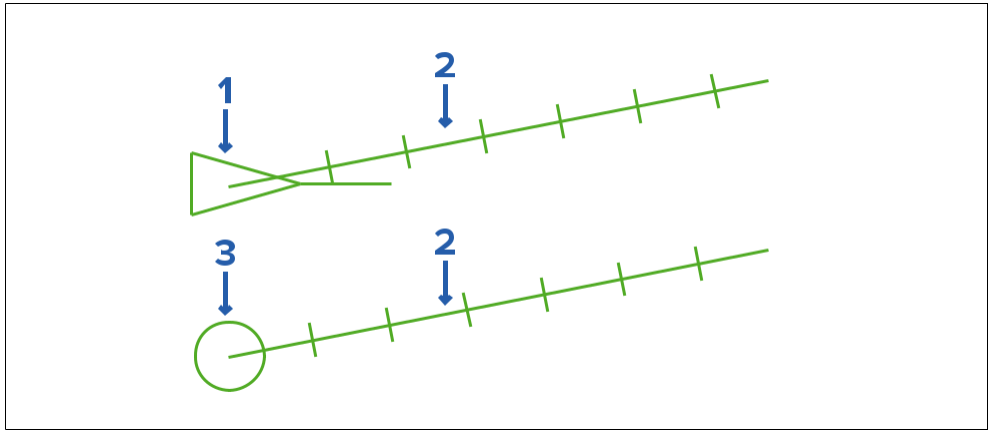
- Using the *[+]* and *[ ]* buttons to increase or decrease the time period.
- Selecting the current value and choosing a time period option.
- Selecting the current value and using the slider control to adjust the time period.

Setting the vector time period to 0 will disable the display of vectors.
The motion mode for vectors can be changed by selecting the *[R]*(Relative) or *[T]* (True) button located next to the *[Vector]* setting in the Display controls area.

- In *[True]* reference mode, vectors are shown ground referenced (i.e. their actual Course Over Ground).
- In *[Relative]* reference mode, vectors are shown relative to your vessel's movement.

The regular time interval for the perpendicular line can be set by selecting *[Vectors (min)]*.
Vectors are always displayed for tracked radar targets. Vectors are only displayed for AIS targets when the target has been activated.
AIS targets can be activated by selecting the target.

Example target symbols



1. Example AIS Target symbol.
2. Vector line.
3. Example Radar Target symbol.

Adjusting vector time increments

The time interval which the perpendicular vector lines represent can be adjusted.
Vectors *[Time increments.]*

1. Select *[Vectors (min)]*, located on the left side of the screen.
2. Select the *[Time increments]* toggle switch to enable or disable the perpendicular time increment lines on vectors.
3. Select the *[Time increments minutes]* value to adjust the time increment.

Trails

Trails show the historical movements of Radar targets, for the time specified in the *[Trails]* setting. As soon as the Radar is set to transmit, trails will begin to be processed. If the target's trail and movement is pointing towards your vessel and its range is decreasing, it should be treated as a collision threat.

To allow dynamic adjustment of the trails time period, 30 minutes of trails data is stored in memory. This means that full trails data is not available until the radar has been running for at least 30 minutes. Having a full 30 minutes of trails memory allows trail times to be increased to obtain full situation awareness. The time can also be decreased to reduce onscreen clutter, without losing the stored trail data.

New targets will initially begin to form a trail at first detection and so will take time to build up trails data for the specified trails period.

Radar echoes outside of the current trails memory range (e.g.: if the range scale is incremented more than one range scale) will need to build up data to the specified trails period.

The time period for trails can be changed from the *[Trails (min)]* setting, located in the *[Display controls]*area on the right side of the screen.

The time period for trails can be adjusted by:

- Using the *[+]* and *[ ]* buttons to increase or decrease the time period.
- Selecting the current value and choosing a time period option.
- Selecting the current value and using the slider control to adjust the time period.

Setting the trails time period to 0 will disable the display of trails, however trails will continue to be processed.

Previous trails data is retained in memory. When trails are switched back on, any available historical trails data is displayed.

If the Radar is set to standby, the trails data will deteriorate.

Selecting and holding on the *[Trails (min)]* value will delete the current trails data and restart the recording of trails data.

The color and brightness of trails can be configured from the *[Display setup]* menu, which is accessed using the *[DISP SET]* icon located in the *[Additional features]* menu.

Setting the trails color to a color which contrasts the color used for radar echoes/returns ensures that targets and trails are clearly distinguishable.

Trails motion mode

The motion mode for trails can be changed by selecting the *[R]* (Relative) or *[T]* (True) button located next to the *[Trails]* setting.

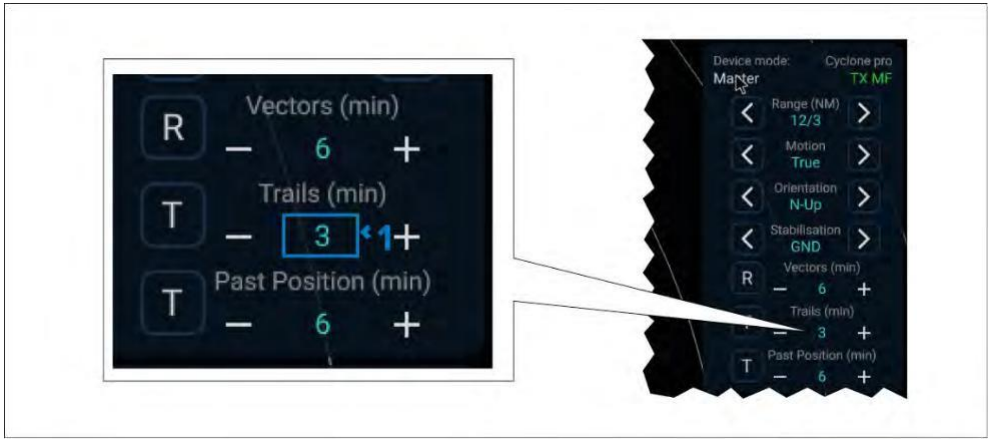
- In *[True]* reference mode, trails are shown ground referenced (i.e. their actual Course Over Ground).
- In *[Relative]* reference mode, trails are shown relative to your vessel's movement.

Note:

Trails and Past position share motion mode. (i.e.: if trails are switched to *[True]*; Past position will also switch to *[True]*.).

Resetting Trails

Trails data can be reset.



1. Long press on the current *[Trails]* time period to reset trails data.

Past Position

Past Position shows the historical movements of AIS targets and tracked Radar (ARPA) targets by dropping a past position marker every minute which are joined using a vector line trailing behind the target. If a target's Past Position vector line is pointing towards your vessel and its range is decreasing, it should be treated as a collision threat.

The time period for Past Position can be changed from the *[Past Position (min)]* setting, located in the Display controls area on the right side of the screen.

The time period for Past Position vectors can be adjusted by:

- Using the *[+]*and *[ ] b*uttons to increase or decrease the time period.
- Select the current value and choose a time period option.
- Select the current value and use the slider control to adjust the time period.

Setting the Past Position time period to 0 will disable the display of past position.

When Past Position is switched off, the vector lines are removed from the screen but the data is retained so that if Past Position is switched back on, previous position history will be shown again.

Selecting and holding on the *[Past Position (min)]* value will delete all Past Position data and restart.

When AIS is disabled, no new past position vectors are shown. However, Past Position data is stored so that if AIS is enabled again the stored data will be shown.

Past position motion mode

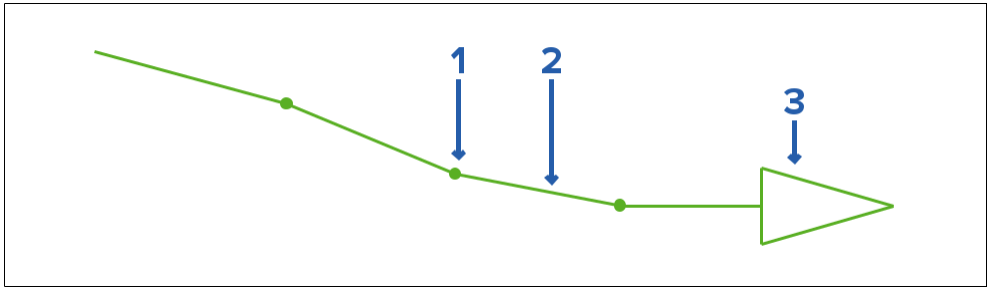
The motion mode for past position can be changed by selecting the *[R]* (Relative) or *[T]* (True) button located next to the Past Position setting in the Display controls section.

- In *[True]* reference mode, Past Position vectors are shown ground referenced (i.e. their actual Course Over Ground).
- In *[Relative]* reference mode, Past Position vectors are shown relative to your vessel's movement.

Note:

The Trails and Past Position share motion mode. (i.e.: if Trails is switched to *[True]*, Past Position will also switch to *[True]*.).

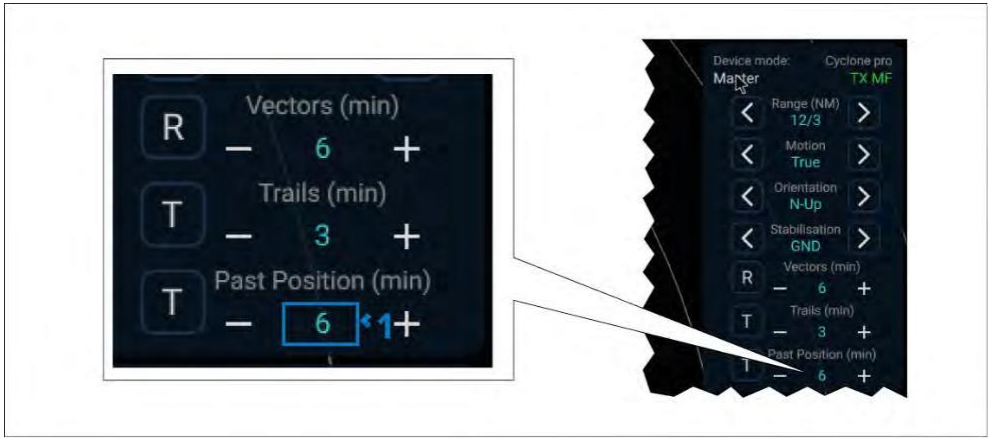
Example



1. Past Position markers are placed every minute.
2. Markers are joined by a vector line.
3. Target symbol.

Resetting Past position

Past position data can be reset.



1. Long press on the current *[Past Position]* time period to reset trails data.

Selecting Vectors, Trails or Past Position Pre-sets

Vectors, Trails and Past Positions all have pre-set options that can be selected.
To access the pre-sets follow the steps below.

1. Select the current value of either the *[Vectors]*, *[Trails]* or *[Past Position]* setting.
2. Select a value or use the slider to set the desired value.

Signal processing controls

Optimum performance is usually achieved using the default settings. You can adjust the image using the signal processing controls to improve the quality of the displayed image.
The signal processing controls are located on the right side of the screen.

The following controls are available:

- *[Gain]*.
- *[Rain]* anti clutter.
- *[Sea]* anti clutter.

Controls can be set to *[Auto]*or can be adjusted manually. When set to *[Auto] t*he slider control for each setting will have a green outline. When manually set, the slider control for each setting will have a blue outline.

Manual control

Move the slider circle along the adjustment range to manually adjust the setting level.

Automatic control

Select the *[Auto]* option to put all settings to automatic control.

When the *[Auto]* option is enabled, the system automatically controls the Gain, Rain anti clutter and Sea anti clutter levels. The slider controls will be centered along the adjustment range and fixed in position. Therefore, the slider controls will not represent the actual level of filtering applied.

Gain control

The *[Gain]* control determines the signal strength at which target returns are shown onscreen. The higher the setting, level the more targets and clutter will appear onscreen.

Rain anti-clutter control

Precipitation appears on the Radar screen as lots of small echoes which continuously change size, intensity and position, known as rain clutter. Depending on the intensity of the rainfall, this clutter can sometimes appear as large hazy areas. The *[Rain]* anti clutter control is used to reduce the clutter produced by precipitation, improving the quality of the radar image.

The *[Rain]* anti clutter control suppresses the clutter, making it easier to identify real objects. The higher the *[Rain]* anti clutter control level, the more clutter will be suppressed.

The optimum setting for the *[Rain]* anti clutter control is so that nearly all clutter is suppressed, meaning that small targets can be easily identified.

Note:

Landmasses will also become thinner as the *[Rain]* anti clutter control level is increased.

Limitations

- If the *[Rain]* anti-clutter control is too low, targets may not be visible.
- If the *[Rain]* anti-clutter control is too high, targets and rain clutter may not be visible.
- When both precipitation and sea clutter are present simultaneously, performance will be degraded further.

Sea anti-clutter control

Radar echoes from breaking waves, sea spray and backscatter appears on the Radar screen as clutter. The clutter appears centred around ownship which reduces performance of short range target detection. These echoes are not repetitive or consistent in position or size. With high winds and extreme conditions, echoes from sea clutter may cause dense background clutter in the shape of an almost solid disc. The *[Sea]* anti clutter control is used to reduce the clutter, improving the quality of the radar image.

The *[Sea]* anti clutter control suppresses clutter for up to 5 NM (depending on conditions) making it easier to identify real objects. The higher the setting value, the more clutter will be suppressed. The optimum setting for the *[Sea]* anti clutter control is so that some clutter is still shown, but the clutter is sufficiently reduced, meaning that small targets are easily identified.

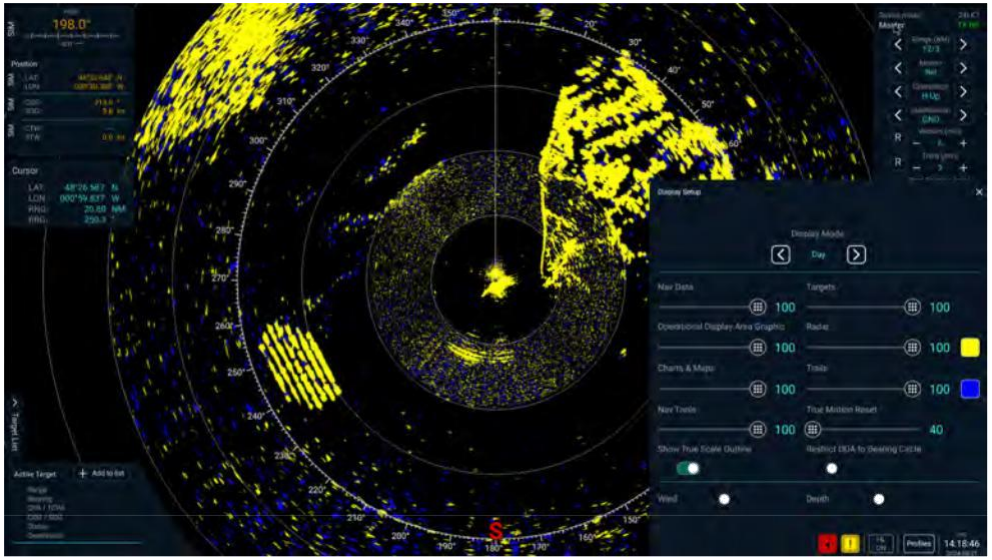
Limitations

- As the *[Sea]* anti-clutter control increases, the amount of clutter decreases. Smaller targets may have a similar or smaller echoes than the clutter and so may not be visible onscreen. Using the target Enhancement settings may improve the visibility of these targets.
- If the *[Sea]* anti-clutter control is too low, targets may not be visible.
- If the *[Sea]* anti-clutter control is too high, targets and sea clutter may not be visible.
- When both precipitation and sea clutter are present simultaneously, performance will be degraded further.

7.17 Display Setup

The *[Display Setup]* menu provides settings used to change the display mode and customize the way the screen looks.

The *[Display Setup]* menu is accessed from the *[Additional features]* menu on the right side of the screen.



The *[Display Setup] m*enu includes the following settings:

- *[Display mode]*— Change the display mode between *Day*, *Dusk* and *Night*.
- *[Nav data]*— Brightness control for data outside of the operational area.
- *[Operational Display Area Graphic]*— Brightness control for data within the operational area such as Heading line, range rings, own vessel outline etc.
- *[Charts & Maps]*— Brightness control for charts and user maps.
- *[Nav Tools]* — Brightness control for EBLs, VRMs, PI Lines and Bearing scale.
- *[True motion reset]*— In true motion mode this control determines the distance from the edge of the screen your own vessel is before the display resets.
- *[Targets]* — Brightness control for tracked radar targets and AIS targets including vectors and past position indicators.
- *[Radar]*— Brightness control for the radar feed and change the color used for radar returns.
- *[Trails]*— Brightness control for trails and change the color used for trails.
- *[Show True Scale Outlines]*— Enables and Disable the display of the true scale outline for ownship.
- *[Restrict ODA to bearing circle]*— Restricts the Radar picture so that it is only drawn within the bearing circle.
- *[Wind]*— Displays Wind direction and speed onscreen.
- *[Depth]*— Displays Current Depth and depth history onscreen.

7.18 Electronic Bearing Lines (EBLs)

An EBL is used to determine a target's bearing from your vessel, or from another target. 2 EBLs are available.

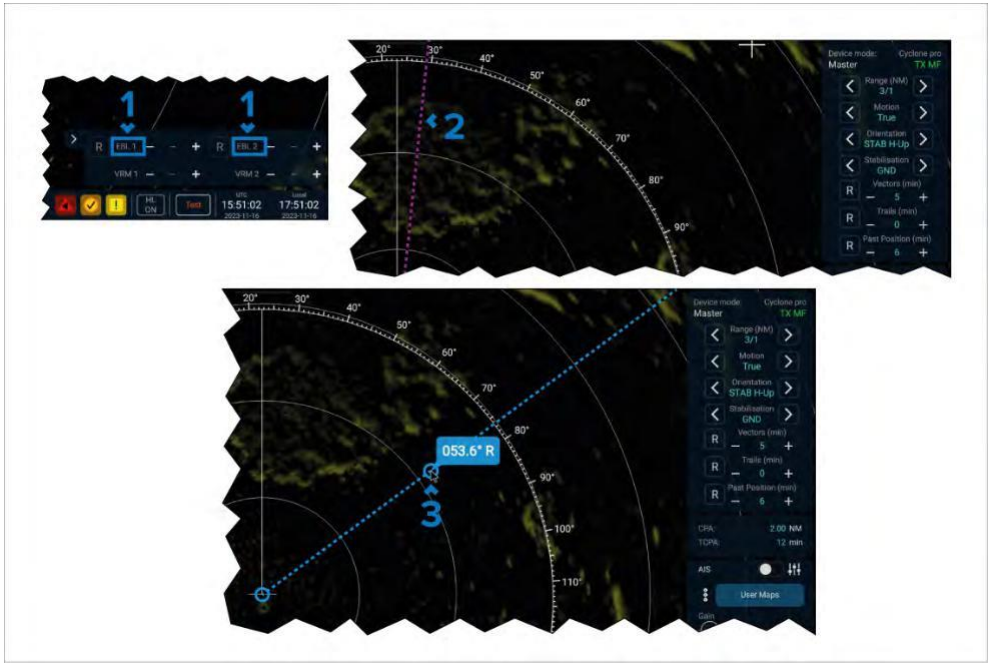
EBL context menu

Selecting an EBL onscreen will open the *[EBL]*context menu. The *[EBL]* context menu provides options related to the EBL.
The following options are available from the context menu:

- *[Bearing]*— The EBL's current bearing.
- *[Edit EBL]*— Select to adjust the EBL's position.
- *[Set Origin]*— Select to change the EBL type. The types of EBL are:
  - *Fixed*— The EBL will be geographically fixed to its current location.
  - *Motion*— The EBL will travel with ownship.
  - *Target*— The EBL's position will lock to an AIS or tracked Radar target and travel with the target.
- *[Edit Origin]*— Select to edit the lat/long of the EBL.
- *[Reset to CCRP]*— Select to reset the EBL's origin to the CCRP.
- *[Reset All]*— Select to reset all EBL's origin and bearing to default positions.

Creating an EBL

Follow the steps below to create an EBL.

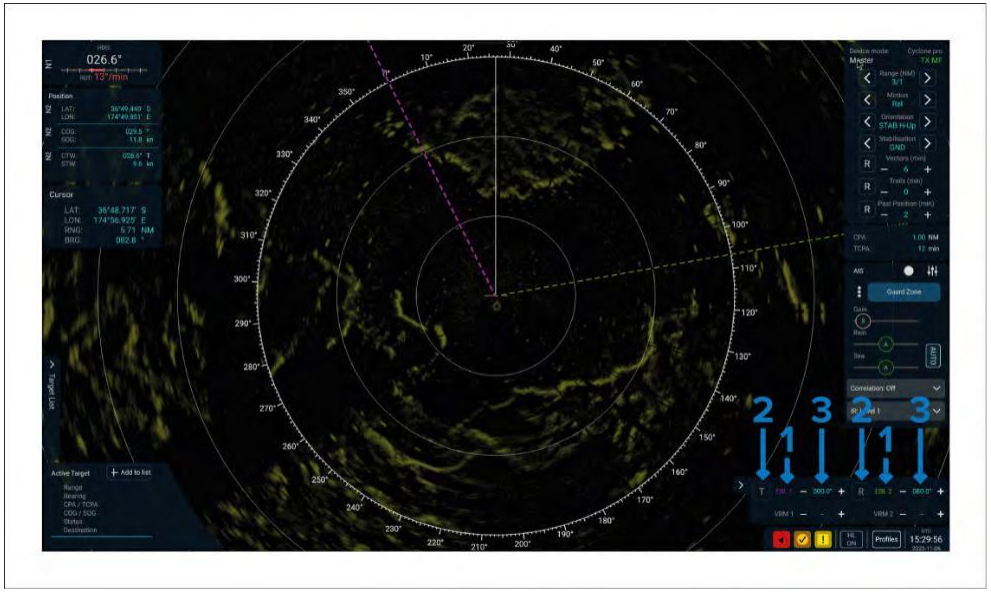


1. Turn on an EBL by selecting either *[EBL 1]* or *[EBL 2]*.
2. Double click on the EBL line to enter edit mode.
3. In edit mode click the desired location for the EBL.

The EBL can be edited again by double clicking the EBL line.

Creating an EBL using the menu

EBLs can be created and adjusted using the EBL/VRM menu.



1. Enable either the *[EBL 1]* or *[EBL 2]* toggle switch located on the bottom right of the screen.
   By default *[EBL 1]* will be set to 0 degrees and *[EBL 2]* is set to 90 degrees.
2. Select the *[R]* or the *[T]* next to the *[EBL]* toggle switch to change the EBL's motion mode (T = True motion and R = Relative motion).
3. Use the *[+]* (plus) and *[ ]* (minus) buttons to increase or decrease the EBL's bearing, alternatively select the current bearing value to enter a new bearing using the onscreen numeric.

Resetting EBLs

EBLs can be reset to the CCRP bearing, or reset to default bearings.
Select and hold on the *[EBL 1]* or *[EBL 2]* label to open the reset options.

- *[Reset to CCRP]*— Select to reset the EBL's origin to the CCRP.
- *[Reset All]*— Select to reset all EBL's origin and bearing to default values.

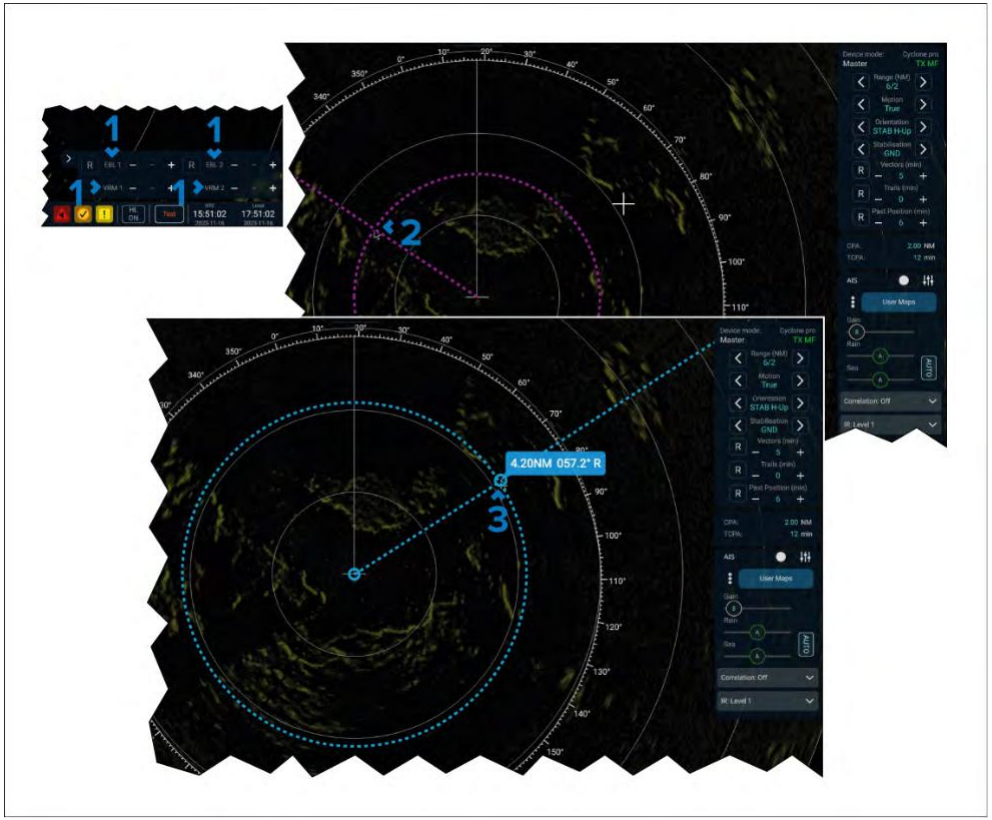
Editing EBLs

- EBLs can be adjusted to change their bearing or change the origin point.
- The EBL's origin point can be adjusted using the *[Edit Origin]* option from the *[EBL]* context menu.

- The EBL's bearing can also be changed using the *[Edit EBL]* option from the *[EBL]* context menu and then selecting a location.

Creating a combined EBL & VRM

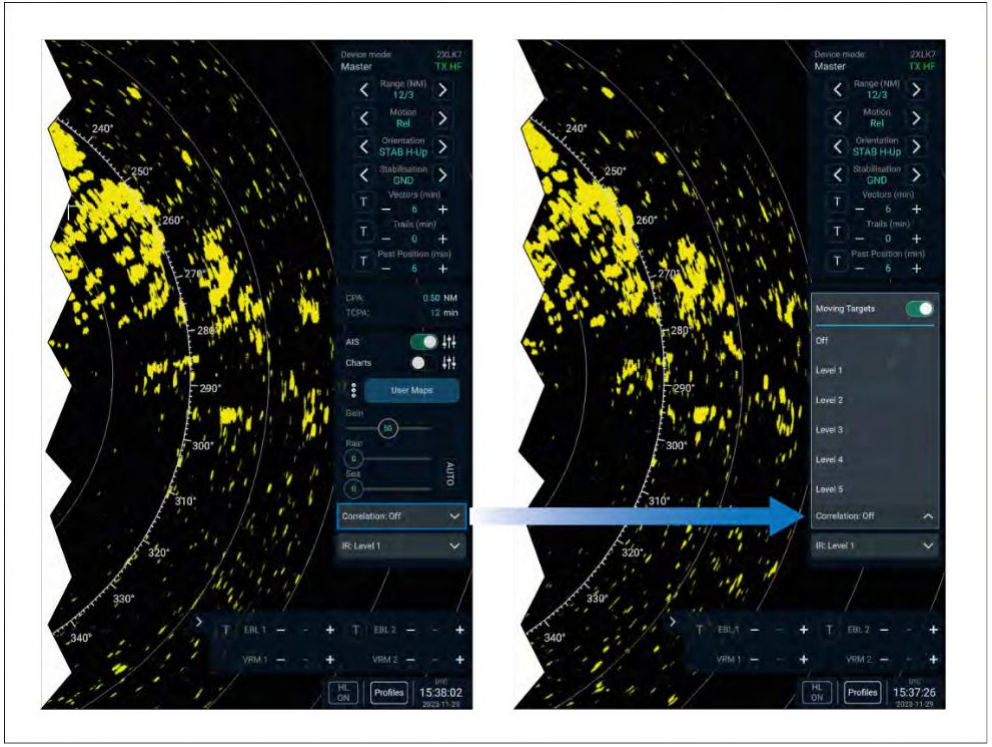
EBL 1 & VRM 1 or EBL 2 & VRM 2 can be created as a combined EBL/VRM.



1. Turn on either *[EBL 1]* and *[VRM 1]* or *[EBL 2]* & *[VRM 2]*.
2. Double click the point where the EBL and VRM intersect to enter edit mode.
3. In edit mode click the desired point where the EBL and VRM should intersect.

7.19 Enhanced target detection

Enhanced target detection is used to improve the visibility of targets by reducing sea clutter and rain clutter. Enhanced target detection can be achieved using the *[Correlation]* setting.



Correlation of stable targets will appear at a higher intensity than clutter or precipitation as clutter and precipitation is random.
There are 5 levels of *[Correlation]* which can be selected from the Radar controls area.
The Correlation levels are:

- *[Off]*— No target enhancement processing is used. The target intensity depends on signal strength. Small targets may appear at a similar level to clutter. No moving target threshold is applied.
- *[Level 1]*— Low correlation threshold, along with a low averaging and a low integration threshold is applied to the data. The radar image is processed over a low number of scans. Low moving target threshold is applied.

- *[Level 2]*— Slightly higher correlation threshold, along with slightly more averaging and a slightly higher integration threshold is applied to the data. The radar image is processed over a greater number of scans. Slightly higher moving target threshold is applied.
- *[Level 3]*— Medium correlation threshold, along with a medium averaging and a medium integration threshold is applied to the data. The radar image is processed over a greater number of scans. Medium moving target threshold is applied.
- *[Level 4]*— Medium correlation threshold, along with a medium averaging and a medium integration threshold is applied to the data. The radar image is processed over a greater number of scans. Higher moving target threshold is applied
- *[Level 5]*— High correlation threshold, along with a high averaging and a high integration threshold is applied to the data. The radar image is processed over a high number of scans. High moving target threshold is applied.

Limitations:

Most sea clutter spikes are suppressed, however any spikes that correlate over several scans may still be visible.

The higher the Correlation level the longer it will take for the radar image to build up.

Moving target

Each Correlation level sets a moving target threshold.

If the *[Moving target]* option is enabled, after a few scans any target that appears to be moving will become orange.

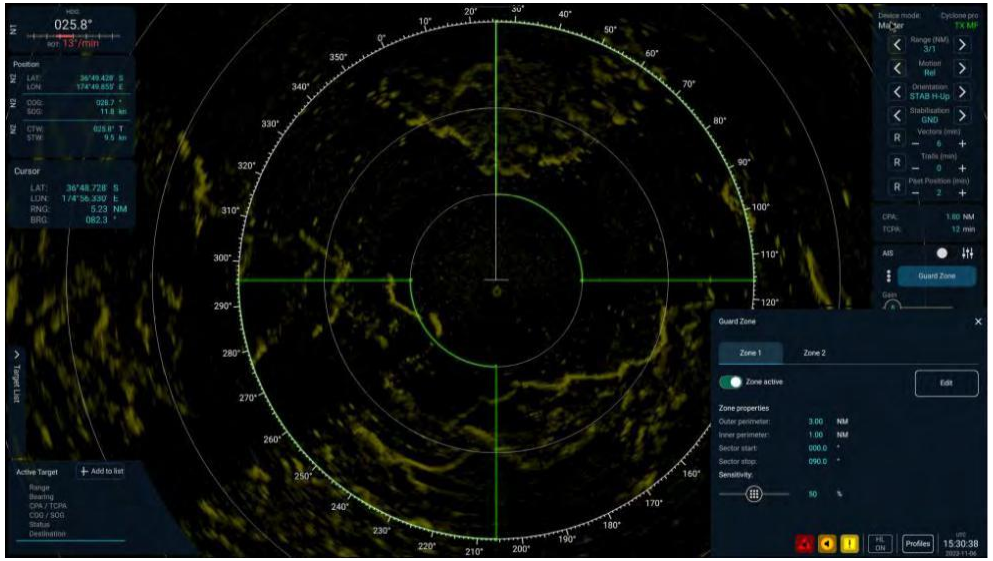
The *[Moving target]* toggle switch is located in the *[Correlation]* drop down menu.

Fast moving targets may not fully correlate, particularly on the lower range scales. Correlation should therefore be applied on longer range scales, typically on or above 3 NM range scale. A radar scanner using a faster rotating antenna can assist in target detection under these conditions.

If correlation is used on short pulse and/or a low range scale, small targets with a fast relative speed may not correlate.

7.20 Guard zones

Guard zones alert you if radar targets and AIS targets are detected within a defined zone. Radar targets are acquired and tracked automatically if they are detected in a guard zone. AIS targets which enter the guard zone are automatically activated.



2 guard zones can be configured.

The guard zones are displayed onscreen using a green outline.

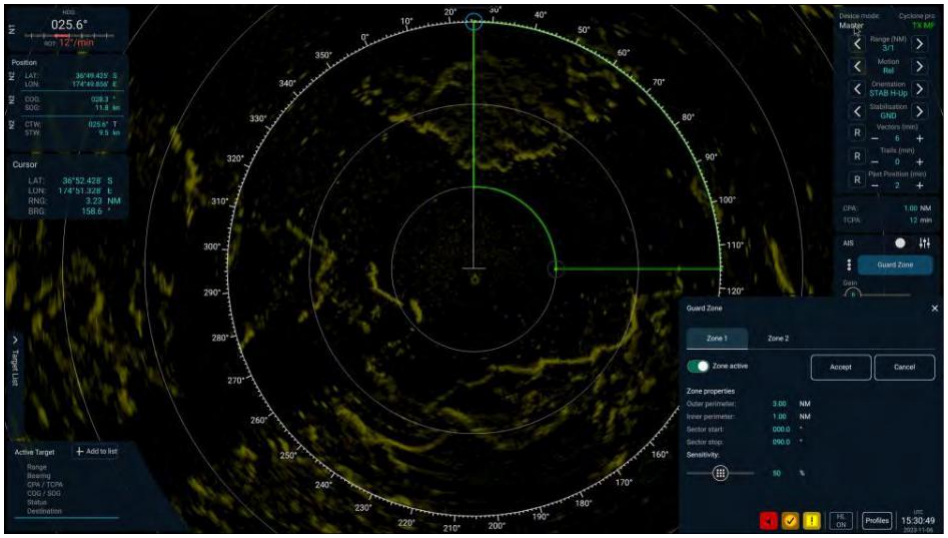
Configuring a guard zone

Follow the steps below to configure a guard zone.

1. Select *[Guard Zone]* from the *[Additional features]* menu.
2. Select either *[Zone 1]* or *[Zone 2]*.
3. Enable the *[Zone active]* toggle switch.

   Enabling the zone first allows you to see the adjustments to the guard zone onscreen as you make them.

4. Select *[Edit]*.



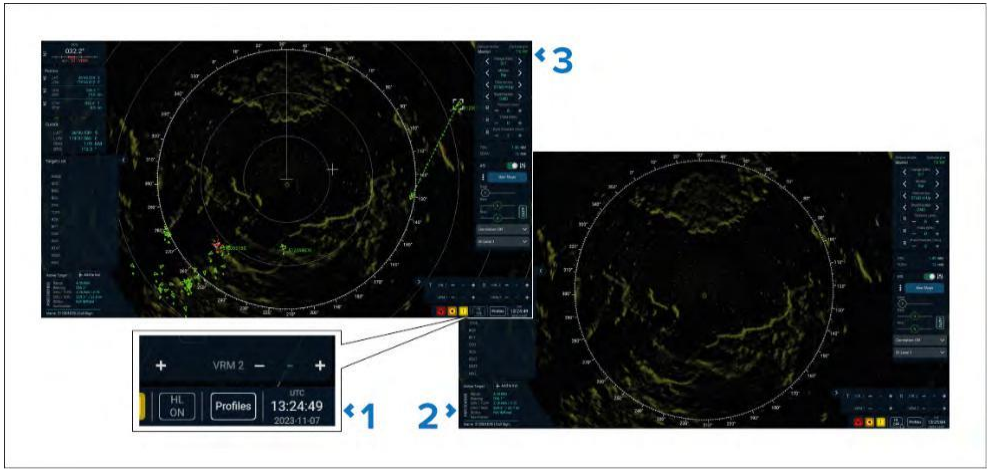
5. Select and drag the circle on the edge of the outer perimeter to the desired position.
6. Select and drag the circle on the edge of the inner perimeter to the desired position.
   Alternatively, once *[Edit]* has been selected, you can select each value from the menu and use the numeric keypad to enter new values for the guard zone.
7. If required, adjust the *[Sensitivity]* slider to the desired value.

   The sensitivity value determines the size of echoes/returns that will trigger the guard zone warning.

8. Select *[Accept]*.
9. Close the *[Guard Zone]* menu by selecting the *[X]* located in the top right corner of the menu.

7.21 Heading line suppression

The heading line suppression icon located on the bottom right of the screen temporarily hides onscreen features and targets, leaving just the scanned radar image and bearing scale. The heading line, range rings, ownship symbol, AIS targets, and tracked radar targets are removed.



1. Heading line suppression icon location.
2. Selecting and holding on the *[HL ON]* icon suppresses items other than the scanned radar image and bearing scale. The icon will change to *[HL OFF]* whilst it is selected.
3. Once the icon is released, the screen will return to normal operation (*[HL ON]*).

7.22 Keyboard shortcuts

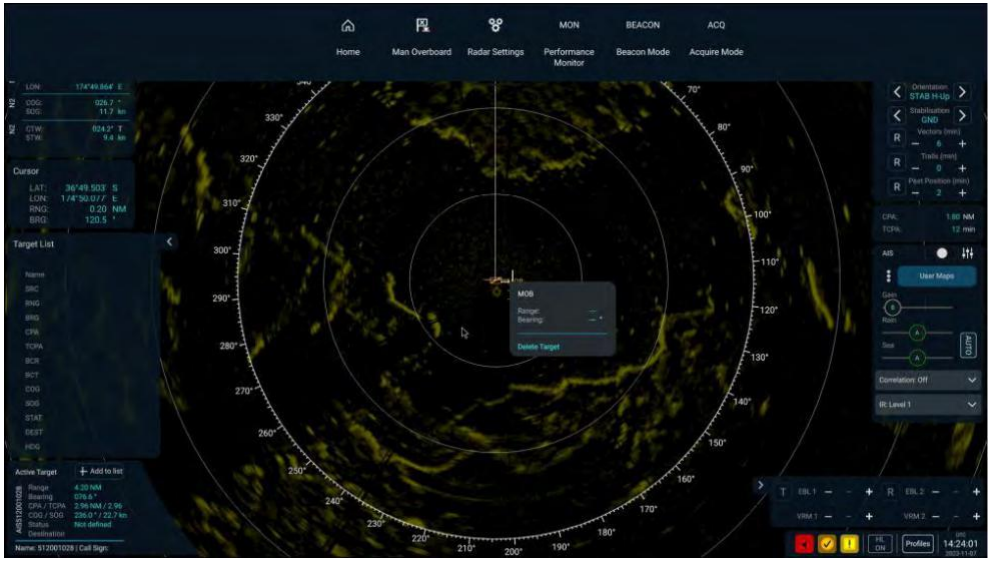
The function ‘F’ keys on the optional KRS keyboard are used for specific shortcuts.

- *[F1]*— Radar Transmit *[TX]* standby *[STBY]*.
- *[F2]*— Acknowledge alarms.
- *[F3]*— Enable and disable display of *[AIS]* targets.
- *[F4]*— Chart On/Off.
- *[F5]*— Temporary Suppression *[HL Off]*, whilst pressed.

- *[F6]*— Open or close the *[Shortcut menu]*.
- *[F7]*— *[Take Screenshot]*.
- *[F8]*— *[Acquire]* at cursor location.
- *[F9]*— *[Radar offset]* reset.
- *[F10–F12]*— Undefined.

7.23 Man Over Board (MOB)

The MOB alert can be activated from the *[Pull down]* menu.



Pull down the menu bar and select the *[Man Overboard]* icon.

The MOB marker, range and bearing are placed onscreen at the position your vessel was at when the MOB was activated and the MOB caution is triggered.

MOB context menu

Select and hold the *[MOB]* icon to open the *[MOB]* context menu. The *[MOB]* context menu shows range and bearing of the MOB marker, and also provides the option to remove the MOB marker by selecting *[Delete target]*.

7.24 Manual Devices (Speed, Heading, Position)

Speed, Heading and Position details can be entered manually using the manual devices available in the *[Device Selection]* menu.

Adjusting a manual device's value

By default the values of manual devices will update automatically to match the value from the currently selected device. You can adjust a manual device's value manually from the *[Device Selection]* menu. Once a manual device's value has been manually adjusted it will remain static until adjusted again.

1. Select a device name from the position details area, located on the left side of the screen.
   The *[Device Selection]* menu is displayed.
2. Select the relevant manual device's current value.
3. Adjust the value using the onscreen numeric keypad.
4. Select *[OK]*.
5. To use this value/device as the system data source, select the tick box next to the device name.
6. Select the *[X]* located on the top right of the menu to close the *[Device Selection]* menu.

CHAPTER 8: O TO Z OPERATORS INSTRUCTIONS

CHAPTER CONTENTS

*Card reader: option

8.1 Operational Display Area (ODA)

By default, the Operational Display Area (ODA) will cover the entire screen.
If desired, the ODA can be restricted to the bearing scale circle.
Use the *[Restrict ODA to bearing circle]* toggle switch located in the *[Display setup] m*enu to enable and disable the ODA restriction.

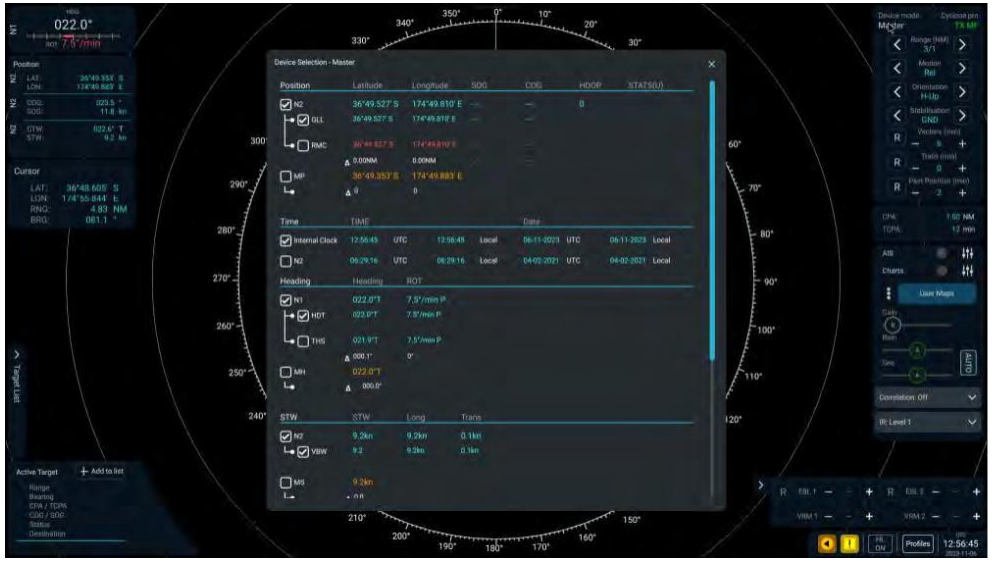
1. **Disabled** —The ODA will fill the available screen.
2. **Enabled** — The ODA will be restricted to the bearing scale circle.

8.2 Ownship data

Ownship data received from connected sensors/devices is displayed on the left side of the screen. The following own vessel data can be displayed: Heading, Rate of Turn (ROT), Latitude, Longitude, Speed (SOG / STW), Course (COG / CTW), Depth and Wind.

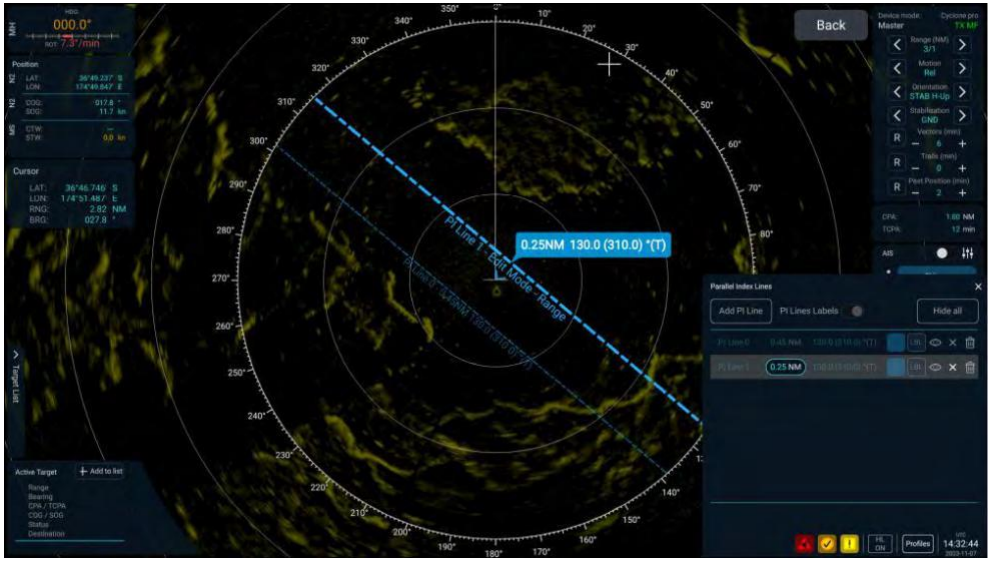
The connected sensor/device name is displayed next to the data.

Selecting the device name will open the *[Sensor Selection]* menu, where you can select which sensor's data is displayed. Where multiple sources of data are available, the *[Sensor Selection]* menu will also show the delta value which is the difference from the selected device's value.



8.3 Parallel Index Lines

Parallel index (PI) lines are fixed lines that can be placed at a specified range and bearing from your ownship. The range and bearing of PI lines do not change when ownship heading changes or display range is altered. The *[PI Lines]* menu is accessed from the *[Additional features]* menu located on the right side of the screen.



PI lines can be used to monitor a vessel's position in relation to the ground track or pre-determined passage plan.

Two index lines can be used, set in parallel. One line may indicate the intended ground track line, and the second line a safety limit.

The distance perpendicular to the bearing of the PI line may be set to the planned passing distance from a fixed radar object, creating a visual reference that the object should not pass. Deviation due to tide set and drift or position sensor errors can be readily identified.

In relative motion mode, observation of the fixed object's echo moving along the PI line will indicate whether the ship is maintaining its planned track.

If the echo deviates from the PI line it provides immediate indication that ownship is not maintaining the desired ground track.

In true motion mode, PI lines move with ownship. As long as the ship remains on track, the echo of the mark will stay on the PI line as it moves across the display.

Creating a PI line

Follow the steps below to create a PI line.

1. Select and hold on a location onscreen.

   The *[Radar]*context menu is displayed.
2. Select *[Add PI line]* from the context menu.

   A PI line is displayed onscreen and the *[Edit PI line]* menu is displayed.
3. Select *[Range]* from the menu.

   When *[Range]* is selected, two arrows will be displayed either side of the PI line.
4. Select a position for the PI line or select and drag the PI line to the desired position.
5. Select *[Bearing]* from the menu.

   When *[Bearing]* is selected, two rotation symbols will be displayed at either end of the PI line.
6. Select and hold on the PI line and drag the PI line to the desired bearing.
7. Select *[Truncate]* from the menu.

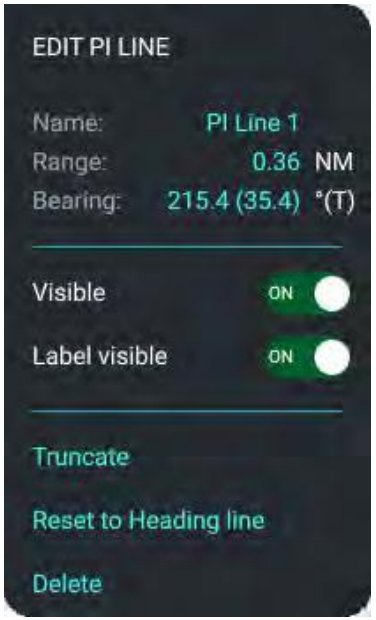
   When *[Truncate]* is selected, two circle symbols will be displayed at either end of the PI line, and arrow lines pointing towards the center of the PI line are displayed on the PI line.
8. To shorten or lengthen the PI line, select and hold on one of the circles and drag in or out.
9. To choose a color for the PI line, select *[Color]* from the menu.
10. To close the menu, select the *[X]* in the corner of the *[Edit PI line]* menu.
11. When line creation is complete, select the *[Back] b*utton that is displayed in the top right corner of the screen.

PI lines can be edited or deleted from the *[PI line]* context menu, or from the *[PI line]* settings menu.

PI Line context menu

Selecting and holding on a PI line will display the *[PI Line]* context menu.

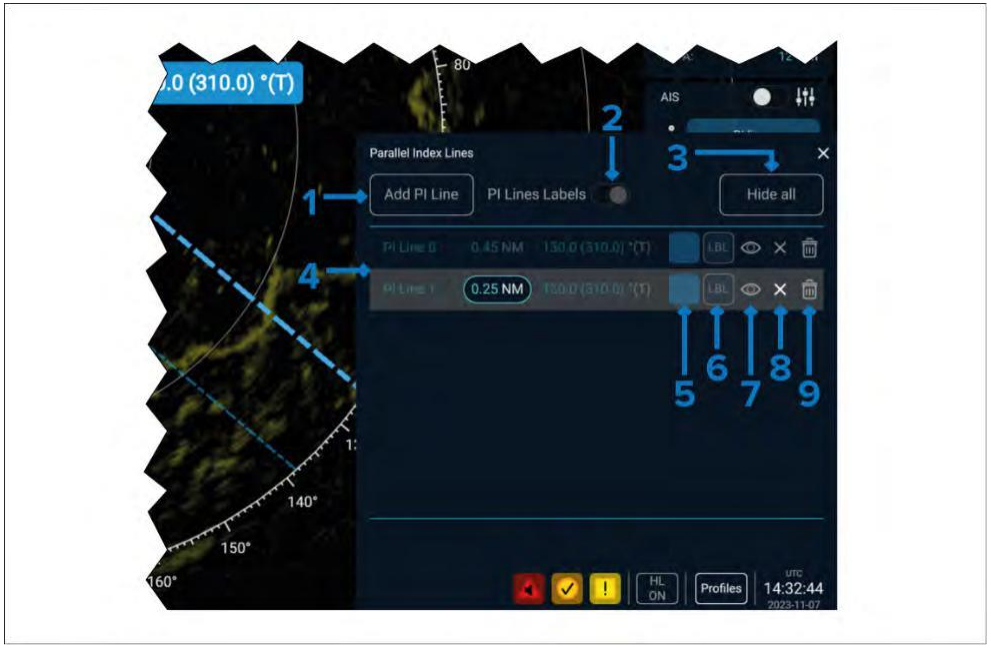
The following information and options are available from the context menu:



- *[Name]*— Select the current name to edit the PI line's name using the onscreen keyboard.
- *[Range]*— Select the current range value to adjust the range using the onscreen keypad.
- *[Bearing]*— Select the current bearing value to adjust the bearing using the onscreen keypad.
- *[Visible]*— Enabled by default, switch toggle off to hide the PI line.
- *[Label Visible]*— Enabled by default, switch toggle off to hide the PI line's label.
- *[Truncate]*— Select to adjust the length of the PI line.
- *[Reset to Heading line]*— Select to reset the PI line's position to ownship's heading line.
- *[Delete]*— Select to delete the PI line.

PI Line settings menu

The *[PI line]* settings menu is accessed by selecting the *[PI lines]* button from the *[Additional features]* menu, located on the right side of the screen. Pi lines can be created, edited and deleted from the *[PI lines]* settings menu.



1. *[Add PI Line]*— Select to add a new PI line.
2. *[PI Lines Labels]*— Enable to display PI line labels onscreen, disable to hide.
3. *[Hide all]*— Select to hide all PI lines.
4. List of all PI Lines.
5. *[Fill color]* icon — Select to edit color.
6. *[LBL]* icon — Select to show/hide the onscreen PI Line label.
7. *[Eye]* icon — Select to show/hide the PI Line.
8. *[Pencil]* icon — Select to edit the PI Line.
9. *[Trash can]*— Select to delete the PI Line.

8.4 Pull down menu

The *[Pull down]* menu is opened by selecting and holding at the top of the screen and dragging down. The menu is hidden by dragging up on the menu.

1. *[Home]*— Select to Close the Radar app and return to the Standby screen.
2. *[Man Overboard]*— Select to activate the Man Overboard alarm.
3. *[Radar Settings]*— Select to open the password restricted *[Radar Settings]* menu.
4. *[MON — Performance Monitor]*— Select to enable the Performance monitor. For details refer to: **p.103 — Performance monitor**
5. *[BEACON — Beacon Mode]*— Select to enable Beacon mode. For details refer to: **p.42 — Beacon mode**
6. *[ACQ — Acquire Mode]*— Select to enable the Acquire mode. For details refer to: **p.37 — Acquire mode**

8.5 Radar display offset

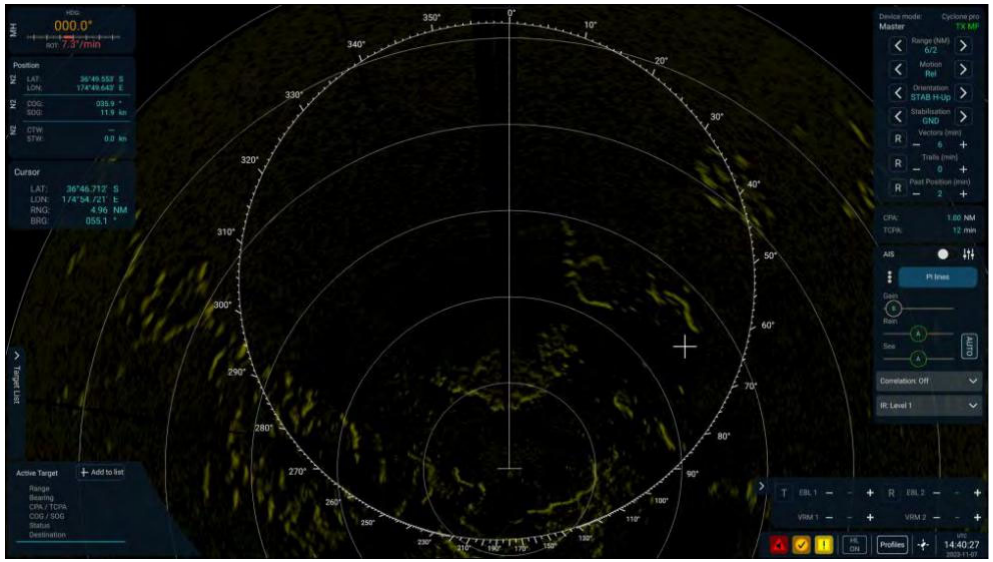
The Radar display offset enables you to view an area that would otherwise be off screen.

Drag the cursor to initiate a display offset in the opposite direction of the drag (e.g.: dragging down the screen will offset the display so that more area is revealed at the top of the screen). To activate the display offset when the touchscreen is disabled you must select and hold on ownship CCRP and then drag the cursor.

Radar display offset can be performed in any direction.

Note:

The Display offset is configured in the *[Radar settings]* menu and can be set to a range of between 50% to 75% of the Display range.



To center your vessel on the screen, select the *[Find ship]* icon located in the notification area at the bottom right of the screen.

8.6 Radar settings menu

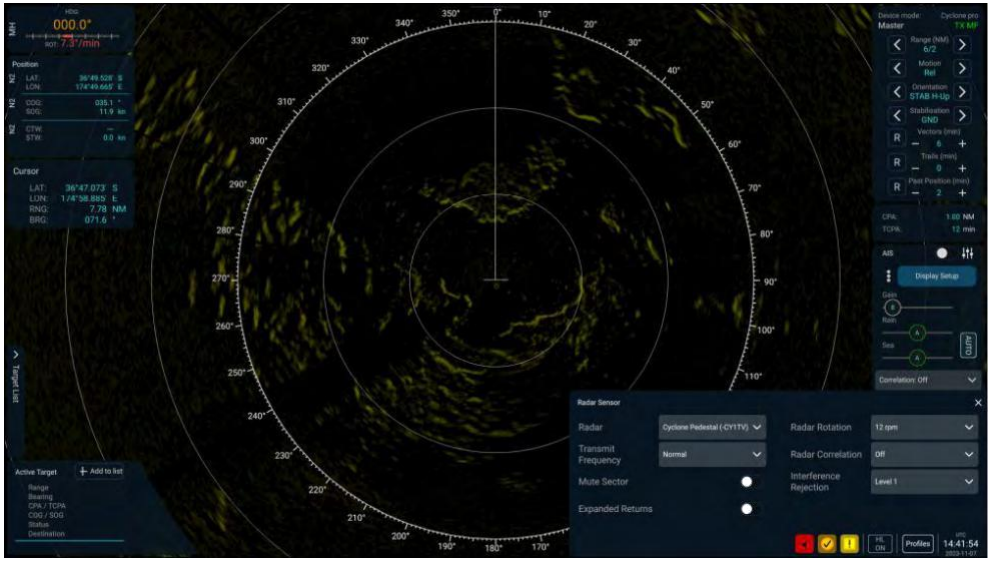
The Radar settings menu (accessed from the *[Pull down]* menu) is restricted, and requires a password to access.

For details of the Radar settings menu, refer to the KRS *Installation manual.*

8.7 Radar sensor menu

The *[Radar Sensor]* menu provides further Radar scanner related settings.

The *[Radar Sensor]* menu is accessed by selecting the Radar scanner name heading located at the top right of the screen.



The following settings are available:

- *[Radar]*— Select Radar scanner.
- *[Transmit frequency]*— Switch Radar transmit frequency between *[Low]* (TX LF), *[Normal]* (TX MF) and *[High]* (TX HF). Changing the Transmit frequency can reduce interference on the Radar image.
- *[Mute Sector]*— When a Blank sector or Blank sectors have been configured, enabling *[Mute sectors]* will display the configured Blank sector(s).
- *[Expanded Returns]*— When enabled, increases the Radar pulse length to provide larger target returns.
- *[Radar Rotation]*— Allows you to select the appropriate rotation speed for your range. The *Auto* option provides an increased refresh rate at Radar ranges up to 3 NM.
- *[Radar Correlation]*— Instead of a new radar return appearing instantly when it is picked up on a scan, the Radar correlation allows the return to gradually appear over a number of scans.
- *[Interference Rejection]*— Suppresses interference from other Radar scanners in the vicinity. For details refer to: **p.96 — Radar interference**

8.8 Reference target

Tracked radar targets can be set as a reference target.

Only 1 target can be used as a reference target at a time.

AIS must be switched off before a reference target can be assigned.

The target must be fully acquired.

For accurate COG/SOG calculations, the tracked target must be stationary.

When a reference target is enabled, COG & SOG are calculated from the reference target.

The referenced target will be available in the *[Device selection]* menu as a source for COG/SOG.

Once assigned as a reference, the target will be named ‘R1’.

Precautions and notes:

- Target Loss — If a reference target is lost it may have a major impact on the accuracy of true speed and true course readings of targets and ownship speed readings will be inaccurate.
- A Lost reference target will trigger a ‘Lost reference target’ alert.
- AIS Restrictions — Due to conflicts between common consistent references (CCRP), tracked radar targets cannot be acquired as a reference target when AIS targets are enabled. Enabling AIS targets will cause a *[Reference Target]* to be unassigned.
- Relative Velocity — Reference Targets are only used for the calculation of True Speed, calculation of Relative Speed may be inaccurate and should not be used to calculate Relative velocity.

Assigning a reference target

To assign a Reference Target follow the steps below.

1. Select and hold on an acquired radar target
   The *[Acquired target]* context menu is displayed.
2. Enable the *[Reference target]* toggle switch.

Once assigned the target will be marked as ‘R1’.

Unassigning a reference target

To unassign a Reference Target follow the steps below.

1. Select and hold on the Reference target.
   The *[Acquired target]* context menu is displayed.

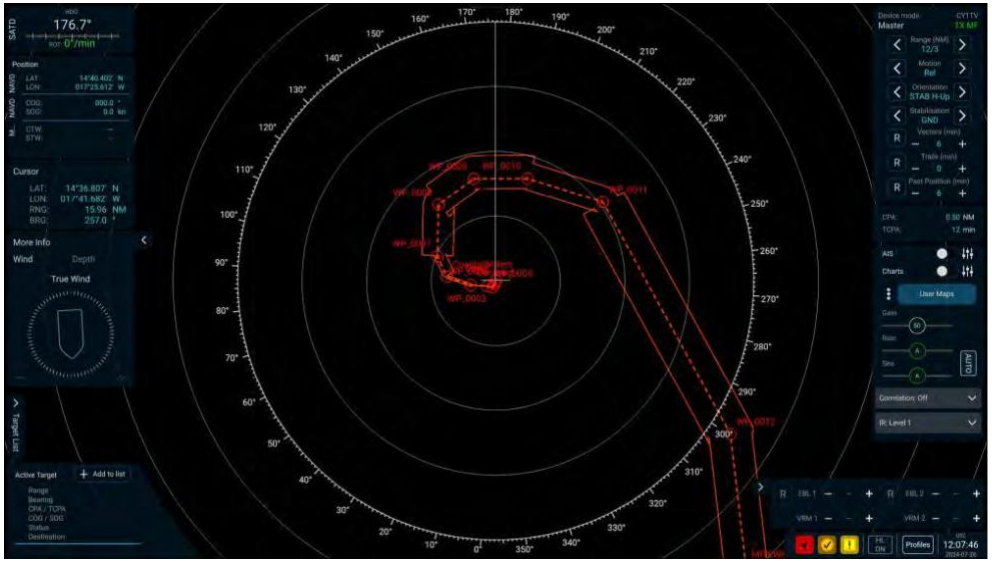
2. Disable the *[Reference target]* toggle switch.

Once unassigned, the target will be removed from the *[Device selection]* menu and will no longer be marked as ‘R1’.

8.9 Route Manager

The Route Manager can be used to import routes from a memory card to the display’s internal memory.

The display can import routes in the Route plan exchange format (RTZ), and can also receive routes automatically when transmitted using RTE and RMB telegrams.



The routes on the memory card must be located in a folder named “KRSRoutes”, located in the root directory of the memory card.

The *[Route Manager]* is accessed from the *[Additional Features]* menu located on the right side of the screen.

Importing a route

RTZ routes can be imported from a memory card using the Route Manager.

1. Select the relevant external memory card slot.
   A list of routes in the “KRSRoutes” folder will be displayed.

Note:

The route files must be in the “KRSRoutes” folder.

2. Select the route that you want to import.
3. Select *[Import]*.
4. Select *[Load]*.

Enabling automatic receipt of routes

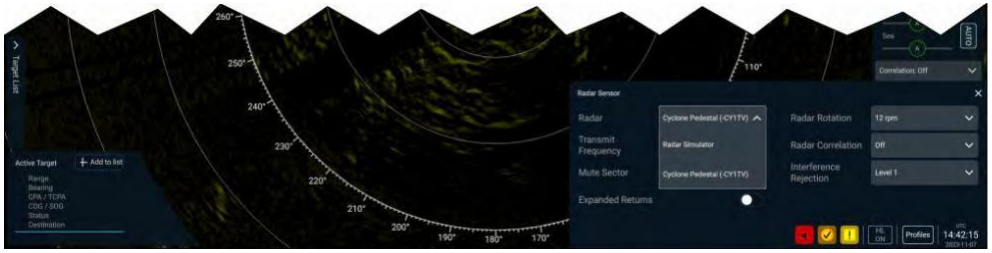
The display can be configured to automatically receive routes sent using RTE and RMB Telegrams.

1. Select *[Routes]* from the *[Additional Features]* menu.
2. If required, enable the *[Load RTE Route Automatically]* toggle switch.
3. If required, enable the *[Load RMB Route Automatically]* toggle switch.

Routes sent by a connected external device will be automatically received by the display.

8.10 Simulator

A simulator is available that can be used for demonstration and testing purposes. The simulator uses a replay of recorded data that is saved to internal or external memory. The demo simulator requires live data from Gyro, Speed and Position sensors to use Radar features.
The simulator is enabled from the *[Radar Sensor]* menu.



There are 2 options for the simulator:

- *[Internal]*— The internal simulator plays a pre-recorded data file which is on the display's internal memory.
- *[External]*— The external simulator plays pre-recorded data that has been saved to a MicroSD card inserted into the display's external card reader*. Once a file has been selected playback will commence.

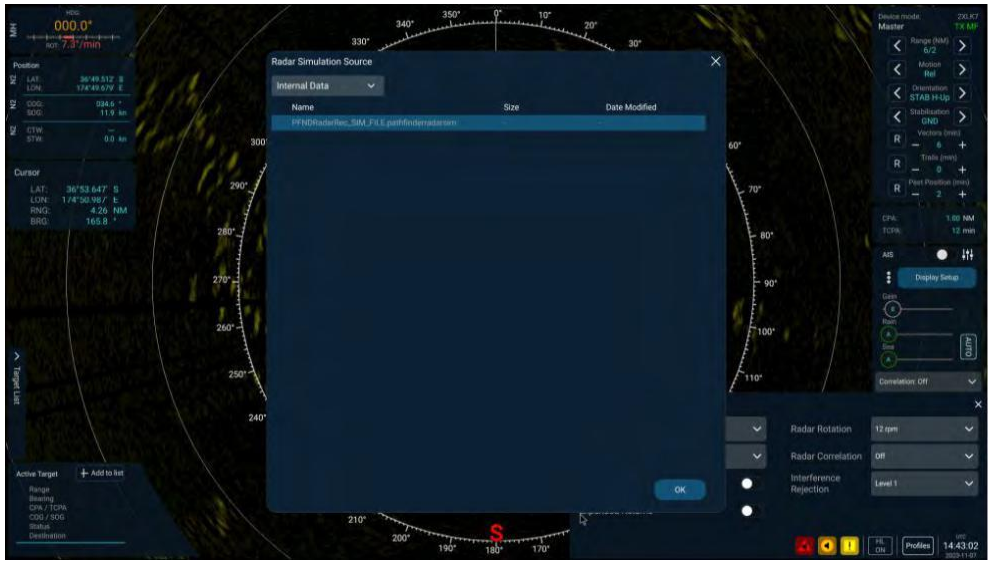
A red 'S' is displayed onscreen at all times to indicate the data is simulated.

If the pre-recorded data contains navigation data these values are used for the simulator and the values will appear orange.
The Radar controls and features will behave as described in this manual.

The simulator is disabled by selecting a real Radar scanner from the *[Radar Sensor]* menu.

Enabling the simulator

The simulator plays pre-recorded data in place of live data from a Radar scanner.
Follow the steps below to enable the simulator.

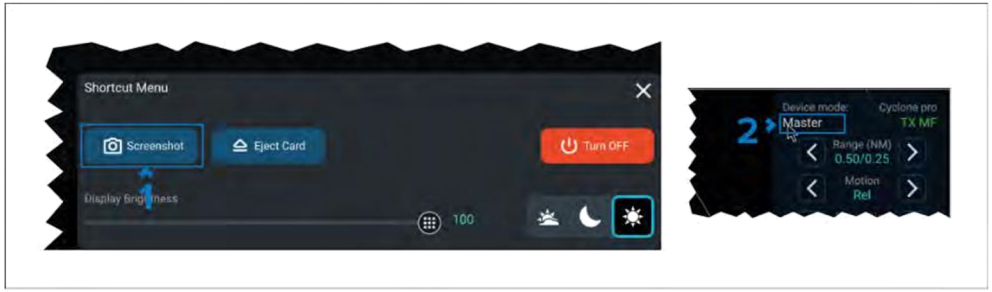


1. Select the Radar scanner name heading located at the top right of the screen.
2. Select the *[Radar]* name from the menu.
3. Select *[Radar simulator]*.
4. Select either *[Internal]*, or *[External]*.
   When *[External]* is selected the file browser will be displayed to enable you to select a file to play.

The Pre-recorded data will commence playback.

8.11 Screenshot

A screenshot of what is currently displayed on the screen can be taken and saved to a memory card.
Screenshots can be taken by:



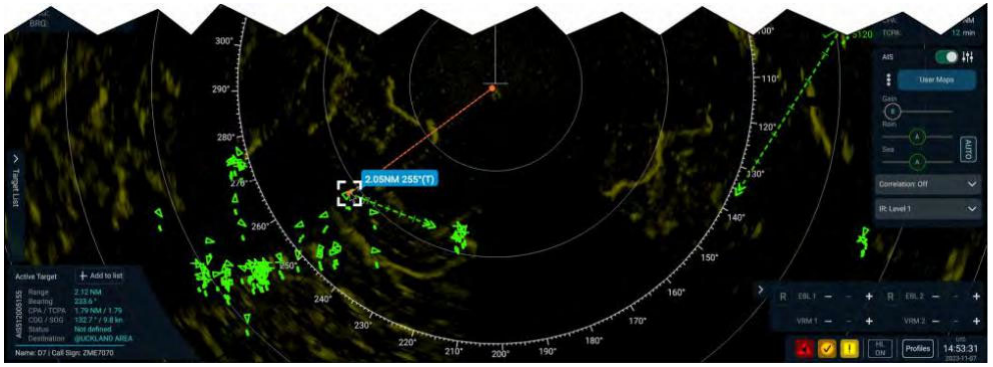
1. Selecting the *[Screenshot]* button under the *[Shortcut Menu]*; or:
2. Selecting and holding on *[Master]* under the *[Device mode]* heading, located in the top right corner of the Radar screen.

8.12 Tape measure

The tape measure feature can be used to measure the distance and bearing between 2 points.

Note:

The touchscreen must be disabled from the *[This display]* settings menu for the tape measure feature to be available.

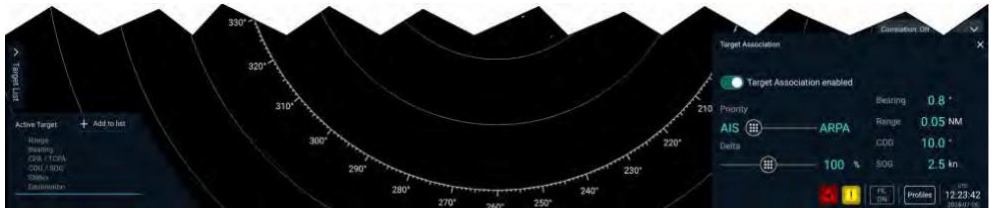


Select and hold on the first point and then drag the cursor to the second point, a temporary line will be drawn and distance and bearing will be displayed.
When the cursor is released the tape measure line is removed.

8.13 Target Association

Target association allows association (linking) of tracked radar targets with AIS targets that appear to represent the same vessel.
The Target association feature is only available when AIS is enabled.

To open the *[Target Association]* menu, select *[Target Association]* from the *[Additional features]* menu, located on the right side of the screen.
When the *[Target Association]* toggle switch is enabled, the system will compare the Range, Bearing, COG and SOG of AIS and tracked radar targets to determine if they are associated (i.e.: the same target), based on the *[Delta]* setting.



Priority: AIS

When *AIS (default)* is set as the *[Priority]* the data in the Target List and target info will be based on the AIS data.
Activated AIS targets will have a circle drawn around the triangle. **Priority: ARPA**

When *ARPA* is set as the *[Priority]* the data in the Target List and target info will be based on the tracked radar target's data.
Tracked radar targets will have the 'AIS' triangle symbol drawn within the radar target symbol.
Associated targets will appear in the Target List only once, and will use the data from the target which has priority.
The Target List will identify associated targets in the source field: *[AIS + ARPA] is* displayed when the AIS target has priority and *[ARPA + AIS] is* displayed when tracked radar targets have priority.
Selecting the source field in the targets list will switch the priority.

The *[Delta]* setting has 3 values:

- *50%*

- *100% (default)*
- *300%*

If the difference (delta) between the tracked radar target and AIS targets is within the following Delta values, the targets will be associated (linked):

Delta = 50%

- Range: 45 m
- Bearing: 0.4°
- COG: 5.0°
- SOG: 1.3 kn

Delta = 100%

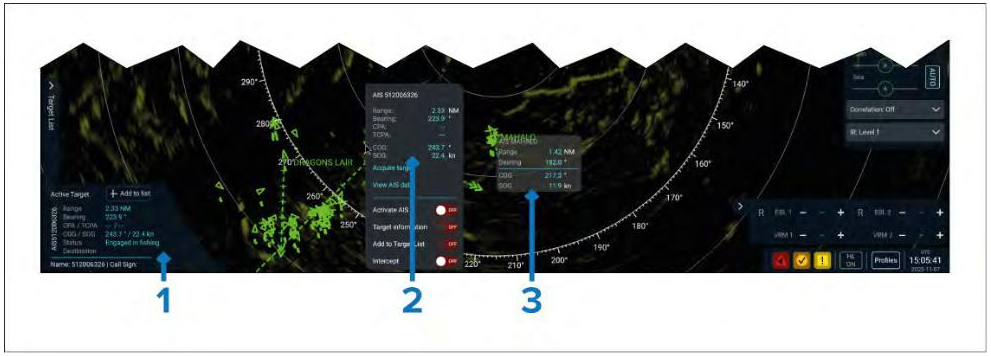
- Range: 90 m
- Bearing: 0.8°
- COG: 10.0°
- SOG: 2.6 kn

Delta = 300%

- Range: 270 m
- Bearing: 2.4°
- COG: 30.0°
- SOG: 7.5 kn

8.14 Target information

Target data is either data transmitted from AIS targets or data created by the system for tracked radar targets.
Target information can be viewed from the following locations:



1. **Active target box** — displays information about the last selected target, or will temporarily display data for the target that the cursor hovers over.
2. **Target context menu** — displays information for the selected target.
3. **Next to target symbol** — when the *[Target information]* toggle switch has been enabled from the target's context menu.

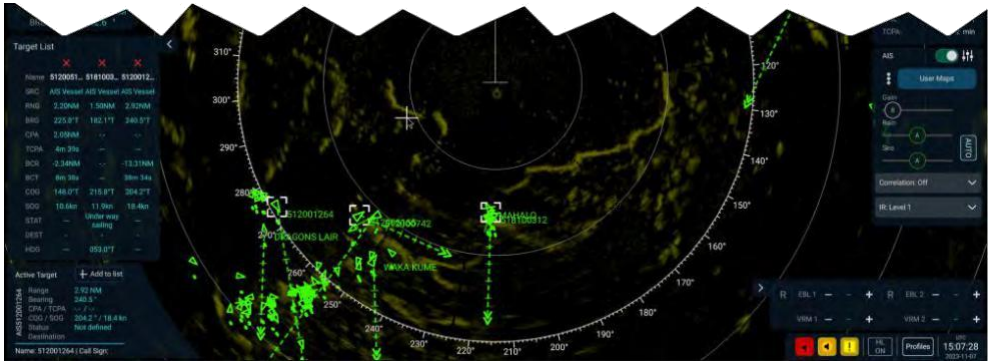
Note:

- Radar targets must be acquired before Target information is available.
- AIS targets must be activated before the *[Target information]* toggle switch can be enabled.

8.15 Target list

When a tracked target is selected, it becomes active and its details appear in the *[Active Target] b*ox, located in the bottom left corner of the screen. Active targets can be added to the *[Target List]*.
Targets can be added to the *[Target List]* by either:

- Double clicking on the acquired target.
- Selecting *[+Add to List]* from the *[Active target]* box.
- Enabling the *[Add to Target List]* toggle switch from the target's context menu.



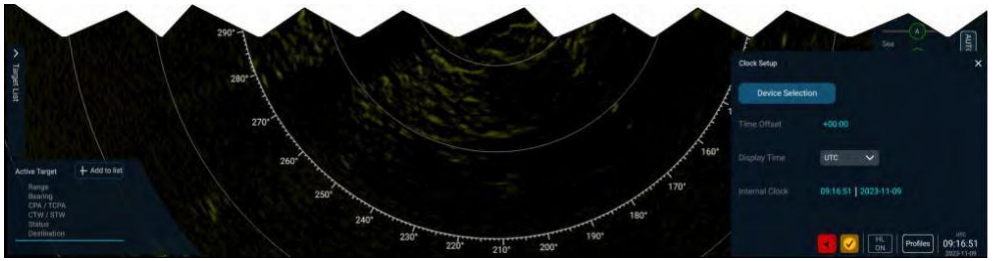
When a target is selected, onscreen selection brackets are placed around the target. If the target is added to the *[Target List]* the selection brackets will remain.
Targets can be removed from the *[Target List]* by selecting the red ‘X’ located above the target’s data.
All targets in the *[Target List]* will have the selection brackets around their target symbol.
If the target is deleted, it is also removed from the *[Target List]*.

Note:

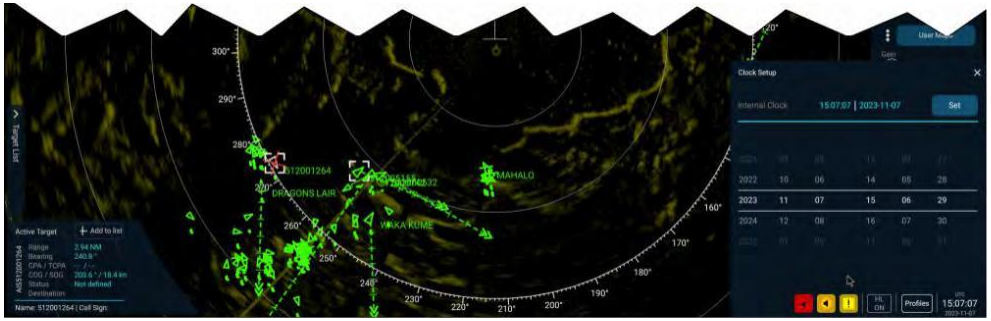
- AIS targets must be activated before they can be added to the *[Target List]*.
- Radar targets must be acquired before they can be added to the *[Target List]*.

8.16 Time

The time and date is shown in the Standby screen and on the Radar display in the bottom right corner.



Selecting *[Device selection]*opens the *[Device selection] m*enu where you can choose the device which provide date and time to the system.
An offset can be applied to the current time by selecting the *[Time Offset]* value and adjusting the offset.
The display time can be switched between UTC and local time or both can be displayed simultaneously using the *[Display Time]* drop down.
Selecting the current *[Date]*or *[Time]* opens the *[Clock Setup]* menu. From the *[Clock Setup]* menu, the date and time format and options can be configured.



The time and date can be adjusted by dragging up or down on each value. Save the change by selecting *[Set].*
You can go back to the Time and date menu by selecting the Date or Time at the top of the *[Clock Setup]* menu.

8.17 Tracked Radar targets (ARPA)

Radar targets of interest, such as targets that pose a potential collision threat can be acquired and tracked. Radar targets can be acquired manually, or can be acquired automatically when they appear within an active guard zone area.
Up to 100 surface targets with relative speeds of up to 150 knots can be tracked. Radar tracking facilities are available within 0.1 to 24 nautical miles on all range scales.
Target tracking plots acquired radar targets and calculates their course and speed.
Target vectors can be displayed which indicate the target’s predicted future path and its velocity. For details refer to: **p.53 — Vectors**
Additional information such as bearing, range, CPA, TCPA, course and speed can be shown in the *[Active Target] b*ox, *[Target List]* target context menu or next to the target symbol.

The radar screen must be continually adjusted and tuned to ensure that actual surface objects are visible and unwanted targets such as noise and clutter are not acquired and tracked.

In addition to ships and other surface vessels, targets can also be echoes from landmasses, reefs, sea surfaces and/ or clutter.

As the amount of clutter changes with environment, *[Gain]*, *[Sea]*and *[Rain]* controls should be adjusted accordingly to ensure actual target echoes are still visible.

During slow turns there is no effect on tracked targets however, for faster turning rates of greater than 150°/minute (depending on gyro), there is some influence on all tracked targets which lasts for a minute or two and then reverts to full accuracy.

The course of a tracked targets lags 15 to 30 seconds at high relative speed, or 3 to 6 seconds at near zero relative speed.

For target tracking when manual speed is being used, the speed input MUST be adjusted every time that ownship speed changes.

During acquisition and tracking, circle symbols are used to identify target status. Tracked targets are assigned unique sequential numbers. For further details and examples of target tracking symbols refer to: **p.100 — Tracked radar target symbols**

Radar target acquisition data source requirements

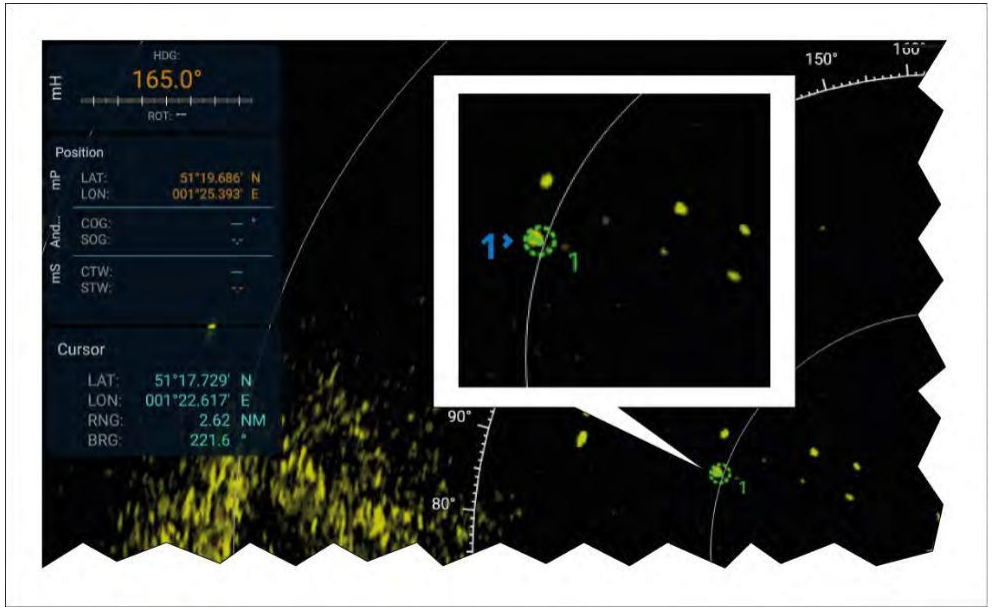
Radar target acquisition requires external devices that transmit relevant data to be available on your system

The following data sources are required:

Data type	Example data source
COG (Course Over Ground)	GPS or GNSS receiver.
SOG (Speed Over Ground)	GPS or GNSS receiver.
THS / HDT (True Heading)	Compass or Autopilot sensor providing fast heading data. (The gyro compass or equivalent heading sensor must have an update rate that is adequate for the ship's rate of turn. In general for non-high speed craft, the update rate should be a minimum of 10 Hz.).

Acquiring a Radar target

Radar targets can be acquired and tracked.



1. Double click on the desired object/target.

Once acquired the target will be tracked.

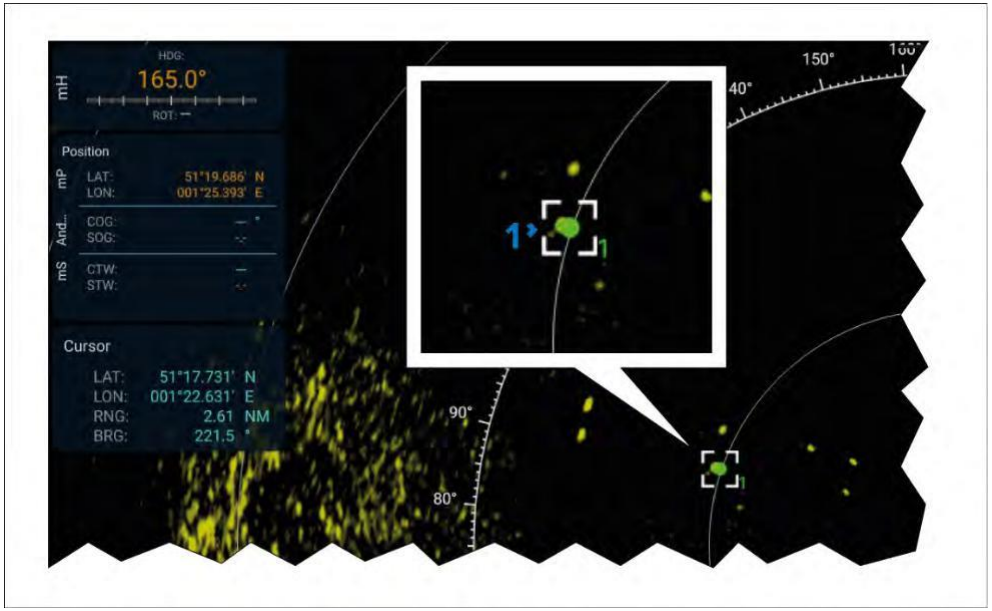
Acquiring a Radar target using the context menu

Radar target acquisition can be initiated from the Radar context menu. AIS targets can also be acquired as Radar targets from the AIS target context menu.

1. Select and hold on the desired object / target.
   The relevant context menu is displayed.
2. Select *[Acquire target]*.
   Once acquired the target will be tracked.

Selecting a Radar target

Tracked Radar targets can be selected.

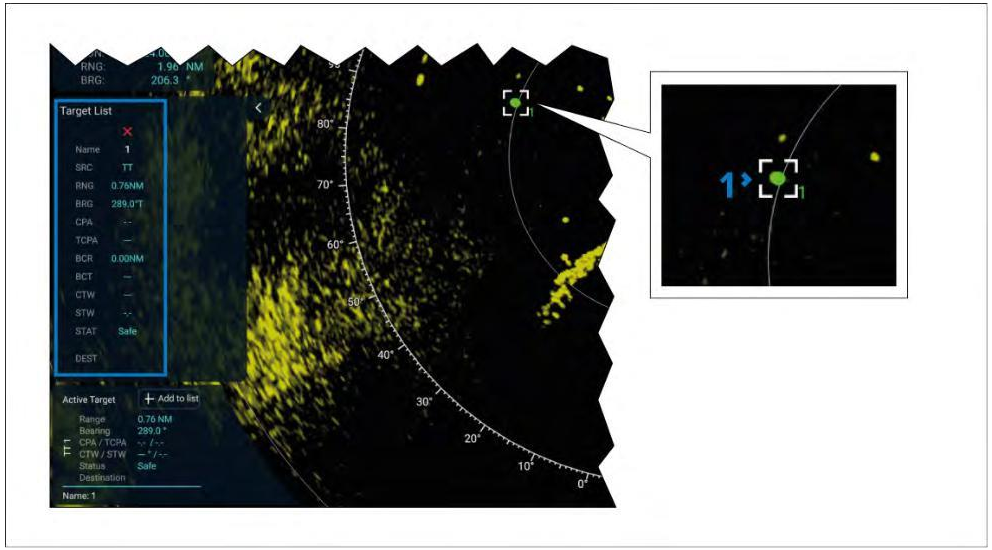


1. Single left click on the acquired Radar target to select

it. Selection brackets will be placed around the target.

Adding a Radar target to the target list

Acquired Radar targets can be added to the Target List.



1. Double click on an acquired target to add it to the Target List.

Deleting Radar targets

Radar targets can be deleted.

1. Double click on a Radar target that is already in the *[Target List]*.
2. For targets not in the *[Target List] d*ouble click to add to the *[Target List]* and then double click again to delete the target.

Deleting a target using the context menu

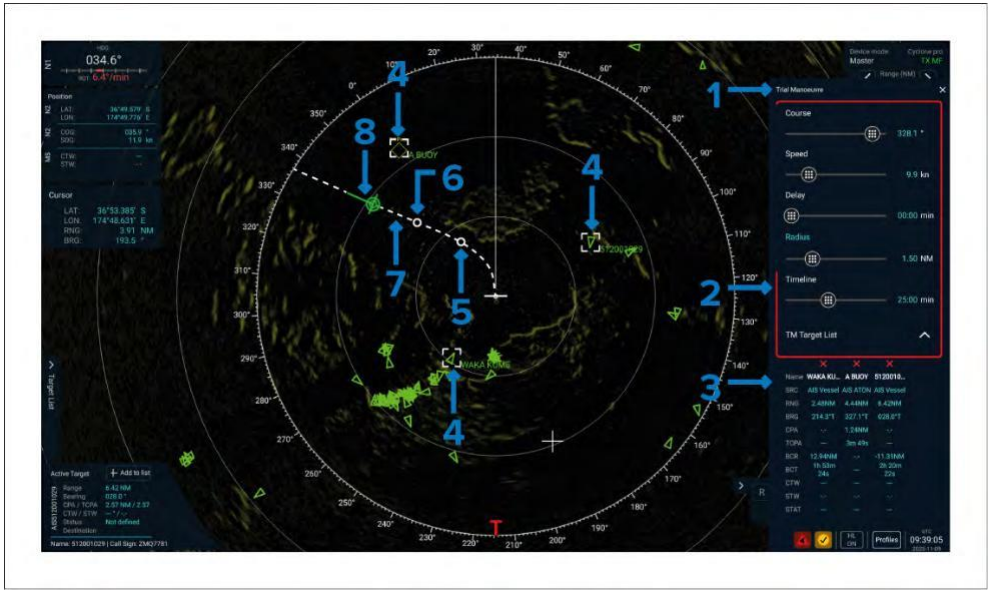
Radar targets can be deleted using the *[Radar target]* context menu.

1. Select and hold on the tracked radar target
   The Radar target context menu is displayed.
2. Select *[Delete Target]*.

The target symbol will be removed from the screen and the target will no longer be tracked, unless it enters a guard zone.
You can also delete all radar targets by selecting the *[Delete All Targets]* from the *[Additional features] m*enu located on the right side of the screen.

8.18 Trial Manoeuvre

The Trail Manoeuvre feature simulates the effect a change of course, speed, time to manoeuvre and Radius/Rate Of Turn (ROT) would have so that if necessary, avoidance action can be taken if there is a potential for a collision.
The Trial Manoeuvre simulation is applied to tracked radar targets and AIS targets and will show the predicted positions of the targets and ownship based on the values specified in the *[Trial Manoeuvre]* settings.
The *[Trial Manoeuvre]* settings are accessed from the *[Additional features]* menu, located on the right side of the screen.
When the *[Trial Manoeuvre]* menu is opened a red 'T' is placed onscreen to signify that Trial Manoeuvre simulation is active.



1. *[Trial Manoeuvre]* settings menu.
   - Use the *[Course]*, *[Radius]*/ *[ROT]*, *[Speed]*, *[Delay]* and *[Timeline]* settings to configure simulation of ownship's intended manoeuvre.
   - Selecting the *[Radius]*heading will switch to *[ROT]*.
   - Selecting the *[ROT]* heading will switch back to *[Radius]*.
   - By using the *[Timeline]* slider you will see where ownship, tracked radar targets and AIS targets will potentially be at that point in the manoeuvre.
2. If the *[Trial Manoeuvre]* menu is open for 30 seconds without an input, the red inactive countdown will appear. When the red inactive countdown disappears (2:30 minutes later) then the *[Trial Manoeuvre]* settings menu will be closed and the Radar screen will be returned to its previous state.
3. The Trial Manoeuvre Target List will reflect the changes that the *[Trial Manoeuvre]* settings would cause to selected targets. The Target List can be opened and closed by selecting the *[TM Target List]* Arrow.
4. Selected targets — Targets are selected by double clicking. Data for selected targets will be displayed in the Target List.
5. The first circle represents the specified *[Delay]*— The *[Delay]* time can also be altered by dragging the circle.
6. The second circle represents the specified *[Radius]* or *[ROT]*— The *[Radius]*or *[ROT]* can also be altered by dragging the circle.
7. The line after the second circle represents the specified Course — The *[Course]*can be altered by dragging the line.
8. The green circle symbol represents ownship position at that point in the *[Timeline]*.

Note:

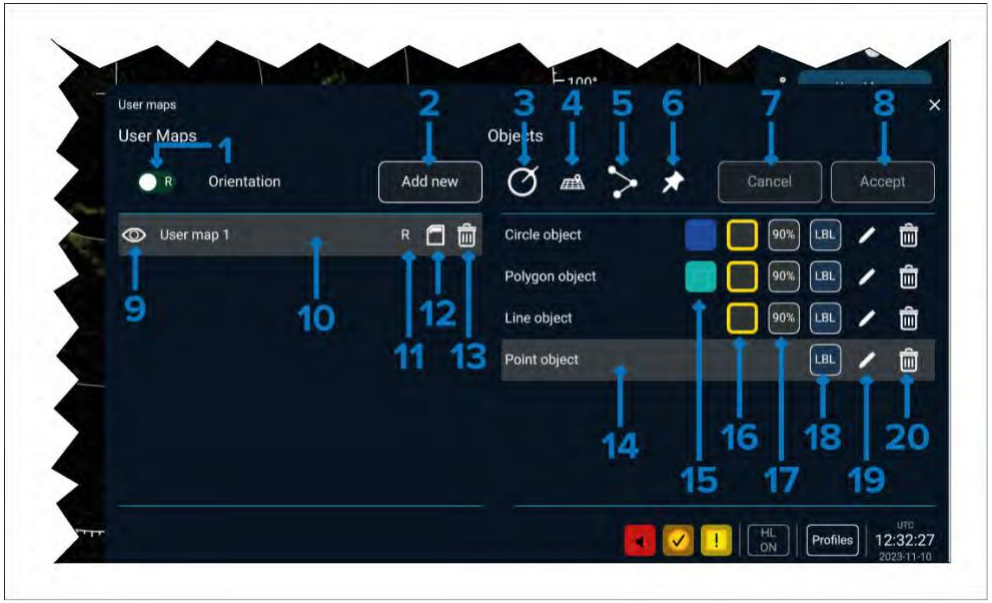
When Trial Manoeuvre is active, *[Past position]* will be disabled and vector mode will be switched to *[True]*.

8.19 User maps

User maps can consist of circles, area (polygons), lines and points which can be drawn on the Radar screen.
The following limits apply to User map objects:

- **Circle object** — Up to 10,000 Circle objects can be created.
- **Area objects** — Up to 10,000 Area objects can be created with a maximum of 1,000 point per object.
- **Line objects** — Up to 10,000 Line objects can be created with a maximum of 1,000 points per object.
- **Point objects** — Up to 10,000 point objects can be created.

User maps settings menu



1. *[Motion]*— Select to switch between *[True]* and *[Relative]* motion modes.
2. *[Add new]*— Select to add a new user map.
3. *[Circle object]* icon — Select to add a circle object to the current user map.
4. *[Area object]* icon — Select to add an area object to the current user map.
5. *[Line object]* icon — Select to add a line object to the current user map.
6. *[Point object]* icon — Select to add a point object to the current user map.
7. *[Cancel]*— Select to cancel an object if it has not yet been Accepted.
8. *[Accept]*— Select to accept/save the current object.
9. *[Eye]* icon — Select to show/hide the user map.
10. User map list. — List of all currently loaded user maps
11. *[Motion mode]*— Identifies the motion mode of the user map.
12. *[Save]* icon — Select to choose the external memory location where the user map will be saved. Saving user maps to memory card enables them to be transferred to another display .
13. *[Trash can]*— Select to delete the current user map and all its objects.
14. Object list — List of all object in the currently selected user map.
15. *[Fill color]* icon — Identifies the object fill color. Select to edit colors and opacity.
16. *[Stroke color]* icon — Identifies the object stroke color. Select to edit colors and opacity.
17. *[Opacity]* icon — Identifies the object opacity. Select to edit colors and opacity.
18. *[LBL]* icon — Select to show/hide the onscreen object name.
19. *[Pencil]* icon — Select to edit the object size or position.
20. *[Trash can]*— Select to delete the object.

Creating a user map

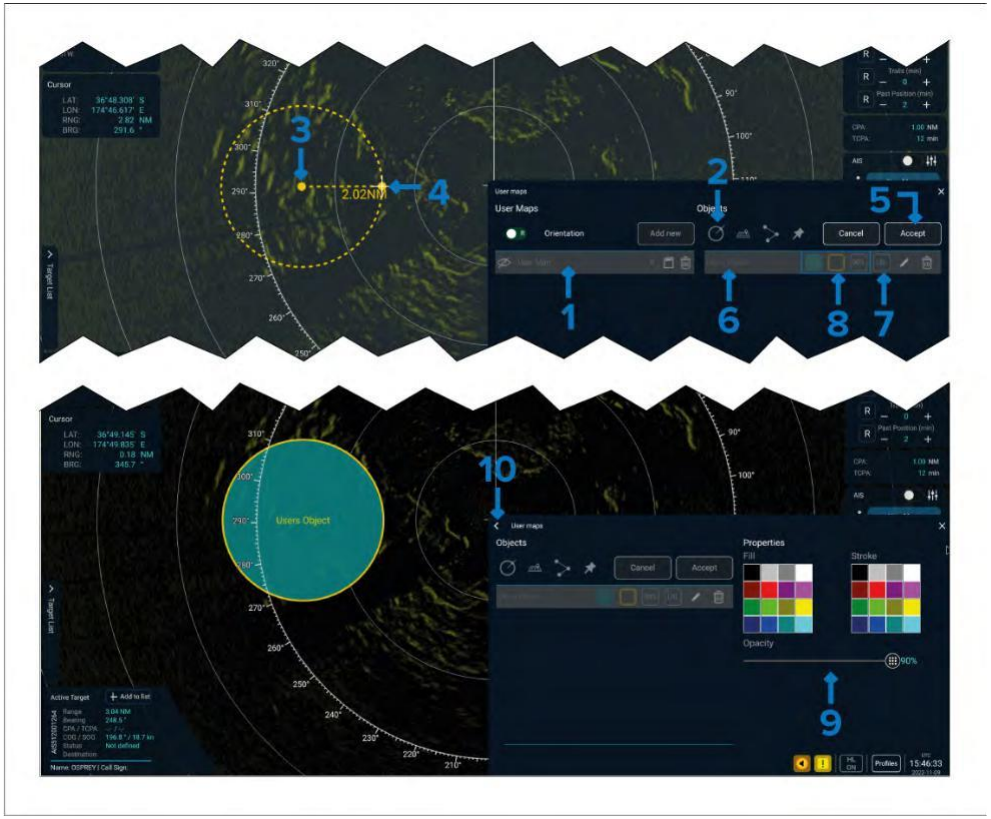
Follow the steps below to create a user map.

1. Select the *[User Maps]* button from the *[Additional features]* menu.
2. Set the desired *[Motion]* mode using the toggle switch (*[R]*= Relative, *[T]*= True).
3. Select *[Add new]*.
4. Select the new user map entry.
5. Select and hold user map name to rename the user map.
6. Select the memory card icon and choose a save location. User maps saved to memory card can be transferred to another display.

User maps can be hidden or shown using the *[Eye]* symbol, and deleted using the *[Trash can]* symbol.

Creating a circle object

To add a circle object to a user map follow the steps below.

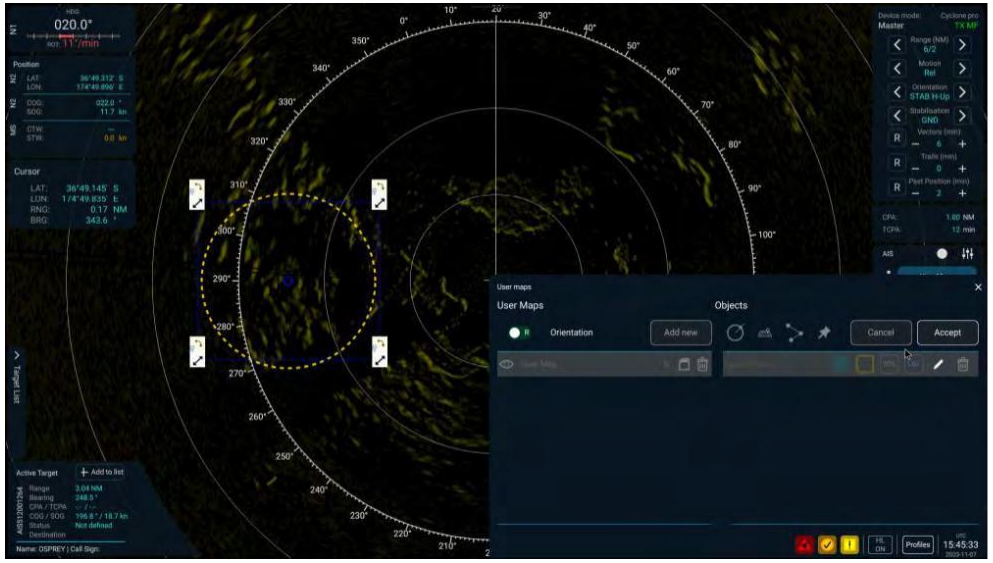


1. Select an existing user map or add a new one.
2. Select the *[Circle object]* icon.
3. Select the location for the center of the circle object.
4. Select the location for the perimeter of the circle object.
   A circle with a dashed line and a radius line will be drawn.
   Subsequent onscreen selections will change the size of the circle.
5. Select *[Accept]* to create the circle object.
6. Select and hold on the object's name (i.e.: *[Users Object]* to rename the object.
7. Selecting the *[LBL]* icon will show/hide the object's label.
8. Select either the *[Fill color]*, *[Stroke color]* or *[Opacity]* icons to open the *[Properties]* menu.
9. Adjust the *[Fill color]*, *[Stroke color]* and *[Opacity]* as desired.
10. Select the back arrow *[<]* located in the top left of the *[User maps]* settings menu.

Select the *[Pencil]* icon to change the size or position of the object. Select the *[Trash can]* icon to delete the object.

Adjusting a circle object size or position

Once a circle object has been created in a user map its size and position can be adjusted.

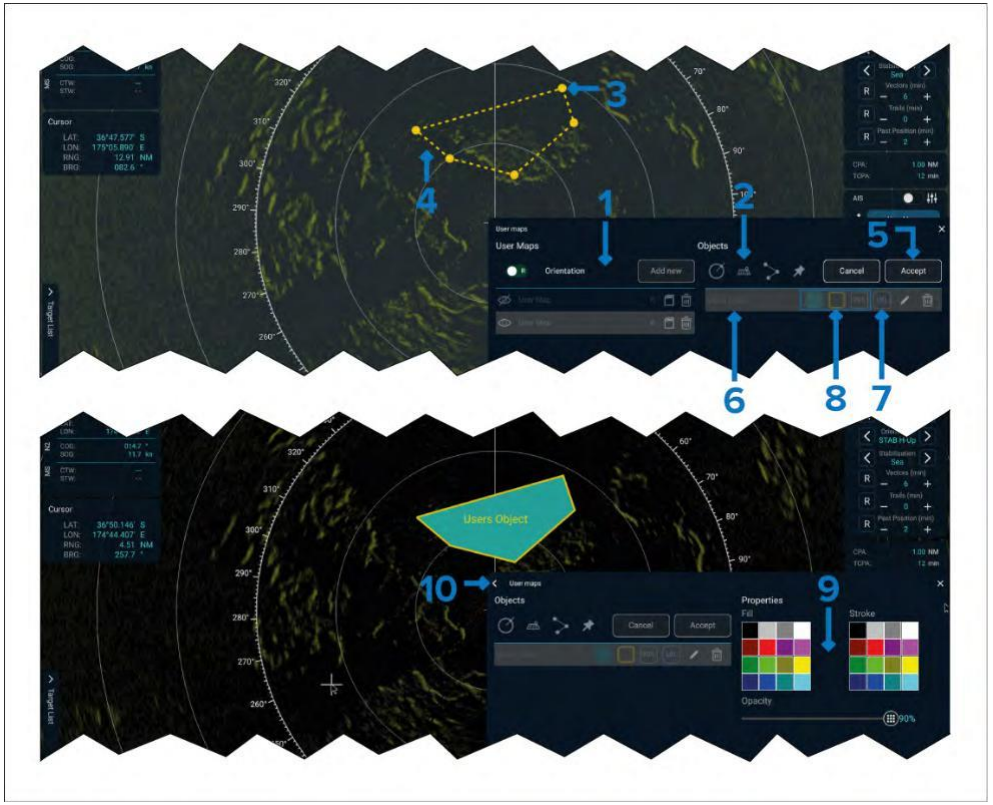


With the circle object selected in the *[User maps]* menu:

1. Select the *[Pencil]* icon.
2. Drag the object to a new location.
3. Drag on the *[Resize]* (straight) arrows and/or *[Rotate]* (curved) arrows located in the corners of the object to rotate and/or resize the object as required.
4. Select the *[Pencil]* icon again to save the changes to the object.

Creating an area object

To add an area object to a user map follow the steps below.

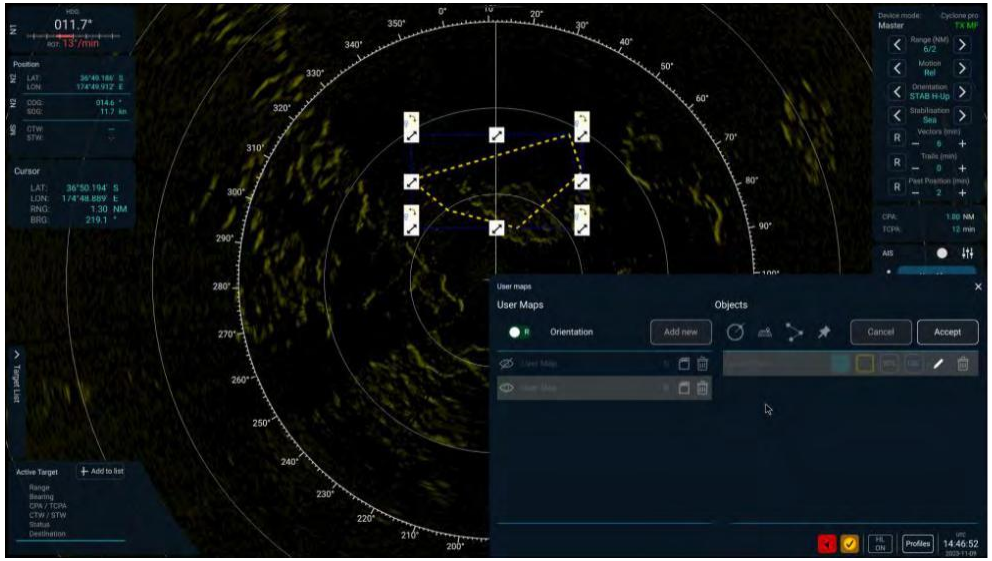


1. Select an existing user map or add a new one.
2. Select the *[Area object]* icon.
3. Select the location for the first corner point of the area object.
4. Select the location for subsequent corner points of the area object.
   As you click, a polygon with a dashed line will be drawn onscreen.
5. Select *[Accept]* to create the object.
6. Select and hold on the object's name (i.e.: *[Users Object]*) to rename the object.
7. Selecting the *[LBL]* icon will show/hide the object's label.
8. Select either the *[Fill color]*, *[Stroke color]* or *[Opacity]* icons to open the *[Properties]* menu.
9. Adjust the *[Fill color]*, *[Stroke color]* and *[Opacity]* as desired.
10. Select the back arrow *[<]*located in the top left of the *[User maps]* settings menu.

Select the *[Pencil]* icon to make further changes to the object. Select the *[Trash can]* icon to delete the object.

Adjusting an area object

Once an area object has been created in a user map its size and position can be adjusted.

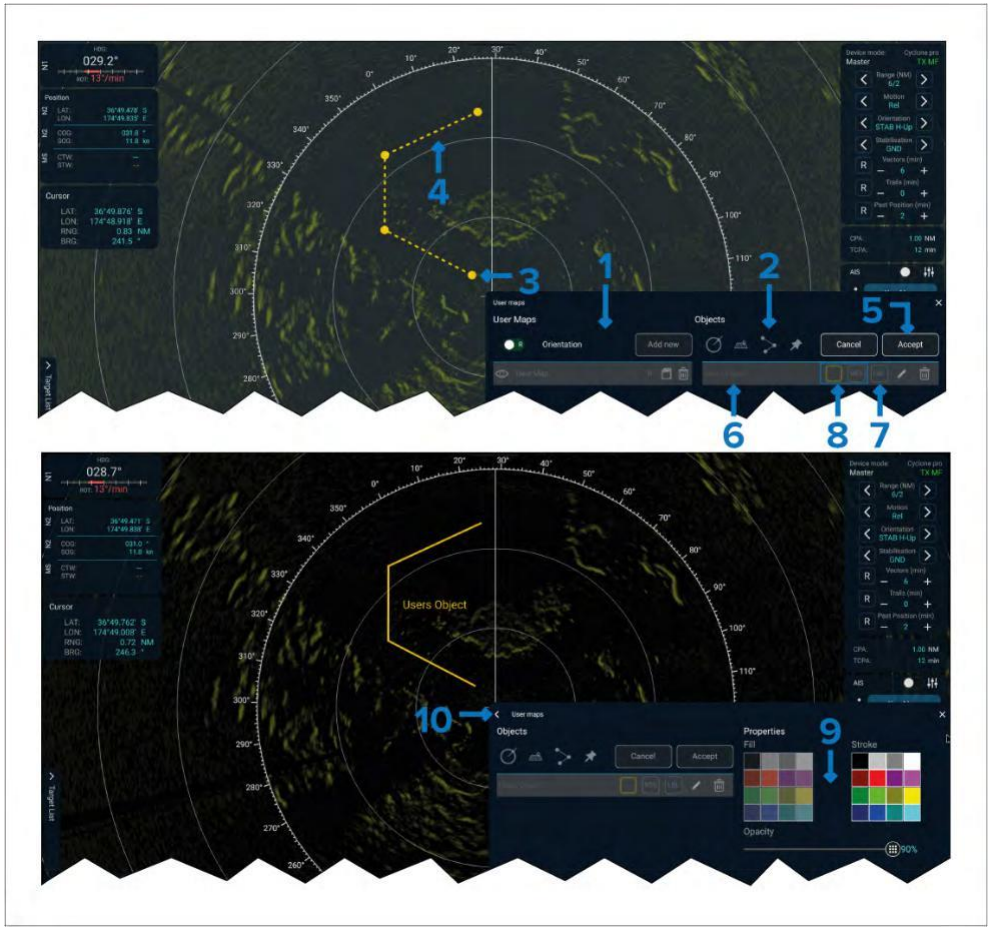


With the area object selected in the *[User maps]* menu:

1. Select the *[Pencil]* icon.
2. Drag the object to a new location.
3. Drag on the *[Resize]* (straight) arrows and/or *[Rotate]* (curved) arrows located in the corners and edges of the object to rotate and/or resize the object as required.
4. Select the *[Pencil]* icon again to save the changes to the object.

Creating a line object

To add a line object to a user map follow the steps below.

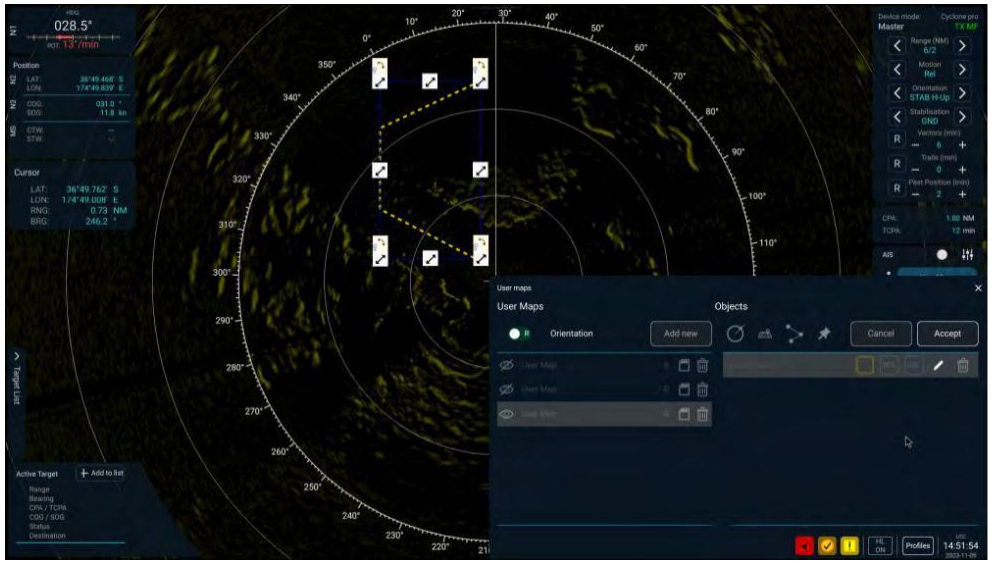


1. Select an existing user map or add a new one.
2. Select the *[Line object]* icon.
3. Select the location for the first point of the line object.
4. Select the location for subsequent points of the line object.
5. Select *[Accept]* to create the object.
6. Select and hold on the object's name (i.e.: *[Users Object]*) to rename the object.
7. Selecting the *[LBL]* icon will show/hide the object's label.
8. Select either the *[Stroke color]* or *[Opacity]* icons to open the *[Properties]* menu.
9. Adjust the *[Stroke color]* and *[Opacity]* as desired.
10. Select the back arrow *[<]* located in the top left of the *[User maps]* settings menu.

Select the *[Pencil]* icon to make further changes to the object. Select the *[Trash can]* icon to delete the object.

Adjusting a line object size or position

Once a line object has been created in a user map its size and position can be adjusted.



With the line object selected in the *[User maps]* menu:

1. Select the *[Pencil]* icon.
2. Drag the object to a new location.
3. Drag on the *[Resize]*(straight) arrows and/or *[Rotate]* (curved) arrows located in the corners of the object to rotate and/or resize the object as required.
4. Select the *[Pencil]* icon again to save the changes to the object.

Creating point objects

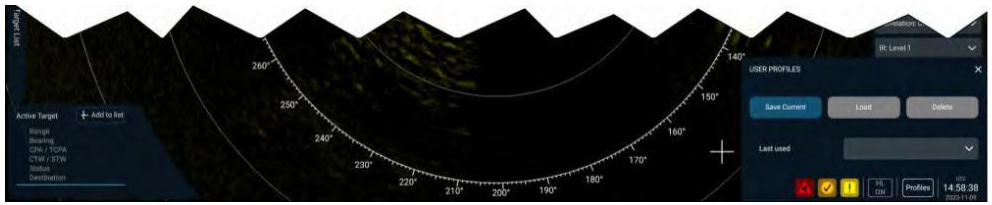
Point objects are represented using symbols that are drawn on the screen at the selected location. To add a point object to a user map follow the steps below.

1. Select an existing user map or add a new one.
2. Select the *[Point object]* icon. A list of symbols is displayed.
3. Select a symbol from the list.
4. Select a location onscreen to place the point object.
5. Select *[Accept]* to create the object.
6. Select and hold on the object's name (i.e.: *[Users Object]*) to rename the object.

Select the *[Trash can]* icon to delete the object.

8.20 User Profiles

User profiles allow the creation of user specific profiles. When a user profile is created, it saves the current setup and allows it to be changed or reloaded. The *[User profiles]* menu can be accessed from the *[Additional features]* menu.



User profiles settings

The table below identifies the settings for the default user profile. These are also the settings that are stored in saved user profiles.

Function	Default values
Band	X-band, if selectable, otherwise remain as selected
Signal processing controls (Gain Rain anti clutter and Sea anti clutter):	Radar gain automatically optimized, where provided. Sea anti clutter and Rain anti clutter manual controls set "as is" or set to "zero".
Tuning	Automatically optimized where provided, otherwise remain as is
Range	6 NM
Fixed range rings	Off
VRMs	On
EBLs	On
Parallel index lines	Remain unchanged
Orientation Mode	North Up
Presentation Mode	True Motion
Vector mode	Relative
Vector time	6 min
Stabilization Sea/Ground	Sea
Off-Centre	Off-Centre, with appropriate look ahead
Target trails	On
Past positions	Off

Function	Default values
Radar target tracking	Continued
Automatic radar target acquisition	Off
Graphical AIS reported target display	On
Graphical AIS data report display	On
Graphical AIS locating device display	On
Graphical AIS ASM display	Off
Radar and AIS Target Association	Association on, priority AIS
Operational alerts (except collision warnings)	On
Collision warnings	On (limits CPA 2 nm; TCPA 12 min)
Display of maps, navigation lines and routes	Last setting
Display of charts	Off

Saving a user profile

Follow the steps below to save the current radar setup as a user profile.

1. Select the *[Profile]* button located at the bottom of the screen near the time.
2. Select *[Save Current]*.
   The onscreen keyboard is displayed.
3. Enter a name for the user profile and select *[OK]*.

The user profile is saved

Loading a user profile

Follow the steps below to load a saved user profile.

1. Select the *[Profile]* button located at the bottom of the screen near the time.
2. Select the *[Last used]* field.
3. Select the Profile you want to load.
4. Select *[Load]*.
5. Select *[Yes]* to confirm.
6. Select the *[X]* close icon to shut the menu.

The name of the loaded profile is displayed in the *[Profile] b*utton.

The default user profile can be loaded at anytime by selecting and holding on the *[Profile]* button.

Deleting user profiles

Follow the steps below to delete a user profile.

1. Select the *[Profile] b*utton located at the bottom of the screen near the time.
2. Select the *[Last used]* field.
3. Select the Profile you want to delete.
4. Select *[Delete]*.
5. Select *[Yes]* to confirm.
6. Select the *[X]* close icon to shut the menu.

8.21 Variable Range Markers (VRMs)

VRMs are used to determine a target's range from your vessel, or from another target. 2 VRMs are available.

VRM context menu

Selecting a VRM onscreen will open the *[VRM]* context menu. The *[VRM]* context menu provides options related to the VRM.
The following options are available from the context menu:

- *[Range]*— The VRM's current range.
- *[Edit VRM]*— Select to adjust the VRM's position.
- *[Set Origin]*— Select to change the VRM type. The types of VRM are:

– *Fixed*— The VRM will be geographically fixed to its current location.
– *Motion*— The VRM will travel with ownship.
– *Target*— The VRM's position will lock to an AIS or tracked Radar target and travel with the target.

- *[Edit Origin]*— Select to edit the lat/long of the VRM.
- *[Reset to CCRP]*— Select to reset the VRM's origin to the CCRP.
- *[Reset All]*— Select to reset all VRM's origin and distance to default positions.

Creating a VRM

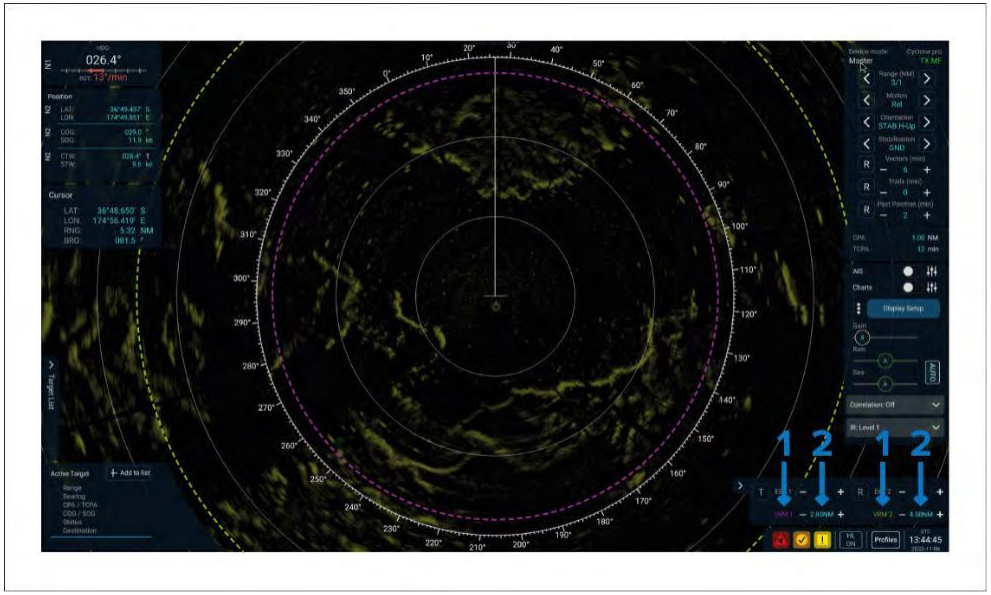
Follow the steps below to create a VRM.

1. Turn on an VRM by selecting either *[VRM 1]* or *[VRM 2]*.
2. Double click on the VRM line to enter edit mode.
3. In edit mode click the desired location for the VRM.

The VRM can be edited again by double clicking the VRM line.

Creating a VRM using the menu

VRMs can be created and adjusted using the EBL/VRM menu.



1. Enable either the *[VRM 1]* or *[VRM 2]* toggle switch located on the bottom right of the screen.
   By default VRM 1 will be set to 3 NM and VRM 2 is set to 6 NM.
2. Use the *[+]* (plus) and *[ ]* (minus) buttons to increase or decrease the VRM's distance, alternatively select the current distance value to enter a new distance using the onscreen numeric.

Resetting VRMs

VRMs can be reset to the CCRP bearing, or reset to default bearings. Select and hold on the *[VRM 1]* or *[VRM 2]* label to open the reset options.

- *[Reset to CCRP]*— Select to reset the VRM's origin to the CCRP.
- *[Reset All]*— Select to reset all VRM's origin and bearing to default values.

Editing VRMs

- VRMs can be adjusted to change their bearing or change the origin point.

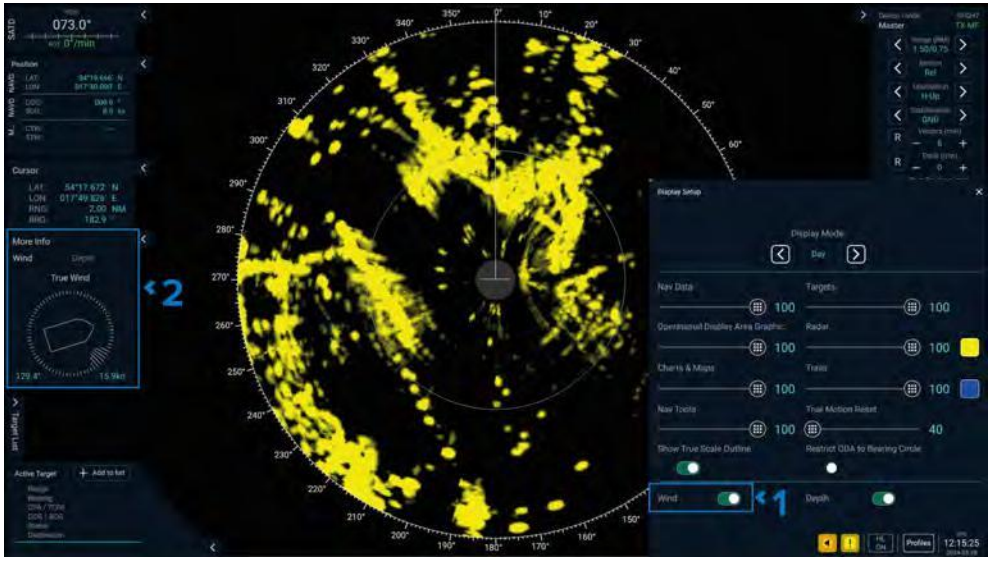
- The VRM’s origin point can be adjusted using the *[Edit Origin]*option from the *[VRM]* context menu.
- The VRM’s bearing can also be changed using the *[Edit VRM]* option from the *[VRM]* context menu and then selecting a location.

8.22 Wind data

Wind data from a connected external device can be displayed onscreen.

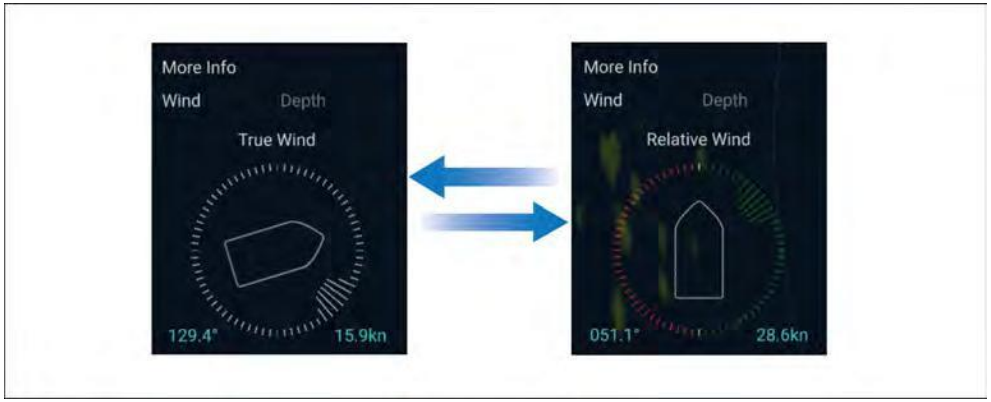
Enable the *[Wind] t*oggle switch located in the *[Display setup]* menu to view *[Wind]* data onscreen.

Current wind speed and direction will be displayed on the left side of the Radar screen.



If both Wind data and Depth data are enabled, you can switch between data by selecting either *[Wind]* or *[Depth]* from the *[More info]* box.

True / Relative wind



To switch to *[Relative wind]* data, long-press on the *[True Wind]*label .
A further long-press switches back to the display of *[True Wind]* data.
The *[More Info]* box is automatically hidden when the *[Targets List]* is displayed.

CHAPTER 9: INTERPRETING THE RADAR DISPLAY

CHAPTER CONTENTS

9.1 Factors influencing Radar performance

A number of factors can influence the performance of a Radar scanner.

The following factors influence target detection:

- Target characteristics such as Radar Cross Section (RCS), stability and aspect, height.
- Wind speed and direction relative to the line of sight between the antenna and the target.
- Sea state, wave height, clutter spike characteristics.
- Precipitation and intensity.
- Radar installation location and height.

A target may have a low probability of detection at close range but an acceptable or a high probability of detection at farther ranges.

Antenna design

The design of the antenna will influence detection performance. The vertical radiation pattern of the antenna is designed to ensure that:

- there is no loss of performance when the vessel pitches and rolls.
- the main beam pattern minimizes performance degradation due to nearby structures.
- there is minimal illumination of precipitation.

Radar scanners operate in a horizontally polarized mode with a design that minimizes side lobes which might otherwise be exhibited on larger targets.

Radar location and height

Radar performance is dependent on the location of a radar scanner. Sectors that need to be muted (no transmission) and potential blind sectors should be recorded for each sensor with bearings saved on the radar display.

Antenna height is an important factor in target detection. A higher antenna will provide a better range of first detection, however it will also extend the clutter field and effectively mean that small targets are more difficult to detect. A lower antenna height may result in waves masking small targets that have a height similar to wave peaks.

The height of the Antenna above the waterline also affects minimum and maximum range performance.

Range and bearing discrimination

The ability to discriminate between objects that are close together depends on the range and bearing discrimination performance. Range discrimination is mainly dependent on the pulse length. Bearing discrimination is a factor of the size of target and the antenna's parameters.

Radar resolution

There are two important factors in radar resolution (discrimination); bearing resolution and range resolution.

Bearing resolution is the ability of the radar to separate and display echoes from two separate targets with an echoing area of 10 m^2 that are at the same range and positioned close to each other. It is proportional to the antenna length and reciprocally proportional to the wavelength. This condition is normally satisfied with a radiator of 1.22 m (4 ft) or longer in the X band. An enhancement feature which increases target size in bearing will reduce the presented bearing discrimination.

Range resolution is the ability of the radar to separate and display echoes from two separate targets with an echoing area of 10 m^2 that are on the same bearing and positioned close to each other. The resolution is primarily a factor of pulse length. However, an enhancement feature which increases target size in range will reduce range discrimination.

Bearing accuracy

One of the most important features of the radar is how accurately the bearing of a target can be measured. However, the bearing is usually taken relative to the ship's heading, and thus, proper adjustment of the heading line at installation is an important factor in ensuring accurate bearing. The bearing of a target can be measured more accurately, if it is positioned towards the outer extreme of the radar operational area. To minimize error when measuring the bearing of a target, show the target at the extreme position on the screen by selecting a suitable range.

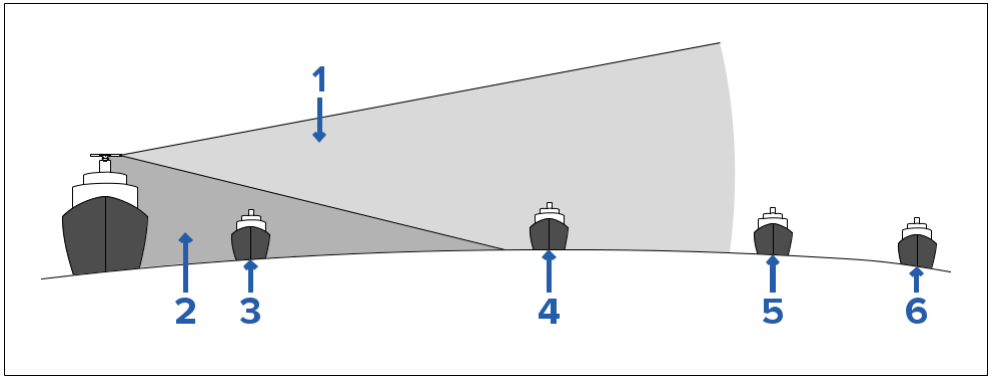
9.2 Radar range

Minimum range

Radar performance on larger ships may suffer from shadowing where the minimum radar detection range is degraded by a combination of antenna height, ship structures and cargo. The minimum range is defined by the shortest distance at which, using a scale of 1.5 NM or 0.7 NM, a target having an echoing area of 10 m^2 is still shown separate from the point representing the antenna position. It is mainly dependent on the pulse length, antenna height and location, ownship structure and an efficient transmission line.

Maximum range

The maximum range varies considerably depending on several factors such as the height of the antenna above the waterline, the height of the target above the waterline, the size, shape and material of the target, and atmospheric conditions. Under normal atmospheric conditions, the maximum range is equal to the radar horizon and can be slightly longer. The radar horizon is longer than the optical horizon by approximately 6% because of the diffraction property of the radar beam.

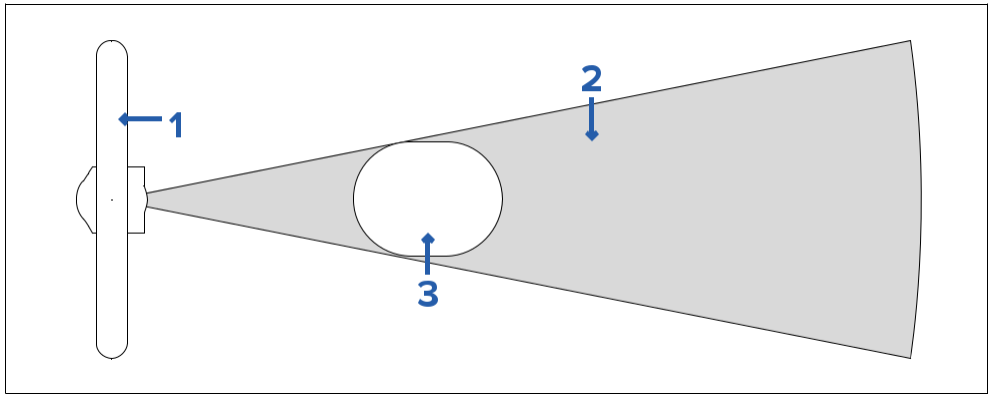


1. Radar horizon (beam).
2. Blind area.
3. Ship will not be visible on the display as it is too close and therefore outside of the radar beam.
4. Ship will be visible on the display as it is within the radar beam.
5. Ship may be visible on the display as it is only just outside of the radar beam.
6. Ship will not be visible on the display as it is too far and therefore outside of the radar beam.

9.3 Blind sectors

Obstructions such as funnels and masts near the Radar antenna may obstruct the Radar beam and cause Radar shadows or ‘blind sectors’. If the obstruction is relatively narrow, there will be a reduction of the beam intensity, though not necessarily a complete block. However, for wider obstructions there may be a total block of the radar beam in the shadow area. There may also be multiple echoes which extend behind the obstruction.

Blind sector effects can normally be minimized by careful selection of the Radar antenna location prior to installation. Targets cannot be detected within the blind sector.



1. Antenna.
2. Blind sector.
3. Obstruction (superstructure, funnels, masts, etc).

9.4 False echoes

Any large obstruction may reflect the radar beam, causing false echoes. The surface of the obstruction reflects a significant proportion of the transmitted energy at an angle creating a false echo. Reflected signals from these objects reach the antenna and are presented on the bearing at which the antenna is pointing. The range of the false echo is the same distance (via the reflecting surface) of the object causing the false echo; however, it is possible to have multiple false echoes at equal distances.

False targets (echoes) usually occur as a result of reflections originating from large structures such as other ships, a harbour building, storage tanks or wind farms.

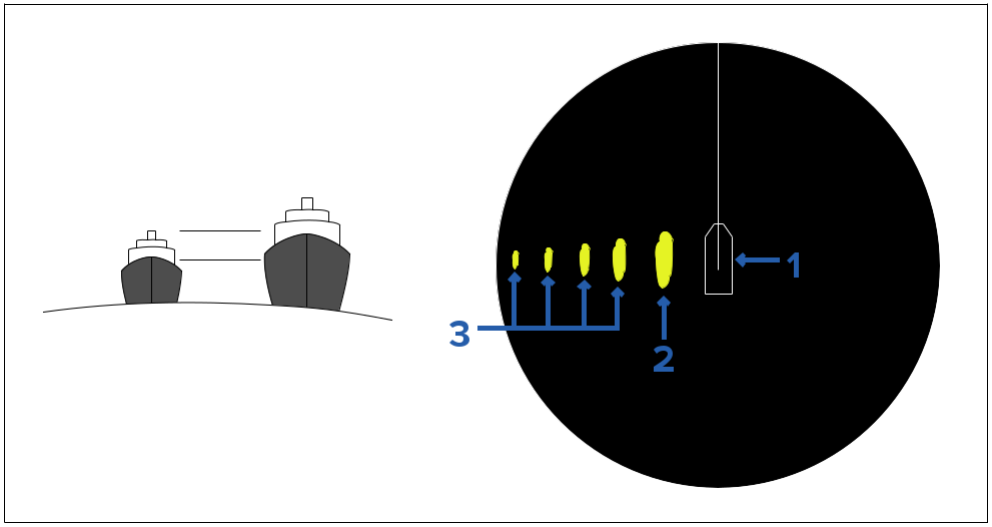
Ownship structures can also generate similar reflections. These reflections are normally seen as a large arc on the radar screen. Adjusting the signal processing control functions may reduce or suppress a reflection, but at the expense of lower target detection performance. Radar systems provide techniques to prevent false targets resulting from previous transmissions (second-time-around echoes). Koden KRS Radar has superior processing techniques to reduce these reflections.

Radar operators must make themselves aware of the bearings of obstructions which may produce false echoes.

Multiple echoes

Multiple echoes can occur when another ship or vessel is passing on a parallel course at short range. The radar signal will be reflected back and forth between the actual target and ownship, resulting in multiple echoes being displayed beyond the range of the actual target. Multiple echoes always occur on the same bearing as the actual target and at exact multiples of the actual target's range.

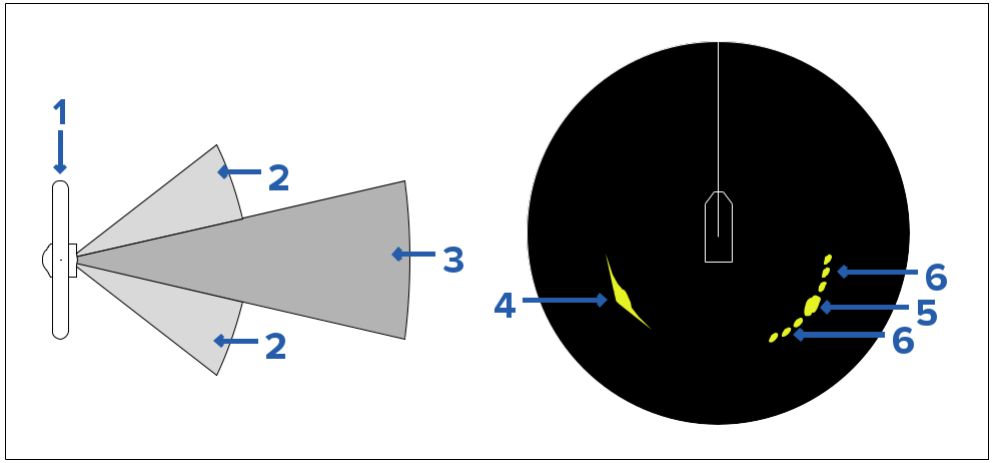
The false echoes become weaker as the amount of energy reflected diminishes with each return. Multiple echoes can be reduced and often removed by decreasing the *[Gain]* (sensitivity) or adjusting the *[Sea]* anti clutter control.



1. Ownship.
2. Actual target.
3. Multiple echoes.

Side lobe echoes

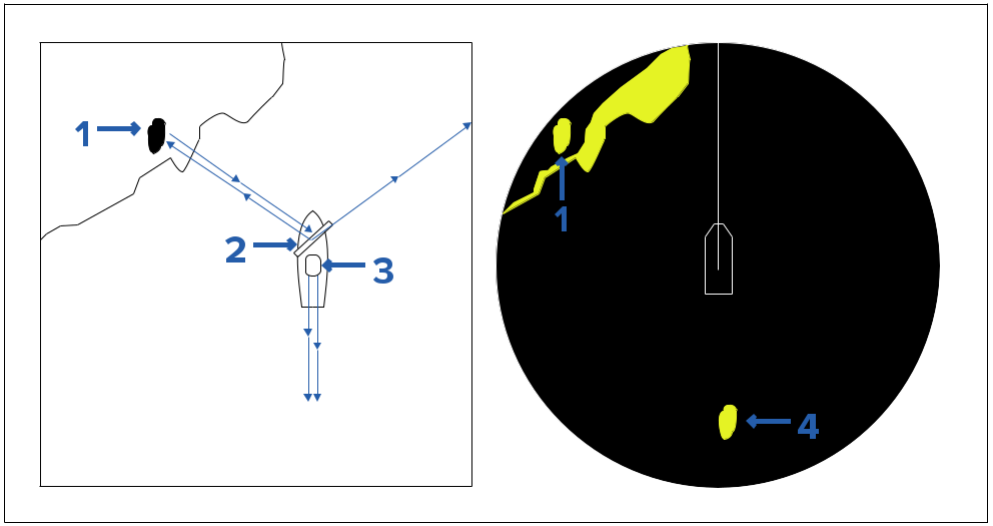
Side lobe patterns are produced by small amounts of energy from the radar beam that are radiated outside the narrow main beam. The effects of side lobes are most noticeable with larger targets at short ranges (normally below 3 NM). Side lobe echoes form either arcs on the Radar screen, or a series of echoes on either side of the actual target; forming a broken arc. The appearance of side lobe echoes can be reduced using the *[Gain]* and/or *[Sea]* anti clutter controls.



1. Radar antenna.
2. Side lobes.
3. Main lobe.
4. Arc.
5. Actual target.
6. Side echoes.

Inconsistent echoes

In built up areas and in narrow congested waters the radar beam may be reflected along a number of paths, producing confusing spurious echoes on the screen. Inconsistent echoes may not always appear in the same location and may not correlate. Adjusting the *[Gain]* control can minimize inconsistent echoes.

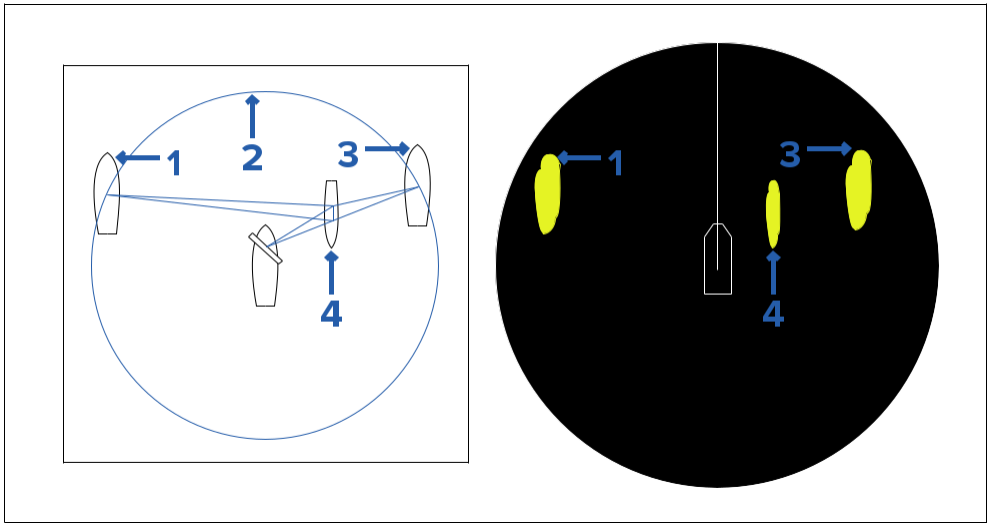


1. Actual object.
2. Radar antenna.
3. Funnel.
4. Inconsistent echo.

Ghost echoes

Ghost echoes can occur when the Radar beam is reflected off an obstruction; like a ship passing between the antenna and the actual target. This can cause a ghost echo of the actual target to appear on the bearing at which the antenna is pointing. The ghost echo will behave in the same manner as the actual target. However, because the antenna is not directed at the actual target the returns from the ghost target will be weaker than those of the actual target. The range of the ghost echo will be the same as the range of the actual target. The Ghost target echo will appear on the screen at the same radius as the actual target. The VRM facility can be used to confirm this. However, there is no way of determining if the target is a ghost echo or the actual target.

Other types of ghost echoes include echoes of groups of targets (which appear to be real). When in the vicinity of land masses, these may be from large inland objects and may be caused by a combination of atmospheric conditions, unusual propagation conditions and reflection.



1. Actual target.
2. Common radius.
3. Ghost target.
4. Passing ship or other obstruction.

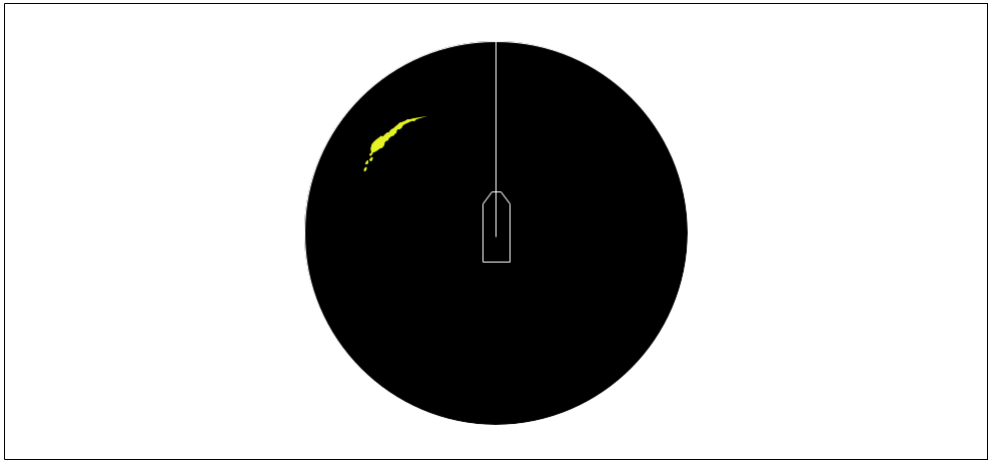
Virtual image

A large target close to ownship may be represented at two positions on the screen. One of them is the actual echo directly reflected by the target and the other is a false echo which is caused by the mirror effect of a large object on or close to ownship. For example: If ownship comes close to a large metal bridge a false echo may temporarily be seen on the screen.

9.5 Target smearing

Where obstructions occur in close proximity to the antenna, the radar beam may be dispersed causing target smearing to occur.

This is indicated by a number of weaker echoes appearing around a stronger target echo on the screen. When the antenna points directly at the target the returns are at their strongest and these form the thickest part of the arc shaped pattern on the screen.

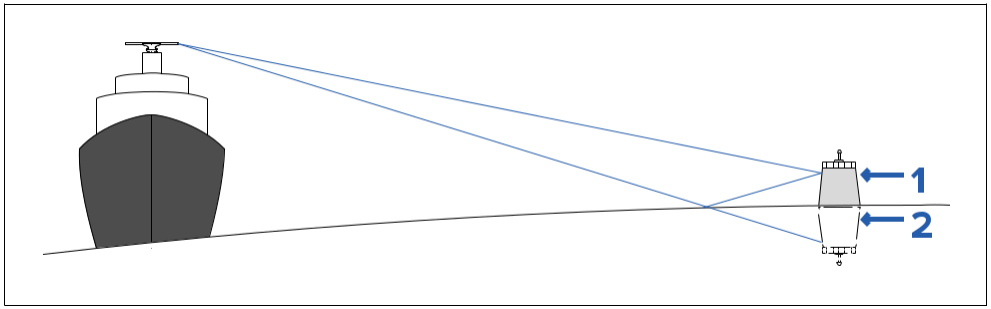


9.6 Multipath interference

The Radar beam can reflect back directly from the target or from a sea surface reflection of the target. When this multipath interference occurs the two signals will either reinforce each other or they may cancel each other creating a null.

Multipath interference usually occurs on simple targets (comprising a single reflector) such as buoys, in calm sea states where the water is acting like a mirror. Multipath interference may produce a large number of signal nulls at short range that become less frequent as range increases.

In the higher sea states, when the sea is rough and the water is less likely to reflect, or when the target is complex (comprising a number of reflectors), the effect of multipath interference is less pronounced so that the nulls are less deep. As the height of the radar antenna (or target) increases, then the frequency of the nulls also increases. The frequency of the nulls also increments with increasing radar frequency.



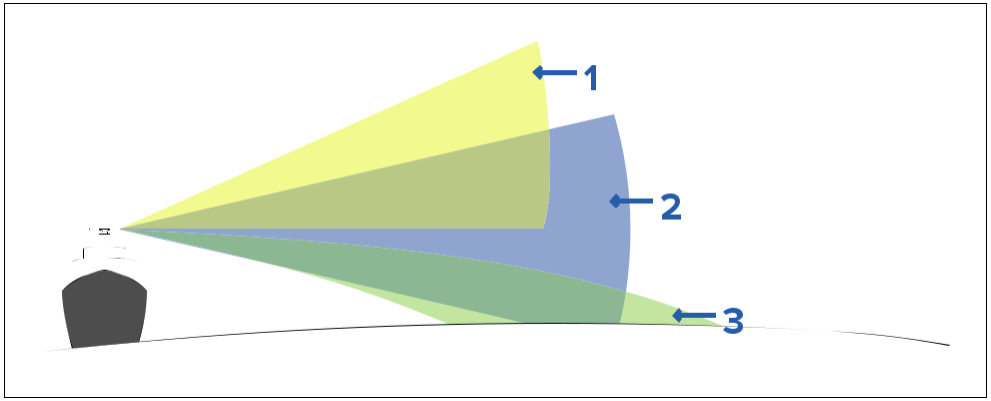
1. Actual target.
2. Reflection.

9.7 Atmospheric conditions

Radar signals can be adversely impacted by poor atmospheric conditions.

The radar beam normally travels in a straight line however, certain atmospheric conditions may cause the beam to bend upwards or downwards. The effect of this condition is known as anomalous propagation.

Anomalous propagation



1. **Sub-refraction** — Sub-refraction occurs under unstable atmospheric conditions and causes the radar beam to bend upwards. Sub-refraction causes the radar beam to overshoot distant targets that would have been detected in standard atmospheric conditions. Sub-refraction results in a reduced operational range of the radar.

2. **Standard refraction** — Standard radar beam refraction occurs under normal atmospheric conditions.
3. **Super-refraction** — Super-refraction occurs under stable atmospheric conditions and causes the radar beam to bend downwards. Super-refraction causes the radar beam to follow the earth's surface and improves the operational range of the radar, enabling detection of targets over the horizon.

Ducting

Ducting is a special type of super-refraction which occurs when the radar beam which is bent downwards reflects off the earth's surface back into the atmosphere but is trapped by a layer of dense air which causes the beam to be reflected back to the earth's surface. This action may occur a number of times allowing targets to be detected over far great distances than the radar's operation range. However, these echoes may return several signals later and are shown at false ranges. Transmission 'jitter' techniques are applied to minimize these false echoes or second time round returns.

Examples of atmospheric conditions:

- **Fog and mist** — Fog and mist may cause some signal attenuation resulting in a small reduction in Radar range.
- **Dust storms** — In some locations dust storms can produce difficult conditions, appearing similar to clutter onscreen.
- **Hail, Snow and Ice** — Hail and snow produce effects similar to that of rain clutter. Dense snow has a greater effect than lighter flurries which, owing to the small reflecting surface, have minimal effect. The echoes from ice depend on the form and shape of the ice. In general the effects produced by various forms of ice are as follows:
  - Smooth Flat Ice: Most of the radar beam is reflected at the angle of incidence, providing little or no return signal. Sometimes an advantage is gained by setting up the controls to obtain sea clutter right up to the edge of the ice. Patches of water in a smooth ice field are often revealed by clutter returns when sufficient wind disturbs the surface of the water.
  - Pack Ice: Strong multiple echoes are obtained from pack ice, producing a pattern onscreen similar to excessive sea clutter. The ice left in the wake of a vessel passing through an ice field may be distinguished clearly on the screen.
  - Ice Walls: Strong echo returns are obtained depending on the angle that the walls are to the sea surface to scatter the reflected beam.
  - Icebergs: As the angle of iceberg faces is rarely normal to the surface of the sea, much of the reflected signal from the radar beam does not reach the antenna, providing a weak signal return. Also the surrounding dense air produces a higher than usual atmospheric attenuation.
  - Growlers: The detection of growlers by radar is uncertain due to the small surface area above water and the mass that is submerged.

9.8 Target Detection Influencing Factors

The detection of targets, particularly small or marginal radar targets, is very susceptible to antenna height and horizontal beam width, target size and height, sea state, clutter characteristics, and atmospheric conditions. Even small changes in these parameters will impact target detection. Target Radar Cross Sections provide the means to define different targets and the radar signal they generate.

The Target Tracking processing monitors the same signal as the radar image presented so when the screen is showing strong echoes the tracking system can also see, acquire and track those same echoes.

Adverse conditions

Conditions creating False echoes, Sea clutter, Rain clutter, noise and other performance related factors previously mentioned in this chapter will all adversely impact the Radar's ability to detect, acquire and track targets. Target glint or local abnormal reflections of the microwave beam may cause echoes to be unstable and result in unexpected or misleading swinging of target vectors. The user must be aware of these effects and that such effects do not represent a malfunction to ensure decisions are not made based on misleading information.

Key sources of error

A comprehensive guide to Target Tracking use and potential error sources is to be found in the "Automatic Radar Plotting Aids Manual" by A G Bole and K D Jones (Heinemann, London).

The following summary of key sources of error and their consequences is included here as a short form user guide.

- Ownship heading line must be correctly aligned.
- Ownship gyro error — This will introduce error into the predicted course of other ships but is unlikely to conceal a Target Tracking collision situation since all course data will be affected, including ownship. It can, however, result in miss-assessment in dealing with collision avoidance.

- Ownship log error — This will result in incorrect ‘true’ speed and course readout for every other ship. Any stationary targets being tracked will also acquire an apparent speed. Log error can result in dangerous miss-assessment of a situation.
- Pitch and Roll of Ownship — This will reduce bearing and range accuracy. The errors are usually small; typically less than 1 degree in azimuth and 50 metres in range, but serious rolling can cause intermittent echoes and target loss.
- Target Swap — This is a recognized tracking phenomenon if echoes pass very close or merge. Processing includes features designed to minimize the effect, but the user should still be alert to the possibility that swap can occur.
- Tracker Smoothing — In some circumstances this can cause the Tracking vectors to lag behind the real world situation. In order to present a usefully stable vector presentation despite the changes in the radar echo returns, the Target Tracking processing includes sophisticated mathematical filters. These present an averaged picture which is the best indication of the current track, whilst also detecting manoeuvre as quickly as possible.

Summary

The compromise between stability and responsiveness can affect vector presentation and course and speed readings during and immediately after a target manoeuvre or ownship manoeuvre.

When a tracked target or ownship has completed a manoeuvre, the system presents, in a period of not more than 1 minute, an indication of the target’s motion trend and shown within 3 minutes the target’s predicted motion in accordance with specified tolerances.

The user must allow the necessary time to elapse before using Target Tracking data as the basis for a critical decision.

Rain clutter (Precipitation)

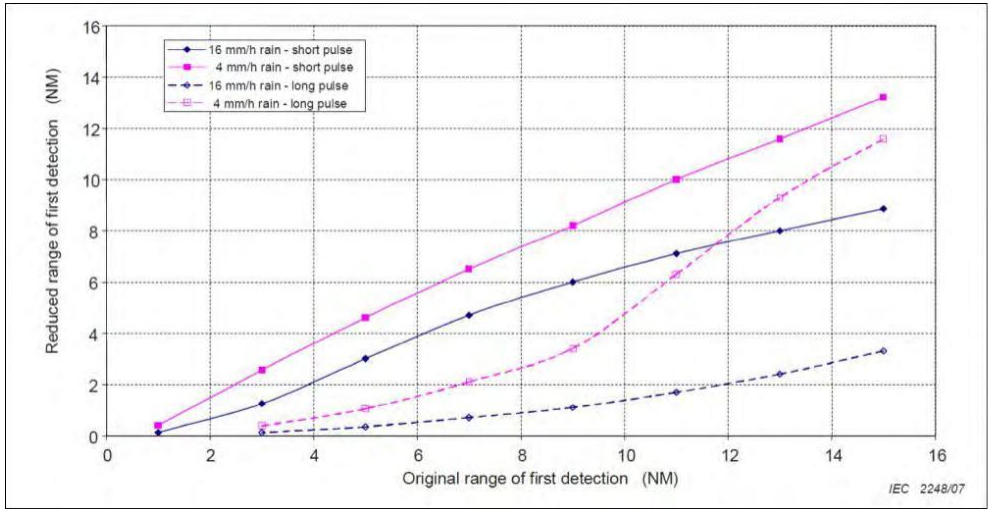
Rain (precipitation) will degrade radar performance by causing additional clutter onscreen and potential loss of target returns.

Rain clutter is different from sea clutter as rain can produce continuous returns which cover large areas of the screen

Rain storms and heavy rainfall can be tracked easily due to the clutters continual movement over and area.

Rain clutter creates a high return of noise-like reflections that effectively decreases the signal to noise levels within the radar receiver. In addition, it creates an attenuation of the radar signal, which also decreases the signal to noise levels. Both these effects reduce the target detection capability of a radar system. Koden KRS Radar is a coherent radar system and maintains a high resolution at all ranges and together with front-end processing, will provide superior performance in rain.

The following graphs illustrate the advantage of short pulse and X band radar systems:



9.9 Target Detection in clutter conditions

Gain

The raw Radar return signal consists of targets, precipitation sea clutter and a level of noise generated by the Radar system. The *[Gain]*control reduces unwanted radar returns to optimize the radar image.

The manual *[Gain]*control sets the detection threshold for the strength of targets. The gain should be set to a level that eliminates or produces minimal noise, when viewed beyond any sea clutter. The *[Gain]*control may require further adjustment when the range scale changes.

Sea state

Low (calm) sea state

Multi-path signals can either enhance or reduce signal strength, depending on the target range and characteristics. The detection range for targets at optimum Gain, assuming that it is not obscured by the horizon, will depend on target's characteristics and the propagation (ducting) conditions. In some circumstances, ducting will permit visibility of targets at much longer ranges than could normally be expected. A higher radar antenna will normally increase the range of detection, but may deteriorate performance in an adverse clutter conditions.

Koden's KRS Radar transmits multiple pulse lengths, which provides enhanced detection.

High (rough) sea state

Rough sea: As sea roughness increases, target detection is less affected by multi-path effects but more adversely affected by sea clutter. The nature of the signal reflected from a wave is different than the signal reflected from a target. Processing techniques assist in making the target more visible. Clutter signals increase when viewed upwind. Although sea clutter signals can look like actual targets, as most clutter is in the form of sea spikes they will fail to correlate.

The rapid movement of high speed ships, especially on shorter range scales may fail to correlate, impacting target detection. Very large waves may also obscure targets, and in these conditions targets may not be visible to the radar system.

High winds will cause small targets (e.g. buoys and yachts) to heel over, reducing the reflected radar signal and the therefor target detection.

Sea clutter

Radar echoes from breaking waves, sea spray and backscatter appears on the Radar screen as clutter. The clutter appears centred around ownship which reduces performance of short range target detection. These echoes are not repetitive or consistent in position or size. With high winds and extreme conditions, echoes from sea clutter may cause dense background clutter in the shape of an almost solid disc. The *[Sea]*anti clutter control is used to reduce the clutter, improving the quality of the radar image.

The clutter range is dependent on the radar antenna height and the sea state, although other factors can also influence the extent of the clutter.

The *[Sea]*anti-clutter control helps to improve target detection by reducing the visibility of clutter on the radar screen.

The *[Sea]*anti-clutter control applies maximum attenuation at zero range (ownship) and reduces the attenuation as the range increases.

The *[Sea]*anti-clutter control can be manually adjusted or set to automatic.

The table below provides predictions for target visibility, for small targets with a nominal range of 0.7 NM, depending on sea state.

X band target RCS	**Sea state**			
	1 to 2	**2 to 3**	**3 to 4**	**4 to 5**
1.0 m^2	>80%	50% to 80%	0%	0%
5.0 m^2	>80%	>80%	50% to 80%	0%
10.0 m^2	>80%	>80%	>80%	50% to 80%

Predictions have assumed minimal anti-clutter signal processing.

Excessive sea clutter spikes above the mean clutter level will degrade the false alarm rate and may therefore reduce target visibility (for a given false alarm rate) compared to those predictions shown in the above tables. The characteristics of the sea clutter may vary in different locations, according to geographical characteristics.

Target masking (screening) has not been included in these calculations and in high sea states, masking (shadowing) will also degrade visibility of low targets.

The antenna height is taken as 15 m (49.21 ft); other antenna heights will give different predictions and will be subject to a different effect of multi-path. The targets are assumed to have the characteristics shown and fluctuate in accordance with Swerling case 1. A combination of wind speed and average wave height may be used as a means of assessing the sea state.

The following influences target detection:

- Target description (characteristics), RCS, stability, aspect, height.
- Wind strength and direction relative to the line of sight between antenna and target.
- Estimated sea state, wave height, clutter spike characteristics.
- Measured or estimated rainfall and rain extent.
- Any variation in antenna height.

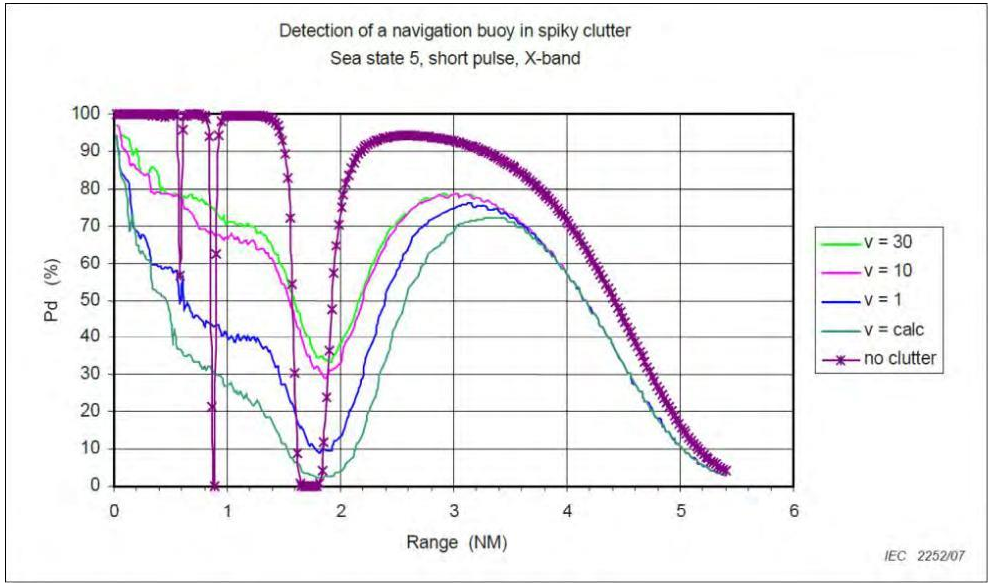
Many variables impact actual radar performance and therefore all predictions are indicative. A target may demonstrate a low probability of detection in the near range with an acceptable or a high probability of detection at farther ranges. This may be a result of multi-path signals which are creating signal cancellation at close range.

Atmospheric conditions, e.g.: ducting, can enhance or degrade detection performance depending on antenna height, target height and range, and radar frequency. If the Gain or Sea anti-clutter threshold is set too high, point targets appear small or may even be fully suppressed. The user should set the signal processing controls to retain some clutter speckles to promote a better sensitivity within the clutter field. Although such a setting increases the false alarm rate and gives a noisier presentation, detection sensitivity is improved.

In adverse weather conditions considerable echo returns may be obtained from the sea. Under these circumstances, the sea clutter returns may be greater than the reflections from buoys and other small targets and thus impact the detection of actual targets. In these conditions use the Gain and Sea anti clutter controls to reduce the clutter so that actual targets can be distinguished.

High sea swell tend to produce random echoes and clutter on the screen. Clutter returns from sea breaking on shoals and sand banks may help to show the position of these hazards. Sea spikes generate signals with similar characteristic to targets and vary in density and intensity in different localities. Their presence raises the false alarm rate and degrades the presentation of the radar image; therefore spikes will reduce the probability of detection with the radar presentation set up for a low false alarm rate. The radar equation has a clutter distribution factor (k) and also includes a distribution shape factor (v) to represent the effect of sea spikes.

The following graph indicates the variation of the shape factor (v) and demonstrates the impact of sea spikes on target detection. The lower (v) equates to a more spiky clutter. High sea spikes will degrade the false alarm rate and therefore detection performance. The upper plot shows the detection of a buoy in a clutter free environment, clearly showing the effects of multi-path nulls. This figure illustrates this case for a probability of detection with a low false alarm rate. Sea clutter may vary such that lower detection is achieved due to the presence of wave spikes. Atmospheric conditions can enhance or degrade detection performance. The presence of rain will degrade performance in the rain area by causing additional clutter and target return loss.



Rain clutter

Precipitation appears on the Radar screen as lots of small echoes which continuously change size, intensity and position — this is known as clutter. The clutter can sometimes appear as large hazy areas, depending on the intensity of the rainfall. The clutter reduces the Radar's target detection performance.

The level of reduction in target detection performance is dependent on radar antenna characteristics, transmission frequency and pulse length.

A shorter transmission pulse provides better detection.

The *[Rain]*anti-clutter control helps to improve target detection by reducing the impact of precipitation on the radar screen. However, solid targets such as land masses will appear thinner.

When the *[Rain]*anti clutter control is set to *[Auto]* target detection is optimized and a short pulse for conventional magnetron transmitters is selected to provide best performance.

The Koden KRS Radar features a high discrimination on all range scales, maintaining a higher detection performance in all rain clutter conditions.

9.10 Reflectors and beacons

Reflectors

Reflectors are designed to give maximum return from radar transmissions and may be fitted to buoys to aid navigation, to sundry features such as dangerous outcrops of rocks, and to any hazard that would impair the navigation of a vessel. Small boats may also have reflectors fitted to increase the range at which they can be detected.

Note:

Some small buoys have a reduced cross-sectional area when heeling over in high sea states.

Beacons

Radar beacons (also known as RACONS) produce a specific, coded signal response when the radar transmission interrogates the beacon. The reflected signal then gives a precise echo paint on the radar screen. This effect can be reduced when using a high Correlation level (RACONS are not normally affected by Interference Rejection).

9.11 Interpreting objects

The size of a target that appears on screen is dependent on many factors and may not be proportional to its actual physical size. Nearby objects may appear to be the same size as distant larger objects. With experience, the approximate size of different objects can be determined by the relative size and color / brightness of the echoes.

The size of onscreen targets are impacted by:

- The physical size of the reflecting object.
- The material that the object is made from (metallic surfaces reflect signals better than non-metallic surfaces).
- The verticality of the object (objects such as cliffs reflect signals better than sloping objects such as sandbanks).
- The height of costal regions (High coastlines and mountainous coastal regions can be observed at longer Radar ranges. Therefore, the first sight of land may be a mountain several miles inland from the coastline. Although the coastline may be much nearer, it may not appear on the Radar until the vessel is closer to shore).
- The target's reflective visibility (Some targets, such as buoys and small vessels are difficult to discern because they do not present a consistent reflecting surface as they pitch and roll in the waves. Consequently these echoes tend to fade and brighten, and at times disappear momentarily).
- Similar sized targets (Buoys and small vessels resemble each other, however vessels can often be distinguished by their motion.

9.12 Radar interference

Interference from other radar scanners operating the area is shown on the screen as irregular curved spoke like patterns extending from the centre to the edge of the radar image.

If interference is present, use the *[Interference Rejection]*control in the *[Radar Sensor] m*enu to suppress the interference.

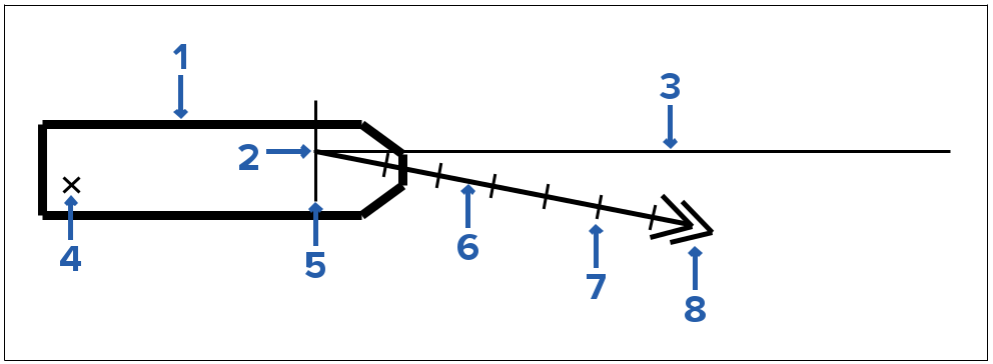
The higher the level, the more interference suppression is used.

CHAPTER 10: SYMBOLS

CHAPTER CONTENTS

10.1 Ownship symbols

The following details provide information on the symbols used for ownship based on those shown in IEC-62388 Ed 1. Further information on the IEC specification, contact to Koden dealer or Koden.



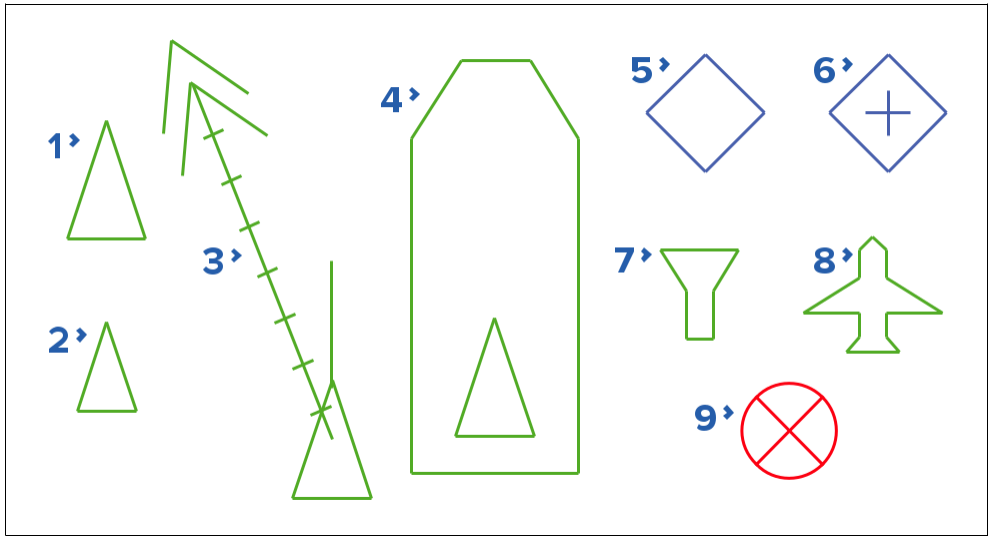
1. **Ownship scaled outline** — Ownship scaled outline is a true scaled outline of ownship relative to the CCRP. The ownship symbol is orientated along its heading. The ownship scaled outline symbol is used at shorter range scales.
2. **CCRP** — The point at which the heading line and beam line intersect represents the CCRP location.
3. **Heading line** — The ownship heading line is drawn extending from the CCRP location in the direction of ownship heading.
4. **Radar antenna** — The physical location of the Radar antenna is represented using a cross. The radar image is centered around the Radar antenna location.
5. **Beam line** — The ownship beam line is a line perpendicular to the heading line centered at the CCRP. When the ownship outline is less than 6 mm, the beam line is used and referred to as the 'ownship' symbol.
6. **Vector line** — The vector line is drawn from the CCRP. The length of the vector line represents where ownship will be when the time specified in the *[Vector (min)]* setting has elapsed.
7. **Vector time increments** — Lines are drawn perpendicular to the vector line at 1 minute intervals.
8. **Stabilization mode** — A double arrow is used to represent Ground referenced stabilization a single arrow is used to represent Sea referenced stabilization.

10.2 AIS target symbols

The following details provide information on the symbols used for AIS targets based on those shown in IEC-62388 Ed 1. Further information on the IEC specification, contact to Koden dealer or Koden.

AIS targets are represented using triangle symbols. The color and appearance identifies the target's status. Target symbols will be orientated to the target's reported heading (or COG if heading is not reported). If no heading or COG is reported then the target symbol will be orientated toward the top of the screen.

AIS target symbols

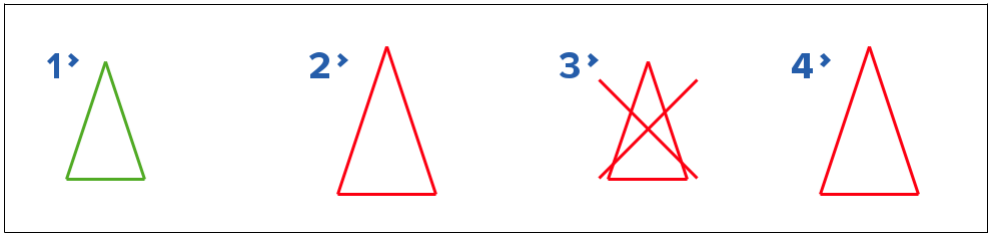


1. **AIS target** — A triangle with a solid green outline is used for AIS targets.
2. **Sleeping AIS target** — A sleeping (not activated) AIS target uses a small triangle with a green outline and does not have heading or vector lines.
3. **Activated AIS target** — An activated AIS target symbol will include a heading line and velocity vector line (when relevant data is being reported). The vector line will include 2 arrows at the end to represent *[GND]* (Ground) stabilization mode or 1 arrow at the end to represent *[Sea]* stabilization mode.
4. **True scaled outline AIS target** — AIS targets will show a True scaled outline. True scaled outlines will not be shown if heading data for the

target is not available or when the current range would draw the symbol with the same beam as the standard symbol.

5. **Physical AIS Aid to Navigation (AtoN) basic shape** — A diamond with a solid blue outline is used to represent physical AtoNs. AtoNs will also include a symbol located on the top point to identify its type. For details of the various types of physical AtoNs, refer to: **p.99 — AtoNs (Physical)**
6. **Virtual AIS Aid to Navigation (AtoN) basic shape** — A diamond with a dashed blue outline with a plus symbol in the center is used to represent virtual AtoNs. AtoNs will also include a symbol located on the top point to identify its type. For details of the various types of physical AtoNs refer to: **p.100 — AtoNs (Virtual)**
7. **Land Base Stations** — A polygon with a green solid outline is used for Land base stations.
8. **AIS SAR (Search And Rescue) aircraft** — An aircraft shape with a solid green outline is used to represent SAR aircraft targets.
9. **Search & Rescue Transponders (SARTs)** — A circle with a solid red outline and a cross through it is used for SARTs.

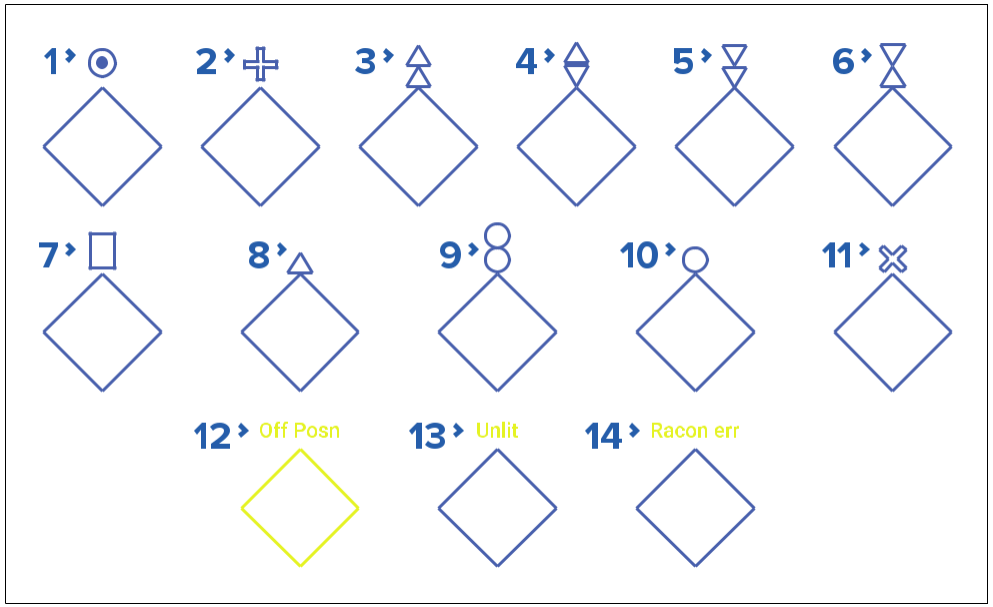
AIS target status



1. **Uncertain AIS target** — A dashed outline is used to signify that the system cannot compute a collision avoidance calculation.
2. **Dangerous AIS target** — If an AIS target becomes dangerous then the symbol will change to a larger red triangle. Dangerous AIS targets are automatically activated and the symbol will flash until acknowledged. When the target is no longer considered dangerous the symbol will revert to using a green outline.
3. **Lost AIS target** — If an AIS target becomes lost then it will turn red and a cross will be placed through the target symbol. The target symbol will flash until it is acknowledged. Once acknowledged the lost target symbol will be removed from the screen.
4. **Multiple status** — Combinations of target status are used when a target meets more than one condition (e.g.: Dangerous and uncertain target will have red dashed outline).

AtoNs (Physical)

Physical AtoNs use additional symbols above the basic shape to signify their type.

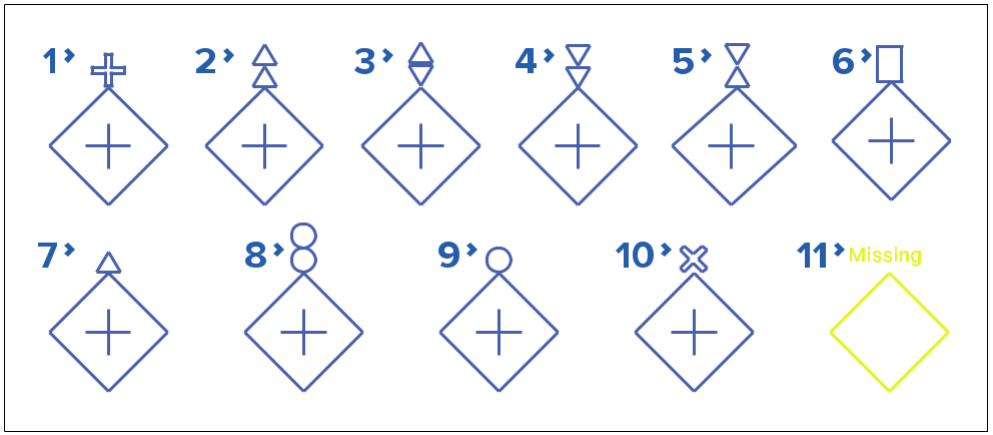


1. Racon.
2. Emergency wreck mark.
3. North cardinal mark.
4. East cardinal mark.
5. South cardinal mark.
6. West cardinal mark.
7. Port hand mark.
8. Starboard hand mark.
9. Isolated danger.

10. Safe water.
11. Special mark.
12. Off position.
13. Unlit.
14. Racon failure.

AtoNs (Virtual)

Virtual AtoNs use additional symbols above the basic shape to signify their type.

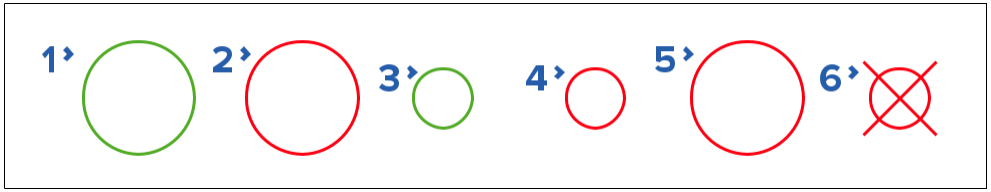


1. Emergency wreck mark.
2. North cardinal mark.
3. East cardinal mark.
4. South cardinal mark.
5. West cardinal mark.
6. Port hand mark.
7. Starboard hand mark.
8. Isolated danger.
9. Safe water.
10. Special mark.
11. Missing.

10.3 Tracked radar target symbols

During acquisition and tracking, circle symbols are used to identify target status. Tracked targets are assigned unique sequential numbers.

Tracked target symbols



1. **Manual acquisition** — The symbol for a target that is being manually acquired will have a dashed green outline.
2. **Auto acquisition** — The symbol for a target that is being automatically acquired will have a dashed red outline.
3. **Manually acquired target** — The symbol for a target that has been acquired manually will be smaller and have a solid green outline.
4. **Auto acquired target** — The symbol for a target that has been automatically acquired within an acquisition zone will be smaller, have a red outline and will flash until acknowledged. The unacknowledged target will continue to flash even if it moves outside of the acquisition zone. Once acknowledged if the target moves outside of the acquisition zone then it will colored green.
5. **Dangerous target** — If a radar target becomes dangerous then the symbol will change to a larger red circle. A dangerous radar target symbol will flash until acknowledged. When the target is no longer considered dangerous the symbol will revert to using a green outline.
6. **Lost target** — If a radar target becomes lost then it will turn red and a cross will be placed through the target symbol. The target symbol will flash until it is acknowledged. Once acknowledged the lost target symbol will be removed from the screen.

CHAPTER 11: TROUBLESHOOTING

CHAPTER CONTENTS

11.1 Troubleshooting

The troubleshooting section provides possible causes and the corrective action required for common problems that are associated with the installation and operation of your product.

Before packing and shipping, all Koden products are subjected to comprehensive testing and quality assurance programs. If you do experience problems with your product, this section will help you to diagnose and correct problems to restore normal operation.

If after referring to this section you are still having problems with your product, please refer to the *Technical support* section of this manual for useful links and Koden technical support contact details.

11.2 Backup

Settings and data can be backed up to internal and external memory.

The backup procedure includes the following data and settings:

- Radar configuration settings (Radar Name, number Blank sectors etc).
- Ship data (External devices and ownship settings).
- User maps.
- User profiles.
- Past position.
- 12 Hour log.
- Alert configuration settings.
- Crash logs (crash and system logs).

The backup file can be used at a later date to restore your data and settings.

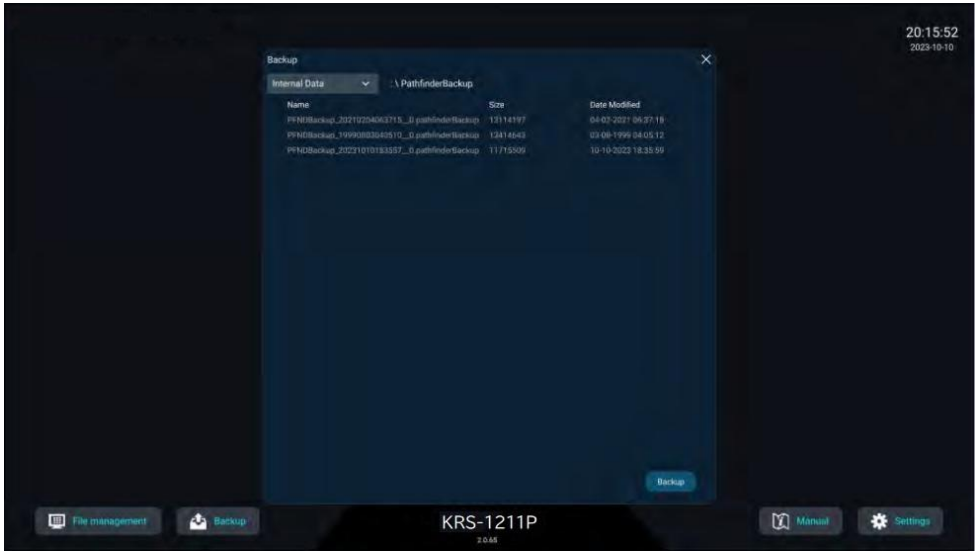
For details on restoring user data and settings refer to the Installation manual.

Performing a backup

A backup should be performed as part of commissioning, but can also be performed by the operator.

Note:

During commissioning a backup should be made and saved to both internal and external memory.



From the Standby screen:

1. Select the *[Backup]* icon.
2. Select the memory device from the drop down list.
3. Select *[Backup]*.
4. Select *[OK]* on the backup confirmation notification.

The backup file will be created in the ':\KRSBackup' folder of the internal or external memory.

The name for the backup file will be in the following format:
PFNDBackup_YYYMMDDHHMMSS_ShipName_DisplaySN

11.3 Performance monitor

The Performance monitor compares current Radar scanner performance against the Radar scanner's performance when the system was commissioned.
The Performance monitor is activated by selecting the *[MON]* button from the *[Pull down]* menu.
Whilst the Performance monitor is running, the *[MON]* button text will be blue.

Once completed, if the Performance monitors passes then the *[MON]* button will turn green for 3 minutes and then revert to normal.
If the Performance monitor fails, then a warning will be triggered and the button will turn red for 3 minutes and then revert to normal.

Note:

The Performance monitor can only be run once the Radar has been transmitting for at least 2 minutes.

Performance monitor checks should be carried out in line with IMO regulations or ship specific requirements/instructions.
If the performance monitor fails please contact Koden Technical Support.

11.4 Power up troubleshooting

Product does not turn on or keeps turning off

Possible causes	Possible solutions
Blown fuse / tripped breaker.	1. Check condition of relevant fuses and breakers and connections, replace if necessary. (Refer to the *Technical Specification* section of Installation manual for fuse ratings.) 2. If fuse keeps blowing check for cable damage, broken connector pins or incorrect wiring.
Poor / damaged / insecure power supply cable / connections	1. Check that the power cable connector is correctly orientated and fully inserted into the display connector and locked in position. 2. Check the power supply cable and connectors for signs of damage or corrosion, and replace if necessary. 3. With the display turned on, try flexing the power cable near to the display connector to see if this causes the unit to restart or lose power. Replace if necessary. 4. Check the vessel's battery voltage and the condition of the battery terminals and power supply cables, ensuring connections are secure, clean and free from corrosion. Replace if necessary. 5. With the product under load, using a multi-meter, check for high voltage drop across all connectors / fuses etc, and replace if necessary.
Incorrect power connection	The power supply may be wired incorrectly, ensure the Installation manual have been followed.

Product will not start up (restart loop)

Possible causes	Possible solutions
Power supply and connection	See possible solutions from the table above, entitled ‘Product does not turn on or keeps turning off’.
Software corruption	In the unlikely event that the product’s software has become corrupted, contact Koden dealer or Koden.

11.5 Radar troubleshooting

Problems with the Radar and their possible causes and solutions are described here.

No connection can be made to the scanner

Possible causes	Possible solution
Radar not transmitting	Select *[STBY]* from the top right corner of the radar screen.
Damaged or disconnected Power cable / Data cable	1. Check that the cable connectors are fully inserted and locked in position. 2. Check the power supply cable and connectors for signs of damage or corrosion, replace if necessary. 3. With the unit turned on, try flexing the cable near to the display connector to see if this causes the unit to re-boot/loose power, replace if necessary. 4. Check the vessel’s battery voltage, the condition of the battery terminals and power supply cables, ensuring connections are secure, clean and free from corrosion, replace if necessary. 5. With the product under load, using a multi-meter, check for high voltage drop across all connectors/fuses etc (this can cause the unit to reset/turn off), replace if necessary. 6. Check condition of relevant breakers and fuses, replace if necessary. If breaker keeps tripping or fuses keep blowing, contact a Koden authorized dealer for assistance.
[Power] switch in OFF position	Ensure *[Power]* switch is in the ON position.
Software mismatch between equipment may prevent communication.	Ensure KRS radar contain the latest available software. For more information, contact Koden dealer or Koden.

Displayed bearing is different to the true bearing

Possible causes	Possible solution
Bearing alignment adjustment required	Carry out the Bearing Alignment procedure described in the latest version of the Operation manual.

Radar will not initialize (Voltage control module (VCM) stuck in “sleep mode”

Possible causes	Possible solution
Intermittent or poor power connection	Check power connection at VCM. (Voltage at input = 12 / 24 V, Voltage at output = 42 V)

Picture not updated or appears to be locked-up. This may be indicated by the UTC/Local time not changing

Possible causes	Possible solution
Possible system error	If the Display hasn't rebooted itself then shut down and restart the processor.

CHAPTER 12: IEC-61162 MESSAGES

CHAPTER CONTENTS

12.1 IEC61162 Messages

The following table details the IEC61162 messages that can be accepted by the Koden KRS Radar.
This list is current for the KRS operating system version V1.0 and is subject to change with later versions of software.

Note:
Items in **bold** are mandatory sentences.

Input

Telegram	Parameter
AAM	Waypoint Arrival Alarm
ACK	**Acknowledge Alarm**
ACN	**Alert Command**
ALR	**Alarm State**
APB	Autopilot B Sentence
BWC	Bearing & Distance to Waypoint (Great Circle)
BWR	Bearing & Distance to Waypoint (Rhumb Line)
DBT	Depth Below Transducer
DPT	Depth
DSC	Digital Selective Caller Information
DSE	Expanded Digital Selective Caller Information
DTM	**Datum Reference**
GBS	GNSS Satellite Fault Detection
GGA	**Geographic Position (GPS Fix Data)**
GLC	Geographic Position (Loran-C)
GLL	**Geographic Position (Latitude and Longitude)**
GNS	**Geographic Position (GNSS Fix Data)**
GSA	GNSS DOP and Active Satellites
GST	GNSS Pseudorange Noise Statistics
GSV	GNSS Satellites In View
HBT	**Heartbeat**
HDG	Heading, Deviation and Variation
HDM	Heading, Magnetic
HDT	**Heading True**
MDA	Meteorological Composite
MSK	MSK Receiver Interface
MSS	MSK Receiver Signal Status
MTW	Water Temperature
MWV	Wind Speed and Angle
RMA	Recommended Minimum Specific Loran-C Data
RMB	Recommended Minimum Navigation Information
RMC	Recommended Minimum Specific GNSS Data
ROT	**Rate of turn**
RTE	Routes
SSD	AIS Ship Static Data
THS	**True Heading and Status**
TTM	Tracked Target Message
TLB	Tracked Target Label
TTD	Tracked Target Data
VBW	**Dual Ground/Water Speed**
VDM	**AIS Target Data**
VDO	**AIS Ownship Information**
VHW	**Water Speed and Heading**
VLW	Dual Ground Water & Distance
VSD	AIS Voyage Static Data
VTG	**Course Over Ground and Ground Speed**

Telegram	Parameter
WPL	Waypoint Location
XTE	Measured Cross Track Error
ZDA	**Time and Date**

Output

Telegram	Parameter	Transmission Time
ACK	**Acknowledge Alarm**	**Event based (on alert acknowledge)**
ALC	**Cyclic Alert Output**	**30 seconds**
ALF	**Alert Data Output**	**Event based (on alert state change or on request by ACN)**
ALR	**Set Alarm State**	**Event based (on alert state change)**
ARC	**Alert Command Refused**	**Event based (on command refused)**
DBT	Depth Below Transducer	2 seconds
DPT	Depth	2 seconds
EVE	**General Event Message**	**Event based (1 second after user input)**
GLL	Geographic Position (Latitude and Longitude)	2 seconds
GSA	GNSS DOP and Active Satellites	1 second
GST	GNSS Pseudorange Noise Statistics	2 seconds
GSV	GNSS Satellites In View	1 second
HBT	**Heartbeat**	**30 seconds**
OSD	**Ownship Data**	**2 seconds**
RSD	**Radar System Data**	**2 seconds**
SRP	System function ID resolution	30 seconds
TLB	**Tracked Target Labels**	**1 second**
TTD	**Tracked Target Data**	**1 second**
TTM	Tracked Target Message	1 second
VHW	Water Speed and Heading	2 seconds
VTG	Course Over Ground and Ground Speed	2 seconds
VR	Screen Output	Period defined in advanced settings, default is 5 seconds.

CHAPTER 13: ABBREVIATIONS

CHAPTER CONTENTS

13.1 Abbreviations

Term	Abbreviation
Acknowledge	ACK
Acquire, Acquisition	ACQ
Aids to Navigation (applies to AIS)	AtoNs
Air Search & Rescue (applies to AIS)	ASARs
Acquisition Zone	AZ
Additional Military Layer	AML
Adjust, Adjustment	ADJ
All purpose STructured Eurocontrol suRveillance information eXchange	ASTERIX
Altitude	ALT
Anchor Watch	ANCH
Antenna	ANT
Automatic	AUTO
Automatic Frequency Control	AFC
Automatic Gain Control	AGC
Automatic Identification System	AIS
Automatic Identification System – Search and Rescue Transmitter	AIS-SART
Automatic Radar Plotting Aid	ARPA
Autopilot	AP
Auxiliary System/Function	AUX
Available	AVAIL
Azimuth Indicator	AZI
Background	BKGND
Beacon mode	BCM
Bearing	BRG
Bearing Waypoint To Waypoint	BWW
Bow Crossing Range	BCR
Bow Crossing Time	BCT
Built in Test Equipment	BITE
Calibrate	CAL
Cancel	CNCL
Cancel All	CNCL ALL
Category	CAT
Centre	CENT
Change	CHG
Chart Display Settings	CHT DISP SET
Chart Management	CHT MGMT
Chart Safety Settings	CHT SF SET
Circularly Polarized	CP
Clear	CLR
Closest Point of Approach	CPA
Compact Disk Read Only Memory	CDROM
Conning	CONN
Consistent Common Reference Point	CCRP
Consistent Common Reference System	CCRS
Contrast	CONT
Coordinated Universal Time	UTC
Correction	CORR
Course	CRS
Course Over the Ground	COG
Course Through the Water	CTW
Course To Steer	CTS
Course Up	C UP

Term	Abbreviation
Cross Track Distance	XTD
Cross Track Limit	XTL
Cursor	CURS
Curved Heading Line	CHL
Dangerous Goods	DG
Data Collection Unit	DCU
Date	DATE
Dated Objects	DO
Day	DAY
Day/Night	DAY/NT
Dead Reckoning, Dead Reckoned Position	DR
Decrease	DECR
Default Settings	DFLT SET
Delay	DELAY
Delete	DEL
Departure	DEP
Depth	DPTH
Destination	DEST
Deviation	DEV
Differential GNSS	DGNSS
Differential GPS	DGP
Digital Selective Calling	DSC
Display	DISP
Display Settings	DISP SET
Display Brilliance	BRILL
Distance	DIST
Distance To Go	DTG
Down	DN

Term	Abbreviation
Drift	DRIFT
Electromagnetic Compatibility	EMC
Electronic Bearing Line	EBL
Electronic Chart Display and Information System	ECDIS
Electronic Chart System	ECS
Electronic Navigational Chart	ENC
Electronic Position Fixing System	EPFS
Electronic Range and Bearing Line	ERBL
Emergency Position Indicating Radio Beacon	EPIRB
Emergency Position Indicating Radio Beacon – AIS	EPIRB-AIS
ENC Management Report	ENC MGMT REP
ENC Update Status Report	ENC UPD STATUS
Enhance	ENH
Enter	ENT
Equipment	EQUIP
Error	ERR
Estimated Position	EP
Estimated Time of Arrival	ETA
Estimated Time of Departure	ETD
European Geo-Stationary Navigational Overlay System	EGNOS
Event	EVENT
Exclusion Zone	EZ
Export Route	ROUTE EXP
External	EXT
Federal Communications Commission	FCC
Frequently Asked Questions	FAQ
Forward	FWD

Term	Abbreviation
Frequency	FREQ
Global Maritime Distress and Safety System	GMDSS
Global Navigation Satellite System	GNSS
Global Orbiting Navigation Satellite System	GLONASS
Global Positioning System	GPS
Great Circle	GC
Grid	GRID
Ground	GND
Grounding Avoidance System	GAS
Guard Zone	GZ
Head Up	H UP
Heading	HDG
Heading Line	HL
Heading Line Off	HL OFF
High Definition Multimedia Interface	HDMI
High Frequency	HF
High Speed Craft	HSC
Horizontal Dilution Of Precision	HDOP
Identification	ID
Import Chart	IMPORT CHT
Import Route	ROUTE IMP
Increase	INCR
Indication	IND
Information	INFO
Information Report	INFO REPORT
Infrared	INF RED
Initialisation	INIT

Term	Abbreviation
Input	INP
Input/Output	I/O
Integrated Navigation System	INS
Integrated Radio Communication System	IRCS
Interference Rejection	IR
International Maritime Organization	IMO
Innovation, Science and Economic Development Canada — previously Industry Canada (IC)	ISED
Interval	INT
JavaScript Object Notation	JSON
Label	LBL
Latitude	LAT
Latitude/Longitude	L/L
Leeway	LWY
Light Emitting Diode	LED
Limit	LIM
Line Of Position	LOP
Liquid Crystal Display	LCD
Local Area Network	LAN
Log	LOG
Long Pulse	LP
Long Range	LR
Longitude	LON
Loran	LORAN
Lost Target	LOST TGT
Low Frequency	LF
Magnetic	MAG
Main Bang Suppression	MBS

Term	Abbreviation
Man Overboard	MOB
Manoeuvre	MVR
Manual	MAN
Manual Update	MAN UPD
Map(s)	MAP
Maritime Mobile Services Identity number	MMSI
Maritime Polluant (applies to AIS)	MP
Maritime Safety Information	MSI
Marker	MKR
Master	MSTR
Maximum	MAX
Medium Frequency	MF
Medium Pulse	MP
Menu	MENU
Minimum	MIN
Missing	MISSING
Mute	MUTE
Nautical Mile	NM
Navigation	NAV
Night	NT
Normal	NORM
North Up	N UP
Off	OFF
Off centred	OFF CENT
Officer of the Watch	OOW
Offset	OFFSET
On	ON
Out/Output	OUT

Term	Abbreviation
Own Ship	OS
Own Ship Look-Ahead	LOOK AHEAD
Panel Illumination	PANEL
Parallel Index Line	PI
Past Positions	PAST POSN
Passenger Vessel (applies to AIS)	PASSV
Performance Monitor	MON
Permanent	PERM
Person Overboard	POB
Personal Computer	PC
Personal Identification Number	PIN
Pilot Vessel	PILOT
Position	POSN
Positional Dilution Of Precision	PDOP
Power	PWR
Predicted	PRED
Predicted Area of Danger	PAD
Predicted Point of Collision	PPC
Pulse Length	PL
Pulse Repetition Frequency	PRF
Pulse Repetition Rate	PRR
Pulses Per Revolution	PPR
Racon	RACON
Radar	RADAR
Radar Cross Section	RCS
Radar Overlay	RADAR OVR
Radar Settings	RADAR SET
Radar Plotting	RP

Term	Abbreviation
Radar Transponder	TPR
Radio Frequency	RF
Radius	RAD
Range	RNG
Range Rings	RR
Raster Chart Display System	RCDS
Raster Navigational Chart	RNC
Rate Of Turn	ROT
Receiver	RX
Receiver Autonomous Integrity Monitoring	RAIM
Reference	REF
Relative	R
Relative	REL
Relative Motion	RM
Revolutions per Minute	RPM
Rhumb Line	RL
Roll On/Roll Off Vessel (applies to AIS)	RoRo
Root Mean Square	RMS
Save User Settings	SAVE USR
S-Band (applies to Radar)	S-BAND
Safety Of Life At Sea (Convention)	SOLAS
Scan to Scan	SC/SC
Search And Rescue	SAR
Search And Rescue Transponder	SART
Search And Rescue Vessel	SARV
Select	SEL
Select User Settings	USR SEL

Term	Abbreviation
Short Pulse	SP
Signal to Noise Ratio	SNR
Silence	SLNC
Simulation	SIM
Slave	SLAVE
Sleeping Target (applies to AIS)	ST
Speed	SPD
Speed and Distance Measuring Equipment	SDME
Speed Over the Ground	SOG
Speed Through the Water	STW
Stabilized	STAB
Standard Display	STND DISP
Standby	STBY
Starboard/Starboard Side	STBD
Station	STN
Symbol(s)	SYM
Synchronization	SYNC
System Electronic Navigational Chart	SENC
System Function Identifier	SFI
Target	TGT
Target Association	TA
Target Tracking	TT
Time Difference	TD
Time Dilution Of Precision	TDOP
Time Of Arrival	TOA
Time Of Departure	TOD
Time to CPA	TCPA

Term	Abbreviation
Time To Go	TTG
Time to Wheel Over Line	TWOL
Track	TRK
Track Control System	TCS
Tracking	TRKG
Track Made Good	TMG
Transceiver	TXRX
Transferred Line Of Position	TPL
Transmitter	TX
Transmitting Heading Device	THD
Trial	TRIAL
Trial Manoeuvre	TM
Trial Settings	TRIAL SET
Trigger Pulse	TRIG
True	T
True Motion	TM
Tune	TUNE
Ultrahigh Frequency	UHF
Uninterruptible Power Supply	UPS
Universal Serial Bus	USB
Universal Time, Coordinated	UTC
Unstabilised	UNSTAB
Update Log	UPD LOG
Update Review	UPD REV
User Chart	USR CHT
User Maps	UM
Variable Range Marker	VRM
Variation	VAR

Term	Abbreviation
Vector	VECT
Very High Frequency	VHF
Very Low Frequency	VLF
Vessel Aground (applies to AIS)	GRND
Vessel at Anchor (applies to AIS)	ANCH
Vessel Constrained by Draught (applies to AIS)	VCD
Vessel Engaged in Diving Operations	DIVE
Vessel Engaged in Dredging or Underwater Operations (applies to AIS)	DRG
Vessel Engaged in Towing Operations (applies to AIS)	TOW
Vessel Not Under Command (applies to AIS)	NUC
Vessel Restricted in Manoeuvrability (applies to AIS)	RIM
Vessel Traffic Service	VTS
Vessel Underway Using Engine (applies to AIS)	UWE
Video	VID
Visual Display Unit	VDU
Voltage Converter Module	VCM
Voyage	VOY
Voyage Data Recorder	VDR
Water	WAT
Waypoint	WPT
Waypoint Closure Velocity	WCV
Wheel Over Line	WOL
Wheel Over Point	WOP
Wheel Over Time	WOT
World Geodetic System	WGS
X-Band (applies to Radar)	X-BAND

CHAPTER 14: TECHNICAL SUPPORT

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14.1 KRS technical support

For technical support for you KRS Radar system, please contact Koden dealer or Koden.
If you need to request technical support, please have the following information to hand:

- Product name.
- Product identity.
- Serial number.
- Software application version.
- System diagrams.

14.2 Approval certificates

For the approval certificates for the system, contact Koden dealer or Koden.

Appendix A Alerts list

The following Alerts can be raised by the system.

Alert	Description	Type	Cate-gory	Alert Identifier
Man Overboard	Man Overboard	Alarm	B	3097
AIS Conn. Lost	AIS Connection Lost	Warning	B	3008
AIS Lost Target	AIS Lost Target	Warning	A	3052
Lost Target	Lost Target	Warning	A	3052
Interc Arrival	Intercepted Arrival	Alarm	A	3031
Obstruct Detect	Obstruction Detected	Warning	A	3032
Anchor Drag	Anchor Drag Risk	Alarm	A	3031
Bottom Lock Lim	Bottom Lock Limited	Warning	A	11038
No AvailSp SCRSt	No Available Space for Screenshot file	Caution	A	11039
No AvailSp SCRSt	No Available Storage for Screenshot file	Caution	A	11040
LiveD Gen Serv	Live Data Generic Services	Warning	A	11088
LiveD Bat Serv	Live Data Battery Services	Warning	A	11089
Dbi Alt Alarm	Dbi Alt Alarm	Alarm	A	11090
Dbi Alt Warning	Dbi Alt Warning	Warning	A	11091
Dbi Alt Info	Dbi Alt Info	Caution	A	11092
Anchor Watch Limit	Anchor watch limit exceeded	Warning	A	3032
AIS Cap. Neared	AIS Capacity Neared	Caution	B	3043
ARPA Cap. Neared	ARPA Capacity Neared	Caution	B	3043
AIS C.Exceeded	AIS Capacity has been exceeded	Warning	A	3042
ARPA C.Exceeded	ARPA capacity has been exceeded	Warning	A	3042
No Radar Detected	No Radar Detected	Alarm	B	3002
No Radar Detected	No Radar Detected	Warning	B	3001
No Conn.Radar	Radar is not connected	Warning	B	3002
Reference Target was lost	Reference target was lost	Warning	A	3052
No Speed Through Water	No Speed Through Water	Warning	B	3015
No Speed Over Ground	No Speed Over Ground	Warning	B	3015
No Depth	No Depth	Warning	B	3015
No Wind Speed	No Wind Speed	Warning	B	3015
No Humidity	No Humidity	Warning	B	3015
No Atmospheric Pressure	No Atmospheric Pressure	Warning	B	3015
No Air Temperature	No Air Temperature	Warning	B	3015

Alert	Description	Type	Cate-gory	Alert Identifier
Heartbeat Timeout	Heartbeat Timeout	Caution	B	11104
Invalid VBW Data	A VBW message contains invalid data	Warning	A	3005
Diff. Geo. Datum	A Different geodetic datum has been received	Warning	A	3005
No Position	No Position	Warning	A	3015
No Position	No Position	Caution	B	3016
No Heading	No Heading	Caution	B	3016
No Speed Over Ground	No Speed Over Ground	Caution	B	3016
No Speed Through Water	No Speed Through Water	Caution	B	3016
No Depth	No Depth	Caution	B	3016
Collison Alert	Collision Alert	Alarm	A	3044
New GZ Target	Guard Zone Alert	Warning	A	3048

Appendix B KRS system technical specification

Antenna

Specification	RSA-1SP
Antenna Size:	6ft
Antenna Type:	Slotted Array
Polarization:	Horizontal
Beamwidth (Vertical):	25°
Beamwidth (Horizontal):	1.32°
Rotation Speed (rpm):	12, 24, 36, 48, 60
Max Wind Speed:	100 Kn
Weight:	12 Kg

Transceiver

Specification	RSB-111P
Max Range Scale:	96 Nm
Rotation Speed (rpm):	12, 24, 36, 48, 60
Power Connection:	1
Data Connection:	1
Transmitter Frequencies (Mhz):	9370, 9400, 9430
Receiver Characteristics:	Linear
Receiver Noise:	<5 dB
Peak Power Output:	110 W
Power Consumption (Typical):	95 W
Power Consumption (Standby):	30 W
Power Consumption (Max):	195 W

Specification	RSB-111P
Dimensions (mm):	388 x 360 x 335
Weight:	16 Kg

	Pulse Width (ns)	PRF (kHz)
0.25	46	4.8
0.5	46	4.8
0.75	192	4.8
1.5	192	4.8
3	2300	4.8
6	3900	4.8
12	17600	3.6
24	35000	1.6
48	79000	0.82
96	79000	0.7

	Processing
Minimum Range:	Better than Minimum Range detailed in IEC 62388[1]
Range Discrimination:	Better than Range Discrimination detailed in IEC 62388[2]
Range Accuracy:	Better than Range Accuracy detailed in IEC 62388[3]
Bearing Discrimination:	Better than Bearing Discrimination detailed in IEC 62388[4]
Bearing Accuracy:	Better than Bearing Accuracy detailed in IEC 62388[3]
Warm Up Time:	Better than Warm Up Time detailed in IEC 62388[5]
Orientation Modes:	H-UP, STAB H-UP, C-UP, N-UP
Stabilization Modes:	Ground, Sea

	Processing
Motion Modes:	True, Relative
Target Tracking:	100 Targets (Auto or Manual)
AIS:	4,000 targets simultaneously displayed 6,000 targets processed
Past Positions:	Off, 1-30 mins
Vectors:	Off, 1-30 mins
Trails:	Off, 1-30 mins
Radar Maps:	Unlimited, 6,000 points per map
Acquisition Zones:	2
PI Lines:	Unlimited

	Range Rings (NM)
0.25	0.13
0.5	0.25
0.75	0.38
1.5	0.75
3	1
6	2
12	3
24	6
36	6
48	8
96	16

Note:

1. (MSC.192/5.4.1) With own ship at zero speed (or at a fixed land-based site), an antenna height of 15 m above the sea level and in calm (minimal clutter) conditions, the navigational buoy (with corner reflector) in Table 2 shall be detected at a minimum horizontal range of 40 m from the antenna position and up to a range of 1 NM, without changing the setting of control functions other than the range scale selector
2. (MSC.192/5.5.1) The radar system shall be capable of displaying two point targets on the same bearing, separated by 40 m in range, as two distinct objects.
3. (MSC.192/5.2) The radar system range and bearing accuracy shall be: Range: within 30 m or 1 % of the range scale in use, whichever is greater; Bearing: within 1° in typical operational and environmental conditions.
4. (MSC.192/5.5.2) The radar system shall be capable of displaying two point targets at the same range, separated by 2,5° in bearing, as two distinct objects.
5. (MSC.192/5.8) The radar equipment shall be fully operational (run or transmit status) within 4 min after switch-on from cold. A standby condition shall be provided, in which there is no operational radar transmission. The radar shall be fully operational within 5 s from the standby condition.

Displays

	16”	19”	22”	24”
Part Number:	RSD-16P	RSD-19P	RSD-12P	RSD-14P
Screen Size:	15.6”	18.5”	21.5”	24”
Resolution:	1920 x 1080 pixels	1920 x 1080 pixels	1920 x 1080 pixels	1920 x 1200 WUXGA
Illumination:	1300 nits	1200 nits	1275 nits	1300 nits
Viewing Distance (m):	0.6	0.7	0.8	0.9
Weight (kg):	5.9	7.6	9.9	11.3
Dimensions (mm):	248.22 x 394.9 x 174.95	289.44 x 461.78 x 174.95	326.33 x 533.56 x 180.75	386.84 x 578.4 x 177.39

Interfacing

	All
Ethernet Ports:	3 PoE (10/100/1,000 Mbits/s)
IEC-61162-450 Enabled:	Yes
Buzzer Output:	2 Bare-ended wires

	A80792
Serial Port Inputs:	8 Configurable Opto-isolated
Serial Port Outputs:	6 Configurable ISO-Drive isolated
Alarm Output:	1 Alarm output relay (N/O and N/C contacts) Activated on System Fail or Specific Alert ID
LAN:	10/100BaseT, automatic polarity detection

	KRS Radar System
Input:	AAM, ACK, ACN, ALR, APB, BWC, BWR, DBT, DPT, DSC, DSE, DTM, GBS, GGA, GLC, GLL, GNS, GSA, GST, GSV, HBT, HDG, HDT, MDA, MSK, MSS, MTW, MWV, NSR, RMA, RMB, RMC, ROT, RRT, RTE, SRP, SSD, THS, TLB, TTD, TTM, VBW, VDM, VDO, VHW, VLW, VSD, VTG, WPL, XTE, ZDA
Output:	AAM, ACK, ALC, ALF, ALR, APB, ARC, BWC, BWR, DBT, DPT, DTM, EVE, GBS, GGA, GLC, GLL, GNS, GSA, GST, GSV, HBT, HDG, HDT, MDA, MSK, MSS, MTW, MWV, OSD, RMA, RMB, RMC, RRT, RSD, RTE, SRP, TLB, TTD, TTM, VHW, VLW, VTG, WPL, XTE, ZDA

Power supply

	V (DC)	V (AC)
RSB-111P	24 (via VCM100)	110 / 230 V via AC Power Kit
KRS Radar Displays	24	110 / 230 V via AC Power Kit
KRS DCU	24	110 / 230 V via AC Power Kit

Environmental

	RSB-111P
Waterproof Rating:	IPx6
Operating Temperature Range:	-25°C to +55°C (-13°F to 131°F)
Humidity:	Up to 93% at 40°C (104°F)
Maximum Wind Speed:	100 Kn

	All
Waterproof Rating:	IPx6, IPx7
Operating Temperature Range:	-25°C to +55°C (-13°F to 131°F)
Humidity:	Up to 93% at 40°C (104°F)

	A80792
Waterproof Rating:	IP40
Operating Temperature Range:	-25°C to +70°C (-13°F to 158°F)
Humidity:	Up to 95% at 55°C (131°F)

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