

Raymarine®

CYCLONE / CYCLONE PRO

Installation Instructions

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CHAPTER 1: IMPORTANT INFORMATION

Safety warnings

Warning: Product installation and operation

• This product must be installed and operated in accordance with the instructions provided. Failure to do so could result in personal injury or damage to your vessel. It may also cause poor product performance or invalidate the product warranty.

• Raymarine highly recommends certified installation by a Raymarine approved installer. A certified installation qualifies for enhanced product warranty benefits. Register your warranty on the Raymarine website: www.bit.ly/rym-warranty

Warning: Weather conditions

When working in adverse weather conditions, ensure that a full risk assessment is carried out prior to working aloft. Adverse weather conditions can include — but are not restricted to — high winds, heavy rain, snow, ice, or a sea state which may cause vessel pitch and roll.

Warning: Working aloft

When working at height, ensure that:

• All applicable regulatory, employer, shipyard and vessel health & safety requirements are adhered to, including but not limited to the inspection and use of Personal Protective Equipment (PPE), such as approved safety harnesses and protective gloves etc.

• All nearby devices with moving parts or which emit Radio Frequency (RF) radiation are fully electrically and mechanically isolated.

• Someone in authority and at ground level is aware of the required works and that suitable clear warnings are in place.

• A safety cordon is put in place below the working area.

• All access routes are secure. Beware of wet or slippery surfaces, such as work areas or ladder rungs etc.

• All equipment and loose items such as replacement equipment and tools are safely stowed or secured, to prevent a drop hazard.

Warning: Object lifting

• When lifting the product, equipment or spare items to a platform or via a ladder, heavy objects must be lifted using a suitably-rated lifting bag or strops.

• Where applicable, it is highly recommended that you use the lifting equipment (e.g. lifting bag or strops) which is supplied with your product. Raymarine will not be held liable for any product damage, vessel damage or personal injury which is caused as a result of using a third-party alternative.

• You MUST NOT manually carry heavy objects up ladders, as they can present a drop hazard.

Warning: Potential ignition source

This product is NOT approved for use in hazardous/flammable atmospheres. Do NOT install in a hazardous/flammable atmosphere (such as in an engine room or near fuel tanks).

Warning: Radar scanner safety

Before rotating the Radar scanner, ensure all personnel are clear.

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.

Warning: High voltage

This product contains high voltage. Do NOT remove covers or attempt to access internal components, unless specifically instructed in the documentation provided.

Warning: Switch off power supply

Ensure that the vessel's power supply is switched OFF before starting to install this product. Do NOT connect or disconnect equipment with the power switched on, unless instructed to do so in this document.

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.

Cyclone (E70620)

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**
3 ft Antenna (E70628)	0.2 m which is < Swept Volume (0.52 m)	0.3 m which is < Swept Volume (0.52 m)
4 ft Antenna (E70629)	0.2 m which is < Swept Volume (0.67 m)	0.4 m which is < Swept Volume (0.67 m)
6 ft Antenna (E70630)	0.2 m which is < Swept Volume (0.975 m)	0.4 m which is < Swept Volume (0.975 m)

Cyclone Pro (E70621)

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
3 ft Antenna (E70628)	0.2 m which is < Swept Volume (0.52 m)	0.5 m which is < Swept Volume (0.52 m)
4 ft Antenna (E70629)	0.3 m which is < Swept Volume (0.67 m)	0.5 m which is < Swept Volume (0.67 m)
6 ft Antenna (E70630)	0.3 m which is < Swept Volume (0.975 m)	0.5 m which is < Swept Volume (0.975 m)

Product warnings

Warning: Product grounding

Before applying power to this product, it MUST be correctly grounded, in accordance with the instructions provided.

Warning: Positive ground systems

Do NOT connect this unit to a system which has positive grounding.

Warning: Power supply voltage

Connecting this product to a voltage supply greater than the specified maximum rating may cause permanent damage to the unit. For the correct voltage, refer to the information label affixed to the product.

Caution: Power supply protection

When installing this product, ensure that the power source is adequately protected by means of a suitably-rated fuse or thermal circuit breaker.

Caution: Service and maintenance

This product contains no user serviceable components. Please refer all maintenance and repair to authorized Raymarine dealers. Unauthorized repair may affect your warranty.

Caution: Doppler limitations

When the target's speed is more than 60 knots Speed Over Ground (SOG), or the relative speed between your vessel and the target is greater than 120 knots, the direction of target returns from high speed vessels may be displayed incorrectly. Consequently, **the displayed target colors may be inverted, with targets colored red when they should be green, and vice versa.**

Regulatory notices

IEEE statement

IEEE C95.1 – 2005 – Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

ICNIRP Guidelines

When properly installed and operated, the use of this radar conforms to: ICNIRP Guidelines 1998 - International Commission on Non-Ionising Radiation Protection: Guidelines for limiting exposure to time-varying electric, magnetic and electro-magnetic fields (up to 300 GHz) 1998.

Water ingress

Water ingress disclaimer

Although the waterproof rating capacity of this product meets the stated water ingress protection standard (refer to the product's *Technical Specification*), water intrusion and subsequent equipment failure may occur if the product is not installed correctly or subjected to high-pressure washing. Raymarine will not warrant products subjected to high-pressure washing.

Disclaimer

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

Raymarine 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. Raymarine UK Ltd or its affiliates have not tested or screened the third-party hardware.

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EMC installation guidelines

Raymarine equipment and accessories conform to the appropriate Electromagnetic Compatibility (EMC) regulations, to minimize electromagnetic interference between equipment and minimize the effect such interference could have on the performance of your system.

Correct installation is required to ensure that EMC performance is not compromised.

Note:
In areas of extreme EMC interference, some slight interference may be noticed on the product. Where this occurs the product and the source of the interference should be separated by a greater distance.

For **optimum** EMC performance we recommend that wherever possible:

- Raymarine equipment and cables connected to it are:
  - At least 1 m (3.28 ft) from any equipment transmitting or cables carrying radio signals e.g. VHF radios, cables and antennas. In the case of SSB radios, the distance should be increased to 2 m (6.56 ft).
  - More than 2 m (6.56 ft) from the path of a radar beam. A radar beam can normally be assumed to spread 25 degrees above and below the radiating element.
- The product is supplied power from a separate battery to that used for engine start. This is important to prevent erratic behavior and data loss which can occur if the engine start does not have a separate battery.
- Raymarine specified cables are used.
- Cables are not cut or extended, unless doing so is detailed in the installation manual.
- USB cables, where used must not be longer than 1 m (3.28 ft) in length.

Note:
Where constraints on the installation prevent any of the above recommendations, always ensure the maximum possible separation between different items of electrical equipment, to provide the best conditions for EMC performance throughout the installation.

Suppression ferrites

- Raymarine cables may be pre-fitted or supplied with suppression ferrites. These are important for correct EMC performance. If ferrites are supplied separately to the cables (i.e. not pre-fitted), you must fit the supplied ferrites, using the supplied instructions.

- If a ferrite has to be removed for any purpose (e.g. installation or maintenance), it must be replaced in the original position before the product is used.
- Use only ferrites of the correct type, supplied by Raymarine or its authorized dealers.
- Where an installation requires multiple ferrites to be added to a cable, additional cable clips should be used to prevent stress on the connectors due to the extra weight of the cable.

Connections to other equipment

Requirement for ferrites on non-Raymarine cables:

If your Raymarine equipment is to be connected to other equipment using a cable not supplied by Raymarine, a suppression ferrite MUST always be attached to the cable near the Raymarine unit.

For more information, refer to your third-party cable manufacturer.

Compass safe distance

To prevent potential interference with the vessel's magnetic compasses, ensure an adequate distance is maintained from the product.

When choosing a suitable location for the product, you must aim to maintain a distance of **at least** 1 m (3.3 ft.) in all directions from any compasses.

For some smaller vessels it may not be possible to locate the product this far away from a compass. In this situation, when choosing the installation location for your product, ensure that the compass is not affected by the product when it is in a powered on state.

Japanese approvals - Technical Regulation Conformity Certification

This equipment contains specified radio equipment that has been certified to the *Technical Regulation Conformity Certification* under the Radio Law.

Declaration of Conformity (Cyclone)

Declaration of Conformity for product sold into the UK, Australia and New Zealand, and EU member state regions.

Applicability: Cyclone pedastals and antennas.

Raymarine UK Ltd declares that the radio equipment type Cyclone **pedastal** E70620, when fitted with any of the antennas listed below, is in conformity with the relevant sections of the listed designated standards and / or other normative documents:

- 3 ft Open Array Radar **antenna**, part number E70628
- 4 ft Open Array Radar **antenna**, part number E70629
- 6 ft Open Array Radar **antenna**, part number E70630

Region	Standard	Mark
UK	EMC Regulations 2016	UKCA
EU	Radio Equipment Directive 2014/53/EU	CE
Australia and New Zealand	AS/NZS 4417.1 & 2	

The original Declaration of Conformity certificate may be viewed or downloaded via the following web page: www.bit.ly/cyclone-radar-docs

Declaration of Conformity (Cyclone Pro)

Declaration of Conformity for product sold into the UK, Australia and New Zealand, and EU member state regions.

Applicability: Cyclone Pro pedastals and antennas.
Raymarine UK Ltd declares that the radio equipment type Cyclone Pro **pedastal** E70621, when fitted with any of the antennas listed below, is in conformity with the relevant sections of the listed designated standards and / or other normative documents:

- 3 ft Open Array Radar **antenna**, part number E70628
- 4 ft Open Array Radar **antenna**, part number E70629
- 6 ft Open Array Radar **antenna**, part number E70630

Region	Standard	Mark
UK	EMC Regulations 2016	UKCA
EU	Radio Equipment Directive 2014/53/EU	CE
Australia and New Zealand	AS/NZS 4417.1 & 2	

The original Declaration of Conformity certificate may be viewed or downloaded via the following web page: www.bit.ly/cyclone-radar-docs

Declaration of Conformity — VCM100 (E70648)

Declaration of Conformity for product sold into the UK, Australia and New Zealand, and EU member state regions.

Applicability: VCM100 (E70648).
Raymarine UK Ltd declares that the VCM100 (E70648) **Voltage Converter Module**, part number A80808, is in conformity with the relevant sections of the listed designated standards and / or other normative documents:

Region	Standard	Mark
UK	EMC Regulations 2016	UKCA
EU	EMC Directive 2014/30/EU	CE
Australia and New Zealand	AS/NZS 4417.1 & 2	

The original Declaration of Conformity certificate may be viewed on the relevant product page at www.bit.ly/rym-docs

PSTI Compliance

For products sold into the United Kingdom (UK), use the following link to obtain the product's Statement of Compliance with the *Product Security and Telecommunications Infrastructure* (PSTI) Regulations:

Visit the following web address and enter the product's model name or number (SKU) into the provided search field:

- www.bit.ly/rym-sec-com

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.88 — Licensing issuing authorities

FCC Notice

Changes or modifications to this equipment not expressly approved in writing by Raymarine Incorporated could violate compliance with FCC rules and void the operator's authority to operate the equipment.

FCC Approval codes

Cyclone — FCC ID: PJ5-953LPSSR
Cyclone Pro — FCC ID: PJ5-953MPSSR

ISED Canada approval codes

Cyclone — IC:4069B-953LPSSR
Cyclone Pro — IC:4069B-953MPSSR

IMO and SOLAS

The equipment described within this document is intended for use on leisure marine boats and workboats NOT covered by International Maritime Organization (IMO) and Safety of Life at Sea (SOLAS) Carriage Regulations.

Warranty policy and registration

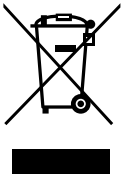
Visit the Raymarine website to **read the latest warranty policy**, and **register** your product's warranty online: www.bit.ly/rym-warranty

It is important that you register your product to receive full warranty benefits. Your product package includes a barcode label indicating the serial number of the unit. This serial number is also provided on a label affixed to the product itself. You will need this serial number when registering your product online.

Product disposal

Dispose of this product in accordance with the WEEE Directive.

The Waste Electrical and Electronic Equipment (WEEE) Directive requires the recycling of waste electrical and electronic equipment which contains materials, components and substances that may be hazardous and present a risk to human health and the environment when WEEE is not handled correctly.



Equipment marked with the crossed-out wheeled bin symbol indicates that the equipment should not be disposed of in unsorted household waste. Local authorities in many regions have established collection schemes under which residents can dispose of waste electrical and electronic equipment at a recycling center or other collection point. For more information about suitable collection points for waste electrical and electronic equipment in your region, refer to the Raymarine website: https://bit.ly/rym-recycling

Technical accuracy

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Multifunction display / chartplotter software version

To ensure optimum performance and compatibility with external devices, your multifunction display (MFD) / chartplotter must be using the latest software version.

To download the latest software, visit: www.bit.ly/rym-software

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CHAPTER 2: DOCUMENT INFORMATION

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- 2.1 Document information (page 16)

2.1 Document information

This document contains important information related to the installation of your Raymarine product.

The document includes information to help you:

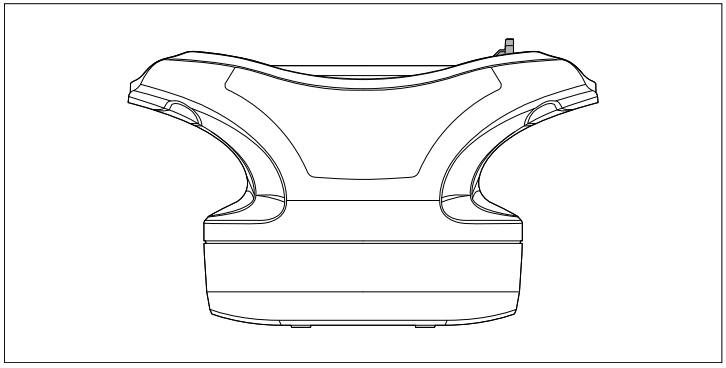
- Plan your installation and ensure you have all the necessary equipment.
- Install and connect your product as part of a wider system of connected marine electronics.
- Troubleshoot problems and obtain technical support if required.

This and other Raymarine product documents are available to download in PDF format from www.bit.ly/rym-docs

Applicable products

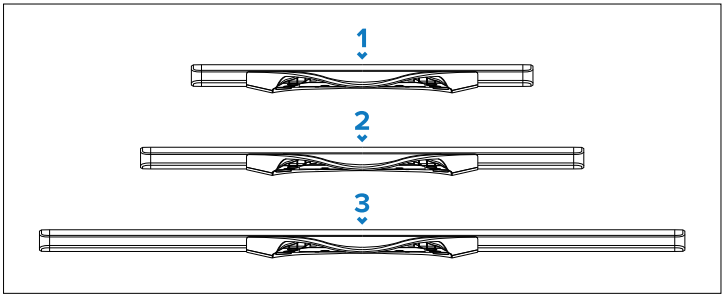
This document is applicable to the following products:

Cyclone Open Array Radar — Pedestal



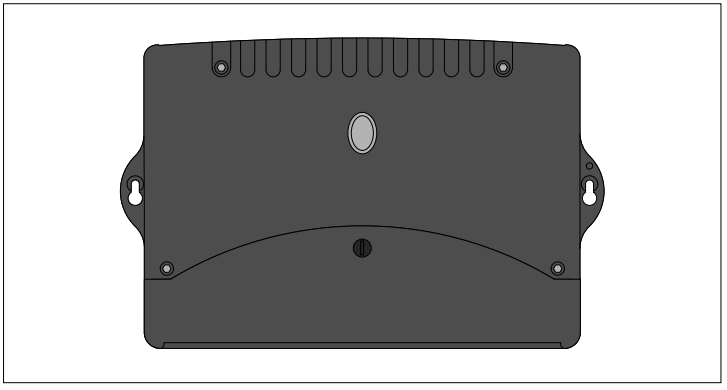
- **E70620**: Cyclone pedestal (**55 W**)
- **E70621**: Cyclone Pro pedestal (**110 W**)

Cyclone Open Array Radar — Antenna



1. **E70628**: Cyclone Antenna (**3 ft** array)
2. **E70629**: Cyclone Antenna (**4 ft** array)
3. **E70630**: Cyclone Antenna (**6 ft** array)

VCM100 Voltage Converter Module



- **VCM100 (E70648)**: Voltage Converter Module

Document illustrations

While every effort is made to ensure that the illustrations provided in this publication accurately reflect the final released product, due to editorial and production lead times, your product — and if applicable — its user interface, may differ slightly from the illustrations provided in this document, depending on product variant and date of manufacture.

All images are provided for illustration purposes only.

Product documentation

The following documentation is applicable to your product:

- **87402** — Cyclone Open Array Radar Installation Instructions (this document)
- **87401** — Cyclone Open Array Radar Pedestal Mounting template

All product documentation is available from the Raymarine website: www.bit.ly/rym-docs

Operation instructions

For detailed operation instructions for your product, refer to the documentation that accompanies your display.

Document	Description	Link
81406	LightHouse 4 Operation Instructions	www.bit.ly/LH4-docs
81370	LightHouse 3 Operation Instructions	www.bit.ly/LH3-docs

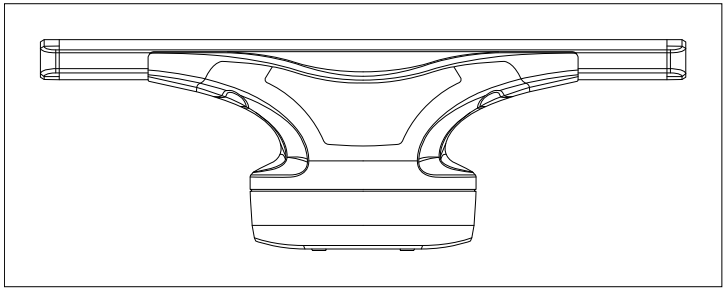
CHAPTER 3: PRODUCT AND SYSTEM OVERVIEW

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3.1 Product overview

The Cyclone and Cyclone Pro are Solid State open array Radar scanners. Cyclone provides a map-like representation of an extended area around your vessel, enabling you to identify birds, weather, other vessels, and land features such as coastlines and hills.



The Cyclone and Cyclone Pro Open Array Radars include the following features:

- Solid-state technology (no magnetron) for improved efficiency, and rapid start-up.
- Choice of 3, 4, or 6 ft antenna array.
- Choice of two power outputs — 55 W (Cyclone) or 110 W (Cyclone Pro).
- Low-profile design (335 mm / 13.1 in height), for greater installation flexibility.
- Instrumented range up to 96 Nm (dependent on model and installation location).
- Scanner rotation up to 60 RPM, for high-speed imaging.
- 100 knot wind rating, meeting the IEC 62388 standard for shipborne Radar.
- Narrow horizontal beam widths for enhanced target separation.
- CHIRP pulse compression for improved target range resolution, and reduced background noise.
- ARPA automatic target acquisition and tracking (up to 100 simultaneous ARPA targets — requires *LightHouse 4, v4.4 or later*, and *Cyclone software v.1.25, or later*), and collision avoidance.
- Doppler display, making it easier to track approaching and receding objects.
- Enhanced Bird Mode — Radar gain and tuning are automatically optimized for identifying clusters of sea birds, to assist you in locating fishing spots.
- Weather detection.
- RangeFusion™ — short and long pulses are combined to provide a high-clarity Radar image for both short-range and long-range targets, simultaneously.
- Radar image display and control via Raymarine multifunction display.
- Real-time heading display.
- Data connection via RayNet cable.
- 12 V or 24 V operation (with VCM100 power converter)
- Waterproof to IPX 6.

Multiple radar scanners

You can use a **maximum of two radar scanners** at any one time, per networked system.

For example, you can install, and simultaneously use:

- A Cyclone series Open Array radar, and another Raymarine® radar (e.g. a Quantum Radome).
- Two Cyclone series Open Array radars.

Note:
You can use **only one Quantum radome** at any one time, per networked system.

For important information on how to position multiple radar scanners to avoid interference between the scanners, refer to:
p.33 — Multiple Radar scanners — location requirements

Doppler Radar overview

Doppler Radar technology makes it easier to track moving objects with ground speed exceeding 3 knots.

The Doppler function highlights objects on the Radar display that are moving towards or away from the vessel (e.g. other vessels, but not land or buoys, for example). Stationary targets will not be highlighted.

Doppler Radar technology is particularly beneficial in a marine environment, where poor weather conditions and visibility can make object tracking challenging. With the integration of Doppler information on the Radar display, the process of matching on-screen Radar returns with real-world objects becomes a much simpler task.

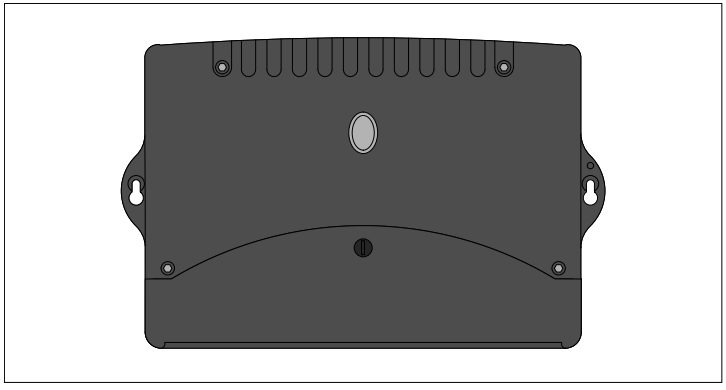
Doppler Radar works by transmitting a microwave signal which is then reflected off a moving object at a distance. By analyzing how the object's motion has altered the frequency of the returned signal, the Doppler Radar can interpret the variation to provide highly accurate measurements of an object's direction of travel, relative to the Radar scanner.

3.2 VCM100 Voltage Converter Module (VCM)

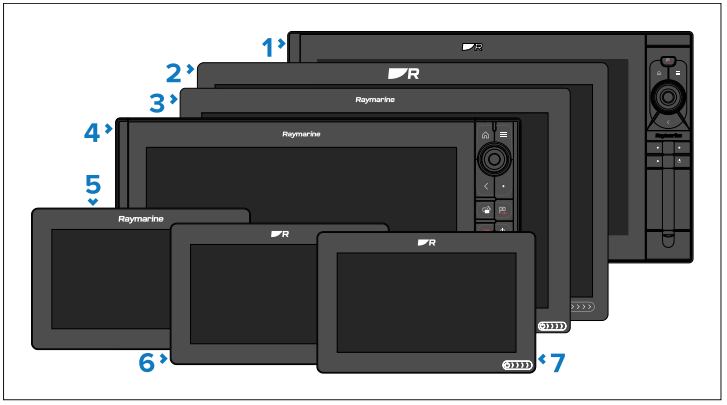
The VCM100 converts the source of direct current from your vessel's power source to a safe level for the connected product.

Important:

- The VCM100 is an **essential** component in your product's system and MUST be used to supply power to the product. The model number of the VCM that is suitable for use with your product is: VCM100 (E70648).
- Do NOT use other versions of the VCM with your product.



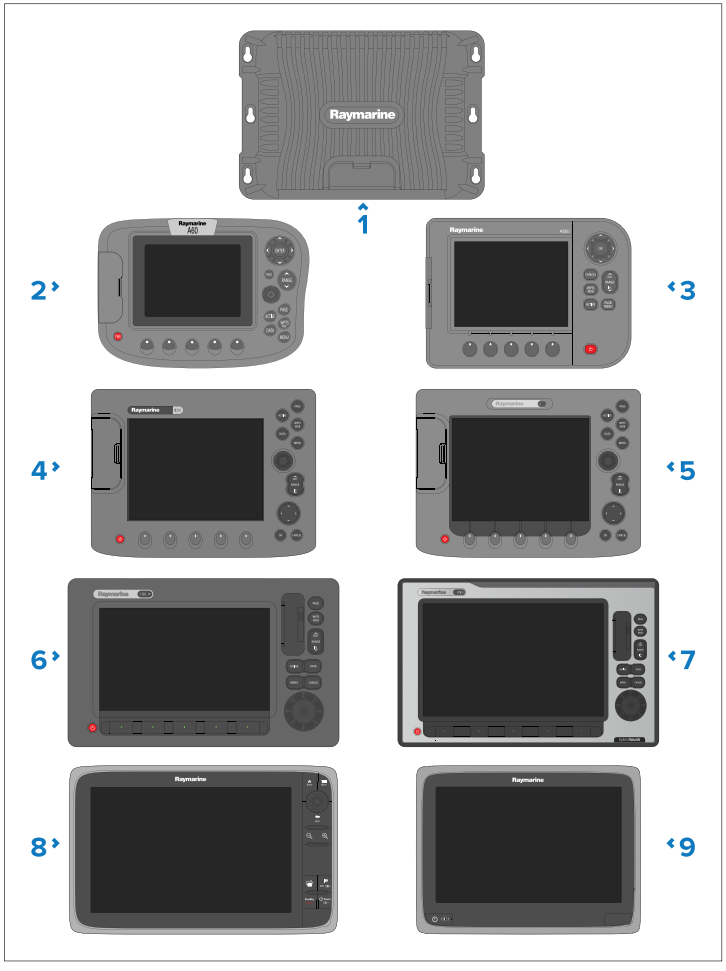
3.3 Compatible multifunction displays / chartplotters



	Compatible Raymarine MFDs / chartplotters	Required software version
1	Axiom 2 Pro	LightHouse 4, v4.3.54 (or later)
2	Axiom 2 XL	LightHouse 4, v4.4.70 (or later)
3	Axiom XL	• LightHouse 4, v4.1.75 (or later) • LightHouse 3, v3.16.61 (or later)
4	Axiom Pro	• LightHouse 4, v4.1.75 (or later) • LightHouse 3, v3.16.61 (or later)
5	Axiom	• LightHouse 4, v4.1.75 (or later) • LightHouse 3, v3.16.61 (or later)
6	Axiom+	• LightHouse 4, v4.1.75 (or later) • LightHouse 3, v3.16.61 (or later)
7	Axiom 2	• LightHouse 4, v4.11.103 (or later)

3.4 Incompatible multifunction displays / chartplotters

This product is NOT compatible with the following legacy Raymarine multifunction displays (MFDs) / chartplotters:



	Incompatible Raymarine MFDs / chartplotters
1	**G-Series** GPM400
2	**“Classic” A-Series** A60, A65
3	**“Classic” A-Series** A50, A50D, A57D, A70, A70D
4	**“Classic” C-Series** C70, C80, C120
5	**“Classic” E-Series** E80, E120
6	**C-Series Widescreen** C90W, C120W, C140W
7	**E-Series Widescreen** E90W, E120W, E140W
8	**c Series** c95, c97, c125, c127 **e Series** e7, e7D, e95, e97, e125, e127, e165
9	**a Series** a65, a67, a68, a75, a77, a78, a95, a97, a98, a125, a127, a128

3.5 ARPA software requirements

Important ARPA software compatibility information.

Important:

- Only LightHouse 4 versions **v.4.4 or later** and Cyclone software **v1.25 or later** support the tracking of up to 100 simultaneous ARPA targets.
- Earlier *Cyclone-compatible* versions of LightHouse 4 support the tracking of up to 50 simultaneous ARPA targets.
- *Cyclone-compatible* versions of LightHouse 3 support the tracking of up to 50 simultaneous ARPA targets.

Note:
To obtain the latest software for your Raymarine products, visit: www.raymarine.com/software

3.6 Software updates

Product software updates may be made available which add new features and improve existing functionality. It's important to ensure that you have the latest software for your products by regularly checking the Raymarine website for new software releases.

To check for the latest software updates and the software update procedure for your specific product(s), refer to: www.bit.ly/rym-software

Unless otherwise stated, software updates for Raymarine products are performed using a Raymarine multifunction display (MFD) / chartplotter.

- Where applicable, you should always backup your user data and settings before performing a software update.
- To update SeaTalk NG products, you must use the datamaster MFD / chartplotter which is physically connected to the SeaTalk NG backbone.
- Ethernet (RayNet) products can be updated from any MFD / chartplotter on the same network as the product to be updated.
- In order to perform a software update, any connected Autopilot or Radar must be switched to Standby.
- The MFD / chartplotter "Check online" feature is only available when connected to the Internet.

Note:
If in doubt as to the correct procedure for updating your product software, refer to your dealer or Raymarine technical support.

Caution: Installing software updates

- The software update process is carried out at your own risk. Before initiating the update process ensure you have backed up any important files.
- Ensure that the product(s) has a reliable power supply and that the update process is not interrupted.
- Damage caused by an incomplete update is not covered by Raymarine warranty.
- By downloading the software update package, you agree to these terms.

3.7 Required additional components

This product forms part of a system of electronics and requires the following additional components for full operation.

- Compatible Raymarine multifunction display / chartplotter. For a list of compatible displays, refer to: **p.20 — Compatible displays**
- Optional ARPA data source. For more information, refer to **p.23 — Radar target acquisition data source requirements**
- Use of the Doppler Radar features requires data sources to be available on your system (e.g. connected to your display, via SeaTalk NG or NMEA 0183). For more information refer to: **p.23 — Doppler data source requirements**.

Radar target acquisition data source requirements

Radar target acquisition requires the following data sources to be available on your system (e.g. connected to your multifunction display, via SeaTalk NG or NMEA 0183).

Data type	Example data source
COG (Course Over Ground)	GNSS (GPS) receiver (multifunction display / chartplotter internal receiver or external receiver).
SOG (Speed Over Ground)	GNSS (GPS) receiver (multifunction display / chartplotter internal receiver or external receiver).
HDG / HDT (True Heading)	Compass or Autopilot sensor providing Fastheading data (e.g. Evolution-Series EV-1 / EV-2).

Doppler data source requirements

Use of the Doppler Radar features requires the following data sources to be available on your system (e.g. connected to your multifunction display / chartplotter, via SeaTalk NG or NMEA 0183).

Required data sources

Data type	Example data source
COG (Course Over Ground)	GNSS (GPS) receiver (MFD / chartplotter internal receiver or external receiver).
SOG (Speed Over Ground)	GNSS (GPS) receiver (MFD / chartplotter internal receiver or external receiver).

Recommended data source

Data type	Example data source
HDG / HDT (True Heading)	Compass or Autopilot sensor providing Fastheading data (e.g. Evolution-Series EV-1 / EV-2).

Note:
A heading data source is not essential for Doppler operation. However it will improve the performance of Doppler mode at slower speeds (< 15 knots), when tide set and leeway are present.

CHAPTER 4: PARTS SUPPLIED

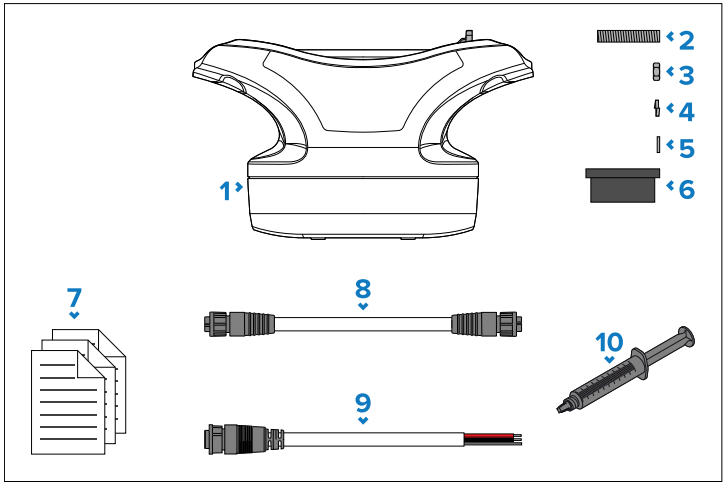
CHAPTER CONTENTS

- 4.1 Parts supplied (Radar scanner pedestal) (page 25)
- 4.2 Parts supplied (Radar scanner antenna) (page 25)
- 4.3 Inline fuse requirement (page 25)
- 4.4 Topfills / System packs — Cyclone (page 26)
- 4.5 Topfills / System packs — Cyclone Pro (page 26)
- 4.6 Parts supplied (VCM100) (page 27)

4.1 Parts supplied (Radar scanner pedestal)

The following parts are supplied with the radar scanner pedestal:

Unpack your product carefully to prevent damage or loss of parts. Check the box contents against the list below. Retain the packaging and documentation for future reference.

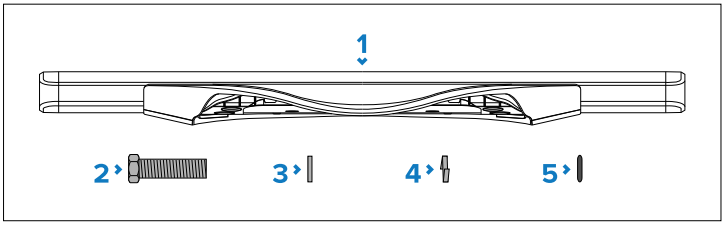


	Description
1	Radar pedestal
2	M10 stud x4
3	M10 nut x8
4	M10 spring washer x4
5	M10 plain washer x4
6	Cable gasket
7	Documentation pack
8	RayNet data cable
9	Power cable
10	Denso paste

4.2 Parts supplied (Radar scanner antenna)

The following parts are supplied with the radar scanner antenna:

Unpack your product carefully to prevent damage or loss of parts. Check the box contents against the list below. Retain the packaging and documentation for future reference.

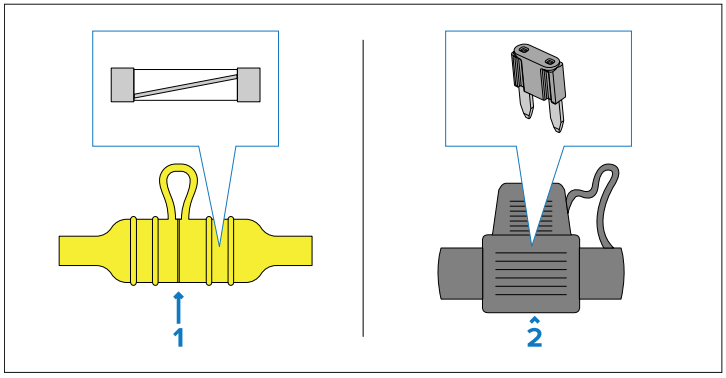


	Description
1	Radar Antenna
2	M8 Hex Bolt x4
3	M8 Plain Washer x4
4	M8 Spring Washer x4
5	O Ring x4

4.3 Inline fuse requirement

If your product is NOT supplied with an inline fuse (whether separately or fitted to the power cable), you MUST fit a suitably-rated inline fuse to your product's red power wire, housed in a waterproof fuse holder.

The illustration below shows the two main types of inline fuse with waterproof holder, for use in marine electronics installations. Fuses in a variety of ratings are widely available at chandleries and marine electrical retailers.
Select one of the following fuse types to protect your product:



1. Waterproof fuse holder containing a “glass”-type inline fuse.
2. Waterproof fuse holder containing a “blade”-type inline fuse.

Fuse ratings:

- *Voltage rating* — must be equal to or greater than the voltage of your vessel’s power supply.
- *Current rating* — refer to the *Inline fuse and thermal breaker rating* section in this document.

4.4 Topfills / System packs — Cyclone

The Cyclone Radar is also available in a range of “topfills” (system packs), which include additional accessories such as cables.

Cyclone 3 ft Array — 15 m Cables (T70491)

Part	Description
E70620	Cyclone Pedestal
E70628	Cyclone 3 ft Antenna
A80653	Cyclone power cable 15 m (49 ft)
A80659	Radar data cable 15 m (49 ft)
E70648	VCM100

Cyclone 4 ft Array — 15 m Cables (T70492)

Part	Description
E70620	Cyclone Pedestal
E70629	Cyclone 4 ft Antenna
A80653	Cyclone power cable 15 m (49 ft)
A80659	Radar data cable 15 m (49 ft)
E70648	VCM100

Cyclone 6 ft Array — 15 m Cables (T70493)

Part	Description
E70620	Cyclone Pedestal
E70630	Cyclone 6 ft Antenna
A80653	Cyclone power cable 15 m (49 ft)
A80659	Radar data cable 15 m (49 ft)
E70648	VCM100

4.5 Topfills / System packs — Cyclone Pro

The Cyclone Pro Radar is also available in a range of “topfills” (system packs), which include additional accessories such as cables.

Cyclone Pro 3 ft Array — 15 m Cables (T70494)

Part	Description
E70621	Cyclone Pro Pedestal
E70628	Cyclone 3 ft Antenna
A80653	Cyclone Power Cable 15 m
A80659	Radar data Cable 15 m
E70648	VCM100

Cyclone Pro 4 ft Array — 15 m Cables (T70495)

Part	Description
E70621	Cyclone Pro Pedestal
E70629	Cyclone 4 ft Antenna
A80653	Cyclone Power Cable 15 m
A80659	Radar data Cable 15 m
E70648	VCM100

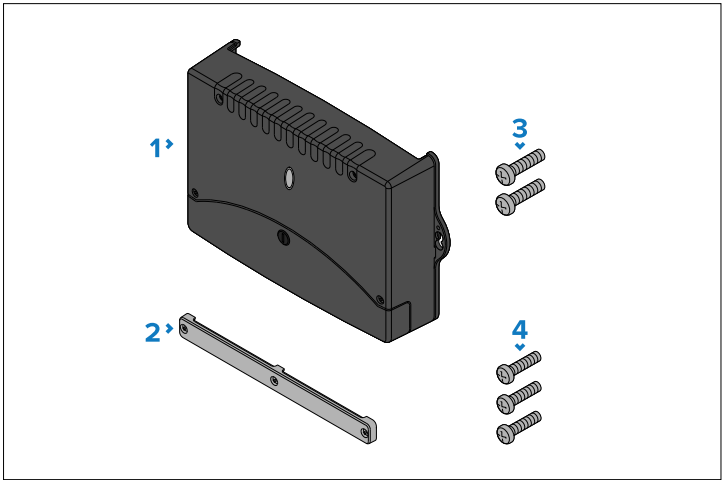
Cyclone Pro 6 ft Array — 15 m Cables (T70496)

Part	Description
E70621	Cyclone Pro Pedestal
E70630	Cyclone 6 ft Antenna
A80653	Cyclone Power Cable 15 m
A80659	Radar data Cable 15 m
E70648	VCM100

4.6 Parts supplied (VCM100)

The following parts are supplied with the VCM100.

Unpack your product carefully to prevent damage or loss of parts. Check the box contents against the list below. Retain the packaging and documentation for future reference.



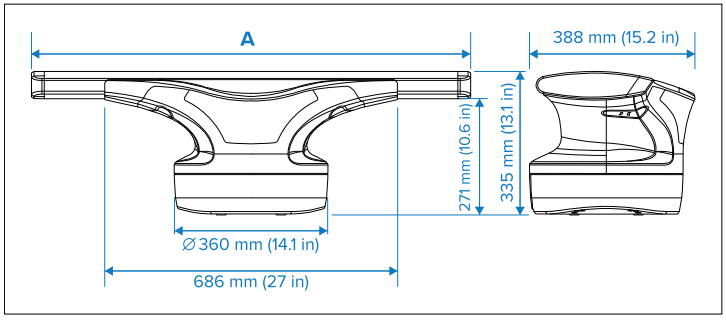
	Description
1	VCM100
2	Cable clamp
3	VCM100 mounting screw x2
4	Cable clamp mounting screw x3

CHAPTER 5: PRODUCT DIMENSIONS

CHAPTER CONTENTS

- 5.1 Product dimensions (Cyclone-Series) (page 29)
- 5.2 Product dimensions (VCM100) (page 29)

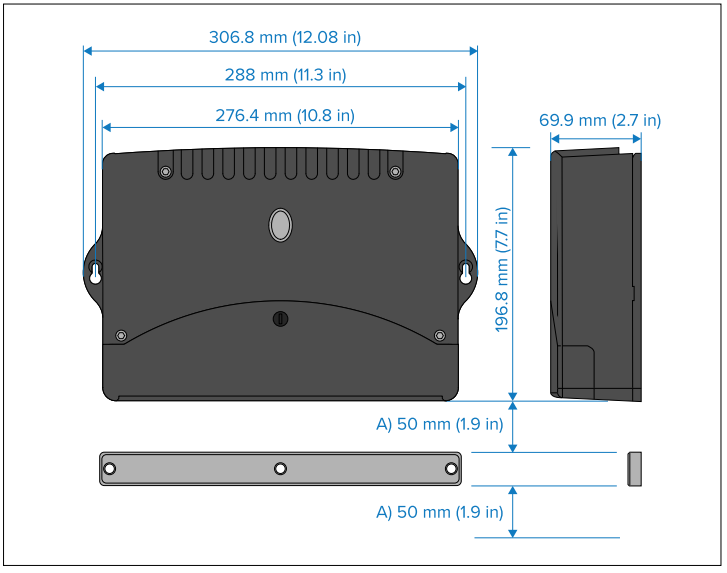
5.1 Product dimensions (Cyclone-Series)



Dimension A — Antenna size is determined by model:

Model	Dimension
E70628 – (36 in array)	1031 mm (40.5 in)
E70629 – (48 in array)	1336 mm (52.5 in)
E70630 – (72 in array)	1945 mm (76.5 in)

5.2 Product dimensions (VCM100)



A) — Minimum cable clearance

CHAPTER 6: LOCATION REQUIREMENTS

CHAPTER CONTENTS

- 6.1 Warnings and cautions (page 31)
- 6.2 Radar position overview (page 31)
- 6.3 Radar scanner general location requirements (page 31)
- 6.4 Compass safe distance (page 32)
- 6.5 Radar scanner mounting angle (page 32)
- 6.6 Multiple Radar scanners — location requirements (page 33)
- 6.7 VCM100 location requirements (page 33)

6.1 Warnings and cautions

Important:
Before proceeding, ensure that you have read and understood the warnings and cautions provided in the following section of this document:

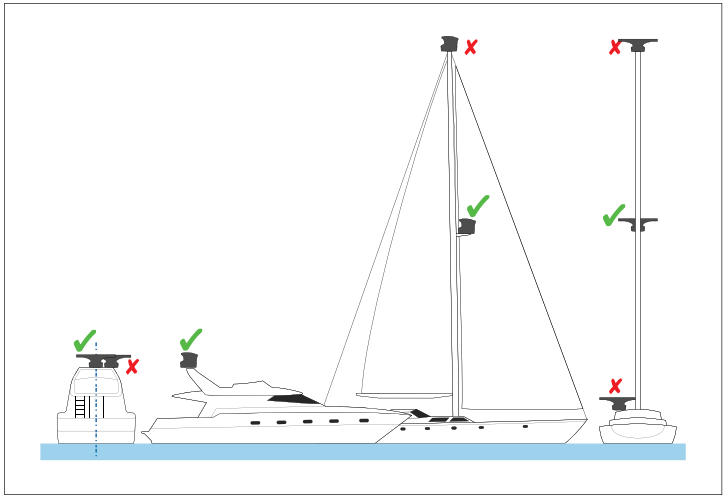
• p.8 — Important information

Warning: Potential ignition source

This product is NOT approved for use in hazardous/flammable atmospheres. Do NOT install in a hazardous/flammable atmosphere (such as in an engine room or near fuel tanks).

6.2 Radar position overview

The optimum height for a Radar scanner is high enough above the waterline to give a long range line-of-sight to the horizon, but not so high as to be adversely affected by the vessel's pitching and rolling.



The scanner must also be mounted where it is:

- Above head height.
- Easily accessible.
- As near as possible to the vessel's centerline.
- On a rigid and stable platform, capable of securely supporting the scanner under seagoing conditions.
- For GPS, ensure unobstructed view of the sky. Avoid large structures above the antenna.
- Clear of large objects such as the flybridge, large engine stacks, searchlights, horns, masts etc.
- Clear of heat and fumes.
- At least 1 m (3 ft) from a magnetic compass or other scanners.

6.3 Radar scanner general location requirements

When selecting a location it is important to consider a number of factors.

Horizontal position

The radar scanner should be positioned as near as possible to your vessel's centerline.

Height

The radar scanner should normally be mounted as high as practical above the waterline:

- Mount the scanner above head height out of range of personnel, to avoid mechanical danger and minimize exposure to electromagnetic radiation.
- Radar operates at the line-of-sight, so a high mounting position gives better long range performance.
- Surrounding large objects, in the same horizontal plane, can interfere with the radar signal and cause blind areas or shadow sectors and false targets on the radar display (see below).

Do not mount the radar scanner so high that it is affected by the pitching and rolling of the vessel.

Shadow areas and false echoes

Mount the radar scanner away from large structures or equipment, such as engine stacks, searchlights, horns, or masts. These objects

may cause shadow areas and false echoes. For example, if you mount the radar scanner on a mast, echoes from other targets may be reflected from the mast. Wet sails may also cause shadow areas, so radar performance may be reduced in the rain. It is particularly important to avoid shadow areas near the bow. Raising or even lowering the radar scanner may help to reduce these effects.
In shadow areas beyond the obstruction there will be a reduction of the beam intensity. There may be a blind sector if the beam intensity is not sufficient to obtain an echo from an object. This may occur even at close range. For this reason the angular width and relative bearing of any shadow area must be determined at installation.
You may be able to detect shadow areas or false echoes on your multifunction display. For example, sea clutter can be used as a good indicator of blind arcs. Dark sectors on the radar display indicate possible shadowed areas. This information should be posted near the display unit and operators must be alert for targets in these blind areas.

Access

The radar scanner should be easily accessible to allow maintenance to be carried out safely. Sufficient clearance must be allowed to fully open the scanner unit for maintenance and service.

Mounting platform

The radar scanner must be mounted on a rigid and stable platform. The platform must be capable of supporting the mass and inertia of the radar scanner under seagoing conditions. The platform should not twist (causing bearing errors) or be subject to excessive vibration or shock.
The platform must be free-draining, to prevent the pooling of water beneath the radar scanner.
The mounting site must be clear of the following:

- Ropes.
- Standing rigging.
- Running rigging.
- Heat.
- Fumes.
- People.

Magnetic compass

Mount the radar scanner at least 1 m (3.28 ft) away from a magnetic compass.

Cables

- All cables should be adequately clamped and protected from physical damage and exposure to heat. Avoid running cables through bilges or doorways, or close to moving or hot objects.
- Where a cable passes through an exposed bulkhead or deckhead, use a watertight feed-through.

6.4 Compass safe distance

To prevent potential interference with the vessel's magnetic compasses, ensure an adequate distance is maintained from the product.

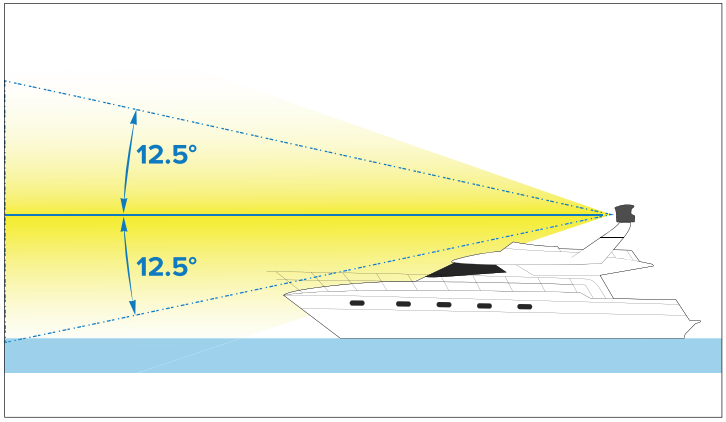
When choosing a suitable location for the product, you must aim to maintain a distance of **at least** 1 m (3.3 ft.) in all directions from any compasses.

For some smaller vessels it may not be possible to locate the product this far away from a compass. In this situation, when choosing the installation location for your product, ensure that the compass is not affected by the product when it is in a powered on state.

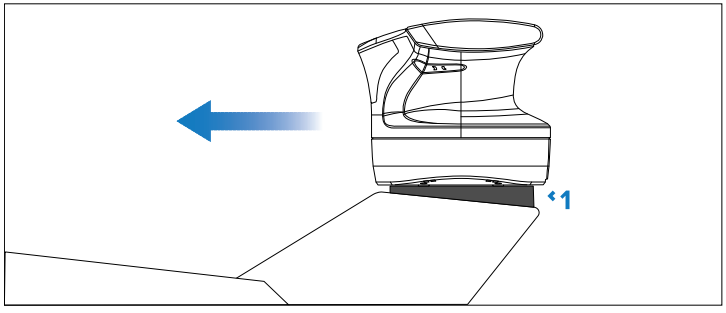
6.5 Radar scanner mounting angle

Ensure the Radar scanner rotates parallel to the water line.

The Radar beam from the Radar scanner is approximately 25° wide in the vertical direction, to give good target detection even when your vessel pitches and rolls.



Planing hull vessels, and some displacement hull vessels, adopt a higher bow angle when the vessel is at cruising speed. This may raise the Radar's main radiation angle, and can cause poor detection of nearby targets. It may be necessary to compensate for the bow rise to ensure optimum target detection. This can be achieved by fitting a wedge or washers between the mounting platform and the base of the Radar scanner, so that the Radar beam remains parallel to the water line when the vessel's bow rises at cruising speed.



1. Wedge or washers

6.6 Multiple Radar scanners — location requirements

There are important considerations when installing multiple radar scanners on the same vessel.

Note:
For SOLAS approved installations only one Radar scanner should be connected to a single display.

- Radar Scanners should be mounted so that they are aligned vertically, one directly above the other, separated by at least 2 m (6.6 ft).
- Multiple scanners should be mounted in a way that minimizes interference between the vertical beamwidths of the 2 scanners.
- In all cases, you should aim to achieve as much physical separation as possible, to minimize any potential interference.
- If the Radar scanners can't be aligned one directly above the other, locate each scanner the same distance from the bow of the vessel. Interference is more likely if the scanners are installed one in front of the other, even when separated vertically.
- If two radar scanners are installed at different locations in a dual radar system, care should be taken to allow for the difference in position of the Radar scanners when switching between the two on your display. This is especially noticeable at short ranges on larger vessels.

6.7 VCM100 location requirements

When selecting a mounting location it is important to consider a number of factors.

- **Mounting orientation** — Ensure product is mounted vertically to allow for efficient heat dissipation.
- **Ventilation** — Ensure that:
  - Equipment is mounted in a compartment of suitable size.
  - Ventilation holes are not obstructed. Allow adequate separation of equipment.

- **Mounting surface** — Ensure equipment is adequately supported on a secure surface. Do not mount units or cut holes in places which may damage the structure of the vessel.
- **Cables** — Ensure the unit is mounted in a location which allows proper routing and connection of cables:
  - Minimum bend radius of 100 mm (3.94 in) unless otherwise stated.
  - Use cable supports to prevent stress on connectors.
  - The maximum length of cable between the battery and the VCM100 should not normally exceed 6 m (19.69 ft). All power cable lengths should be kept as short as possible.
- **Water ingress** — The VCM100 is splashproof, and suitable for mounting below decks only.
- **Electrical interference** — Select a location that is far enough away from devices that may cause interference, such as motors, generators and radio transmitters/receivers.
- **Magnetic compass** — Mount the VCM100 at least 1 m (3.28 ft) away from a magnetic compass.
- **Power supply** — Select a location that is as close as possible to the vessel's DC power source. This will help to keep cable runs to a minimum.

CHAPTER 7: CABLES AND CONNECTIONS

CHAPTER CONTENTS

- 7.1 General cabling guidance (page 36)
- 7.2 Connections overview (page 37)
- 7.3 Cable routing options (page 37)

7.1 General cabling guidance

Cable types and length

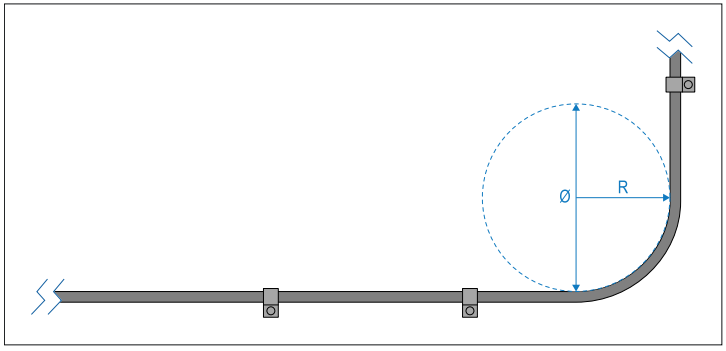
It is important to use cables of the appropriate type and length.

- Unless otherwise stated only use cables supplied by Raymarine.
- Where it is necessary to use non-Raymarine cables, ensure that they are of correct quality and gauge for their intended purpose. (e.g.: longer power cable runs may require larger wire gauges to minimize voltage drop along the run).

Cable routing and bend radius

To maximize cable performance and lifespan, it's important to ensure that all cables are routed correctly and adequate space is provided to allow for each cable's minimum bend radius.

Minimum cable bend radius



Do NOT bend cables excessively. Wherever possible, ensure that your chosen product installation location allows enough clearance for the minimum cable bend diameter specified in the following table:

	Description	Value
Ø	Cable minimum bend **diameter**.	200 mm (7.87 in.)
R	Cable minimum bend **radius**.	100 mm (3.94 in.)

Note:
For products where multiple different cable types are connected, each with a different minimum cable bend radius, the higher figure is provided in the table above (i.e. the cable with the greatest minimum bend radius is specified).

Cable routing — best practices

- Protect all cables from physical damage and exposure to heat. Use trunking or conduit where possible. Do NOT run cables through bilges or doorways, or close to moving or hot objects.
- Secure cables in place using cable clips or cable ties. Coil any excess cable and tie it out of the way.
- Where a cable passes through an exposed bulkhead or deckhead, use a suitable watertight feed-through (conduit).
- Do NOT run cables near to engines or fluorescent lights.
- Always route data cables as far away as possible from:
  - Other equipment and cables.
  - High current-carrying AC and DC power lines.
  - Antennas.

Strain relief

Use adequate strain relief for cabling to ensure that connectors are protected from strain and will not pull out under extreme sea conditions.

Circuit isolation

Appropriate circuit isolation is required for installations using both AC and DC current:

- Always use isolating transformers or a separate power-inverter to run PCs, processors, displays and other sensitive electronic instruments or devices.
- If using Weather FAX audio cables, always use an isolating transformer.
- If using a third-party audio amplifier, always use an isolated power supply.
- If using an RS232/NMEA converter, always ensure optical isolation on the signal lines.

- Always ensure that PCs or other sensitive electronic devices have a dedicated power circuit.

Cable shielding

Ensure that cable shielding is not damaged during installation and that all cables are properly shielded.

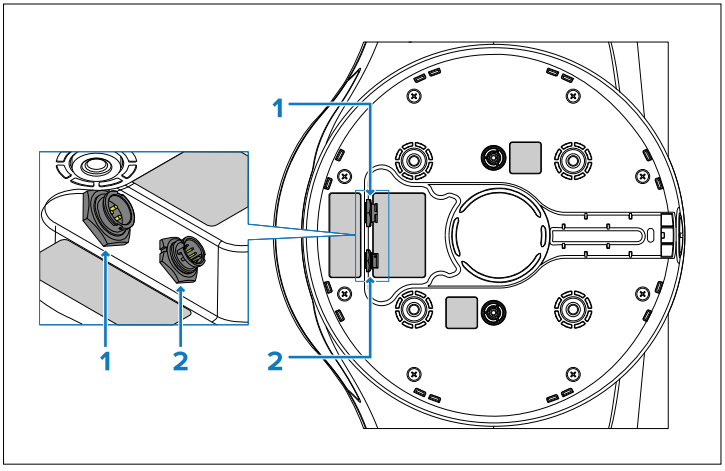
Important:
Be aware that some **third-party** cables and adapters (for example, certain Ethernet cables using RJ45 connectors) are not always shielded. To prevent breaks in cable shielding continuity and potential grounding issues, special attention is required to ensure that any cables, extension cables, adapters, or other signal-coupling devices used in cable runs **maintain all shield connections throughout the cable run**.

Suppression ferrites

- Raymarine cables may be pre-fitted or supplied with suppression ferrites. These are important for correct EMC performance. If ferrites are supplied separately to the cables (i.e. not pre-fitted), you must fit the supplied ferrites, using the supplied instructions.
- If a ferrite has to be removed for any purpose (e.g. installation or maintenance), it must be replaced in the original position before the product is used.
- Use only ferrites of the correct type, supplied by Raymarine or its authorized dealers.
- Where an installation requires multiple ferrites to be added to a cable, additional cable clips should be used to prevent stress on the connectors due to the extra weight of the cable.

7.2 Connections overview

The radar scanner includes the following connectors:



1. Power connector — Connects to the power cable.
2. RayNet connector — Connects to a RayNet radar data cable.

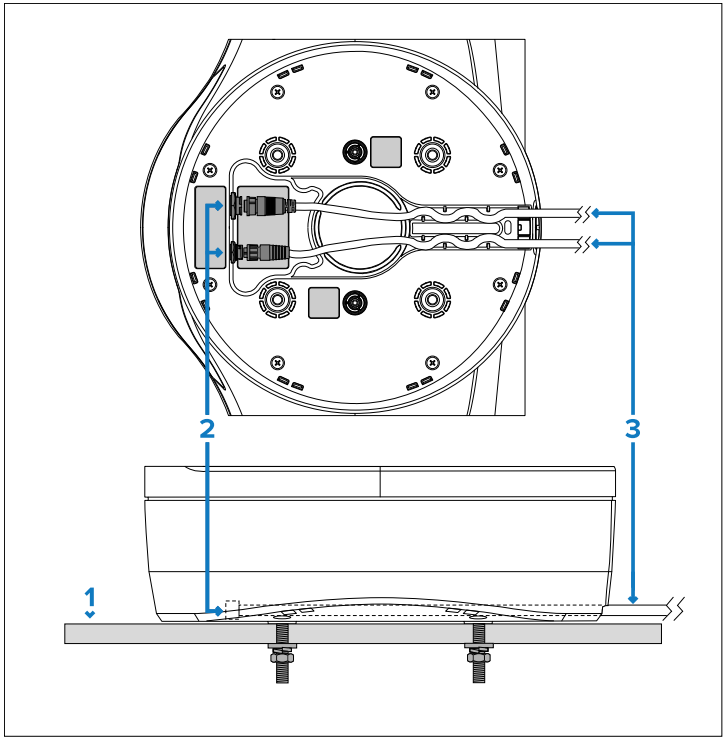
7.3 Cable routing options

You can route the power cable and data cable away from the radar in different ways.

The routing options allow for the cable to exit the radar in two different positions — the option you choose will depend on the radar mounting location.

1. **Rear cable exit** — if the radar is mounted on an extended flat surface, and the cable cannot be routed through the surface.
2. **Surface cable exit** — if the radar is mounted on a flat surface, and the cable can be routed through the surface.

Rear exit

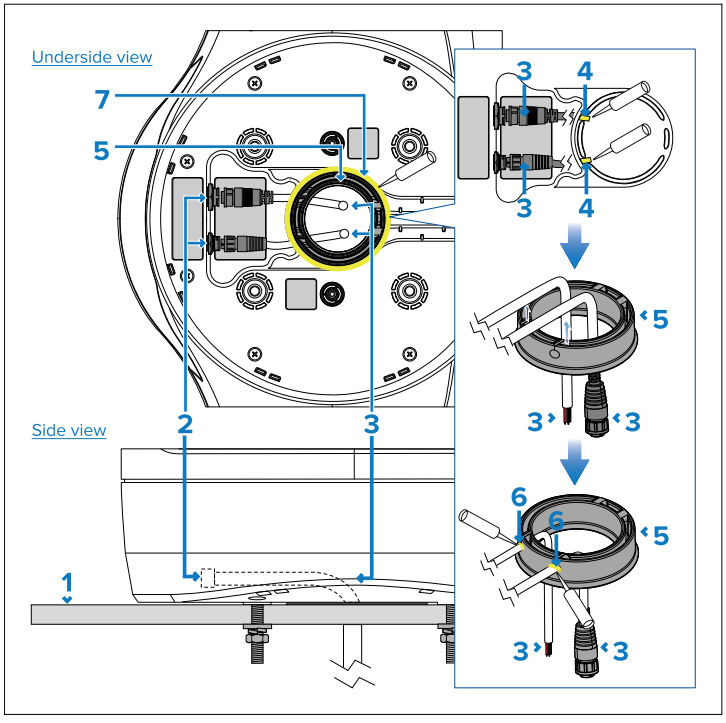


1. Mounting surface.
2. Power and RayNet connectors.
3. Power and RayNet cables.

Through-surface cabling

In this mounting configuration, the radar scanner power and RayNet cables are passed through the mounting surface, via the cable exit aperture on the underside of the pedestal.

Important:
To prevent water ingress, the cable exit aperture on the underside of the pedestal must be completely **sealed with a suitable marine-grade sealant or adhesive**, as described in the following instructions:



1. Connect the power and RayNet cables to the pedestal. **Do NOT supply power to the cables at this time.**
2. **Before** laying the cables in the exit channels on the underside of the pedestal, apply sealant to each of the cable exit channels at the point where the cables pass through them, as shown in (4) in the illustration below.
3. Lay the cables in the channels.
4. Pass the cables through the aperture on the underside of the pedestal, and then through the supplied cable gasket.
5. Push the cables fully into the slits in the cable gasket, as shown in the illustration below.
6. Apply sealant all around the cables at the point where they enter the gasket, as shown in (6) in the illustration below. **Ensure 360° coverage all around the cable entries.**
7. Carefully insert the cable gasket into position in the underside of the pedestal.
8. Seal all around both the top and bottom perimeters of the cable gasket, as shown in (7), to ensure a watertight seal with the pedestal. **Take care to avoid disturbing the sealant around the cable entries.**

CHAPTER 8: MOUNTING

CHAPTER CONTENTS

- 8.1 Warnings and cautions (page 41)
- 8.2 Schematic diagram (page 41)
- 8.3 Tools required (page 41)
- 8.4 Mounting (page 42)

8.1 Warnings and cautions

Important:
Before proceeding, ensure that you have read and understood the warnings and cautions provided in the following section of this document:

• **p.8 — Important information**

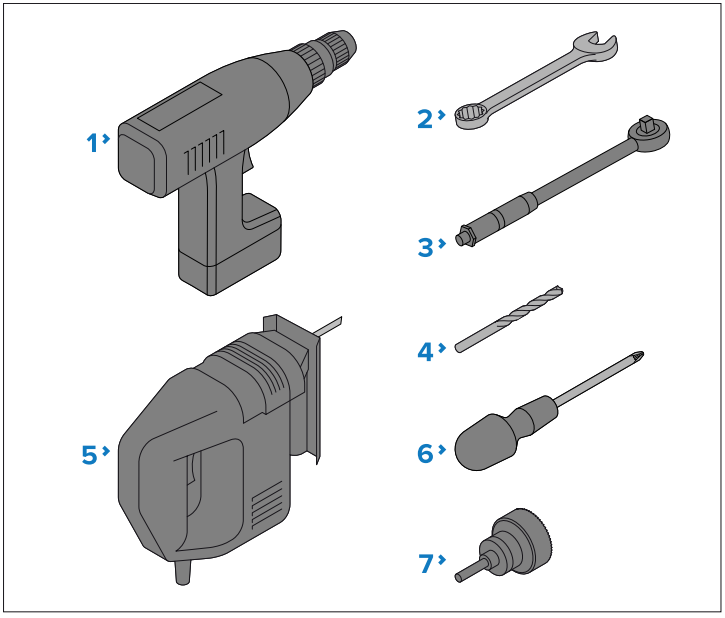
8.2 Schematic diagram

A schematic diagram is an essential part of planning any installation. It is also useful for any future additions or maintenance of the system. The diagram should include:

- Location of all components.
- Connectors, cable types, routes and lengths.

8.3 Tools required

The following tools are required for installation.



1. Drill
2. Spanner, 13 mm (1/2”) and 17 mm (11/16”).
3. Torque wrench
4. Drill bit (appropriate size dependent on thickness and material of mounting surface)
5. Jigsaw
6. Pozi-drive screwdriver
7. 50 mm (2”) Hole saw

8.4 Mounting

Pedestal

Mounting the pedestal

Before mounting the unit, ensure that you have:

- Selected a suitable location.
- Identified the cable connections and route that the cables will take.

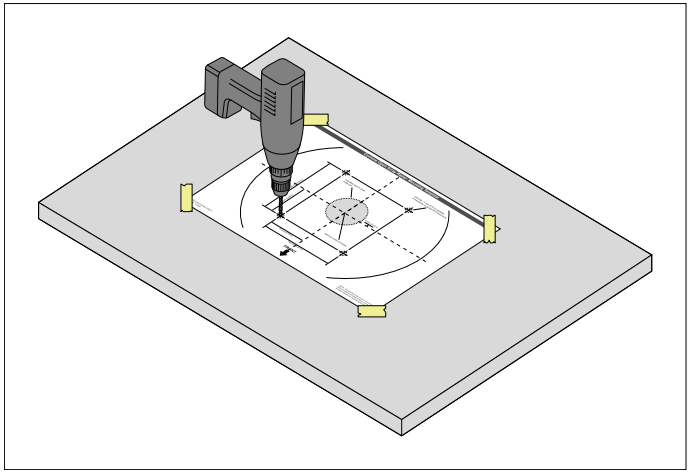
Important:
Prepare suitable lifting equipment (e.g. steel cable or chain) to lift the pedestal into place in its final mounting position, prior to securing the mounting bolts. The lifting equipment must be of a suitable gauge and strength capable of bearing the pedestal's weight of 16 Kg (35.27 lbs) as a minimum, and also capable of passing through the 20 mm (0.79 in) eyebolt hole on the pedestal. Additionally, you must also carefully consider the impact force on the lifting equipment, in the event that the pedestal falls before it is secured to the mounting surface. **Do NOT attach the antenna to the pedestal prior to lifting.**

1. Check the selected location. A clear, flat platform is required for mounting the pedestal unit.

Important:
For more information refer to **p.30 — Location requirements**

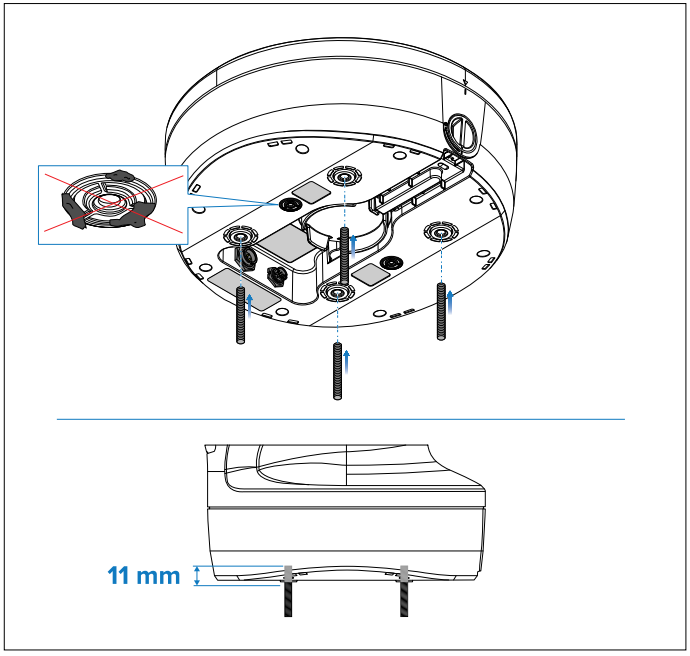
2. Fix the supplied mounting template to the platform, using masking or self-adhesive tape.

Important:
Ensure the mounting template is orientated correctly.



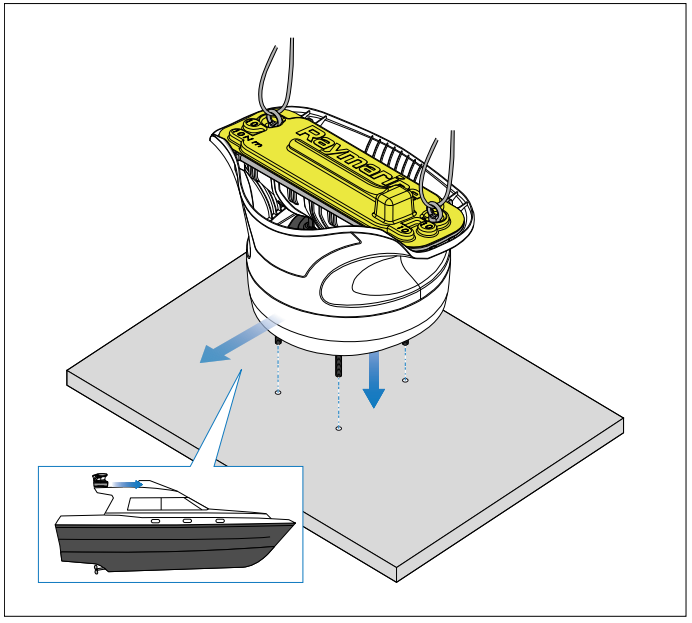
3. Using a 3 mm (0.1 in) drill bit, drill the 4 holes as indicated on the mounting template. Check that the holes have been drilled in the correct position.
4. Using an 11 mm (0.4 in) drill bit, drill through the 4 holes.
5. If you plan to route your cables through the mounting surface, cut the cable hole out using a jigsaw.
6. Remove the mounting template.
7. The pedestal has a transit cover fitted over the open array. This cover must be left in place until the open array antenna is fitted to the pedestal.
8. Insert the studs no more than 11 mm (0.4) into the holes in the pedestal base, and hand-tighten. If the supplied studs are not long enough for the mounting surface thickness, use M10 stainless steel, grade A4-70 studding of a suitable length.

Important:
Ensure the vents on the underside are not blocked.



9. Pass a a suitable steel cable or chain through the 20 mm (0.8 in) eyebolt holes. Once secure, lift the pedestal and test it fits correctly in its final mounting position.

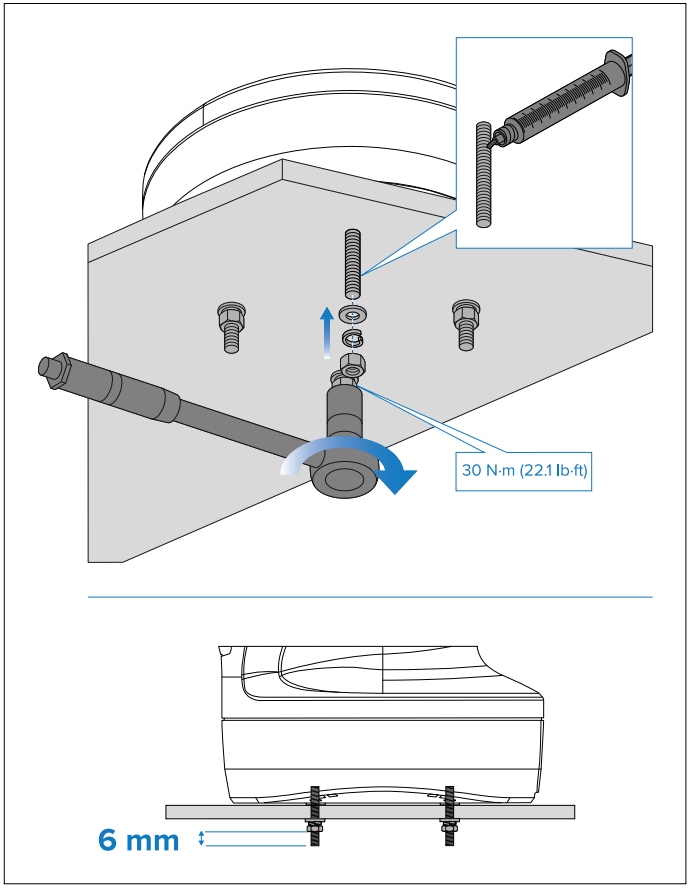
Important:
Ensure the pedestal is orientated correctly.



10. Lift the pedestal up and connect the power and data cables to the connectors on the underside of the pedestal. Organize the cables in accordance with your planned cable routing and place the pedestal back into position. **Ensure that you refer to the relevant cable routing instructions before proceeding to the next step:**
    i. For **rear exit cabling**, refer to: **p.38 — Rear exit**
    ii. For **through-surface cabling**, refer to: **p.39 — Through-surface cabling**

Important:
Ensure that power is NOT supplied to the cables during the installation procedure.

11. Grease the 4 metal studs using the supplied Denso paste.
12. Referring to the following illustration, use the 4 nuts and associated washers to secure the pedestal to the platform.



13. **Tighten each nut to a torque of 30 N·m (22.1 lb·ft)**. Ensure that all 4 sets of nuts and washers are used to secure the pedestal to the mounting platform.
14. Cut-off any excess stud; **there should be no more than 6 mm (0.2 in) of excess stud below the nut**.

Attaching and securing the antenna

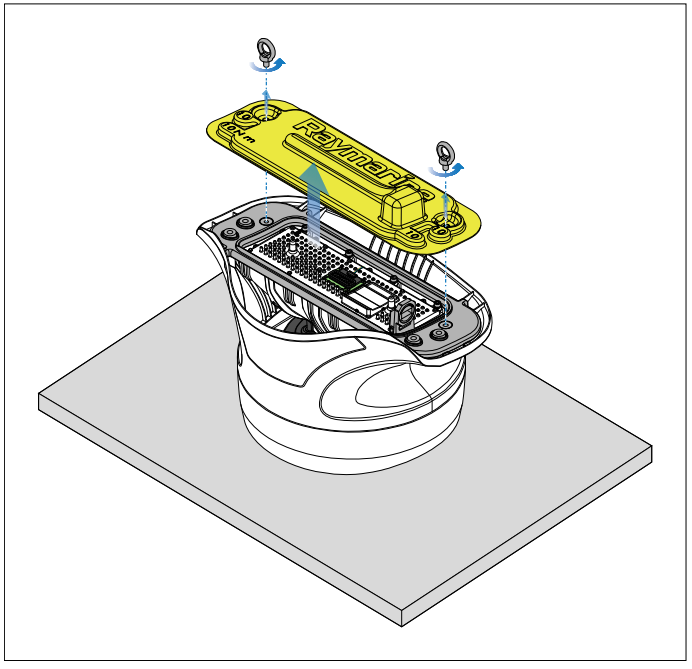
Procedure for attaching and securing the antenna to the pedastal.

Before attaching the antenna to the pedestal unit, ensure that:

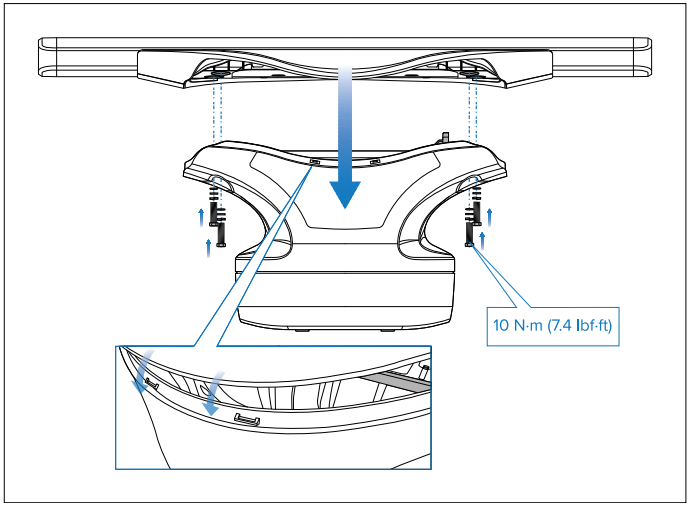
- The pedestal base is securely fixed to the platform.
- Power and data cables are connected securely and routed correctly, but are NOT powered.
- The pedestal power switch is in the OFF position.

1. Unscrew the eyebolts and remove the transit cover.

Important:
Take care not to damage the open array's delicate contacts when removing the cover.



2. Referring to the following illustration, lower the antenna onto the pedestal, placing the front on first and then clipping it in place.



3. Using the 4 hex bolts and associated washers and O-rings, secure the antenna to the pedestal. **Tighten each nut to 10 N·m (7.4 lbf·ft)**.

Radar scanner protection — sailing vessels

Additional considerations apply when installing the radar scanner on a sailing vessel.

- When mounting the radar scanner unit onto the mast, check that the unit is not fouled by the sails, especially when tacking.
- Depending on the type of sailing vessel and the design of the sailplan, a radar scanner guard should be attached to the mast if the sails or rigging contact either the radar scanner unit or the mounting bracket. Without a proper radar guard, serious damage can result to the radar mounting bracket and the radar itself. In extreme cases, such damage could result in the radar scanner unit being pulled off the mast. Therefore, it is recommended that a radar scanner guard should be mounted additionally and separately to the radar scanner mounting bracket.
- To prevent the risk of the radar scanner unit falling in the event that it has been damaged, the security lanyard supplied with the mast bracket MUST be secured properly to the mast and to the radar scanner unit, according to the instructions provided with the bracket. If a safety lanyard is not supplied with the mounting bracket, contact your local dealer for appropriate parts. Do NOT attach other equipment to either the radar scanner unit or the bracket.
- Raymarine strongly recommends that you check the condition and security of the bracket mounting feet, the security lanyard(s), the radar scanner guard, and the radar scanner unit itself, on a yearly basis (or more frequently depending on environmental applications). Any fittings should be replaced as appropriate.

Mounting the VCM100

Instructions for mounting the VCM100.

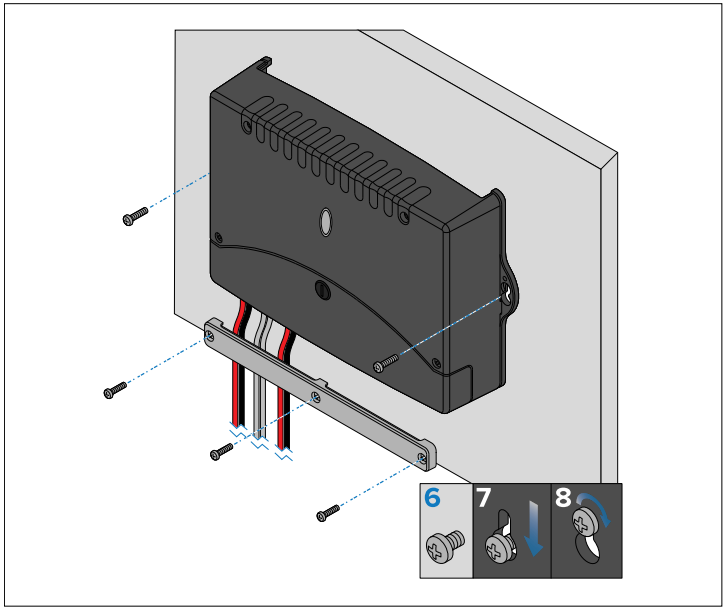
Before mounting the unit, ensure that you have:

- Selected a suitable location, based on the location requirements found in this document. For further information, refer to:
  - **p.30 — Location requirements**

Important:
The VCM100 is splashproof, and suitable for mounting below decks only.

- Identified the cable connections and route that the cables will take.

Important:
Do NOT connect any cables to the power supply until the following steps have been completed.



1. Check the selected location for the unit. The VCM100 requires a clear, flat, vertical surface with suitable space for routing the cables below the unit.
2. Hold the VCM100 in place at the required mounting location.
3. Using a pencil, mark the drilling area inside the mounting lug on each side of the VCM100 unit.
4. Using a 3 mm (0.1 in) drill bit, drill holes at the marked locations.
5. Using a suitable screwdriver, screw the self-tapping mounting screws approximately halfway into the drilled holes.
6. Align the VCM100 mounting lugs with the drill holes.
7. Place the VCM100 into position, and ensure that the VCM100 slides down into position.
8. Secure the VCM100 by fully tightening the screws.
9. Connect the cables, according to the instructions provided in this document.
10. Hold the cable clamp in place over the cables, approximately 50 mm (2 in) below the mounted VCM100 unit.
11. Using a pencil, mark the drilling area inside each mounting bracket hole.

    Ensure that the cables do NOT cover the holes.
12. Using a 3 mm (0.1 in) drill bit, drill a hole through the pencil marks.
13. Hold the cable clamp in place, each hole aligned with the drill holes.
14. Using a suitable screwdriver, screw the self-tapping mounting screws through the bracket holes, into the drilled holes.

CHAPTER 9: SYSTEM CONNECTIONS

CHAPTER CONTENTS

- 9.1 Typical system examples (page 48)

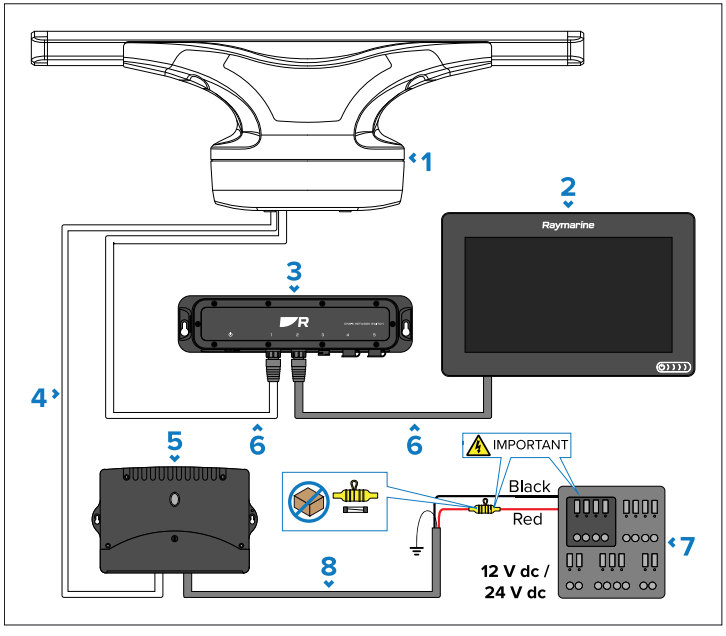
9.1 Typical system examples

The Cyclone Open Array Radar scanner can be connected to a variety of equipment as part of your marine electronics system.

Note:
The following illustrations show the various products that can be connected in a typical system. These systems are shown as an example only and may differ from your planned installation.

- For information on how to connect the products, refer to:
p.35 — Cables and connections
- For information on available cables and accessories, refer to:
p.78 — Spares and accessories

Radar connected using RayNet switch

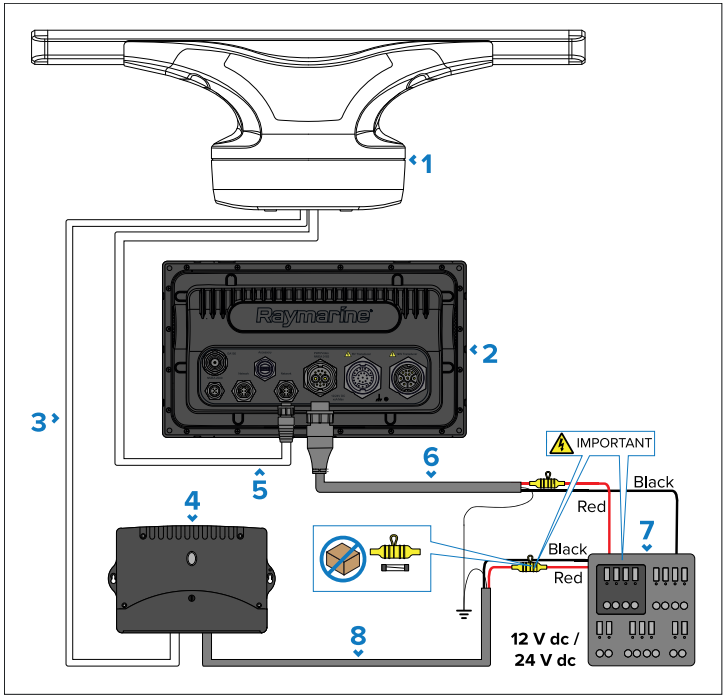


Note:
Some power connections are omitted from this illustration. The network switch and multifunction display each require a dedicated power connection.

Important:
Fuses (not supplied) are required for circuit protection for the Cyclone Radar. For suitable fuse ratings, refer to:
p.51 — Circuit breaker and fuse ratings

1. Cyclone Open Array Radar
2. MFD
3. RayNet network switch
4. Cyclone power cable
5. VCM100 power converter
6. RayNet Radar data cable
7. 12 V dc / 24 V dc Power supply (Distribution Panel or Battery)
8. VCM100 power cable

Radar connected directly to RayNet multifunction display



Important:
Fuses (not supplied) are required for circuit protection for the Cyclone Radar. For suitable fuse ratings, refer to:
p.51 — Circuit breaker and fuse ratings

1. Cyclone Open Array Radar
2. MFD
3. Cyclone power cable
4. VCM100 power converter
5. RayNet Radar data cable
6. MFD power cable
7. 12 V dc / 24 V dc Power supply (Distribution Panel or Battery)
8. VCM100 power cable

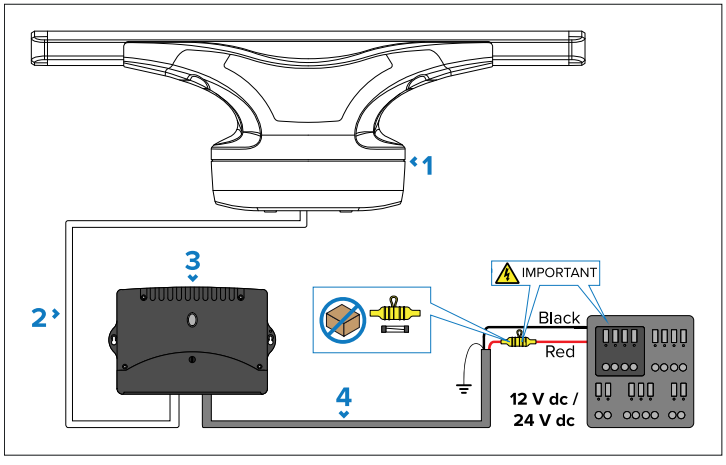
CHAPTER 10: POWER CONNECTIONS

CHAPTER CONTENTS

- 10.1 Pedestal power connections (page 51)

10.1 Pedestal power connections

The radar scanner must be powered via the supplied VCM100 Voltage Converter Module.



1. Radar scanner.
2. Power cable (Part number: A80653).
3. VCM100 power converter.
4. Power cable from vessel power supply to VCM100 (power cable not supplied).
5. Vessel power supply.

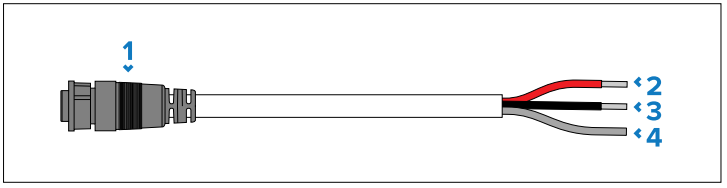
The radar scanner is intended for use on vessel DC power systems operating at 12 or 24 Volts DC.

- All power connections must be made via the VCM100 Voltage Converter Module.
- The radar scanner must NOT be connected directly to a battery.
- The radar scanner's power cable must be connected directly to the VCM100 only.
- Only one radar scanner must be connected per VCM100 unit. Each radar scanner in your system requires a dedicated VCM100 unit.
- The power connection between the radar scanner and the VCM100 must be via an official Raymarine power cable (a power cable is supplied with the radar).
- Do NOT cut and re-join any part of the power cable. A range of cable lengths are available for longer cable runs (refer to **p.78 — Spares and accessories**).

Note:
The maximum length for the radar power cable (including all extensions) is 25 m (82 ft).

- The radar scanner must be connected to the POWER OUT terminals of the VCM100 .
- The screen (drain) strands of the radar scanner's power cable must be connected to one of the VCM100 SCREEN terminals.

The following diagram illustrates the power connections of the supplied power cable.



1. Power connector
2. Red wire — connect to the positive POWER OUT terminal of the VCM100.
3. Black wire — connect to the negative POWER OUT terminal of the VCM100.
4. Screen (drain) strands — connect to one of the SCREEN terminals of the VCM100.

Important:
Fuses (not supplied) are required for circuit protection for the radar scanner. For information, refer to the fuse ratings listed below.

Circuit breaker and fuse ratings

Battery isolator switch, thermal breaker, and fuse ratings.

All power connections between the VCM100 and its power source MUST be protected by a thermal circuit breaker or in-line fuse, fitted close to the power connection. The connection from the output of the VCM100 to the radar pedestal does not require a fuse or circuit breaker.

If you do not have a thermal circuit breaker or fuse in your power circuit (fitted to the DC distribution panel, for example), you MUST fit an in-line breaker or fuse to the positive wire of the power cable.

The following table provides suitable ratings for battery isolator switches, circuit breakers, and fuses.

Power supply	Protection	Cyclone	Cyclone Pro
12 V	Isolator switch	30 A (minimum rating)	30 A (minimum rating)
	Thermal breaker	15 A	15 A
	Fuse	20 A	20 A
24 V	Isolator switch	15 A (minimum rating)	15 A (minimum rating)
	Thermal breaker	8 A	10 A
	Fuse	10 A	15 A



Warning: Positive ground systems

Do NOT connect this unit to a system which has positive grounding.

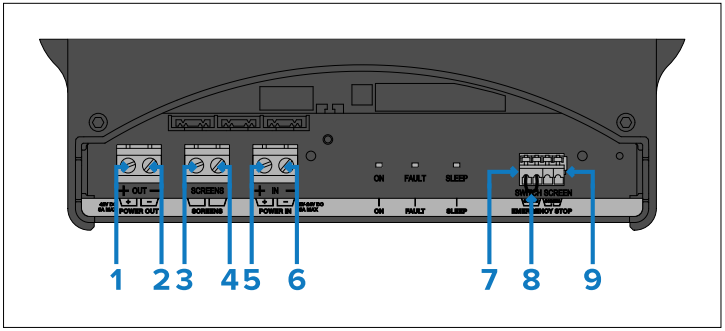
VCM100 power connections

VCM100 power and grounding requirements.

The VCM100 is intended for use on a vessel's DC power system, operating from 12 to 24 Volts DC.

- The VCM100 must be connected to a battery isolator switch, or a DC distribution panel.
- The battery isolator switch or DC distribution panel must be connected to the POWER IN terminals of the VCM100.
- Do NOT connect additional power switches to the cable providing the power feed to the VCM100.
- All power connections between the VCM100 and the power source must have appropriate fuse protection.
- All power connections must be of high quality to minimize resistance and to remove the risk of accidental shorts.
- The VCM100 SCREEN terminals must be connected to your vessel's RF ground system.
- The distribution point should be fed from the vessel's primary power source by 8 AWG (8.36 mm²) cable.
- Ideally, all equipment should be wired to individual suitably-rated thermal breakers or fuses, with appropriate circuit protection. Where this is not possible and more than 1 item of equipment shares a breaker, use individual inline fuses for each power circuit to provide the necessary protection.
- Do NOT connect the radar scanner or the VCM100 to a positively-grounded power system.

The following diagram illustrates the power connections of the VCM100:



1. **POWER OUT (Positive)** — connect to the RED wire of the radar scanner power cable.
2. **POWER OUT (Negative)** — connect to the BLACK wire of the radar scanner power cable.
3. **SCREEN** — connect to the bare screen (drain) strands of the radar scanner power cable.
4. **SCREEN** — connect to your vessel's RF ground system.
5. **POWER IN (Positive)** — connect to the positive terminal of the vessel's power supply (ideally a battery isolator switch or DC distribution panel).
6. **POWER IN (Negative)** — connect to the negative terminal of the vessel's power supply (ideally a battery isolator switch or DC distribution panel).

7. **EMERGENCY STOP (Switch)** — if you have an optional VCM100 emergency stop button, remove the wire bridging link from the VCM100 EMERGENCY STOP terminals, and connect the emergency stop button SWITCH wire to the VCM100 EMERGENCY STOP SWITCH terminal.
8. **EMERGENCY STOP wire bridging link** — only remove if fitting the optional emergency stop button.
9. **EMERGENCY STOP (Screen)** — if you have an optional VCM100 emergency stop button, remove the wire bridging link from the VCM100 EMERGENCY STOP terminals, and connect the emergency stop button SCREEN (drain) wire to the VCM100 EMERGENCY STOP SCREEN terminal.

Important:

• When planning and wiring, take into consideration other products in your system, some of which (e.g. sonar modules) may place large power demand peaks on the vessel's electrical system, which may impact the voltage available to other products during the peaks.

• The information provided is for guidance only, to help protect your product. It covers common vessel power arrangements, but does NOT cover every scenario. If you are unsure how to provide the correct level of protection, please consult an authorized dealer or a suitably qualified professional marine electrician.

More information

It is recommended that best practice is observed in all vessel electrical installations, as detailed in the following standards:

- BMEA Code of Practice for Electrical and Electronic Installations in Boats
- NMEA 0400 Installation Standard
- ISO 13297: Small craft — Electrical systems — Alternating and direct current installations
- ISO 10133: Small craft — Electrical systems — Extra-low-voltage d.c. installations
- ABYC E-11 AC & DC Electrical Systems on Boats
- ABYC A-31 Battery chargers and Inverters
- ABYC TE-4 Lightning Protection

VCM100 power wire gauge

You must provide suitable power wires to connect the VCM100 to the vessel's DC distribution panel or battery isolator switch.

It is essential that both power cores and the screen (drain) are connected and that the connection is of very low resistance, as considerable power passes through this connection.

The following table provides recommended total power cable lengths and gauges. These figures relate to the maximum round-trip length of power cables from the vessel's DC distribution panel or battery isolator switch to the VCM100. Exceeding these lengths may cause unreliable operation.

AWG (American Wire Gauge)	mm^2	Maximum distance (12 V supply)	Maximum distance (24 V supply)
7	10.55	15 m (49.2 ft.)	55 m (180.4 ft.)
8	8.36	10 m (32.8 ft.)	40 m (131.2 ft)
10	5.26	8 m (26.2 ft.)	32 m (104.9 ft.)
11	4.17	6 m (19.6 ft.)	24 m (78.7 ft.)

Note:
If the required lengths result in unacceptably large diameter cables, use 2 or more smaller gauge wires to achieve the required copper wire cross-section. For example, using 2 pairs of 2 mm^2 cables is equivalent to using 2 single 4 mm^2 cables.

VCM100 screen (drain) wire gauge

You must provide and connect a suitable screen (drain) wire between the VCM100's SCREEN terminal and your vessel's RF ground system.

The screen (drain) wire should use an 8 mm braid or AWG 10 (5.26 mm^2) multi-stranded cable.

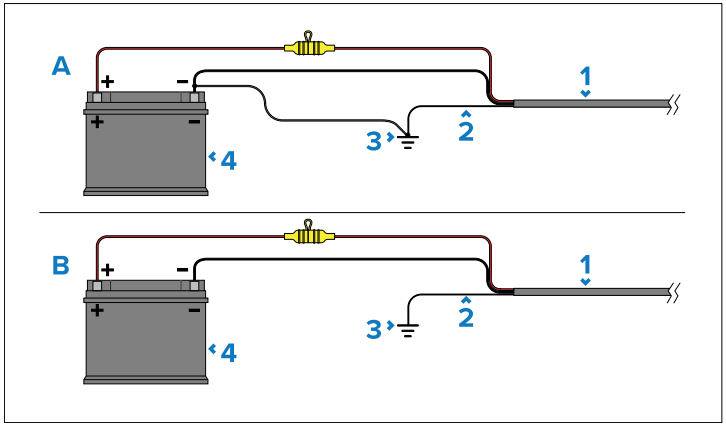
Warning: Product grounding

Before applying power to this product, it MUST be correctly grounded, in accordance with the instructions provided.

VCM100 grounding requirements

Note:
The radar scanner is not grounded directly, but is connected to ground via the VCM100. The following grounding requirements apply to the VCM100:

- The VCM100 power cable screen must be connected to the vessel's common ground point.
- It is recommended that the common ground point is a bonded ground, i.e. with the ground point connected to battery negative, and situated as close as possible to the battery negative terminal. If a bonded ground system is not possible, a non-bonded RF ground may be used.



- **A** — Bonded ground system (preferred)
- **B** — RF ground system (alternative)

1. Power cable to VCM100.
2. VCM100 drain (screen).
3. Bonded (preferred) or non-bonded RF ground.
4. Power supply.

Implementation

If several items require grounding, they may first be connected to a single local point (e.g. within a switch panel), with this point connected via a single, appropriately-rated conductor, to the boat's common ground. The preferred minimum requirement for the path to ground (bonded or non-bonded) is via a flat tinned copper braid, with a 30 A rating (1/4 inch) or greater. If this is not possible, an equivalent stranded wire conductor maybe used, rated as follows:

- for runs of <1 m (3 ft), use 6 mm^2 (#10 AWG) or greater.
- for runs of >1 m (3 ft), use 8 mm^2 (#8 AWG) or greater.

In any grounding system, always keep the length of connecting braid or wires as short as possible.

Important:
Do NOT connect this product to a positively-grounded power system.

References and best practice

It is recommended that best practice is observed in all vessel electrical installations, as detailed in the following standards:

- BMEA Code of Practice for Electrical and Electronic Installations in Boats
- NMEA 0400 Installation Standard
- ISO 13297: Small craft — Electrical systems — Alternating and direct current installations
- ISO 10133: Small craft — Electrical systems — Extra-low-voltage d.c. installations
- ABYC E-11 AC & DC Electrical Systems on Boats
- ABYC A-31 Battery chargers and Inverters
- ABYC TE-4 Lightning Protection

CHAPTER 11: SYSTEM CHECKS

CHAPTER CONTENTS

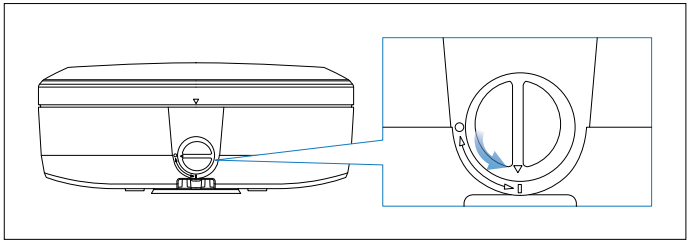
- 11.1 Radar scanner initial power on test (page 56)
- 11.2 Radar check (page 56)

11.1 Radar scanner initial power on test

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

Ensure that all cables have been correctly and securely connected to both the pedestal and a compatible multifunction display (which should initially be powered OFF):

1. Ensure that the pedestal's **Power/Safety** switch is set to ON (i.e. the switch is in the 6 o'clock position).



2. Power on the multifunction 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 pedestal is NOT receiving power, OR it is powered and is in *Sleep* mode.

3. If necessary, adjust the brightness and contrast on the multifunction display, before proceeding with a Radar test, using the display's *Radar* app.

Note:

• For information on performing a Radar test in the Radar app, refer to: **p.56 — Opening the Radar app**

• For an explanation of Pedestal LED status indications, refer to: **p.65 — Cyclone LED indications**

11.2 Radar check

Warning: Radar scanner safety

Before rotating the Radar scanner, ensure all personnel are clear.

Warning: Radar transmission safety

The Radar scanner transmits electromagnetic energy. Ensure all personnel are clear of the scanner when the radar is transmitting.

Opening the Radar app

The following instructions apply to multifunction displays / chartplotters running LightHouse 3 or LightHouse 4 software.

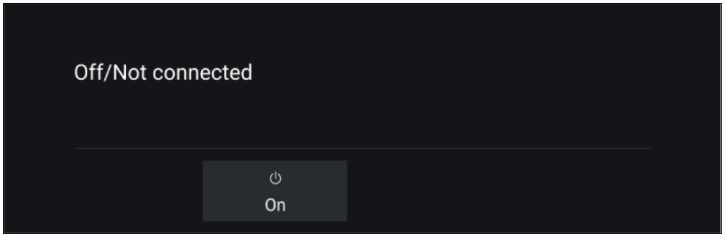
The Radar app is opened by selecting a page icon from the Homescreen that includes the Radar app.

Pre-requisites:

1. Ensure your Radar scanner is compatible. Check the latest details available on the Raymarine website; if in doubt. contact an authorized Raymarine dealer for advice.
2. Ensure you have installed your Radar scanner in accordance with the documentation that was supplied with your Radar.

The Radar app will open in one of 3 states:

Off / Not Connected

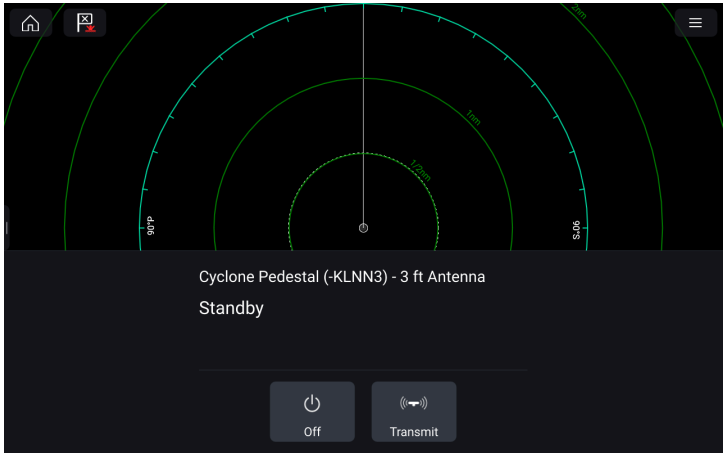


If the '**Off/Not Connected**' message is displayed then:

- your Radar scanner may be powered down, or
- your MFD cannot establish a connection with your Radar scanner

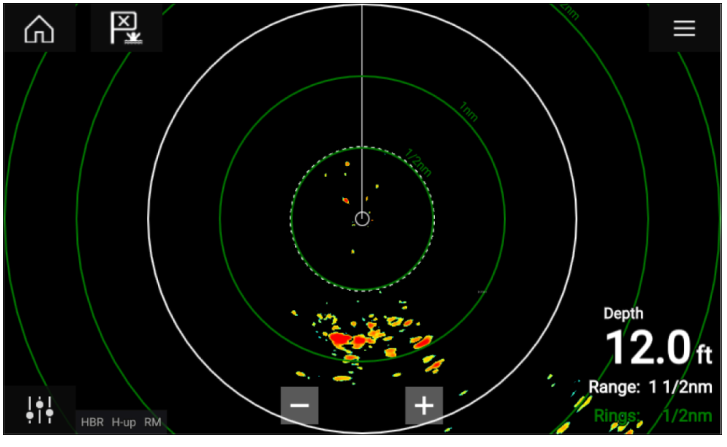
Select *[On]* to power up your Radar. If the '**Radar not found**' message is displayed then a connection could not be established, ensure that network and power connections to your Radar and MFD are correct and free from damage and then power cycle your system. If the Radar scanner can still not be found refer to your Radar's installation documentation for further troubleshooting information.

Standby (Not transmitting)



If the '**Standby**' message is displayed then select *[Transmit]* to begin transmitting.

Transmitting

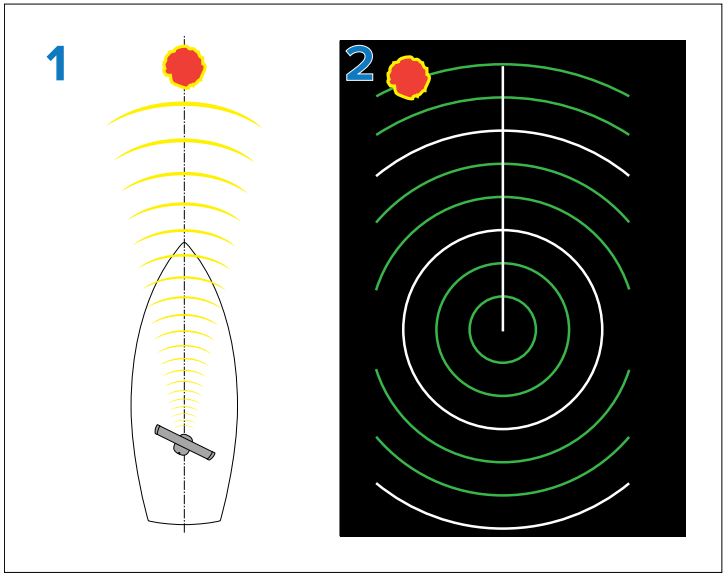


If your Radar scanner is connected, powered up and transmitting then the Radar image is displayed and echoes/targets are displayed onscreen.

Check and adjust bearing alignment

The Radar bearing alignment ensures that Radar objects appear at the correct bearing relative to your boat's bow. You should check the bearing alignment for any new installation.

Example misaligned Radar



1. Target object (such as a buoy) dead ahead.
2. Target displayed on the Radar display is not aligned with the Ship's Heading Marker (SHM). Bearing alignment is required.

Checking alignment

Align the bow with a stationary object between 0.25 and 2 NM away. Reduce the gain to make the target as small as possible on the screen.
Note the position of the object on the Radar screen. If the target is not under the ship's heading marker (SHM), then bearing alignment adjustment is required.

Adjusting alignment

Adjust the *[Bearing alignment]* setting until the target object appears under the SHM.
The *[Bearing alignment]* setting can be accessed from the *[Installation]* tab: *[Menu > Installation > Bearing alignment]*.

Note:
Heading (HDG) is displayed in the Radar application. Please be aware that bearing alignment refers to the **relative** bearing of **targets** to the vessel's bow using visual checks / traditional means.

CHAPTER 12: OPERATION

CHAPTER CONTENTS

- 12.1 Operation instructions (page 60)
- 12.2 Safety switch (page 60)
- 12.3 Radar licensing (page 60)

12.1 Operation instructions

For detailed operation instructions for your product, refer to the documentation that accompanies your display.

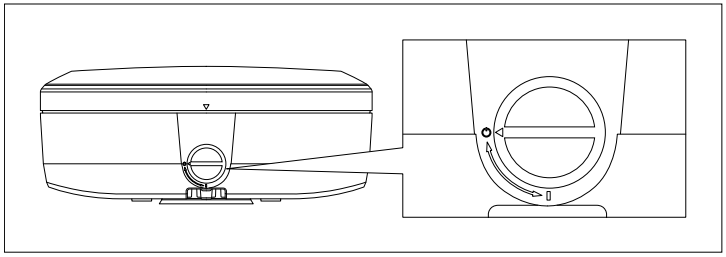
Document	Description	Link
81406	LightHouse 4 Operation Instructions	www.bit.ly/LH4-docs
81370	LightHouse 3 Operation Instructions	www.bit.ly/LH3-docs

12.2 Safety switch

The pedestal's Power switch also acts as a Safety switch, which can be used to quickly stop the antenna rotating.

The pedestal's **Power/Safety** switch is located at the rear of the pedestal, directly above the channel where the cables exit the unit.

To use the **Power/Safety** switch to quickly stop the antenna rotating, turn the switch OFF (i.e. turn the switch to the 9 o'clock position), as shown below:



Note:
It's also possible to quickly stop the radar antenna rotating by switching off the power to the VCM100, via the appropriate fuse / thermal breaker at the vessel's power distribution panel.

12.3 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.88 — Licensing issuing authorities

CHAPTER 13: TROUBLESHOOTING

CHAPTER CONTENTS

- 13.1 Troubleshooting (page 62)
- 13.2 Power up troubleshooting (page 63)
- 13.3 Radar troubleshooting (page 64)
- 13.4 Doppler troubleshooting (page 65)
- 13.5 Cyclone LED indications (page 65)
- 13.6 VCM100 LED indications (page 65)
- 13.7 Radar target acquisition data source requirements (page 66)
- 13.8 Doppler data source requirements (page 66)

13.1 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 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 and servicing* section of this manual for useful links and contact details.

13.2 Power up troubleshooting

Troubleshooting assistance with typical causes of power-related issues, and their solutions.

Product does not power up, or keeps switching 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 *Power Connections* section of your product's Installation Instructions 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 product's *Power* 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 product switched on, try carefully flexing the power cable near to the product's *Power* 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 vessel's power supply may be wired incorrectly. Ensure that the product's *Installation Instructions* have been followed completely.

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 power up, or keeps switching off*'.
Software corruption:	1. In the unlikely event that the product's software has become corrupted, try downloading and installing the latest software from: www.bit.ly/rym-software 2. If your product includes a display: as a last resort, attempt to perform a 'Power on Reset'. Be aware that this will delete all settings / presets and user data, and revert the unit back to factory default settings.

13.3 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 powered down:	If the scanner unit has shut down, awaken it by using the *[Power Up Radar]* option on the Shortcuts page, accessible on your multifunction display / chartplotter by momentarily pressing the power button.
Radar not transmitting:	Select Tx for the relevant Radar scanner from the Shortcuts page.
Damaged or disconnected Power cable / RayNet 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/lose 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 Raymarine authorized dealer for assistance.
Open Array power switch in OFF position:	Ensure Open Array power switch is in ON position.
Software mismatch between equipment may prevent communication:	Ensure all Raymarine products contain the latest available software, check the Raymarine website for software compatibility: www.raymarine.com/software

Displayed bearing is different to the true bearing:

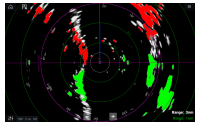
Possible causes	Possible solution
Bearing alignment adjustment required:	Carry out the Bearing Alignment procedure described in the latest version of the relevant LightHouse Operations manual.

Radar will not initialize (VCM100 stuck in “sleep mode”):

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

13.4 Doppler troubleshooting

Doppler coloration is incorrect

Example	Possible solution
Stationary targets such as land are colored red or green when under way: 	1. Check bearing alignment, as described in this document and the MFD Operations manual. 2. At low speeds (< 15 knots) and if a source of Heading data is available on the system, the compass alignment may be incorrect. Check the compass alignment, as described in the manual for the relevant Heading (compass) device.

13.5 Cyclone LED indications

LED indications associated with the Cyclone Radar.

LED color / state	Possible causes
Power LED not lit	Unit is NOT receiving power, OR it is powered and is in *Sleep* mode. **Note:** Ensure that the Cyclone is running software version **v1.22 or later**, which addresses an issue where the Cyclone can remain in Sleep mode after 60 seconds of Radar inactivity and a multifunction display power cycle.
Amber or Red / solid	Unit is receiving power, but the pedestal’s **Power/Safety** switch is in the “Off” position.
Green / flashing once every 30 seconds	Radar is powered on and functioning correctly (is in *Standby* or *Transmit* mode).
Amber or Red / flashing once every 30 seconds	Internal fault. Refer to your dealer or Raymarine® product support.

13.6 VCM100 LED indications

LED indications associated with the VCM100.

LED color / state	Possible causes
Green / solid:	Radar operating normally.
Red / solid:	Fault condition.

LED color / state	Possible causes
Yellow / flashing:	Radar scanner in standby.
Yellow / solid:	Fault condition, unit self-recovers after 20 seconds.

13.7 Radar target acquisition data source requirements

Radar target acquisition requires the following data sources to be available on your system (e.g. connected to your multifunction display, via SeaTalk NG or NMEA 0183).

Data type	Example data source
COG (Course Over Ground)	GNSS (GPS) receiver (multifunction display / chartplotter internal receiver or external receiver).
SOG (Speed Over Ground)	GNSS (GPS) receiver (multifunction display / chartplotter internal receiver or external receiver).
HDG / HDT (True Heading)	Compass or Autopilot sensor providing Fastheading data (e.g. Evolution-Series EV-1 / EV-2).

13.8 Doppler data source requirements

Use of the Doppler Radar features requires the following data sources to be available on your system (e.g. connected to your multifunction display / chartplotter, via SeaTalk NG or NMEA 0183).

Required data sources

Data type	Example data source
COG (Course Over Ground)	GNSS (GPS) receiver (MFD / chartplotter internal receiver or external receiver).
SOG (Speed Over Ground)	GNSS (GPS) receiver (MFD / chartplotter internal receiver or external receiver).

Recommended data source

Data type	Example data source
HDG / HDT (True Heading)	Compass or Autopilot sensor providing Fastheading data (e.g. Evolution-Series EV-1 / EV-2).

Note:
A heading data source is not essential for Doppler operation. However it will improve the performance of Doppler mode at slower speeds (< 15 knots), when tide set and leeway are present.

CHAPTER 14: TECHNICAL SUPPORT

CHAPTER CONTENTS

- 14.1 Raymarine technical support and servicing (page 68)

14.1 Raymarine technical support and servicing

Raymarine provides a comprehensive product support service, as well as warranty, service, and repairs. You can access these services through the Raymarine website, telephone, and e-mail.

Product information

If you need to request service or support, please have the following information to hand:

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

Servicing and warranty

Raymarine offers dedicated service departments for warranty, service, and repairs.
Visit the Raymarine website to **read the latest warranty policy**, and **register** your product's warranty online:

- www.bit.ly/rym-warranty

United Kingdom (UK), EMEA, and Asia Pacific:

- Web: www.bit.ly/rym-service
- Tel: +44 (0)1329 246 932

United States (US):

- Web: www.bit.ly/rym-service
- Tel: +1 (603) 324 7900

Web support

Please visit the "Support" area of the Raymarine website for:

- **Manuals and Documents** — www.bit.ly/rym-docs
- **Technical support forum** — www.bit.ly/rym-support
- **Software updates** — www.bit.ly/rym-software

Telephone and online support

Region	Contact details
All regions	**Online support:** www.bit.ly/rym-support
United Kingdom (UK) and EMEA	**Telephone:** +44 (0)1329 246 777 **Address:** Marine House, Cartwright Drive, Fareham, PO15 5RJ, UK.
United States (US)	**Telephone:** Tel: +1 (603) 324 7900 (Toll-free: +800 539 5539) **Address:** 110 Lowell Road, Hudson, NH 03051, USA.
Australia and New Zealand (Raymarine subsidiary)	**Telephone:** +61 2 8977 0300 **Address:** Suite 1.01, 26 Rodborough Road, Frenchs Forest, NSW, 2086, Australia.
France (Raymarine subsidiary)	**Telephone:** +33 (0)1 46 49 72 30 **Address:** 35 avenue Michel Crépeau, 17000 La Rochelle - France.
Germany (Raymarine subsidiary)	**Telephone:** +49 40 237 808 0 **Address:** Atlantic-Haus, Zirkusweg 1, 20359 Hamburg.
Italy (Raymarine subsidiary)	**Telephone:** +39 02 9945 1001 **Address:** Via L. Manara 2, 20812 Limbiate (MB), Italy.
Spain (Authorized Raymarine distributor)	**Telephone:** +34 96 2965 102 **Email:** sat@azimut.es
Netherlands / Benelux (Authorized Raymarine distributor)	**Telephone:** +31 (0)26 3614 905 **Address:** Florijnweg 21G, 6883 JN VELP, Nederland.

Region	Contact details
Sweden (Raymarine subsidiary)	**Telephone:** +46 (0)317 633 670 **Address:** Bolshedens Industriväg 18, 427 50 Billdal, Sweden.
Finland (Raymarine subsidiary)	**Telephone:** +358 (0)207 619 937 **Address:** Suomalaistentie 1-3, 02270 Espoo, Finland.
Norway (Raymarine subsidiary)	**Telephone:** +47 692 64 600 **Address:** Årvollskogen 30, 1529 Moss, Norway.
Denmark (Raymarine subsidiary)	**Telephone:** +45 437 164 64 **Address:** Centervej 7, 4600 Køge, Denmark.
Russia (Distributor)	**Telephone:** Tel: +7 495 788 0508 **Email:** info@mikstmarine.ru

CHAPTER 15: TECHNICAL SPECIFICATION (CYCLONE)

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- 15.1 Conformance specification (page 71)
- 15.2 Physical specification (pedestal) (page 71)
- 15.3 Physical specification (antenna) (page 71)
- 15.4 Power specification (page 71)
- 15.5 Environmental specification (page 71)
- 15.6 Data connections (page 71)
- 15.7 Range (page 72)
- 15.8 Transmitter specification (page 72)
- 15.9 Receiver specification (page 72)
- 15.10 Antenna specification (page 73)
- 15.11 ARPA target tracking (page 73)

15.1 Conformance specification

Specification	
USA:	47CFR Part 80 Certificate of Approval FCC ID: PJ5-953LPSSR
Canada:	RSS138 Iss. 1 Technical Acceptance Certificate IC:4069B-953LPSSR
European Union & EFTA:	Radio Equipment Directive 2014/53/EU Self-Declaration
Australia / New Zealand:	ACMA Declaration of Conformity Compliance level 3

15.2 Physical specification (pedestal)

Specification	
Dimensions:	Width: 388 mm (15.3 in) Depth: 360 mm (14.2 in) Height: 335 mm (13.2 in) (to top of antenna)
Weight:	16 Kg

15.3 Physical specification (antenna)

Specification	3 ft	4 ft	6 ft
Antenna length:	1031 mm (40.6 in)	1336 mm (52.6 in)	1945 mm (76.6 in)
Antenna weight:	7 Kg (15.4 lbs)	9 Kg (19.8 lbs)	12 Kg (26.5 lbs)

15.4 Power specification

Specification	
Supply voltage (using VCM100):	• Nominal: 12 V dc or 24 V dc • Minimum: 10.2 V dc • Maximum: 31.2 V dc
Power consumption (typical):	70 W
Power consumption (max):	170 W
Power consumption (standby):	28 W
Maximum range scale:	72 Nm
Inline fuse rating:	• 12 V: 20 A • 24 V: 10 A
Thermal breaker rating:	• 12 V: 15 A • 24 V: 8 A
Startup time:	40 seconds
Standby to transmit time:	Less than 5 seconds

15.5 Environmental specification

Specification	
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 Knots

15.6 Data connections

Specification	
Power connection:	1x Power connector
Data connection:	1x RayNet (10 Mbit/s, 100 Mbit/s) connector

15.7 Range

Specification	
1/16 Range (Nm):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
1/8 Range (Nm):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
1/4 Range (Nm):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
3/8 Range (Nm):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
1/2 Range (Nm):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
3/4 Range (Nm):	• 192 Pulse width (ns) • 4.8 PRF (kHz)
1 Range (Nm):	• 192 Pulse width (ns) • 4.8 PRF (kHz)
1 1/2 Range (Nm):	• 192 Pulse width (ns) • 4.8 PRF (kHz)
2 Range (Nm):	• 1675 Pulse width (ns) • 4.8 PRF (kHz)
3 Range (Nm):	• 2300 Pulse width (ns) • 4.8 PRF (kHz)
4 Range (Nm):	• 2710 Pulse width (ns) • 4.8 PRF (kHz)
6 Range (Nm):	• 3900 Pulse width (ns) • 4.8 PRF (kHz)
8 Range (Nm):	• 3900 Pulse width (ns) • 4.8 PRF (kHz)
12 Range (Nm):	• 17600 Pulse width (ns) • 3.6 PRF (kHz)
16 Range (Nm):	• 23600 Pulse width (ns) • 2.4 PRF (kHz)
24 Range (Nm):	• 35000 Pulse width (ns) • 1.6 PRF (kHz)
32 Range (Nm):	• 47000 Pulse width (ns) • 1.2 PRF (kHz)
48 Range (Nm):	• 79000 Pulse width (ns) • 0.82 PRF (kHz)
72 Range (Nm):	• 79000 Pulse width (ns) • 0.7 PRF (kHz)

15.8 Transmitter specification

Specification	
Transmitter frequency:	9370, 9400, 9430 MHz (User Selectable)
Peak power output:	55 W

15.9 Receiver specification

Specification	
Receiver characteristic:	Linear
Receiver noise:	Less than 5 dB

15.10 Antenna specification

Specification	3 ft	4 ft	6 ft
Antenna Beamwidth (vertical):	25°	25°	25°
Antenna Beamwidth (horizontal):	2.83°	1.99°	1.32°
Antenna Polarization:	Horizontal	Horizontal	Horizontal
Antenna Rotation speed:	12 RPM / 24 RPM/ 36 RPM / 48 RPM/ 60 RPM	12 RPM / 24 RPM/ 36 RPM / 48 RPM/ 60 RPM	12 RPM / 24 RPM/ 36 RPM / 48 RPM/ 60 RPM

15.11 ARPA target tracking

Specification	
Target tracking	Tracking of up to 100 simultaneous ARPA targets.

ARPA software requirements

Important ARPA software compatibility information.

Important:

- Only LightHouse 4 versions **v.4.4 or later** and Cyclone software **v1.25 or later** support the tracking of up to 100 simultaneous ARPA targets.
- Earlier *Cyclone-compatible* versions of LightHouse 4 support the tracking of up to 50 simultaneous ARPA targets.
- *Cyclone-compatible* versions of LightHouse 3 support the tracking of up to 50 simultaneous ARPA targets.

Note:
To obtain the latest software for your Raymarine products, visit: www.raymarine.com/software

CHAPTER 16: TECHNICAL SPECIFICATION (CYCLONE PRO)

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- 16.1 Conformance specification (page 75)
- 16.2 Physical specification (pedestal) (page 75)
- 16.3 Physical specification (antenna) (page 75)
- 16.4 Power specification (page 75)
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- 16.8 Transmitter specification (page 76)
- 16.9 Receiver specification (page 76)
- 16.10 Antenna specification (page 77)
- 16.11 ARPA target tracking (page 77)

16.1 Conformance specification

Specification	
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European Union & EFTA:	Radio Equipment Directive 2014/53/EU Self-Declaration
Australia / New Zealand:	ACMA Declaration of Conformity Compliance level 3

16.2 Physical specification (pedestal)

Specification	
Dimensions:	Width: 388 mm (15.3 in) Depth: 360 mm (14.2 in) Height: 335 mm (13.2 in) (to top of antenna)
Weight:	16 Kg

16.3 Physical specification (antenna)

Specification	3 ft	4 ft	6 ft
Antenna length:	1031 mm (40.6 in)	1336 mm (52.6 in)	1945 mm (76.6 in)
Antenna weight:	7 Kg (15.4 lbs)	9 Kg (19.8 lbs)	12 Kg (26.5 lbs)

16.4 Power specification

Specification	
Supply voltage (using VCM100):	• Nominal: 12 V dc or 24 V dc • Minimum: 10.2 V dc • Maximum: 31.2 V dc
Power consumption (typical):	95 W
Power consumption (max):	195 W
Power consumption (standby):	28 W
Inline fuse rating:	• 12 V: 20 A • 24 V: 15 A
Thermal breaker rating:	• 12 V: 15 A • 24 V: 10 A
Maximum range scale:	96 NM
Startup time:	40 seconds
Standby to transmit time:	Less than 5 seconds

16.5 Environmental specification

Specification	
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 Knots

16.6 Data connections

Specification	
Power connection:	1x Power connector
Data connection:	1x RayNet (10 Mbit/s, 100 Mbit/s) connector

16.7 Range

Specification	
1/16 Range (NM):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
1/8 Range (NM):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
1/4 Range (NM):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
3/8 Range (NM):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
1/2 Range (NM):	• 46 Pulse width (ns) • 4.8 PRF (kHz)
3/4 Range (NM):	• 192 Pulse width (ns) • 4.8 PRF (kHz)
1 Range (NM):	• 192 Pulse width (ns) • 4.8 PRF (kHz)
1 1/2 Range (NM):	• 192 Pulse width (ns) • 4.8 PRF (kHz)
2 Range (NM):	• 1675 Pulse width (ns) • 4.8 PRF (kHz)
3 Range (NM):	• 2300 Pulse width (ns) • 4.8 PRF (kHz)
4 Range (NM):	• 2710 Pulse width (ns) • 4.8 PRF (kHz)
6 Range (NM):	• 3900 Pulse width (ns) • 4.8 PRF (kHz)
8 Range (NM):	• 3900 Pulse width (ns) • 4.8 PRF (kHz)
12 Range (NM):	• 17600 Pulse width (ns) • 3.6 PRF (kHz)
16 Range (NM):	• 23600 Pulse width (ns) • 2.4 PRF (kHz)
24 Range (NM):	• 35000 Pulse width (ns) • 1.6 PRF (kHz)
32 Range (NM):	• 47000 Pulse width (ns) • 1.2 PRF (kHz)
48 Range (NM):	• 79000 Pulse width (ns) • 0.82 PRF (kHz)
72 Range (NM):	• 79000 Pulse width (ns) • 0.7 PRF (kHz)
96 Range (NM):	• 79000 Pulse width (ns) • 0.7 PRF (kHz)

16.8 Transmitter specification

Specification	
Transmitter frequency	9370, 9400, 9430 MHz (User Selectable)
Peak power output	110 W

16.9 Receiver specification

Specification	
Receiver characteristic:	Linear
Receiver noise:	Less than 5 dB

16.10 Antenna specification

Specification	3 ft	4 ft	6 ft
Antenna Beamwidth (vertical):	25°	25°	25°
Antenna Beamwidth (horizontal):	2.83°	1.99°	1.32°
Antenna Polarization:	Horizontal	Horizontal	Horizontal
Antenna Rotation speed:	12 RPM / 24 RPM/ 36 RPM / 48 RPM/ 60 RPM	12 RPM / 24 RPM/ 36 RPM / 48 RPM/ 60 RPM	12 RPM / 24 RPM/ 36 RPM / 48 RPM/ 60 RPM

16.11 ARPA target tracking

Specification	
Target tracking	Tracking of up to 100 simultaneous ARPA targets.

ARPA software requirements

Important ARPA software compatibility information.

Important:

- Only LightHouse 4 versions **v.4.4 or later** and Cyclone software **v1.25 or later** support the tracking of up to 100 simultaneous ARPA targets.
- Earlier *Cyclone-compatible* versions of LightHouse 4 support the tracking of up to 50 simultaneous ARPA targets.
- *Cyclone-compatible* versions of LightHouse 3 support the tracking of up to 50 simultaneous ARPA targets.

Note:
To obtain the latest software for your Raymarine products, visit: www.raymarine.com/software

CHAPTER 17: SPARES AND ACCESSORIES

CHAPTER CONTENTS

- 17.1 Accessories (page 79)
- 17.2 Network hardware (page 79)
- 17.3 RayNet to RayNet cables and connectors (page 80)

17.1 Accessories

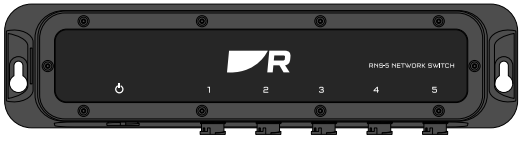
The following accessories are available for your product

- Power Cable 5 m (16.4 ft) — A80651
- Power Cable 10 m (32.8 ft) — A80652
- Power Cable 15 m (49.2 ft) — A80653
- Power Cable 25 m (82.0 ft) — A80654
- Radar Data Cable 5 m (16.4 ft) — A80656
- Radar Data Cable 10 m (32.8 ft) — A80657
- Radar Data Cable 15 m (49.2 ft) — A80658
- Radar Data Cable 25 m (82.0 ft) — A80659

Note:
For more information on additional RayNet cables and adapters, refer to: **p.80 — RayNet to RayNet cables and connectors**

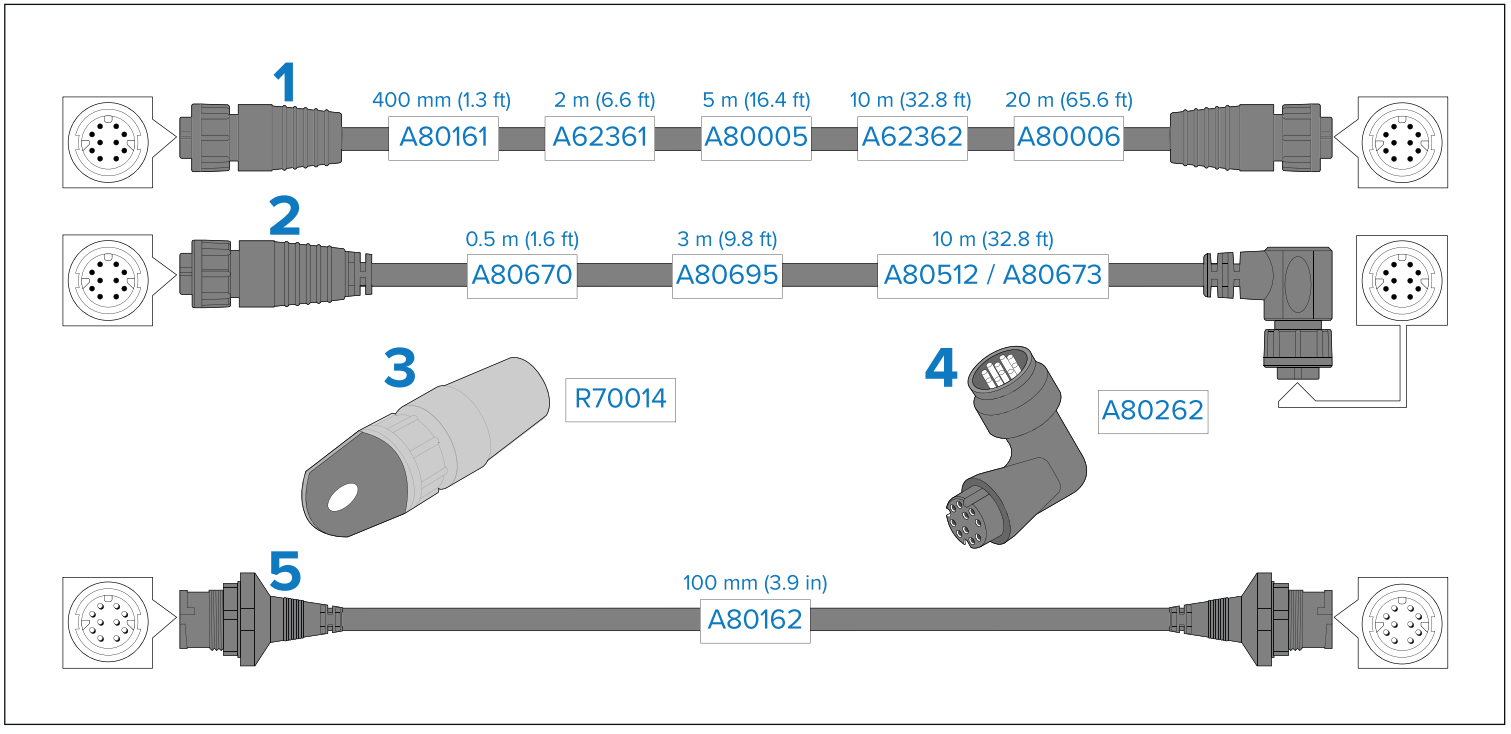
17.2 Network hardware

RNS–5 Network Switch (A80731)



5–port switch for network connection of multiple devices featuring RayNet connectors. Equipment with RJ45 connectors can also be connected using suitable adapter cables.

17.3 RayNet to RayNet cables and connectors



1. Standard RayNet connection cable with a RayNet (female) socket on both ends.
2. Right-angle RayNet connection cable with a straight RayNet (female) socket on one end, and a right-angle RayNet (female) socket on the other end. Suitable for connecting at 90° (right angle) to a device, for installations where space is limited.
3. RayNet cable puller (5 pack).
4. RayNet to RayNet right-angle coupler / adapter. Suitable for connecting RayNet cables at 90° (right angle) to devices, for installations where space is limited.
5. Adapter cable with a RayNet (male) plug on both ends. Suitable for joining (female) RayNet cables together for longer cable runs.

Appendix A Interpreting the radar display

Interpreting objects

The size of a target appearing 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. Given adequate radar operator 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 display 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.)
- Similarly-sized targets. (Buoys and small vessels resemble each other; however, vessels can often be distinguished by their motion.)

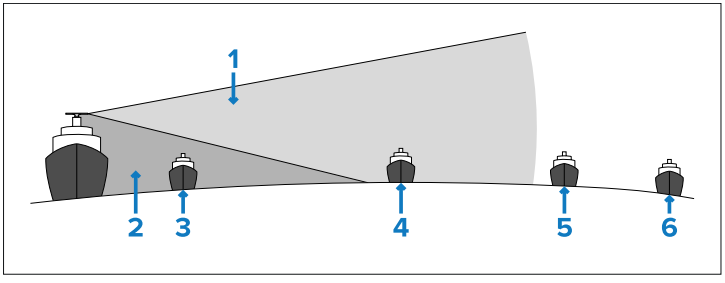
Radar range

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.

Radar image quality

A number of factors may impact the quality of a radar image.

Not all radar echoes are produced by valid targets. Spurious or missing echoes may be caused by:

- Blind sectors.
- False echoes.
- Target smearing.
- Multi-path interference.
- Sea state and wave height.

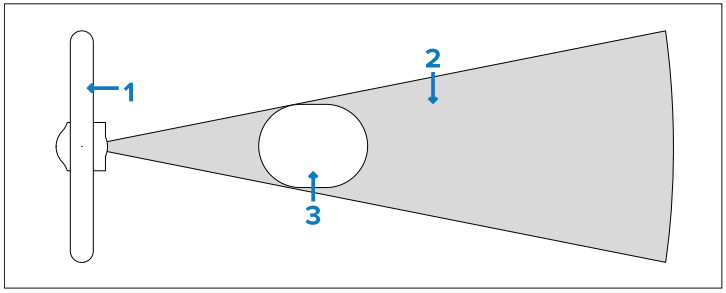
- Precipitation and snow.
- Interference from other radar scanners.

Through observation, practice, and experience, you can generally detect these conditions very quickly and use the radar controls to minimize their impact.

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 radar beam intensity, although it may not block the entire beam. 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’s location prior to installation. Targets will not be detected if they are within the blind sector.



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

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. It is also 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 etc.

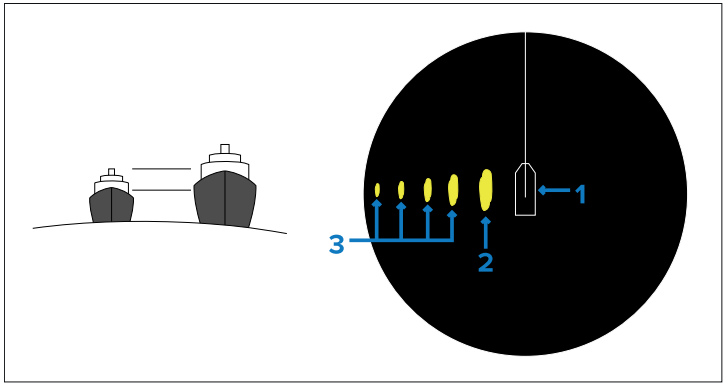
Ownship structures can also generate similar reflections. These reflections are normally seen as a large arc on the radar screen. Adjusting the radar’s signal processing control functions may reduce or suppress a reflection, but at the expense of lower target detection performance. Radar systems provide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

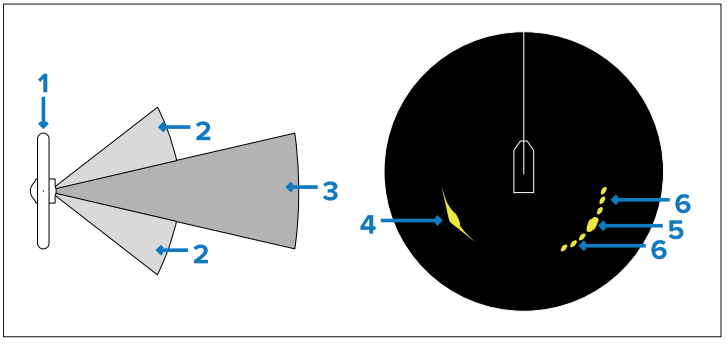
The false echoes become weaker as the amount of energy reflected diminishes with each return. Multiple echoes can be reduced and often removed by decreasing the *[Gain]* (sensitivity) or adjusting the *[Sea]* anti clutter control.



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

Side lobe echoes

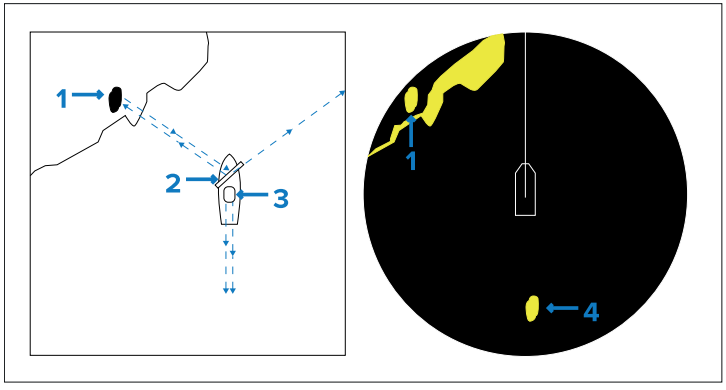
Side lobe patterns are produced by small amounts of energy from the radar beam which are radiated outside of the narrow main beam. The effects of side lobes are most noticeable with larger targets at short ranges (normally below 3 NM). Side lobe echoes form either arcs on the radar screen, or a series 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 radar screen. Inconsistent echoes may not always appear in the same location and may not correlate. Adjusting the *[Gain]* control can minimize inconsistent echoes.

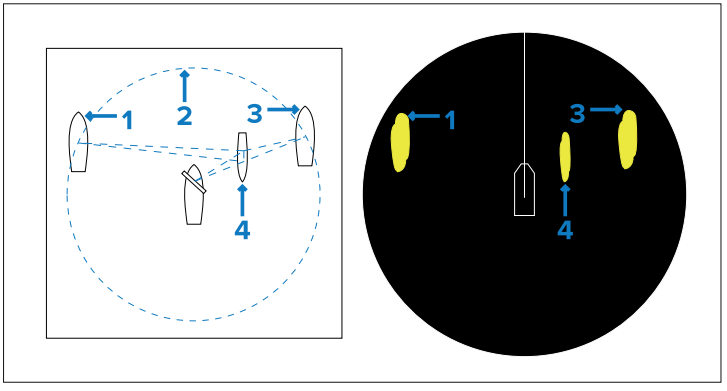


1. Actual object.
2. Radar antenna.
3. Funnel.
4. Inconsistent echo.

Ghost echoes

Ghost echoes can occur when the radar beam is reflected off of 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 to 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 echo will appear on the radar 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

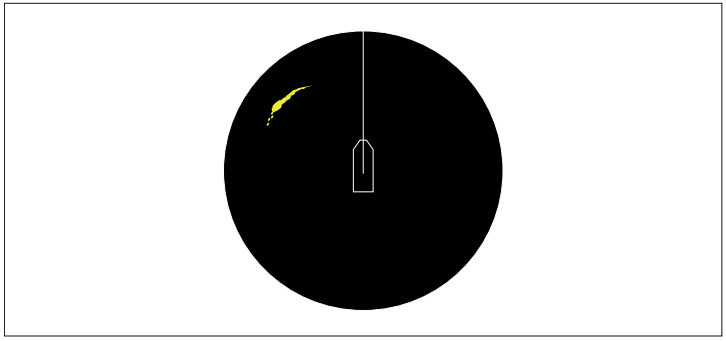
A large target close to ownship may be represented at two positions on the screen. One of them is the actual echo directly reflected by the target, and the other is a false echo which is caused by the

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 radar screen.

Target smearing

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

Target smearing is indicated by a number of weaker echoes appearing around a stronger target echo on the radar 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.

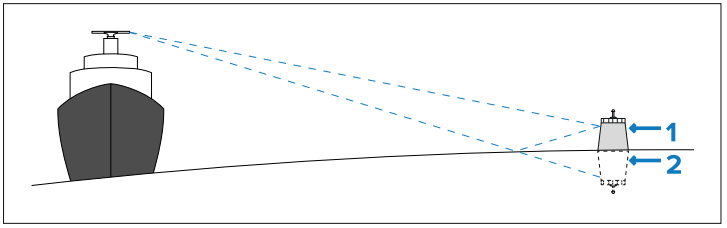


Multi-path interference

The radar beam can reflect back directly from the target or from a sea surface reflection of the target. When this multi-path interference occurs, the two signals will either reinforce one other or cancel each other out, creating a null.

Multi-path 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. Multi-path interference may produce a large number of signal nulls at short range that become less frequent as range increases.

In 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 multi-path interference is less pronounced, so the nulls are less deep. As the height of the radar antenna (or target) increases, the frequency of the nulls also increases. The frequency of the nulls also increments with increasing radar frequency.



1. Actual target.
2. Reflection.

Radar interference

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

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

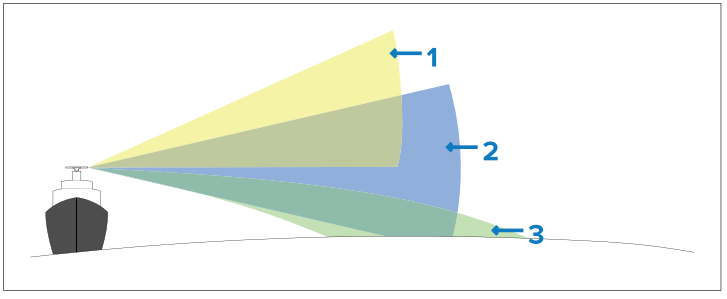
The higher the *[Interference Rejection]* level, the more interference suppression is used.

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 occurring when the radar beam, which is bent downwards, reflects off the earth's surface back into the atmosphere. In this scenario, the beam 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 greater distances than the radar's usual 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 on screen.
- **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 on screen 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 at which the walls are with respect 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.

Reflectors and beacons

Reflectors

Reflectors are designed to give maximum returns from radar transmissions and may be fitted to buoys to aid navigation, or to sundry features such as dangerous outcrops of rocks, or 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 renders echoes precisely on the radar display. This effect can be reduced when using a high Correlation level (RACONS are not normally affected by Interference Rejection).

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 the targets are not obscured by the horizon, will depend on a 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 radar antenna physically located in a higher position will normally increase the range of detection, but may deteriorate performance in adverse clutter conditions.

Raymarine's Pathfinder 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 therefore negatively impacting target detection.

Sea clutter

Radar echoes from breaking waves, sea spray and backscatter appear on the radar screen as clutter. The clutter appears centered 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.

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 Raymarine Pathfinder radar features a high discrimination on all range scales, maintaining a higher detection performance in all rain clutter conditions.

Appendix B Licensing issuing authorities

The following table lists the relevant issuing authority for licences in each region, along with a link to the relevant website. Many authorities allow you to apply for a license online.

Country & regulatory authority	Website
Argentina (AR): Ente Nacional de Comunicaciones	http://www.enacom.gob.ar
Australia (AU): Australian Communications and Media Authority	http://www.acma.gov.au/
Austria (AT): Austrian Regulatory Authority for Broadcasting and Telecommunications	http://www.rtr.at
Belgium (BE): Belgian Institute for Postal services and Telecommunications (BIPT)	http://www.bipt.be
Brazil (BR): Agencia Nacional de Telecomunicacoes	http://www.anatel.gov.br
Bulgaria (BG): Communications Regulation Commission	http://www.crc.bg
Canada (CA): Industry Canada	https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/home
China (ZH): Ministry of Information Industry	http://www.mii.gov.cn
Costa Rica (CR): Superintendencia de Telecomunicaciones	http://sutel.go.cr
Croatia (HR): Croatian Post and Electronic Communications Agency	http://www.hakom.hr/default.aspx?id=7
Cyprus (CY): Office of Electronic Communications & Postal Regulation	http://www.ocecpr.org.cy/nqcontent.cfm?a_id=767&tt=ocecpr&lang=gr
Czech Republic (CZ): The Czech Telecommunication Office	http://www.ctu.eu/main.php?pageid=178
Denmark (DK): Danish Energy Agency	https://ens.dk/en
Estonia (EE): Estonian Competition Authority	http://www.konkurentsiamet.e-e/?lang=en
Finland (FI): Finnish Communications Regulatory Authority	http://www.ficora.fi/en
France (FR): Autorité de Régulation des Communications Électroniques et des Postes	http://www.arcep.fr
Germany (DE): Bundesnetzagentur	http://www.bundesnetzagentur.de
Greece (EL): Hellenic Telecommunications and Post Commission	http://www.eett.gr/opencms/opencms/EETT_EN/index.html
Holland (NL): Autoriteit Consument & Markt	https://www.acm.nl/nl
Hong Kong (HK): Office of Communications Authority	http://www.ofca.gov.hk
Hungary (HU): National Media and Infocommunication Authority	http://www.nmhh.hu
Iceland (IS): Post and Telecom Administration	http://www.pfs.is/default.aspx?cat_id=101

Country & regulatory authority	Website
Indonesia (ID): Indonesian Telecommunications Regulatory Authority	http://www.brti.or.id
Ireland (IE): Commission for Communications Regulation	http://www.comreg.ie
Isle of Man (IM): Communications Commission	http://www.gov.im/government/boards/cc.xml
Italy (IT): Autorità per le Garanzie nelle Comunicazioni	http://www.agcom.it
Jamaica (JM): Spectrum Management Authority	http://www.sma.gov.jm
Japan (JP): Ministry of Internal Affairs and Communications	http://www.soumu.go.jp/english/index.html
Korea, South (KR): Korea Communications Commission	http://eng.kcc.go.kr
Lichtenstein (LI): Office for Communications	http://www.llv.li/amtsstellen/llv-ak-english-page.htm
Lithuania (LT): Communications Regulatory Authority	http://www.rrt.lt/en/home.html
Luxembourg (LU): Institut luxembourgeois de régulation	http://www.ilr.public.lu
Latvia (LV): Elektronisko sakaru direkcija	https://www.vases.lv/lv/content/juras-sakaru-atlaujas
Malaysia (MY): Malaysian Communications and Multimedia Commission	http://www.mcmc.gov.my

Country & regulatory authority	Website
Malta (MT): Malta Communications Authority	http://www.mca.org.mt
Mexico (MX): Instituto Federal de Telecomunicaciones	http://www.ift.org.mx
New Zealand (NZ): Commerce Commission of New Zealand	http://www.comcom.govt.nz
Norway (NO): Norwegian Communications Authority	http://www.nkom.no
Panama (PA): Autoridad Nacional de los Servicios Públicos	http://www.asep.gob.pa/default.asp
Poland (PL): Prezes Urzędu Komunikacji Elektronicznej	http://www.uke.gov.pl
Portugal (PT): Autoridade Nacional de Comunicações	https://www.anacom.pt
Romania (RO): National Authority for Management and Regulation in Communications of Romania	http://www.ancom.org.ro/en
Russia (RU): Ministry of Telecom and Mass Communications of the Russian Federation	https://minsvyaz.ru/en
Saudi Arabia (SA): Communications and Information Technology Commission (Saudi Arabia)	http://www.citc.gov.sa

Country & regulatory authority	Website
Singapore (SG): Info-communications Media Development Authority of Singapore	https://www.imda.gov.sg
Slovenia (SI): Agency for communication networks and services of the Republic of Slovenia	http://www.akos-rs.si/akos-ang
Slovakia (SK): Telecommunications Regulatory Authority of the Slovak Republic	http://www.teleoff.gov.sk/index.php?ID=9
South Africa (ZA): Independent Communications Authority of South Africa	http://www.icasa.org.za
Spain (ES): Comisión Nacional de los Mercados y la Competencia	https://www.cnmc.es/en
Sweden (SE): Swedish Post and Telecom Authority	http://www.pts.se
Switzerland (CH): Office fédéral de la communication	http://www.bakom.admin.ch/themen/frequenzen/00689/01563/index.html?lang=fr
Taiwan (TW): National Communications Commission	http://www.ncc.gov.tw/english/index.aspx
Thailand (TH): National Broadcasting and Telecommunications Commission	http://nbtc.go.th/wps/portal/NTC/eng
Turkey (TR): Information And Communication Technologies Authority	http://eng.btk.gov.tr
United Arab Emirates (AE): Telecommunications Regulatory Authority	http://www.tra.ae
United Kingdom and Northern Ireland (UK (NI)): OFCOM	http://www.ofcom.org.uk
United States (US): FCC	https://www.fcc.gov/bureau-divisions/mobility-division/ship-radio-stations#block-menu-block-4

Appendix C Ethernet (IPv4) networking of Raymarine devices with third-party products

Raymarine uses a custom Ethernet (IPv4) networking configuration. Use the following information to help you understand how Raymarine's Ethernet (IPv4) implementation interacts with third-party Ethernet (IPv4) devices on your vessel, such as routers, switches, Access Points (APs) etc.

Important:

• Third-party networking products such as routers, switches, and Access Points (APs) *may* work when connected to Raymarine networks, when configured correctly. However, correct operation is not guaranteed. It's important to refer to the instructions provided by the relevant third-party device manufacturer, to ensure that your intended use of a third-party device is consistent with the device's design intent.

• Raymarine does not warrant that Raymarine products are compatible with products manufactured by any person or entity other than Raymarine.

• When using third-party products in your Raymarine electronics network, you should be aware of, and understand, the concepts and limitations described in the following Disclaimer:
p.11 — Disclaimer

Overview

- Ethernet (IPv4) networking is a method for interconnecting multiple electronic devices, allowing many devices to function in a network and share data using only a single RJ45 or RayNet connection for each device.
- In order to function correctly, every Ethernet (IPv4) device (whether Raymarine or third-party) must have a unique IP address allocated to it, and it must not conflict with that of any other device.
- IPv4 addresses can be centrally-allocated to devices either **automatically**, using a method known as *DHCP* (Dynamic Host Configuration Protocol), or **manually** (i.e. allocated a static IP address). The most common method for allocating IPv4 addresses on vessel electronics networks is *DHCP*. In this configuration, the *server* device is known as a *DHCP server*.

Client / Server device	Example(s)
Raymarine IPv4 DHCP **client**	• Radar scanner (e.g. Quantum-Series) • Sonar module (e.g. CP470) • IP camera (e.g. CAM300)
Raymarine IPv4 DHCP **server** and self-addressing device	• Chartplotter, running the LightHouse operating system (e.g. Axiom-Series) • Marine Router (e.g. YachtSense Link)
Third-party IPv4 DHCP **client**	IP camera
Third-party IPv4 DHCP **server**	• Router • Switch • Access Point (AP)

Note:
The DHCP server maintains a pool of IP addresses and "leases" an address to any DHCP-enabled client, when the client device first powers up and announces its presence on the network. Because the IP addresses are dynamic (leased) rather than static (permanently assigned), addresses no longer in use are automatically returned to the DHCP server's pool, for subsequent reallocation.

It's also possible to have multiple DHCP servers issuing addresses on an IPv4 network, but to avoid addressing conflicts, all DHCP servers must be carefully configured to only allocate IP addresses in distinct address ranges. The *subnet mask* must also be carefully configured, to ensure that devices can correctly communicate with one another.

Implementation

- Raymarine Ethernet (IPv4) devices expect to use a private **Raymarine IPv4 network**, which is designed to be internal to the vessel only. Raymarine has carefully chosen a specific IP address range (**198.18.0.0/21**) to ensure that it does not interfere with

any external IP address ranges, or other legacy and real-world addressing constraints (including but not limited to marina Wi-Fi networks).

Note:
Raymarine's IP address range is for **local traffic** within the **vessel's private Raymarine network only**, and does NOT traverse across Raymarine products to external networks, or to the Internet.

- In a Raymarine Ethernet (IPv4) network, IP addresses are self-allocated by certain Raymarine equipment in the following range: **198.18.0.32 to 198.18.3.255** (inclusive). **You must avoid placing any devices in this range using manual (static) IP addresses.**
- Whether your network includes only Raymarine Ethernet (IP) devices, or a mixture of Raymarine and third-party Ethernet (IPv4) devices, you have 3 options for configuring the Ethernet (IPv4) network and managing the IP addresses for your devices:

1. Use a Raymarine device as the sole DHCP server to allocate IP addresses automatically to all Raymarine and third-party Ethernet (IPv4) devices on the network. **For the purposes of simplicity and reliability, this is the recommended option for most vessels.** The following Raymarine devices can act as DHCP servers:

   a. **Raymarine chartplotter**, running LightHouse v3.15.62 or later., or

   b. **Raymarine YachtSense Link router**

Note:
If both a Raymarine chartplotter **and** YachtSense Link router are present in the same network, the YachtSense Link router MUST be configured as the DHCP server for that network. To facilitate this, the Raymarine chartplotter's DHCP setting defaults to *Automatic* as standard. On power up, if the YachtSense Link router is detected on the Ethernet network, any chartplotters in the network will disable their own *DHCP Server*, to permit the YachtSense Link router to manage the network's IP addresses. Only Raymarine chartplotters running LightHouse v4.1.65 or later are compatible with the YachtSense Link router. Additionally, the most recent versions of the LightHouse and YachtSense Link software must be used.

2. Use a third-party Ethernet (IPv4) device (such as a router or Access Point) to allocate IP addresses automatically, as a sole *DHCP server*. To do this, refer to the *Configuring a third-party router as DHCP server* section, below.

Note:
Any Raymarine chartplotters will still self-allocate their own IP address, even if a third-party DHCP server is being used to allocate IP addresses to other Raymarine or non-Raymarine *DHCP client* devices (Camera, Radar, Sonar etc.) on the network.

3. Manually configure static IP addresses for your devices. The address range **198.18.0.32 to 198.18.3.255** (inclusive) is used by Raymarine equipment, and any other third-party equipment on the network should not be set to a static IP address in this range. It should instead be set elsewhere in the 198.18.0.0/21 range.

Adding third-party devices to your Raymarine Ethernet (IP) network

- It is recommended that any third-party products connecting to a Raymarine Ethernet (IPv4) network (e.g., a third-party IP camera) are configured as DHCP clients, so that they automatically get allocated a correct IP address within the range used by the **Raymarine IPv4 network**. If this is not possible, (for example, in the scenario that your third-party IP Camera requires a static IP address), you should configure the product to have a static IP

address within the following range: **198.18.0.1 to 198.18.0.31** (inclusive).

- Any third-party router in your network should be performing IPv4 *Network Address Translation* (NAT) from the private address to another one on an upstream interface.

Configuring a third-party router as DHCP server

In the scenario that you wish to use a third-party DHCP server to allocate the IP addresses for your vessel's IPv4 network, use the following information to help you configure the third-party DHCP server to work with Raymarine Ethernet (IPv4) client devices:

1. Configure the third-party DHCP server / router to use Raymarine's subnet details, which are as follows:
   a. Set the DHCP server's IP address to **198.18.0.1**
   b. Set the *netmask* to /21, i.e. **255.255.248.0**
   c. Set the DHCP range from **198.18.4.0 to 198.18.7.254** (inclusive). If this is not possible, ensure that the address range is smaller than this (but within the range of **198.18.4.0 to 198.18.7.254** (inclusive)).
   d. The address range **198.18.0.32 to 198.18.3.255** (inclusive) is used by Raymarine equipment, and therefore you must ensure that any other third-party equipment on the network is NOT set to a static IP address in this range.
2. It may be necessary to set the DHCP setting for **all** of the chartplotters on the vessel to *[Off]*. However, the default option (*[Auto]*) will likely work fine in many cases. If for any reason the third-party DHCP server starts up after the chartplotter starts up, the user should manually set the chartplotter's DHCP switch to *[Off]*. This is because, when the chartplotter starts up, its DHCP *[Auto]* feature tries to detect if another DHCP server is already present on the network.
3. In case of failure of the third-party device, the chartplotters can be easily configured to be the DHCP server again, by setting the chartplotter's DHCP setting back to *[Auto]*.

Adding third-party Wi-Fi Access Points / Wi-Fi routers to your Raymarine Ethernet (IPv4) network

- There is a large volume of multicast IPv4 traffic on the Raymarine Ethernet (IPv4) network. Many consumer Wi-Fi Access Points / Wi-Fi routers simply bridge all multicast traffic from the Ethernet interface to the Wi-Fi interface when there are connected Wi-Fi clients. This will result not only in poor Wi-Fi performance but also in a reduction of usable Wi-Fi spectrum to other Wi-Fi users and vessels in the vicinity. If using a third-party Wi-Fi Access Point or Wi-Fi router, Raymarine recommends that *IGMP Snooping* is enabled on the third-party device, and additional checks are performed, in order to ensure that your device is not bridging any unexpected multicast traffic to its Wi-Fi interface from the Raymarine Ethernet (IPv4) network.
- Raymarine's YachtSense Link router is pre-configured with IGMP Snooping enabled, and therefore does not bridge internal multicast traffic on the wired network to the Wi-Fi network. No additional configuration is required in this respect.

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