Showing or hiding the range rings

To turn the range rings on/off:
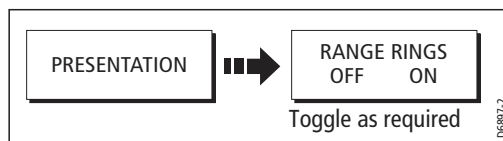
```
┌─────────────────┐        ┌─────────────────┐
│  PRESENTATION   │  ▌▌▌➡  │  RANGE RINGS    │
│                 │        │   OFF     ON    │
└─────────────────┘        └─────────────────┘
                           Toggle as required    D6897-2
```
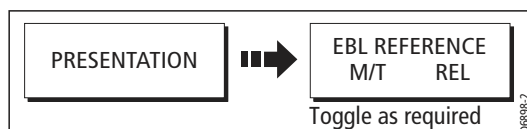
Changing the bearing mode for EBLs

The default bearing mode for EBLs is relative to your vessel's heading. If heading data is available, you can set the bearing mode to be relative (REL), magnetic/true (M/T).

When M/T is selected, the EBL bearings will be expressed as either true or magnetic dependant on the equipment connected. The current EBL bearing is expressed on both the radar screen EBL label and on the ADJUST EBL soft key.

To change the EBL reference:

```
┌─────────────────┐        ┌─────────────────┐
│  PRESENTATION   │  ▌▌▌➡  │  EBL REFERENCE  │
│                 │        │   M/T     REL   │
└─────────────────┘        └─────────────────┘
                           Toggle as required    D6898-2
```

7.7 Getting the best picture

You can improve the quality of the radar picture by using:

- The gain controls - sea, gain, tune, FTC and rain.
- The target display controls - interference rejection, expansion, wakes.

Using the GAIN functions

The gain function reduces the effects of false echoes and clutter.

For the best results Raymarine recommends that you retain the AUTO default setting. You can however adjust these settings manually if required.

Manually adjusting the gain modes

The sea, gain and tune controls can all be adjusted manually if necessary:
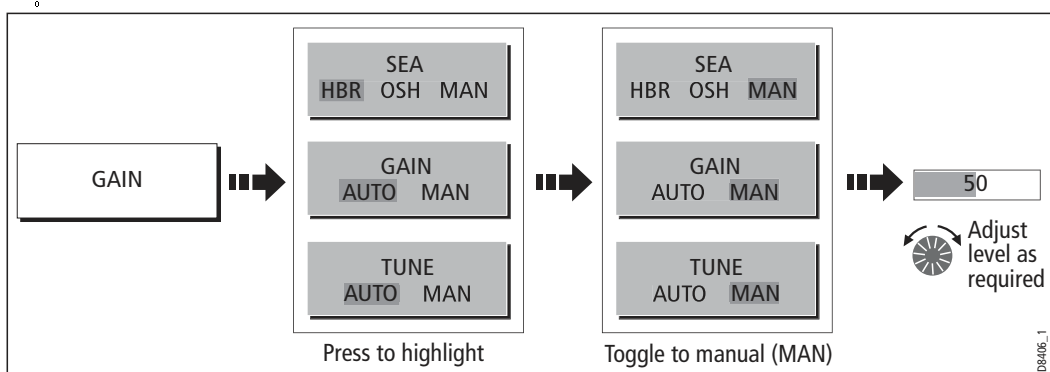
Note: *The new values remain set even when you switch off the display and are applied to both the active window and any other radar windows.*

Sea

Radar echoes from waves around your boat can clutter the centre of the radar picture, making it difficult to detect real targets (see *page 146*).

Adjusting the sea mode will reduce this clutter for up to 5 nautical miles (depending on wave and sea conditions) from your boat. This has the effect of reducing the sea echoes to intermittent small dots whilst small targets remain visible and persistent. Gain levels further from your boat remain unchanged. There are three sea gain modes:

- **HBR** (Automatic Harbor mode) - this takes account of the effects of land clutter so that small target are not lost. It should be used when you are in harbor or in close proximity to land.

- **OSH** (Automatic Offshore mode) - the system continually calculates the required level of sea clutter control.

- **MAN** (Manual mode) - this enables you to select the sea clutter level and then adjust the settings to ensure that all close small targets are visible. On short range scales, do not set the SEA control so high that all clutter is removed, since this could stop you seeing echoes from close targets. The acuteness of the sea clutter curve is set up in the Radar Setup menu (see *page 173*). Manual sea clutter mode should be used in conjunction with the GAIN function (described below).

Gain

The gain function makes the radar picture clearer by changing the sensitivity of radar reception.

- **For long ranges** - select a sensitivity level that gives a slight speckle in the background. Be careful not to set the gain too low, or you may miss weak or small targets.

- **For shorter ranges** - reduce the gain slightly to reduce the speckle and therefore improve target definition.

Note: *If you set the GAIN to MAN (manual), you should check it every time you change the range scale.*

Tune

The tune function is used to fine tune the receiver in the scanner for maximum target returns on the display.

Auto mode

In AUTO mode, the radar tunes itself automatically on all range scales. **This is the default and it is recommended that you leave the TUNE function in AUTO mode, to ensure that the radar receiver is always tuned to receive the maximum signal.**

Manual (MAN) mode

If you do set the TUNE function to MANUAL, you will need to adjust it about 10 minutes after you have turned on the radar, since the required setting will change after the magnetron has warmed up. You should adjust the control to obtain the maximum signal strength (indicated by the eight step horizontal bar.). If you cannot tune the radar successfully, refer to the Installation Guide.

FTC

You can use the Fast Time Constant (FTC) function to remove areas of clutter at a distance from your boat or to distinguish between two very close echoes on the same bearing, which may otherwise merge and appear as one echo

When the FTC function is turned up, only the leading edge of large (rain clutter) echoes is shown, while the effect on smaller (ship) echoes is only slight. As the receiver is less sensitive, and background noise and fill-in returns from land and other large targets reduced, you should turn the FTC function down when its use is not required. Since storm cells are usually visible for long distances due to their extreme altitude, you may wish to leave them displayed so that you can observe the location of bad weather.

Note: *Use FTC in conjunction with the RAIN function to obtain the best picture.*

Rain

Your radar detects echoes from rain or snow. The strength of these echoes is dependent upon the altitude, range, density and size of the snow flakes or rain droplets and will appear on screen (see *page 147*) as countless small echoes continuously changing size, intensity and position.

Turning the RAIN clutter function on suppresses the bulk effect of rain returns from around your boat, so that detection of actual targets is made easier.

Using the enhance echoes functions

You can improve visibility with the enhance echoes function.

Interference Rejection

ON

The interference rejection function, which is normally left switched on, automatically reduces any mutual radar interference when two radar equipped vessels are operating within range of each other (see *page 147*).
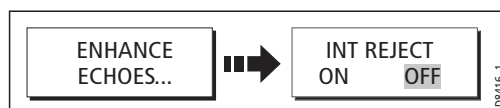
To change the interference rejection setting:
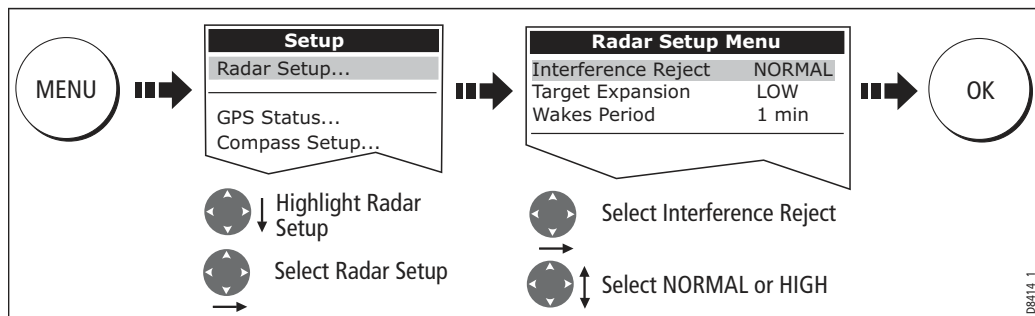
Note: *This menu can also be selected by pressing and holding INT. REJECT.*

OFF

If you wish to detect the presence of other radars in the vicinity:
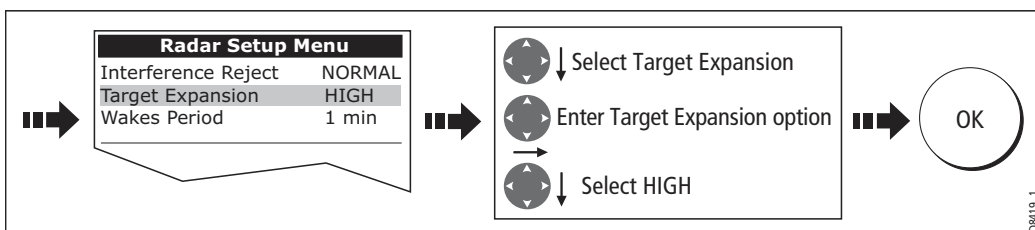

Expansion

The expansion function allows you to either override the pulse length or to give larger returns so targets are easier to see:

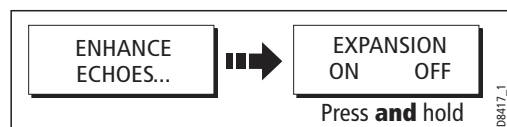## Overriding the pulse length

To override the pulse length:
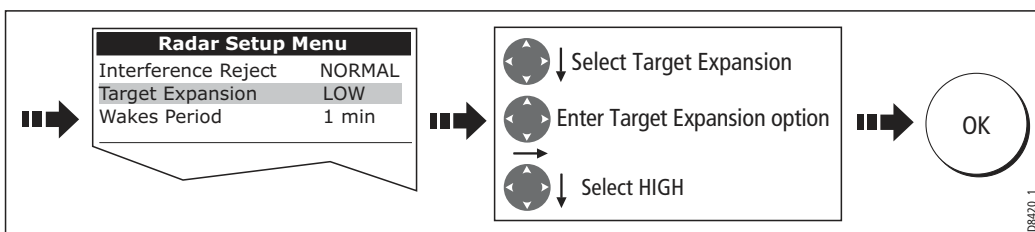
1. Select the Radar Setup Menu:

Larger returns

To alter the processing to give larger returns:

1. Select the Radar Setup Menu:

2. Set the magnification level for target expansion to LOW:

**Note:** *Selecting this option may compromise target resolution.*

Wakes

When the wakes function is switched on, you can see the direction and speed of moving targets relative to your boat. A target is displayed in yellow and as the signal diminishes with time it is shown in paler shades of blue.

Note: *The wakes option is a local setting and will therefore only affect the individual display on which you are working.*
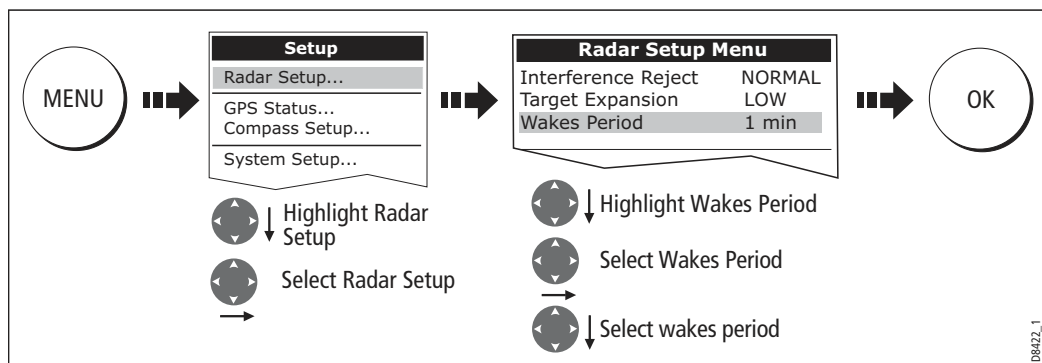
Displaying wakes

To switch on the wakes function:
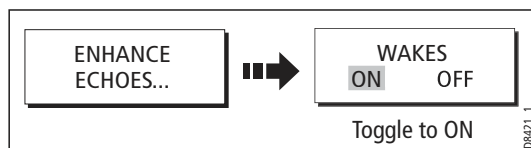
Specifying the wake period

You can select via the Radar Setup Menu, whether these wakes are shown for periods of 10 seconds, 30, seconds, 1 minute, 5 minutes or 10 minutes.
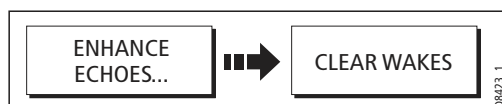
To specify the wake period:

Note: *You can also enter the Radar Setup Menu by pressing and holding the WAKES soft key.*

Removing wakes

When the currently displayed wakes are no longer required they can be remove from your screen:

7.8 Changing the displayed range

You can zoom in or out to view your radar picture at varying scales. The scale is measured from the centre to the top of the window and is displayed in the left-hand corner of the status bar.

The scale you will need is dependent upon where you are navigating and the level of detail that you wish to see:

- **Short range scales** - provide greater detail of radar echoes close to the vessel, and are most suited for use as you approach coastlines, habors or other vessels in the area. The shortest range scale available is 1/8 nautical miles (or the equivalent in the chosen unit).

- **Long range scales** - provide the best overview of the vessel's relationship to landmasses, weather fronts and large ship targets in or beyond the field of vision. The longest range scale available is between 24 and 72 nautical miles (or the equivalent in the chosen unit) depending upon the scanner fitted.

The range of the radar is adjusted by pressing the **RANGE** button.

Press **IN** to decrease the range scale or 'zoom in'.

Press **OUT** to increase the range scale or 'zooms out.

Each press of the button changes the range by one setting. Pressing and holding the button will change the range quickly in the required direction.
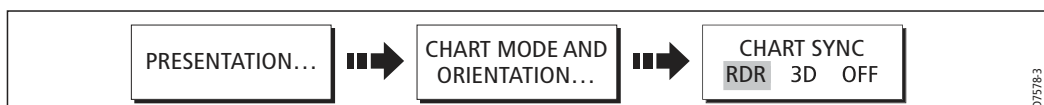
Radar range and chart scale synchronization

The chart application includes an option to synchronize the radar range and chart scale.

When synchronization is switched on:

- The radar range in all radar windows, changes to match the chart scale.
- 'Sync' is indicated in the top left-hand corner of the chart window.
- If you change the radar range, in any radar window, all synchronized chart views change scale to match.
- If you change the scale of a synchronized chart window, all radar windows change range to match.

With a chart window active, set the radar range synchronization:

PRESENTATION…	▶	CHART MODE AND ORIENTATION…	▶	CHART SYNC RDR 3D OFF

Note: *Radar range synchronization is not available when the chart motion mode is set to Autorange.*
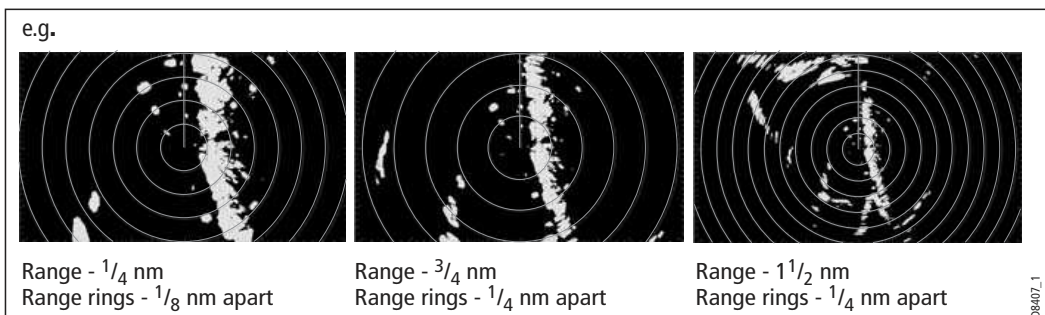
7.9 Measuring distances, ranges and bearings

When you are using the radar application, you can measure distances, ranges and bearings in a variety of ways. These options are detailed in the table below:

| Functions	Distances between points	Range from your boat	Bearings
Range Rings	Yes (approx.)	Yes (approx.)	-
Cursor	-	Yes	Yes
Variable Range Markers (VRMs)	-	Yes	-
Electronic Bearing Lines (EBLs)	-	-	Yes
Floating VRMs	Yes	-	-
Floating EBLs			Yes

... Using the range rings

Use the range rings to gauge the approximate distances between points. Range rings are concentric circles displayed on the screen and centred from your boat at pre-set distances. The number and spacing of the rings changes as you range in and out.

e.g.

Range - $^1/_4$ nm
Range rings - $^1/_8$ nm apart

Range - $^3/_4$ nm
Range rings - $^1/_4$ nm apart

Range - $1^1/_2$ nm
Range rings - $^1/_4$ nm apart

... Using the cursor

To measure the bearing and range from your boat to a specified target, move the cursor to the appropriate position on the screen.

Bearing and range from your vessel to cursor
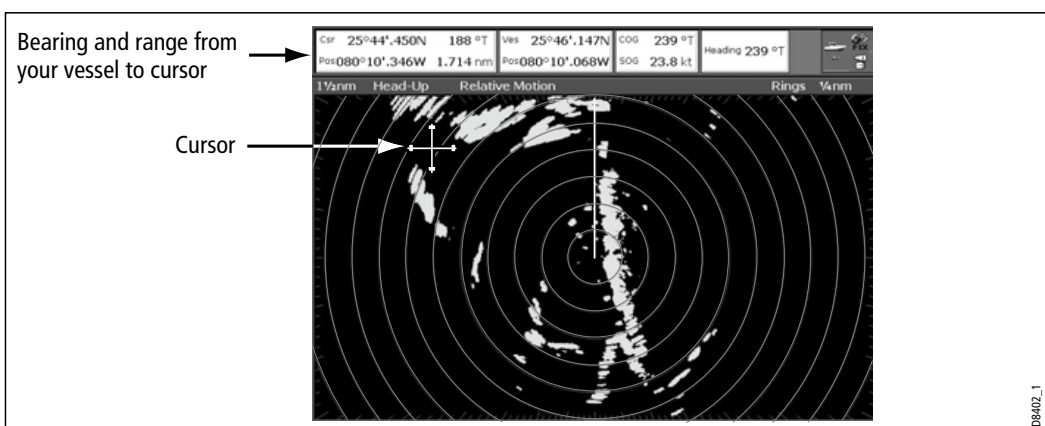
Cursor

**Note:** *If cursor data is not shown, refer to page 10 and page 236.*

... Using VRMs and EBLs

What is a VRM?

A Variable Range Marker (VRM) is a circle centred on your vessel's position and fixed with respect to the heading mode.

When this circle is adjusted to align with a target, its **range** from your boat is measured and displayed on the ADJUST VRM soft key.

The data is also displayed if you select the VRM with the cursor.
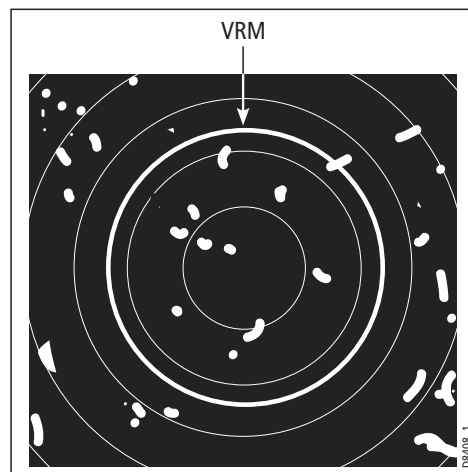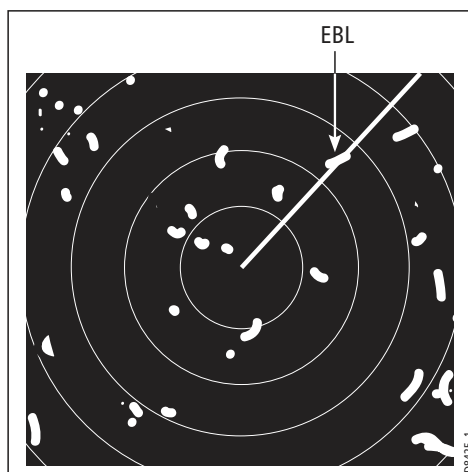

What is an EBL?

An Electronic Bearing Line (EBL) is a line drawn from your boat to the edge of the window.

When this line is rotated to align with a target, its **bearing** relative to your boat's heading is measured and displayed on the ADJUST EBL soft key.

The data is also displayed if you select the EBL with the cursor.

Note: *To change the EBL reference from relative to magnetic or true, see page 154.*

Combined VRM and EBL

A VRM and an EBL can be combined to measure both the **range and the bearing** of the specified target.

Note: *VRMs and EBLs are local settings and will therefore only affect the individual display on which you are working.*
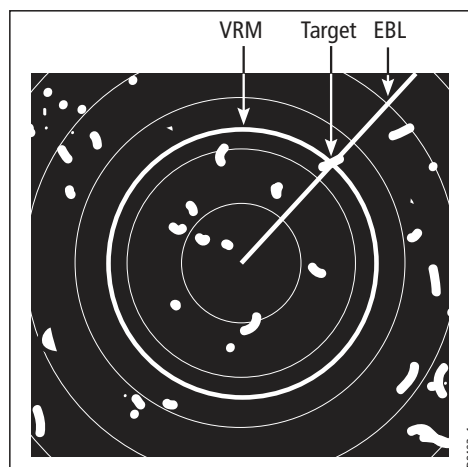
Tracking a target with a VRM/EBL

You will be able to tell which way the target is traveling by watching how it moves in relation to the EBL. If it continues traveling directly along the EBL, it shows that it is on a possible collision course with your boat - take the appropriate action.

Creating a VRM and/or EBL

To use VRMs and EBLs to tell you the range and bearing of a target:
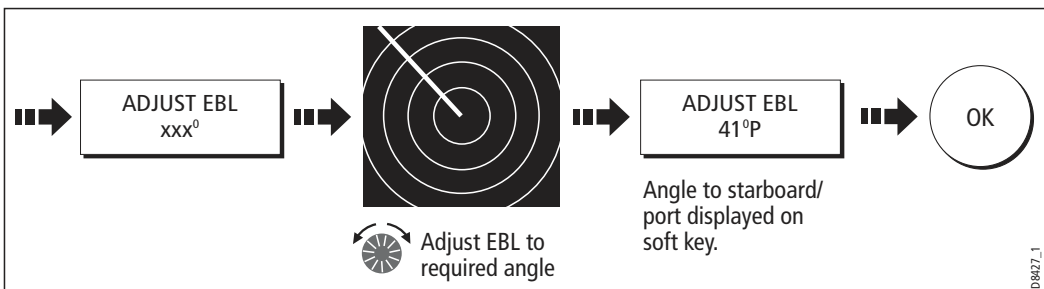
1. Select the VRM/EBL 1 option:
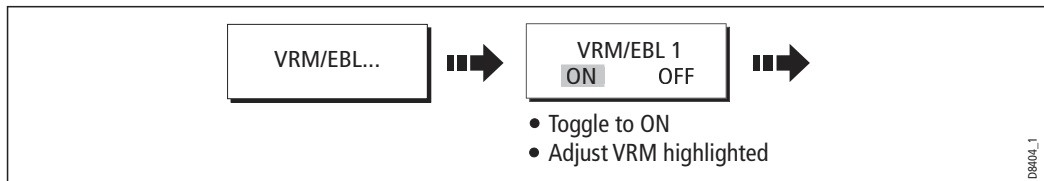
Note: *The first VRM/EBL will be placed at a location of 1/3 of the current range and 030° relative to your boat's head. If this setting is adjusted, the display will retain the adjustments and use them when the VRM/EBL is next turned on.*

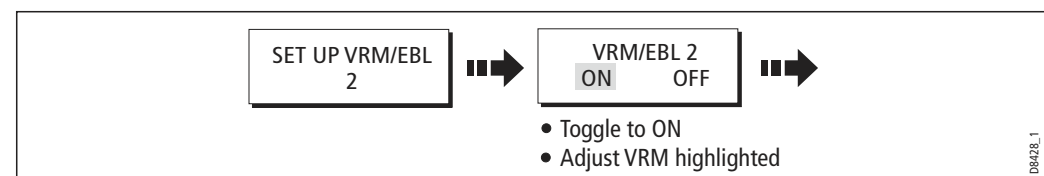2. Adjust the VRM to the required size:
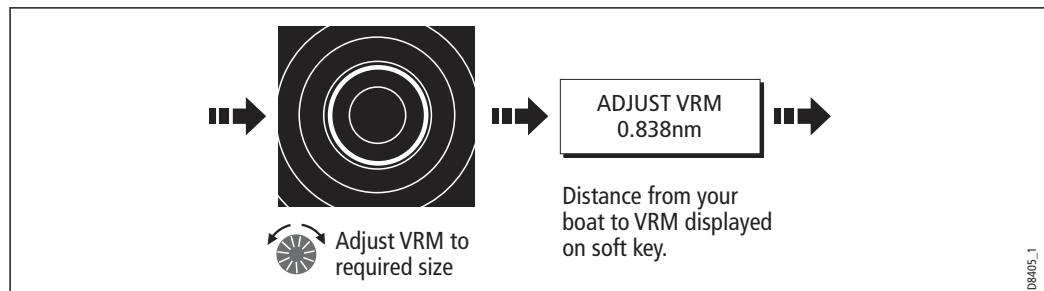
3. Adjust the EBL to the required angle:

4. Save the adjustment and remove control from the VRM/EBL:

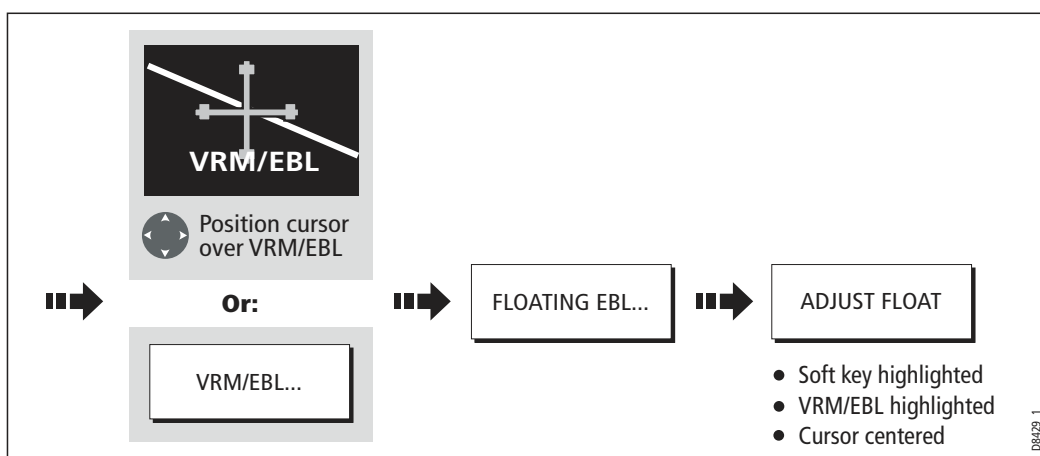5. To place a second VRM/EBL if required:

... Using floating VRMs/EBLs

You can use the VRM/EBL float function to measure the range and bearing between any two points on the radar screen. This function allows you to move the VRM/EBL centre away from your boat's position and onto a target. You can then change the radius of the VRM to determine the distance between two points and change the angle of the EBL, relative to its new origin, to obtain the bearing.

Floating a VRM/EBL

1. Create the VRM/EBL as described previously.

2. Select the floating option:

3. Measure the **range** between two points:
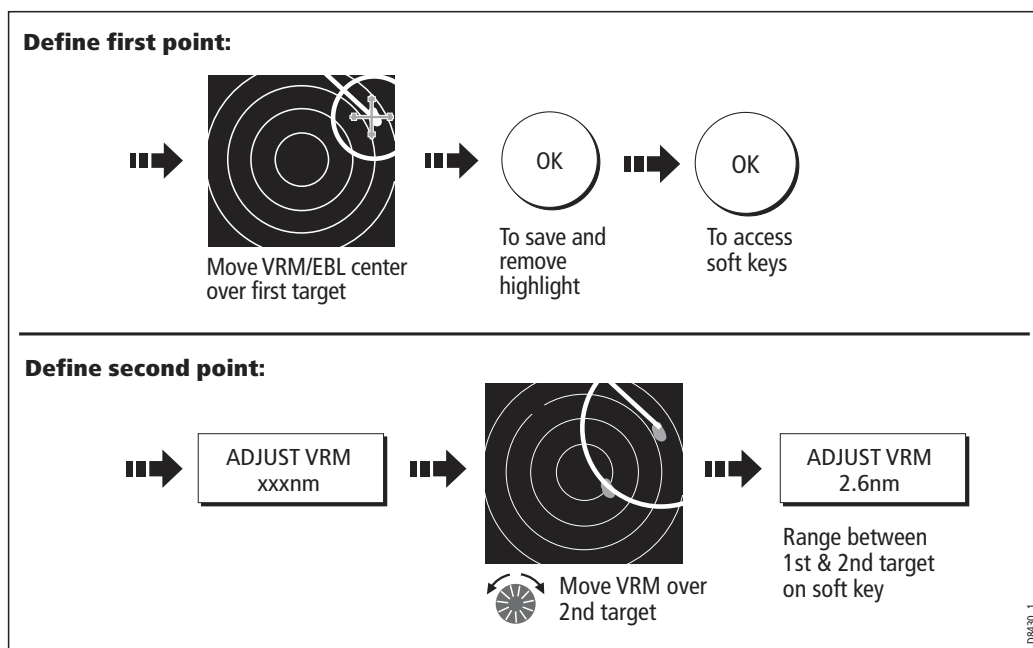
4. Measure the **bearing** between two points:

ADJUST EBL
xxx⁰

Move EBL over
2nd target

ADJUST VRM
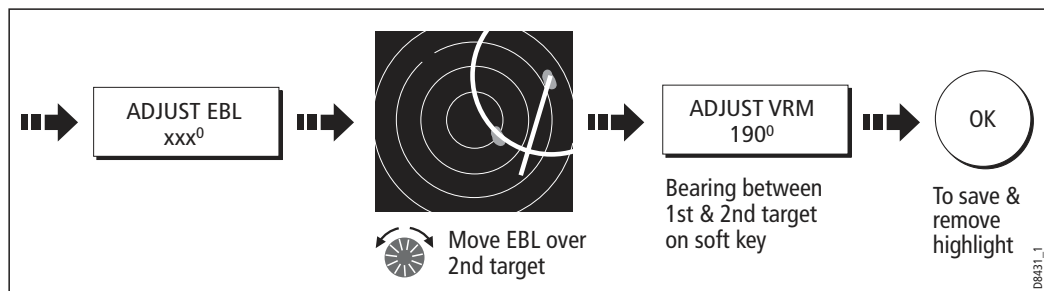190⁰

Bearing between
1st & 2nd target
on soft key

OK

To save &
remove
highlight

5. If required, you can float a second VRM/EBL:

i. Press SET UP VRM/EBL 2.

ii. Toggle the VRM/EBL 2 to ON.

iii. Repeat steps 1 to 8 above.

Unfloating a VRM/EBL

To unfloat VRM/EBLs and return them to the central position:

1. Select the VRM/EBL option.

2. Unfloat VRM/EBL 1 or 2:

To unfloat VRM/EBL 1:

FLOATING EBL...   CENTER   OK

To unfloat VRM/EBL 2:

SET UP VRM/EBL 2   FLOATING EBL...   CENTER   OK
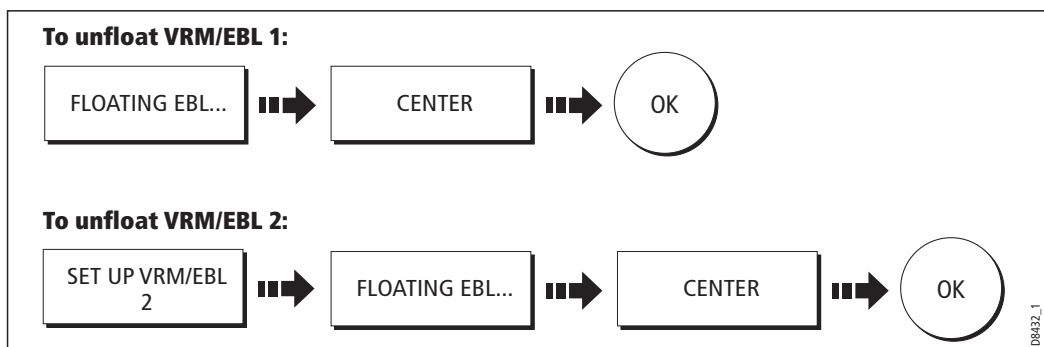
7.10 Using radar to avoid a collision

Your radar includes numerous functions to help you avoid a collision. You can:

* Assess how far away a target is and its bearing (VRMs/EBLs).

* Set an alarm to trigger when a target is within a specified zone (Guard Zones).

* Display detailed information on tracked targets (MARPA).

* Display the identity of other vessels and if broadcasted, their voyage information (AIS).

* Display the range and bearing of a target.

Guard Zones

Guard zones are fixed with respect to the SHM, moving as it moves. They also move if the centre is offset or the range scale is changed, so that the pre-marked area is

maintained. A guard zone only operates when the whole zone is displayed on the screen. An audible alarm sounds to alert you when a target enters the zone.

Guard zones are inactive for 10 seconds after being placed or re-sized, to avoid inappropriate alarms whilst they are being positioned.

You can set up guard zones to be either sector zones or 360° (circular) zones. Your radar can be set up using one or two zones.
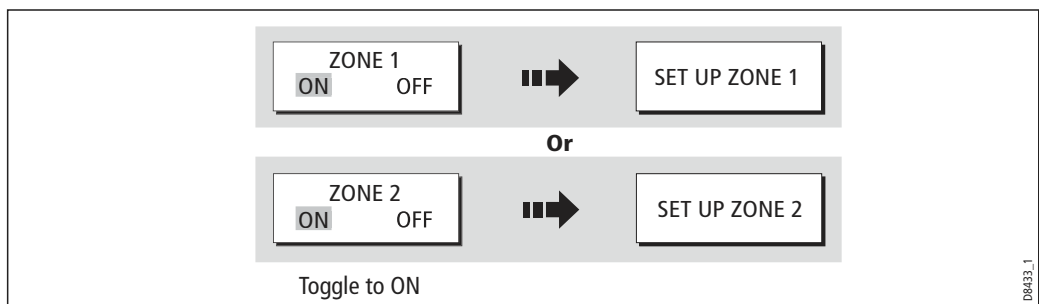
You can adjust the sensitivity of the guard zone via the Alarms Setup Menu described on .

To set up a guard zone:

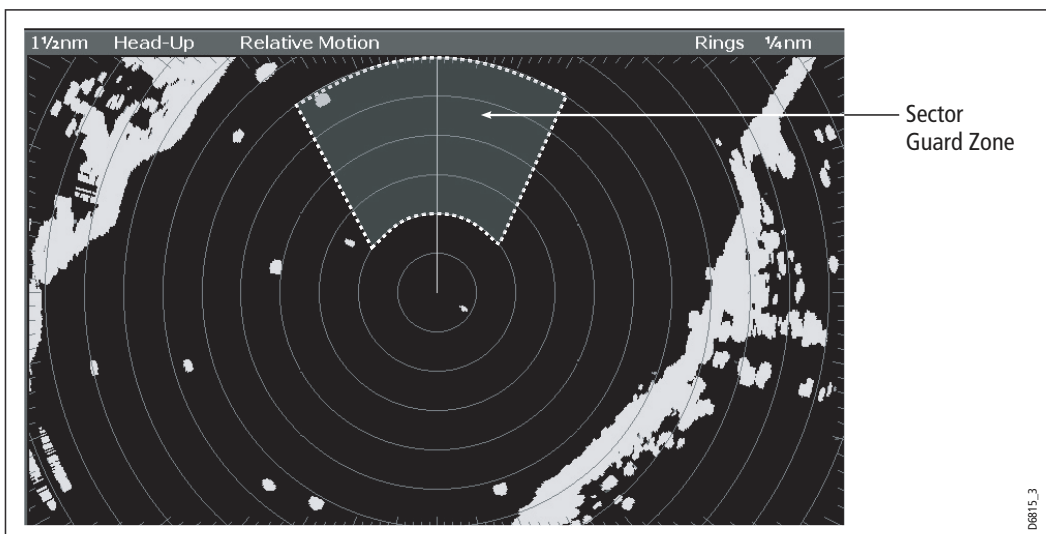1. Select the guard zone option:
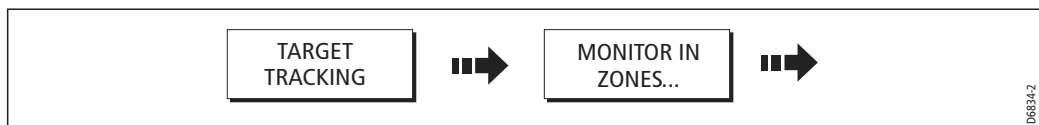
2. Select Zone 1 or 2:

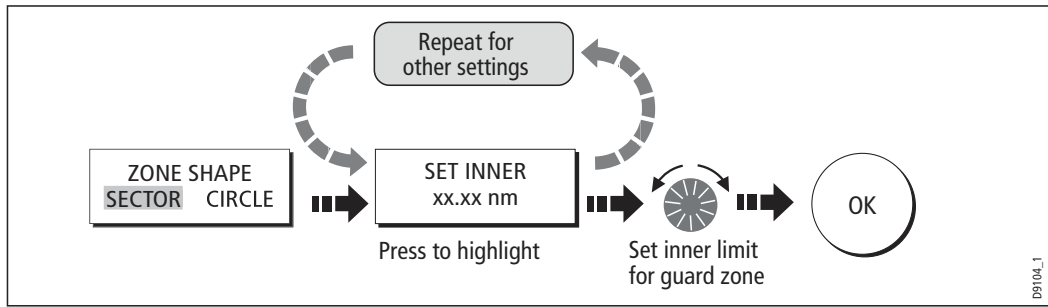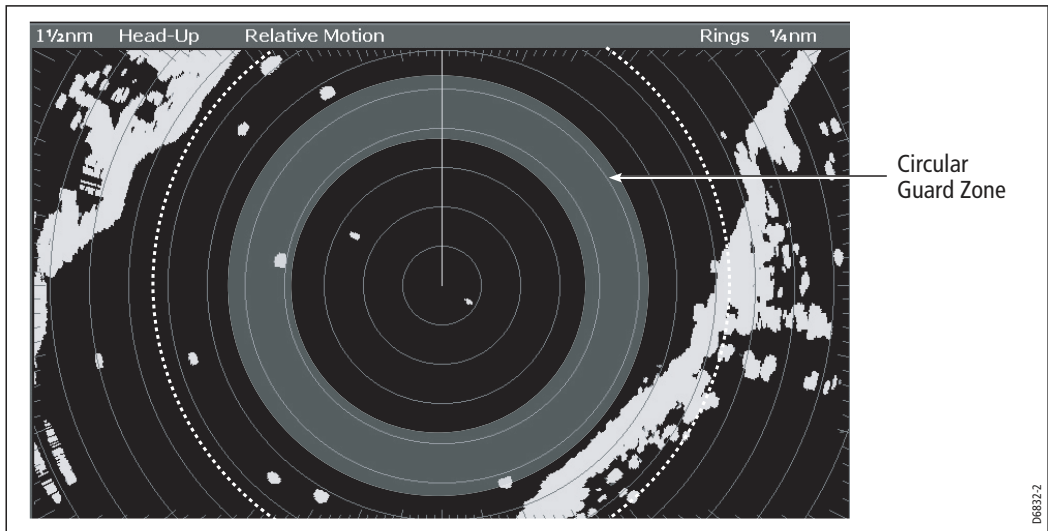You can now select the guard zone to be either a sector or a circular zone.

Sector guard zones

To set up a sector guard zone:

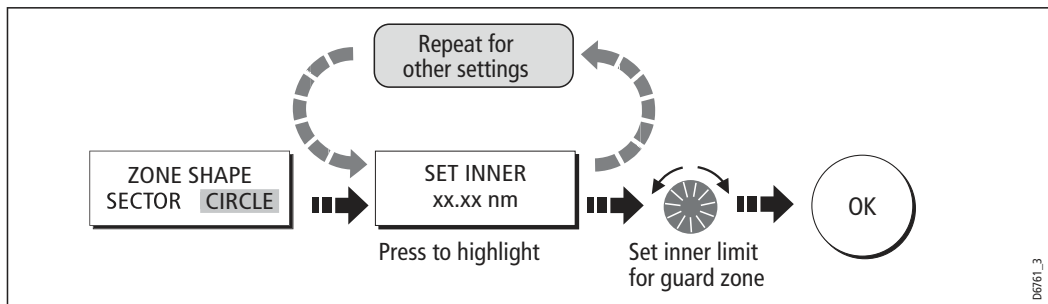## Circular guard zone

Circular
Guard Zone

To set up a circular guard zone:

MARPA

SAFETY NOTICES

MARPA can improve collision avoidance when used wisely. It is the User's responsibility to exercise common prudence and navigational judgements.

There are conditions where acquiring a target may become difficult. These same conditions may be a factor in successfully tracking a target. Some of the conditions are:

- The target echo is weak. The target is very close to land, buoys or other large targets.
- The target or your own ship is making rapid manoeuvres.
- Choppy sea state conditions exist and the target is buried in excessive sea clutter or in deep swells.
- Choppy sea state conditions exist yielding poor stability; own boat's heading data is very unstable.
- Inadequate heading data.

Symptoms of such conditions are that acquisition is difficult and the MARPA vectors are unstable; the symbol wanders away from the target, locks on to another target or changes to a lost symbol target.

If any of these conditions are present, acquisition and tracking may need to be re-initiated or, in some cases be impossible to maintain. Improving the quality of the heading data will reduce the effect of the other conditions.

Introduction to MARPA

You can use the Mini Automatic Radar Plotting Aid (MARPA) functions for target tracking and risk analysis. MARPA improves collision avoidance by obtaining detailed information for up to 10 automatically tracked targets and provides continuous, accurate and rapid situation evaluation.

MARPA automatically tracks acquired targets, calculates target bearing and range, speed and course, Closest Point of Approach (CPA), and Time to Closest Point of Approach (TCPA).

Each target tracked can be displayed with a CPA graphic which shows the target vessel, course and speed (as a vector) and indicates the CPA. The calculated target data can also be shown on your screen. Each target is continually assessed and an audible alarm is sounded if a target becomes dangerous, or is lost.

Effective MARPA operation is dependant on accurate own-ship's heading and speed. Speed Over Ground (SOG) and Course Over Ground (COG) information are required to show true target course and speed. The better the quality of the heading and speed data, the better MARPA will perform. MARPA will function without SOG and COG in relative mode. For the best heading data a Raymarine SMART heading sensor or a gyro-stabilized autopilot is required.

How is a risk assessed?

Each target is monitored to see if it will be within a certain distance from your boat within a certain time. If so, the target is designated as dangerous and an audible warning is sounded along with an on-screen warning being shown. The target symbol changes to the dangerous target symbol and flashes to indicate that it is a dangerous target. Pressing the appropriate soft key will silence the alarm and remove the warning.

If a target is lost, either because the MARPA software has lost contact with it, or because it has moved out of range, an audible alarm is sounded and an on-screen warning appears. The on-screen symbol will change to the target lost symbol. Pressing the appropriate soft key will silence the alarm and remove the on-screen warning and the target lost symbol.

How far from my boat does MARPA work?

MARPA target acquisition is only available at radar range scales of up to 12nm, although tracking continues at all ranges.

If you change to a smaller range scale, targets may be beyond the range of your scanner and will be lost. In such cases, an on-screen warning will indicate that the target is off-screen.

What happens to target data?

All MARPA targets are stored in a MARPA database list which shows the following information:
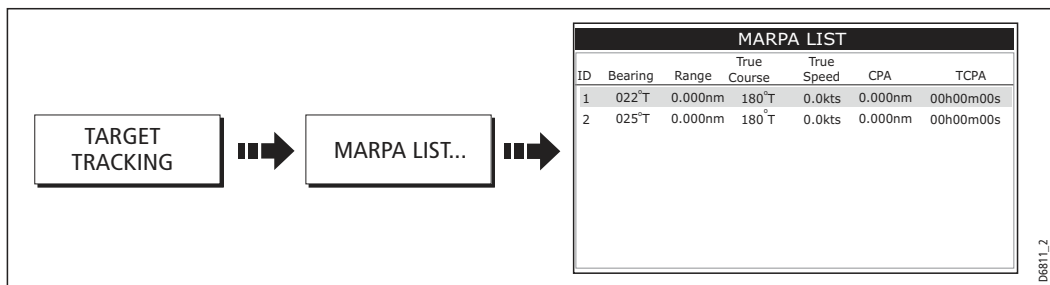
Target display

Each target is displayed as a symbol which indicates its status:

MARPA targets
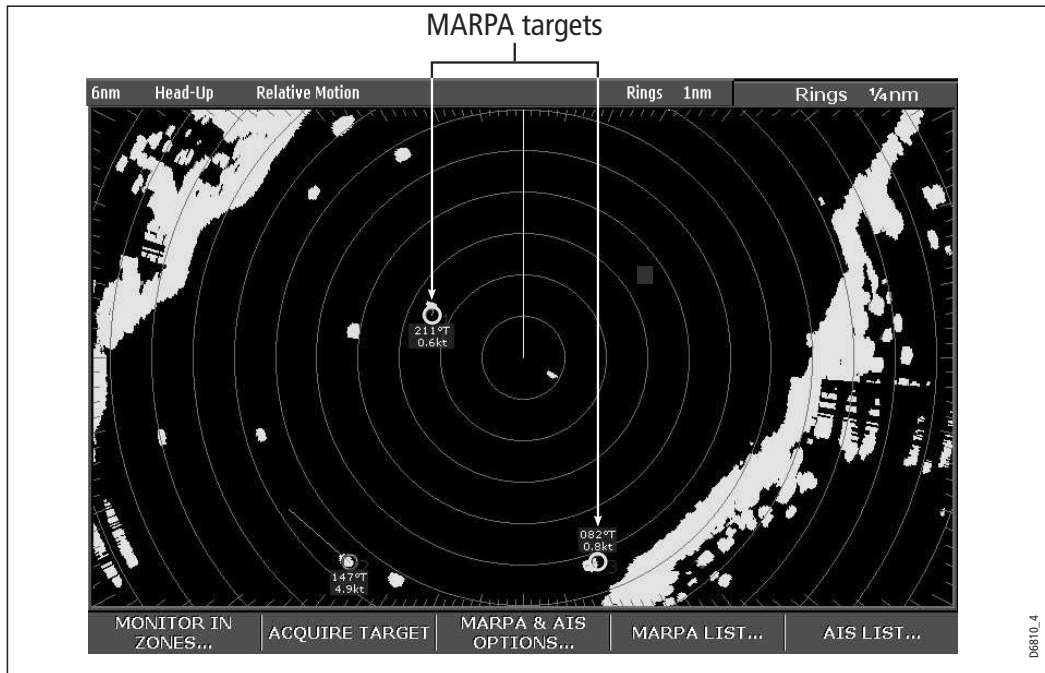
CPA graphics

CPA graphics show vectors for your vessel and a selected target. A vector is a line on-screen showing the predicted courses of your vessel and the selected target if you both remain on your present course. These vectors vary in length due to boat speed and vector length set in the MARPA Setup menu.

Vector
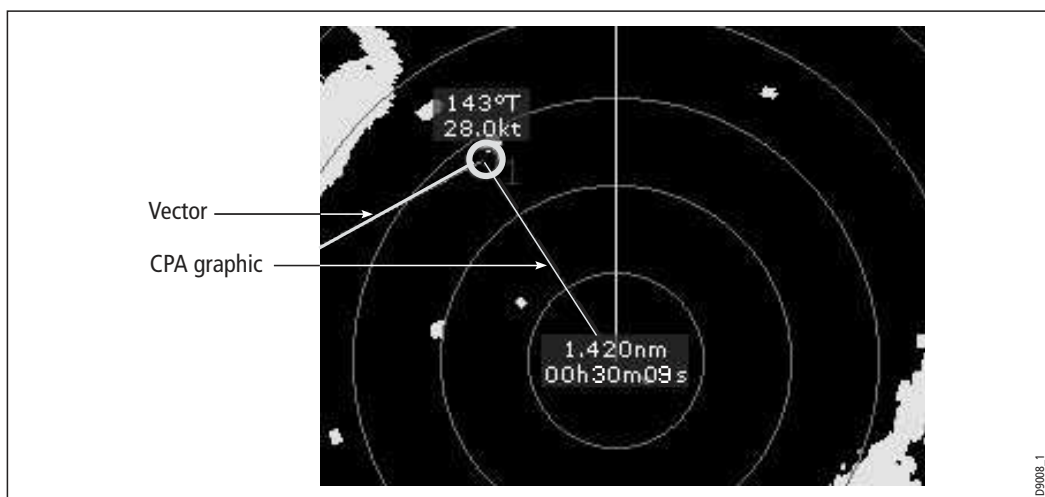
CPA graphic

To display the CPA graphic and associated soft keys:

Move cursor over target

CPA GRAPHIC ON OFF AUTO	**ON** - The CPA graphic will be displayed for as long as the target is being tracked.
CPA GRAPHIC ON OFF AUTO	**OFF** - No CPA graphic is shown.
CPA GRAPHIC ON OFF AUTO	**AUTO** - When you place the cursor over any part of a MARPA symbol, the CPA graphic is displayed. This is the default setting.

True mode

With the display set in True mode, the vectors of your vessel and the target are shown extended to their intersection point. The CPA is shown as a line that is placed on your boat's vector at the point of the CPA. The length and direction of the line indicates the distance and bearing of the target at CPA. The text indicates CPA and TCPA. The text next to the target symbol indicates its true course and speed.

Relative mode

With the display set in Relative mode, no vector extension of your boat is shown. The CPA line emerges from your own boat, with the target vector extension being shown as relative, not true. The text next to the target indicates its course and speed. Press SHOW DETAILS to display the calculated relative course and speed.

Setting up MARPA
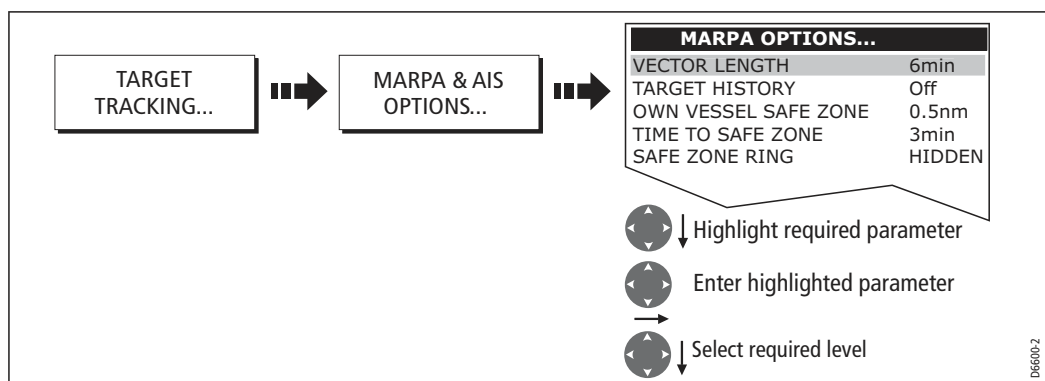
You can set up the following MARPA parameters:

Parameter	Options (Default in **bold**)
Vector Length The time period specified for drawing length of vectors.	0.5min, 1 min, 3 min, **6min**, 12min, 30 min, 60 min
Target History Plots a target's previous position at specified intervals. The four most recent position points are displayed. If True target vectors are selected, the four most recent vessel position points are also displayed.	**OFF**, 0.5 min, 1 min, 3 min, 6 min
Own vessel safe zone The safe zone is a ring, centred on your boat, within which a target is considered dangerous if it will enter this zone within the *time to safe zone* period.	0.1 nm, 0.2nm, **0.5nm**, 1.0 nm, 2.0nm
Time to safe zone If a target enters your safe zone within this time period, it is considered dangerous.	**3 mins**, 6 mins, 12 mins, 24 mins
Safe zone ring Controls whether the safe zone ring is displayed or hidden on screen	Visible **Hidden**

Acquiring a target to track

1. Select target to be acquired:
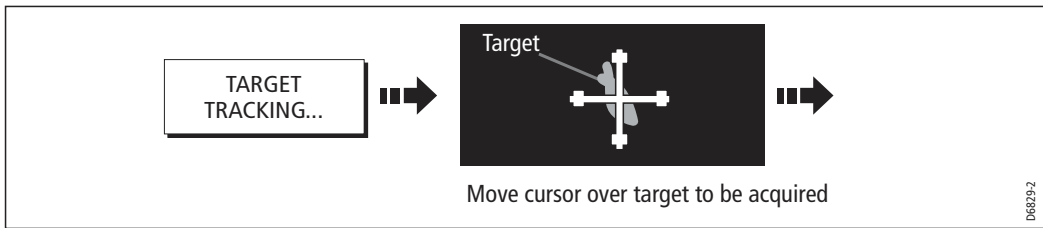
2. Acquire target:
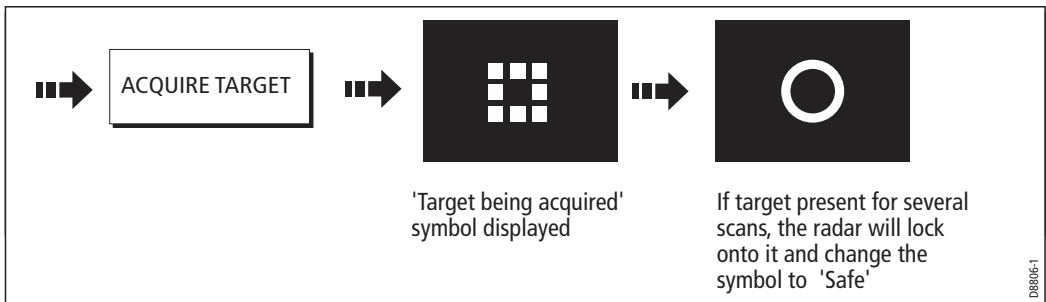
Note: *If set to ON, the CPA graphic is displayed.*

Cancelling targets

... from the screen

To cancel a target from the screen:

...from the MARPA list

To cancel a target from the MARPA list:

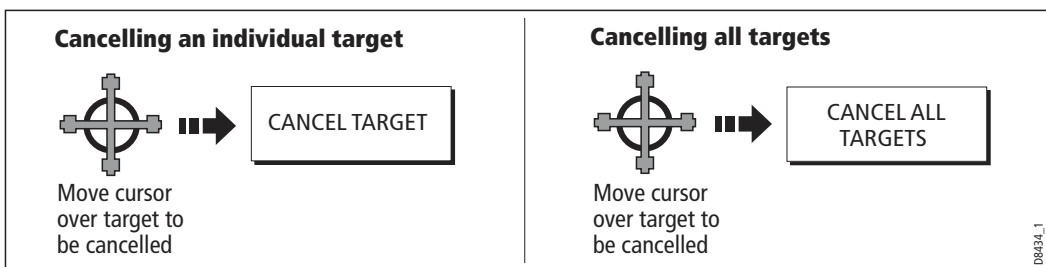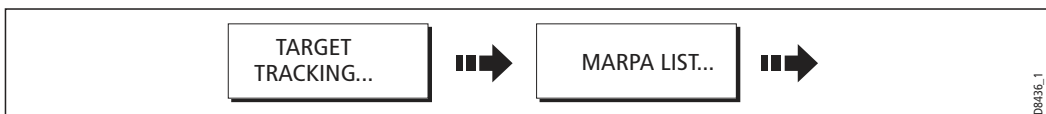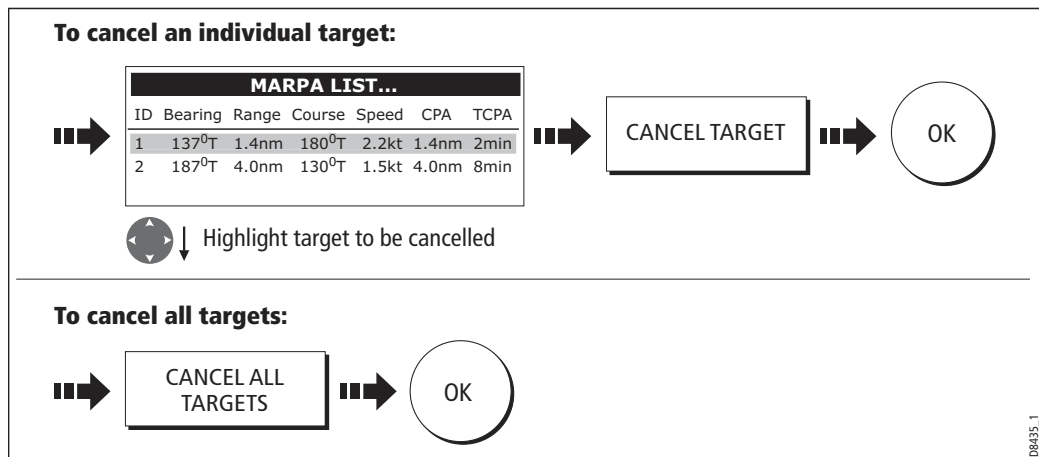1. Display the MARPA List:

2. Cancel target/s:

To cancel an individual target:

MARPA LIST...					
ID	Bearing	Range	Course	Speed	CPA	TCPA
1	137^0T	1.4nm	180^0T	2.2kt	1.4nm	2min
2	187^0T	4.0nm	130^0T	1.5kt	4.0nm	8min

Highlight target to be cancelled

CANCEL TARGET → OK

To cancel all targets:

CANCEL ALL TARGETS → OK

D8435_1

Displaying vessel identity (AIS)

If you have an AIS receiver fitted to your system, you can use the AIS feature to:

- Display a target for any other AIS equipped vessels within a specified range of your boat.
- Display voyage information being broadcasted by these targets i.e. their position, course, speed and rate of turn.
- Display basic or detailed information for each target vessel including safety critical target data.
- Set up a safe zone around your boat.
- View alarm and safety related messages.

This information is displayed in the form of an overlay or as a dialog box on your radar screen. To overlay AIS on a radar window:

PRESENTATION → AIS LAYER   ON   OFF

D9024_1

For more information on AIS, refer to *Chapter 14:Automatic Identification System (AIS)*.

7.11 Setting up your radar

The set up for your radar can be changed from the standard configuration to suit your particular needs. Although you will probably only do this when you first use the radar, you may decide to make subsequent adjustments once you become more familiar with the system. Any settings that you change are retained and become the default settings even when you power off.

To select the Radar Setup menus when a radar window is active:
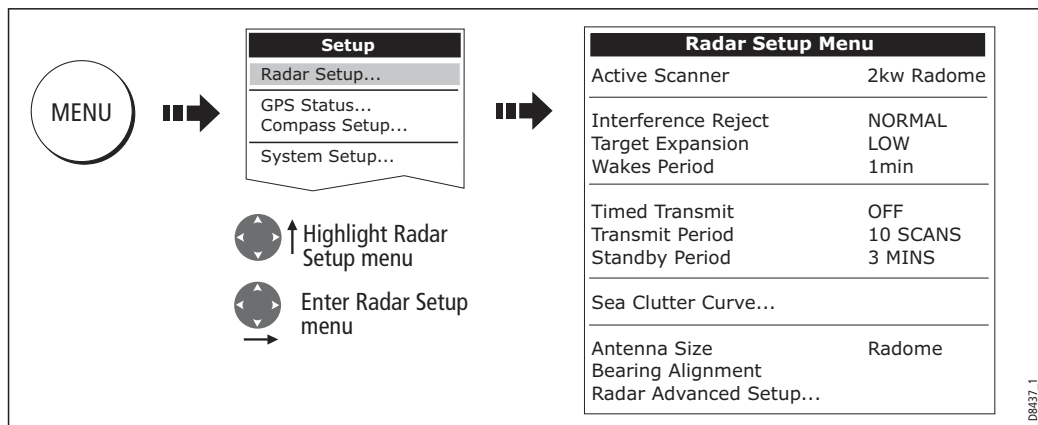
Function Description	Options (Default in **bold**)
Interference Rejection When ON, any mutual radar interference between two radar equipped vessels operating within range of each other, is automatically reduced.	**NORMAL** HIGH
Target Expansion When ON, targets are magnified to make them easier to see.	**LOW** HIGH
Wakes Period When ON, the target is displayed at the brightest level and its previous positions are retained at successively fainter levels on the screen.	10 seconds 30 seconds **1 minute** 5 minutes 10 minutes
Timed Transmit Controls the radar's timed transmission power-save mode.	**OFF** ON
Transmit Period When ON, the scanner performs the number of scans specified and then shuts down for the number of minutes specified by the Standby Period.	**10 scans** 20 scans 30 scans
Standby Period Indicates the number of minutes that the system shuts down - the scanner does not rotate and the display is in standby mode.	**3 minutes** 5 minutes 10 minutes 15 minutes
Sea Clutter Curve... Adjusts the acuteness of the sea clutter curve when the sea clutter option is set to manual (see *page 146*).	1-8
Antenna Size If an open array scanner is fitted, this specifies the size of the scanner.	Open array 48" 72"
Bearing alignment Correct for display azimuth error. Please refer to the E-Series installation guide.	
Radar Advanced Setup Please refer to the E-Series installation guide.	

7.12 Warnings of potential dangers

If switched on, the following alarms will be triggered when you are in the radar application:

- System alarms - anchor, timer, alarm clock and temperature.
- Navigation alarms - arrival and off track.
- Radar alarms - guard zones.
- Fishfinder alarms.
- Weather alarms.
- AIS alarms.
- Depth alarms.
- Data alarms.
- External SeaTalk alarms.

When an alarm is triggered, a buzzer sounds and a pop-up window describing the alarm and how to clear it is displayed.

To switch these alarms on/off and set the limits:
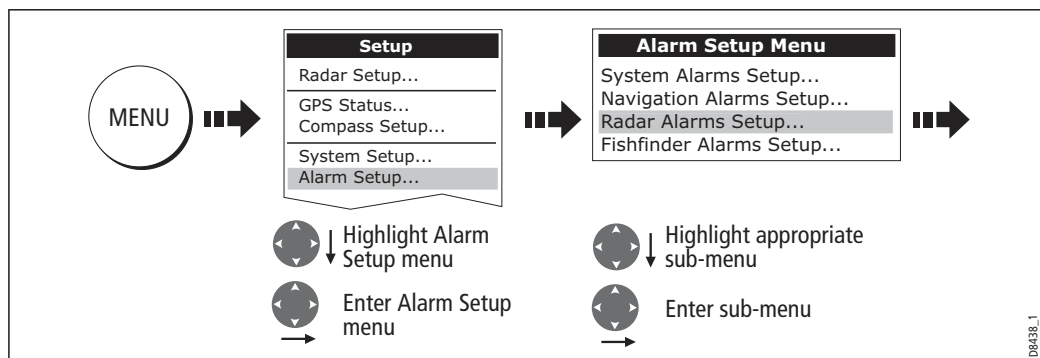
Note: *For more details of alarms, see page 31 and page 232.*

Chapter 8: Radar

- The E-series can be used with digital radar scanners. Digital scanners offer:
- Improved target definition.
- Full-color image.
- Scan-to-scan.
- SuperHD option. Super HD effectively increases the transmitter power by a factor of at least two, and reduces the beamwidth by a similar amount.
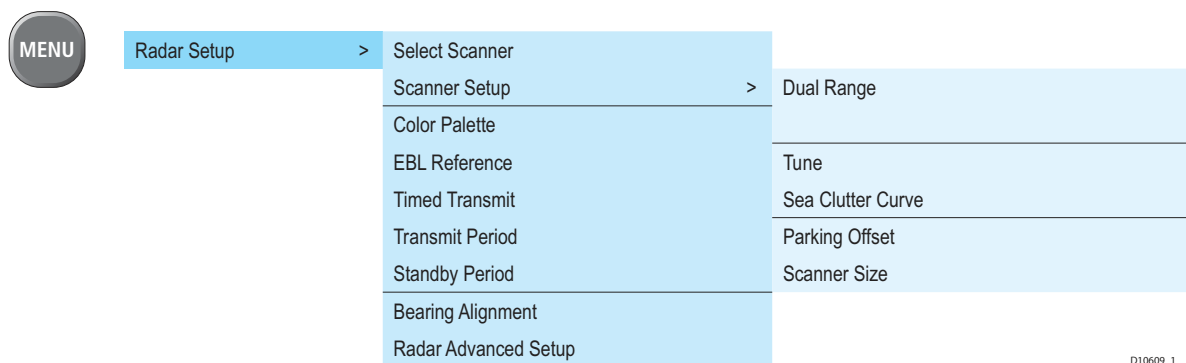- Dual-range operation.

8.1 Radar setup

The Radar Setup Menu lets you customize the way the radar operates. Changes you make in this menu are kept when you remove power from the E-Series system.

.

MENU → Radar Setup >

Select Scanner	
Scanner Setup >	Dual Range
Color Palette	
EBL Reference	Tune
Timed Transmit	Sea Clutter Curve
Transmit Period	Parking Offset
Standby Period	Scanner Size
Bearing Alignment	
Radar Advanced Setup	

D10609_1

Note: *The radar needs to be receiving heading and position data for full functionality.*

Select scanner

Selects which scanner is displayed in the active radar window.

Scanner setup

The scanner setup option lets you customize various aspects of the scanner's behavior.

Dual range

If dual range is set to on, the system allows you to view two ranges simultaneously in one window.

Short range gives you a maximum range of 3 nautical miles; long range provides standard ranges.

When dual range is enabled, chart overlay and synchronization functions are disabled. If you already have chart overlay or synchronization turned on, dual range is not available.

Tune adjust

The tune adjust function is used to fine-tune the scanner's receiver for maximum target returns on the display.

Auto mode: recommended

In AUTO mode, the radar tunes itself automatically on all range scales.

This is the default mode and it is recommended that you leave the tune function in auto mode to ensure that the radar receiver is always tuned to receive the maximum signal.

Manual mode

If you do set the tune function to MANUAL, you will need to adjust it about 10 minutes after you have turned on the radar, as the required setting will change after the magnetron has warmed up.

Adjust the control to obtain the maximum signal strength (indicated by the eight-step horizontal bar). If you cannot tune the radar successfully, refer to the Installation Guide.

Sea clutter curve

Adjust the system's sensitivity to sea clutter. The steepest setting is 1 and the shallowest is 8. The default setting is 4.

Parking offset

The default parking offset is 0 degrees: the scanner aligns with the pedestal, facing forwards.

With parking offset selected you can use the rotary controller to adjust the parking offset from 0 to 358 degrees in steps of two degrees.

This setting change is only available when the digital radar is set to Off or Standby. The changes you make are applied at the end of the next transmit cycle.

To open the radar setup menu

1. Make a radar application window active.

2. Press the **MENU** button.

Antenna size

The antenna size softkey is available to display the antenna size and type you have attached. This should be automatiacally detected by the system.

8.2 Radar alarms

For information about the radar-specific alarms you can configure, see *Alarm Setup Menu* on *page 288*.

Note: *Until you are familiar with interpreting the radar display, take every opportunity to compare the radar display with your physical surroundings. Note the location of boats, buoys and coastal structures and their corresponding echoes on the radar display. Practice harbor and coastal navigation during daylight hours and in clear weather conditions.*

8.3 Powering on/off the various scanner operating modes

To control the power to the radar:
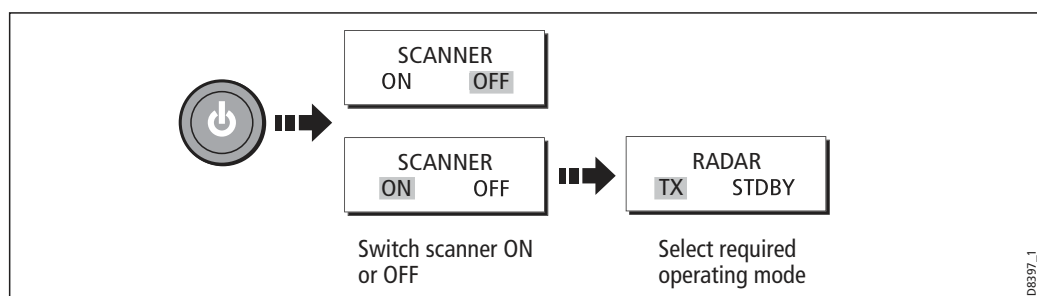
Notes: (1) *When an open array antenna is fitted, the system stops the antenna in the forward facing position when Standby mode is selected.*

(2) *Dual radar support will only allow one radar to be active at any one time. You cannot set up two radar windows, each using a different scanner.*

8.4 Radar status

The following table summarizes the various scanner states and associated status icons.

8.5 Radar range and image quality

Radar operates by transmitting radio pulses, then detecting the reflections as the pulses bounce back from objects within radar range. The reflections are processed and displayed on-screen as 'echoes'.

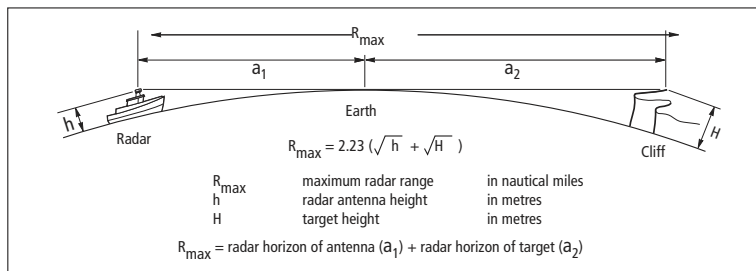| Status	Icon	Description
Transmit (TX)	(Rotating icon)	**Scanner on and transmitting.** This is the usual mode of operation.
Standby (STDBY)	(static icon)	**Scanner powered on but not transmitting; antenna not rotating.** This is a power-save mode used when radar is not needed for short periods. When you return to transmit mode, the magnetron does not need to warm up. This is the default mode.
Off	(grayed-out icon)	**Scanner powered off.** When radar is not required.
Timed transmit	(rotating/static icon)	**Scanner switches between on/transmitting & standby mode.** Power save mode when constant use of radar not required. To set up this option, see *page 177*

Range

Radar range is limited by the height of your scanner and the height of the target, as illustrated below:

$$R_{max} = 2.23 \left(\sqrt{h} + \sqrt{H} \right)$$

R_{max}	maximum radar range	in nautical miles
h	radar antenna height	in metres
H	target height	in metres

R_{max} = radar horizon of antenna (a_1) + radar horizon of target (a_2)

The table below gives the approximate range for various antenna and target heights.

Antenna height (m)	Object height (m)	Range (nm)
3	3	7.7
3	10	10.9
5	3	8.8
5	10	12

Image quality

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

- Side lobes
- Indirect echoes
- Multiple echoes
- Blind sectors
- Sea, rain or snow clutter
- Interference

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

Side lobes

Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside the narrow main beam.

The effects of side lobes are most noticeable with targets at short range (normally below 3 nm) and with large objects. Side lobe echoes form either arcs on the radar screen similar to range rings, or a series of echoes forming a broken arc.
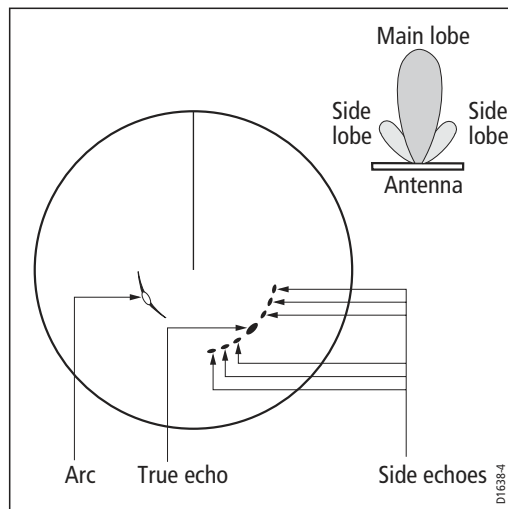
Indirect echoes

There are several types of indirect echoes, or 'ghost' images. These sometimes have the appearance of true echoes, but in general they are intermittent and poorly defined.
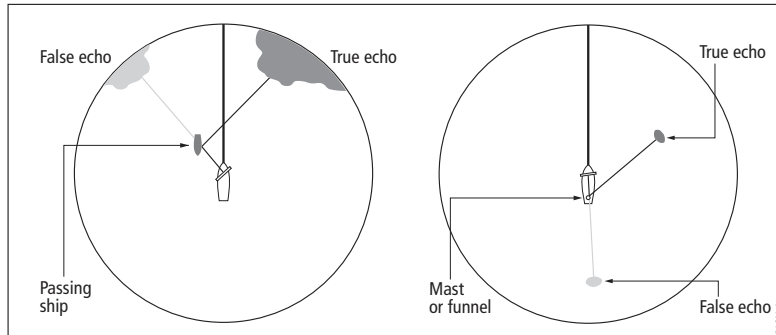
Multiple echoes

Multiple echoes are uncommon but can occur if there is a large object with a wide vertical surface at a comparatively short range. The transmitted signal bounces between the object and your own vessel, producing multiple echoes. The false echoes are displayed beyond the range of the true target echo, but on the same bearing.
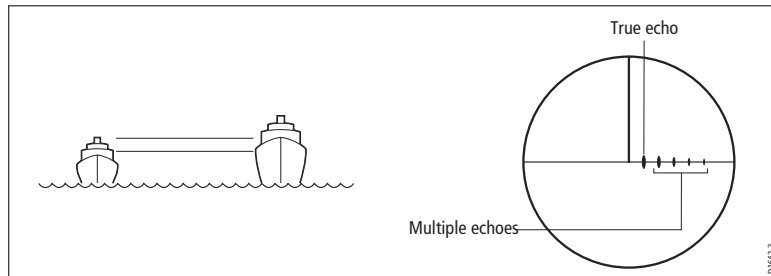
Blind sectors

Obstructions such as funnels and masts near the radar antenna can obstruct the radar beam and cause radar shadows or 'blind sectors'.

If the obstruction is relatively narrow, there will be a reduction of the beam intensity, though not necessarily a complete cut-off. However, with wider obstructions there can be a total loss of signal in the shadow area. There might also be multiple echoes which extend behind the obstruction.

Blind sector effects can normally be minimized by careful selection of the scanner site prior to installation.

Sea clutter

Radar returns from waves around the vessel can clutter the centre of the radar picture, making it difficult to detect real targets. Such 'sea clutter' usually appears as multiple echoes on the display at short range, and the echoes are not repetitive or consistent in position.

In high winds or extreme conditions, sea clutter can produce an almost solid disc on a radar display.
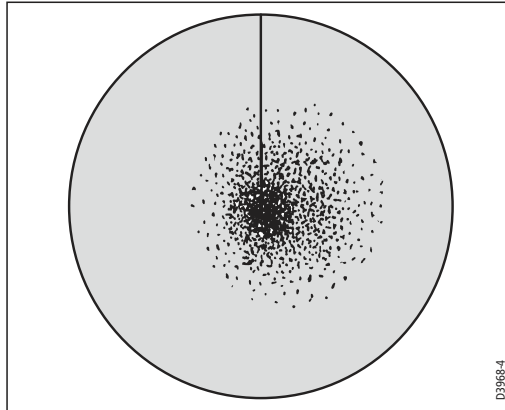
Rain or snow clutter

Radar detects rain and snow. Returns from storm areas and rain squalls consist of countless small echoes which continually change in size, intensity and position.

These returns sometimes appear as large hazy areas, depending on the intensity of the rainfall or snow in the storm cell.
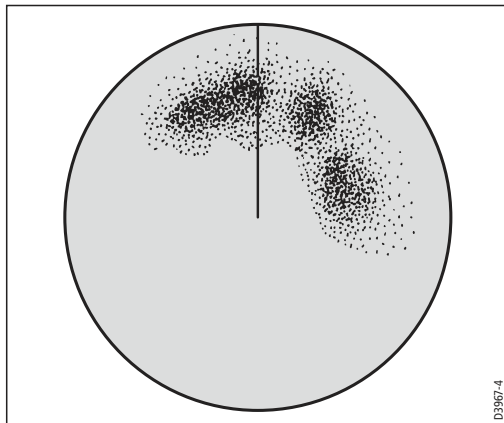
Mutual radar interference

This can occur when two or more radar-equipped vessels are operating within range of each other. The interference usually appears as a spiral of small dots from the display centre, and is most marked at long ranges.

8.6 Radar window overview

Your position

By default your boat is shown at the centre of the radar display and your dead-ahead bearing is indicated by a vertical line known as the Ship's Heading Marker (SHM).
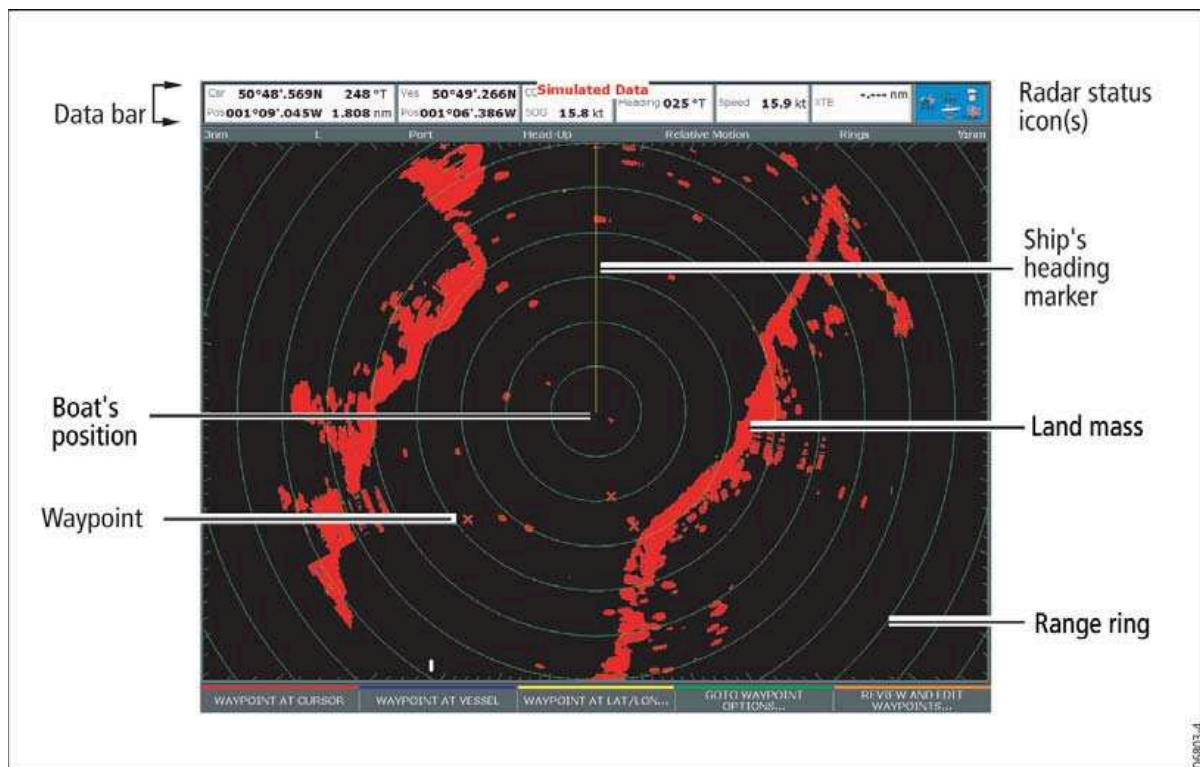
Operation modes

The radar gives excellent results in one of the four preconfigured operation modes under the **GAIN** softkey. Select the mode that best suits your circumstances: attempting to make manual adjustments to the settings could degrade your image. (However, this facility is available.)

See *page 187* for more information.

Other vessels or objects

On-screen targets may be large, small, bright or faint, depending on the size of the object, its orientation and surface type.

Remember that the strength of an object's echo may not be proportional to the physical size of the object. For example, a nearby object might produce an echo of the same strength as a more distant, but larger object.

With experience, the approximate size of different objects can be determined by the relative size and brightness of the echoes.

Factors affecting echo strength

- The physical size of the reflecting object.
- The material from which the object is made. Metallic surfaces reflect signals better than non-metallic.
- Vertical surfaces, like cliffs, reflect the radar signal better than sloping surfaces, like sandbanks.
- High coastlines and mountainous coastal regions can be observed at longer radar ranges. Therefore, the first sight of land may be a mountain several miles inland from the coastline. Although the coastline may be much nearer, it may not appear on the radar until the vessel is closer to shore.
- Some targets, such as buoys and small boats, can be difficult to discern, because they do not present a consistent reflecting surface as they bob about in the waves. Consequently, these echoes tend to behave erratically on the radar screen.
- Buoys and small boats often resemble each other, but boats can often be distinguished by their motion.
- Trees and shrubbery do not reflect radar. Thus, they can disguise the shape of nearby land.

8.7   Using waypoints with the radar

You can use waypoints in the radar application for navigation (just like in the chart application), using the **WPTS/MOB** button.

You can also edit waypoints from within the radar application.

For full details on using waypoints, see *Chapter 3* and *Chapter 4*.

8.8   Radar display options

The presentation softkey on the radar toolbar gives you control over:

- Waypoint behavior
- Radar mode and display orientation
- Range rings
- AIS

These radar settings are locally applied, which means they affect only the scanner and display on which you are working.

Orientation

Radar *orientation* refers to the relationship between the radar display and your direction of travel. There are three orientation modes:

*   Head up
*   North up
*   Course up

These orientation modes are used in conjunction with motion modes (see *page 185*) to control how your vessel's progress is shown on screen.

Heading-Up (H-UP)

This is the default mode for the radar application.
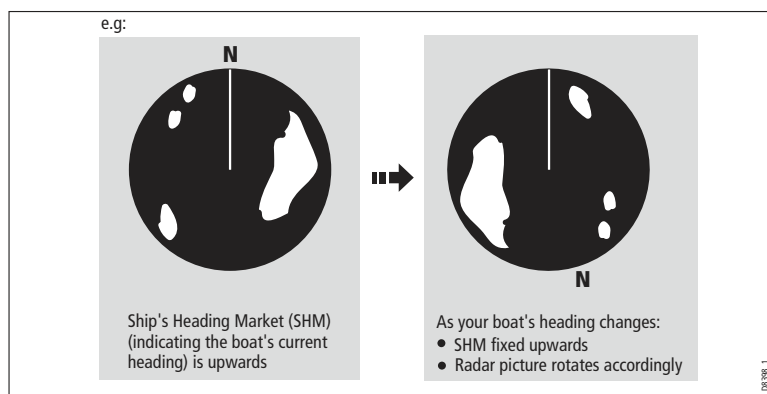
North-Up (N-UP)
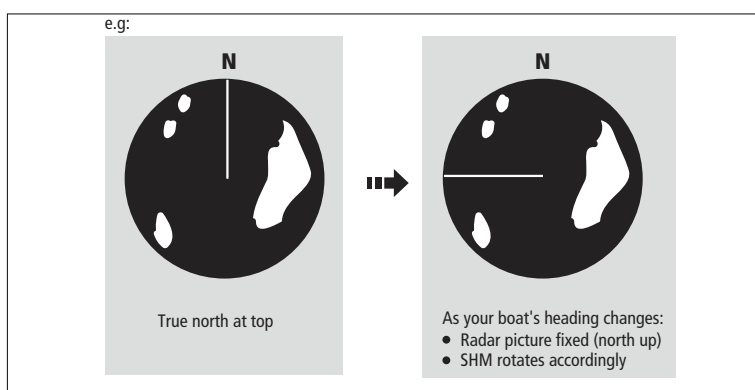
If heading data becomes unavailable while in this mode, a warning message will be shown, the status bar shows North-Up in brackets and the radar uses 0° heading in relative motion. When heading data becomes available once more, North-Up mode is reinstated.

It is not possible to select Head Up mode when the motion mode is set to True.

Course-Up (C-UP)

e.g:

Current course upwards

As your boat's heading changes:
- Radar picture fixed
- SHM rotates accordingly

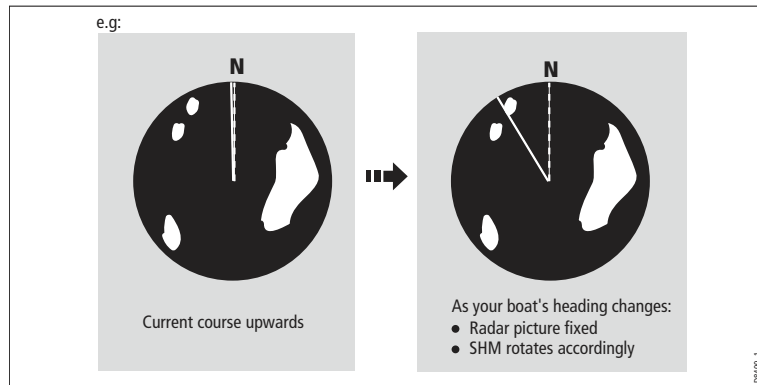If you select a new course, the picture will reset to display the new course upwards.

The reference used for Course-Up depends upon the information available at a given time. The system prioritizes this information in the following order:

1. Bearing from origin to destination (your intended course).
2. Locked heading from an Autopilot.
3. Bearing to waypoint.
4. Instantaneous heading.

If heading data becomes unavailable while in this mode a warning message is displayed; the status bar puts Course-Up in brackets to show it is suspended; and the radar uses 0° heading in relative motion mode.

When heading data becomes available again, Course-Up mode is reinstated.

To select an orientation mode
1. Press the **PRESENTATION** softkey.
2. Press **RADAR MODE & ORIENTATION**.
3. Choose your preferred setting under the **ORIENTATION** softkey.

The selected orientation mode is displayed in the status bar.

Setting the motion mode

Motion modes control how your progress is represented on the display. The selected motion mode is displayed in the status bar. If no position data is available, the status bar shows the motion mode in brackets.

There are two motion modes:

- Relative motion
- True motion

The default setting is relative motion.

Relative motion (RM) with optional vessel offset

When the motion mode is set to Relative, the position of your boat is fixed on the screen and all the targets move relative to the boat.

You can specify whether the boat is fixed in the centre of the window (0 offset) or offset by 1/3 or 2/3:

| 0 offset | $^1/_3$ offset | $^2/_3$ offset |
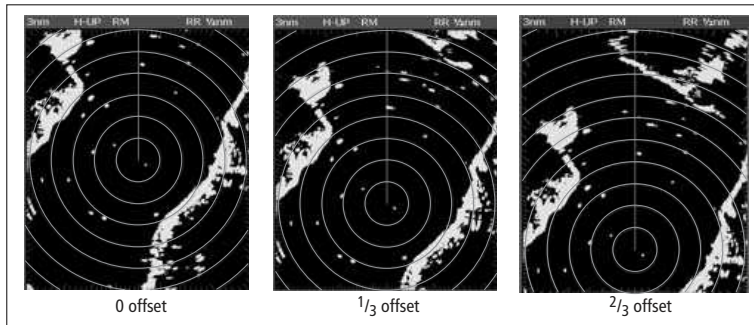
The default vessel-offset value is zero.

True Motion (TM)

When the motion mode is set to True, fixed radar targets maintain a constant position and moving vessels (including your boat) travel in true perspective to each other and to fixed landmasses on the screen. As the boat's position approaches the edge of the screen, the radar picture is automatically reset to reveal the area ahead of the boat.

If heading and position data become unavailable when true motion is selected: a warning message is shown; the display reverts to relative motion; the status bar indicates that True Motion is selected but suspended by showing it in parentheses (TM).

It is not possible to select True Motion when the orientation is set to Head Up.

To set the motion mode
1. Press the **PRESENTATION** softkey.
2. Press **RADAR MODE AND ORIENTATION**.
3. Toggle between True and Relative Motion on the **MOTION MODE** key.

To change the vessel offset
1. Press the **PRESENTATION** softkey.
2. Press **RADAR MODE & ORIENTATION**.
3. Toggle to your desired offset using the **VESSEL OFFSET** softkey.

Changing the bearing mode for EBLs

The default bearing mode for EBLs is relative to your vessel's heading. If heading data is available, you can set the bearing mode to be relative (REL) or magnetic/true (M/T).

When M/T is selected, the EBL bearings will be expressed as either true or magnetic, depending on the equipment connected. The current EBL bearing is given on the EBL label and on the ADJUST VRM/EBL softkey label.

To change the EBL reference
1. Press **MENU**
2. Toggle to **RADAR SETUP** page
3. Toggle to **EBL REFERENCE**
4. Toggle between **MAN/TRUE** and **RELATIVE** on the **EBL REFERENCE** menu.
5. Press **OK** to select the desired option

8.9 Dual range

The E-Series system allows you to view either a short- or a long-range image in separate radar windows. To allow this, dual range must be enabled in the Radar Setup Menu (see *Radar setup* on *page 175*).

To set the range
1. Press the **PRESENTATION** softkey.
2. Press **RADAR MODE & ORIENTATION**.
3. Toggle between **LONG** and **SHORT** on the **DUAL RANGE** softkey.

The default setting is long, which provides a standard scanner range. The short setting provides a maximum range of six or twelve nautical miles.

Note: *If chart-radar sync is turned on in the chart application, you cannot enable dual range in the radar application. If dual range is on, you cannot turn on chart-radar synchronization.*

8.10 Tuning the radar display: GAIN

Gain reduces the effect of false echoes and clutter. For best results, retain the default AUTO setting. You can, however, adjust gain settings manually if required.

Gain presets

There are four preset gain modes to give you the best picture in different circumstances.

Harbor is the default mode. This setting takes account of land clutter so that smaller targets, like navigation buoys, are not lost.

Coastal accounts for the slightly higher levels of sea clutter you might encounter out of harbor and adjusts the radar display accordingly.

Offshore automatically adjusts for high levels of sea clutter.

Buoy is a special mode to enhance the detection of small objects like mooring buoys. It is useful at ranges up to 3/4 nm.

Manually adjusting gain

The gain function makes the radar picture clearer by changing the sensitivity of radar reception.

- **For long ranges** select a sensitivity level that gives a slight speckle in the background. Setting the gain too low can cause weak or small targets to disappear, however.

- **For shorter ranges** reduce the gain slightly to reduce speckle and improve target definition.

Note: *If you control gain manually, check it each time you change the range scale.*

To manually adjust gain settings

1. Press the **GAIN** softkey.

2. Press the **ADJUST** softkey for the preset mode you are in.

3. Select manual on the **GAIN** softkey.

The changes you make are applied to both the active window and any other radar windows displaying this preset. Gain setting changes are kept at system power-off.

Rain clutter

Radar detects echoes from rain or snow. The strength of these echoes depends upon the altitude, range, density and size of the snow flakes or rain droplets and appear on screen as countless small echoes continuously changing size, intensity and position.

Turning the RAIN clutter function on suppresses the bulk effect of rain returns from around your boat, so that recognizing other objects is easier.

Sea clutter

Radar echoes from waves around your boat can clutter the centre of the radar picture, making it difficult to detect real targets (see *page 177*).

Adjusting the sea mode will reduce this clutter for up to 5 nautical miles (depending on wave and sea conditions) from your boat. This reduces sea echoes to intermittent