

FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL FR-2125V



FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

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SAFETY INSTRUCTIONS

WARNING

Radio Frequency Radiation Hazard

The radar antenna emits electromagnetic radio frequency (RF) energy which can be harmful, particularly to your eyes. Never look directly into the antenna aperture from a close distance while the radar is in operation or expose yourself to the transmitting antenna at a close distance.

Distances at which RF radiation levels of 100 and 10 W/m² exist are given in the table below.

Note: If the antenna unit is installed at a close distance in front of the wheel house, your administration may require halt of transmission within a certain sector of antenna revolution. This is possible. Ask your FURUNO representative or dealer to provide this feature.

Model	Radiator type	Distance to 100 W/m ² point	Distance to 10 W/m ² point	RF power density on antenna aperture
FR-2125V (X-band, 25 kW)	XN12AF (4')	1.1 m worst case	10.0 m worst case	200 W/cm ²
	XN20AF 6.5')			
	XN24AF (8')			

WARNING



ELECTRICAL SHOCK HAZARD
Do not open the equipment.

Only qualified personnel should work inside the equipment.



Wear a safety belt and hard hat when working on the antenna unit.


Serious injury or death can result if someone falls from the radar antenna mast.


WARNING



Turn off the radar power switch before servicing the antenna unit. Post a warning sign near the switch indicating it should not be turned on while the antenna unit is being serviced.

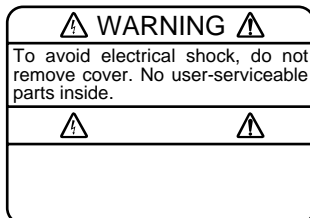
Prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazard.

 WARNING
<p>Do not disassemble or modify the equipment.</p> <p>Fire, electrical shock or serious injury can result.</p>
<p>Turn off the power immediately if water leaks into the equipment or the equipment is emitting smoke or fire.</p> <p>Continued use of the equipment can cause fire or electrical shock.</p>
<p>Use the proper fuse.</p> <p>Fuse rating is shown on the equipment. Use of a wrong fuse can result in equipment damage.</p>

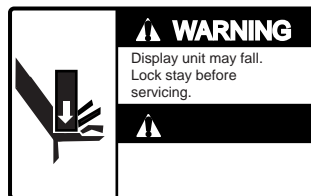
 WARNING
<p>Do not place liquid-filled containers on the top of the equipment.</p> <p>Fire or electrical shock can result if a liquid spills into the equipment.</p>
<p>Do not operate the equipment with wet hands.</p> <p>Electrical shock can result.</p>
<p>Keep heater away from equipment.</p> <p>Heat can alter equipment shape and melt the power cord, which can cause fire or electrical shock.</p>

Danger/Warning Labels in Display Unit

This display unit contains the danger/warning labels shown below. Do not remove the labels. If a label is peeling off or is illegible, contact a FURUNO agent for replacement.



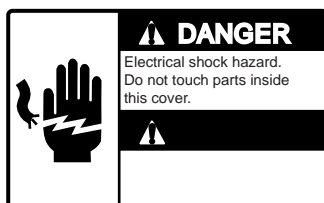
Name: Warning Label
Type: 86-003-1011
Code No.: 100-236-230



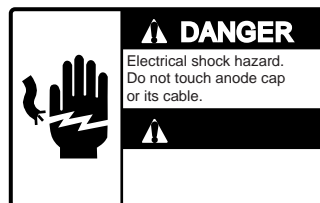
Name: Warning Label
Type: 03-144-1332
Code No.: 100-266-290



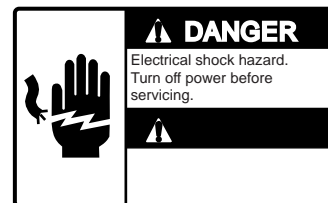
Name: Warning Label
Type: 03-144-1333
Code No.: 100-266-300



Name: Danger Label
Type: 14-055-4202
Code No.: 100-245-220



Name: Danger Label
Type: 14-055-4201
Code No.: 100-243-450



Name: Danger Label
Type: 66-022-2012
Code No.: 100-237-730

Safety Instructions for ARPA ARP-26 (Option)

WARNING

No one navigational aid should be relied upon for the safety of vessel and crew. The navigator has the responsibility to check all aids available to confirm position. Electronic aids are not a substitute for basic navigational principles and common sense.

- This auto plotter automatically tracks an automatically or manually acquired radar target and calculates its course and speed, indicating them by a vector. Since the data generated by the auto plotter are based on what radar targets are selected, the radar must always be optimally tuned for use with the auto plotter, to ensure required targets will not be lost or unwanted targets such as sea returns and noise will not be acquired and tracked.
- A target does not always mean a land-mass, reef, ships or other surface vessels but can imply returns from sea surface and clutter. As the level of clutter changes with environment, the operator should properly adjust the A/C SEA, A/C RAIN and GAIN controls to be sure target echoes are not eliminated from the radar screen.

CAUTION

The plotting accuracy and response of this auto plotter meets IMO standards. Tracking accuracy is affected by the following:

- Tracking accuracy is affected by course change. One to two minutes is required to restore vectors to full accuracy after an abrupt course change. (The actual amount depends on gyrocompass specifications.)
- The amount of tracking delay is inversely proportional to the relative speed of the target. Delay is on the order of 15—30 seconds for high relative speed; 30—60 seconds for low relative speed.

Display accuracy is affected by the following:

- Echo intensity
- Radar transmission pulsewidth
- Radar bearing error
- Gyrocompass error
- Course change (own ship or target)

Safety Instructions for VIDEO PLOTTER RP-26 (Option)



CAUTION

No one navigational aid should be relied upon for the safety of vessel and crew. The navigator has the responsibility to check all aids available to confirm position. Electronic aids are not a substitute for basic navigational principles and common sense.

Digital charts cannot replace official nautical charts.

Digital charts are intended as an aid to navigation. Position should always be checked against nautical charts, as well as other aids to navigation.

Digital charts cannot replace the radar.

Digital charts can only show own ship's position relative to a chart feature (coastline, lighthouse, etc.). They cannot show other vessels, as does the radar. Digital charts can never replace the radar.

Handle chart/memory cards carefully.

- Keep cards away from heat sources.
- Keep cards away from magnets and magnetic material.
- Replace cards in their protective cases after use.

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INTRODUCTION

A Word to the Owner of FURUNO Radar

Thank you for purchasing this FURUNO radar. We are confident you will discover why FURUNO has become synonymous with quality and reliability.

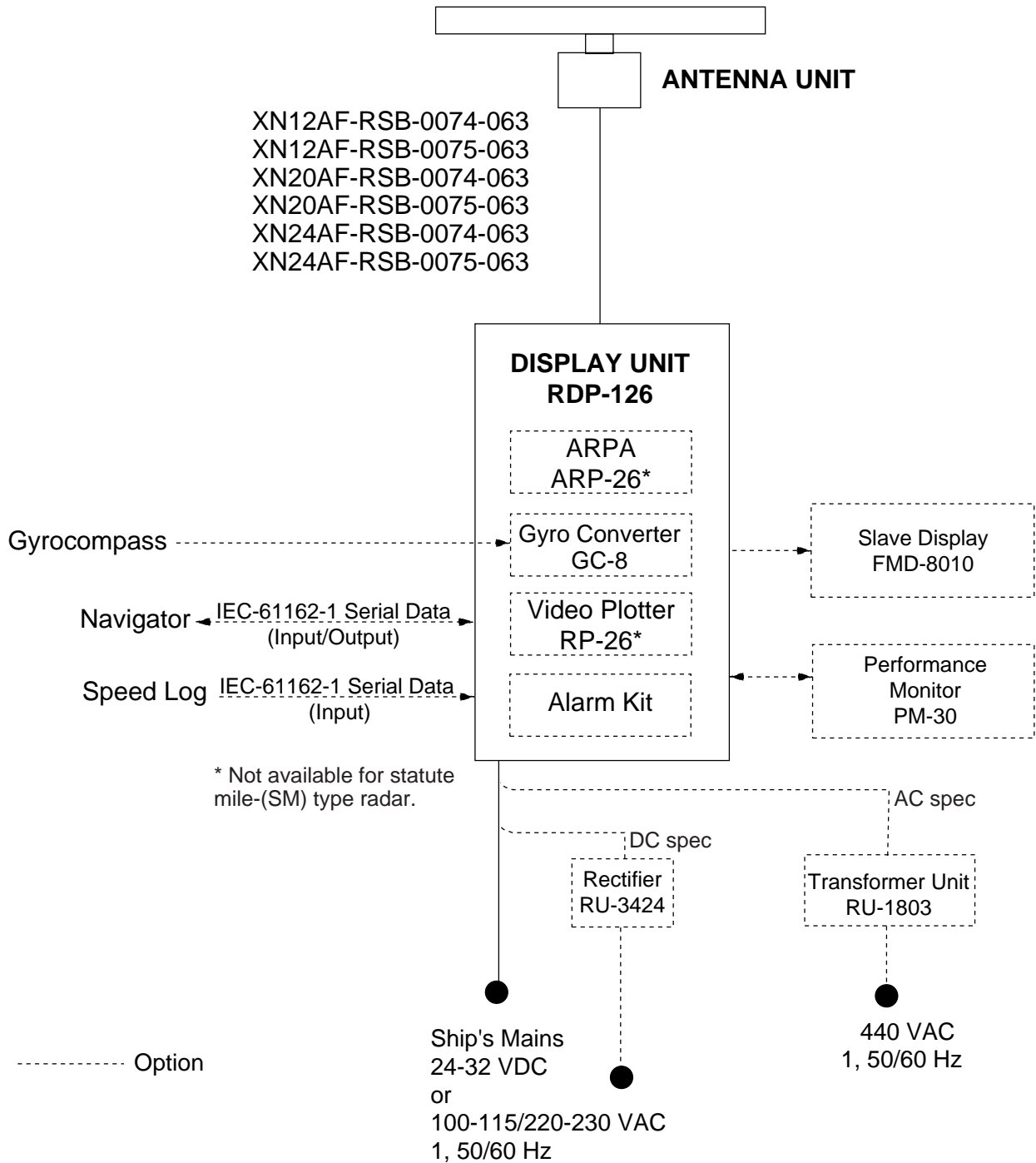
Dedicated in the design and manufacture of marine electronics equipment for more than half a century, FURUNO Electric Company has gained an unrivaled reputation as a world leader in the industry. This is the result of our technical excellence as well as our world-wide distribution and service network.

Please carefully read and follow the safety information and operating and maintenance instructions set forth in this manual before attempting to operate the equipment and conduct any maintenance. Your radar set will perform to the utmost of its ability only if it is operated and maintained in accordance with the correct procedures.

Features of this Series of Radars

- Daylight-bright rasterscan 21-inch multi-color, high-resolution display
- New microprocessing technology with high-speed high-density gate array and software expertise
- New cast aluminum scanner gearbox and new series of radiators
- Easy operation by combination of discrete keys, rotary controls, and menu operation, all logically arranged and configured.
- Electronic Plotting Aid (EPA) fitted standard.
- Reliable CPA and TCPA warning in any plotting mode, accurate target data.
- Stand-alone or integrated configuration
- A Video Plotter (Chart Plotter) is also optionally available.

SYSTEM CONFIGURATION



AC spec or DC spec to be selected.

1. OPERATION

1.1 Turning on the Power

DANGER

Before turning on the radar, make sure no one is near the antenna unit.

Serious injury or death may result if a rotating antenna strikes someone standing nearby.

The [POWER] switch is located at the left corner of the control head. Push it to switch on the radar system. To turn off the radar, push it again. The screen shows the bearing scale and digital timer in approximately 15 seconds after power-on. The timer counts down three minutes of warm-up time. During this period the magnetron, i.e., transmitter tube, is warmed for transmission. When the timer has reached 0:00, the indication STBY appears, indicating the radar is now ready to transmit pulses.

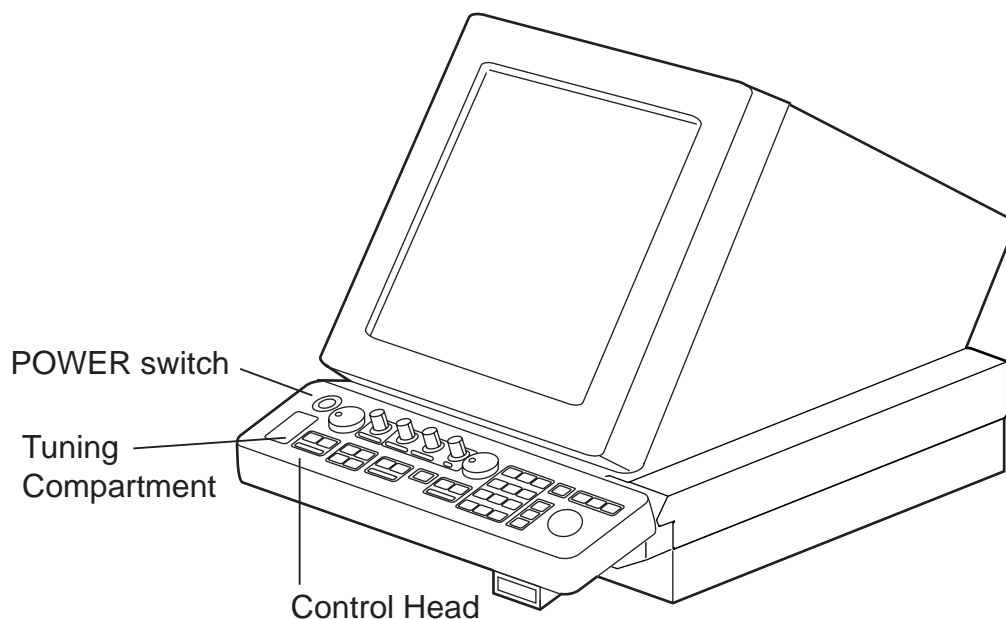


Figure 1-1 Display unit

Note: Allow 10 seconds to elapse before turning off the power, to permit writing of settings.

In warm-up and standby condition, you will see the message BRG SIG MISSING. This is normal because a bearing (azimuth) signal is not yet generated when the antenna is not rotating. ON TIME and TX TIME values shown at the bottom of the screen are the time counts in hours and tenths of hour the radar has been powered.

1.2 Transmitter ON

When the STANDBY status is displayed on the screen, press the transmit switch labeled STBY/TX on the control head of the display unit.

The radar is initially set to previously used range and pulsewidth. Other settings such as brilliance levels, VRMs, EBLs and menu option selections are also set to previous settings.

The transmit switch toggles the radar between STANDBY and TRANSMIT status. The antenna stops in STANDBY status and rotates in TRANSMIT status.

If the antenna does not rotate in TRANSMIT status, check whether the antenna switch in the tuning compartment is in the OFF position.

The magnetron ages with time resulting in a reduction of output power. It is highly recommended that the radar be set to STANDBY status when not used for an extended period of time.

Note: The example screens shown in this manual may not match the screens you see on your display. The screen you see depends on your system configuration and equipment settings.

Quick start

Provided that the radar was once in use with the transmitter tube (magnetron) still warm, you can turn the radar into TRANSMIT condition without 3-minutes standby. If the [POWER] switch has been turned off by mistake or the like and you wish to restart the radar promptly, turn on the switch not later than 10 seconds after power-off.



Video Freeze-up Recovery

Video freeze-up or lock-up can occur unexpectedly on any digital rasterscan radars. This is mainly caused by heavy spike noise in the power line and can be noticed by carefully watching the nearly visible sweep line. If you suspect that the picture is not updated every scan of the antenna or no key entry is accepted notwithstanding the apparently normal pictures, do Quick Start to restore normal operation.

1. Turn off the [POWER] switch and within 10 seconds turn it on again.
2. Press the Transmit switch labeled STBY/TX for transmit condition.

Note: This equipment has a self-diagnostic function to check operational software periodically. If any trouble has been found, the ERROR lamp lights. In this case, do the above procedure.

1.3 Control Head

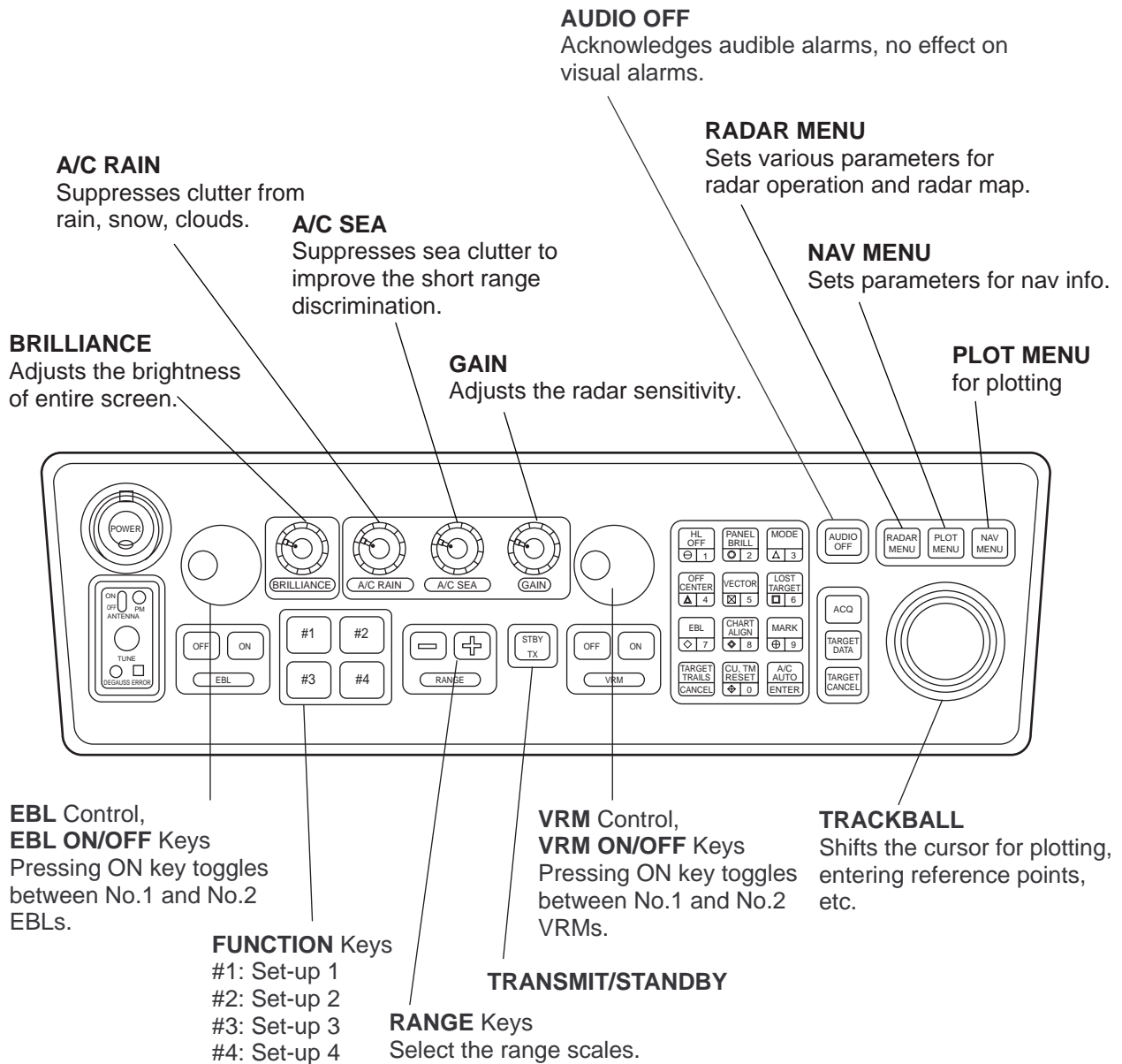


Figure 1-2 Control head

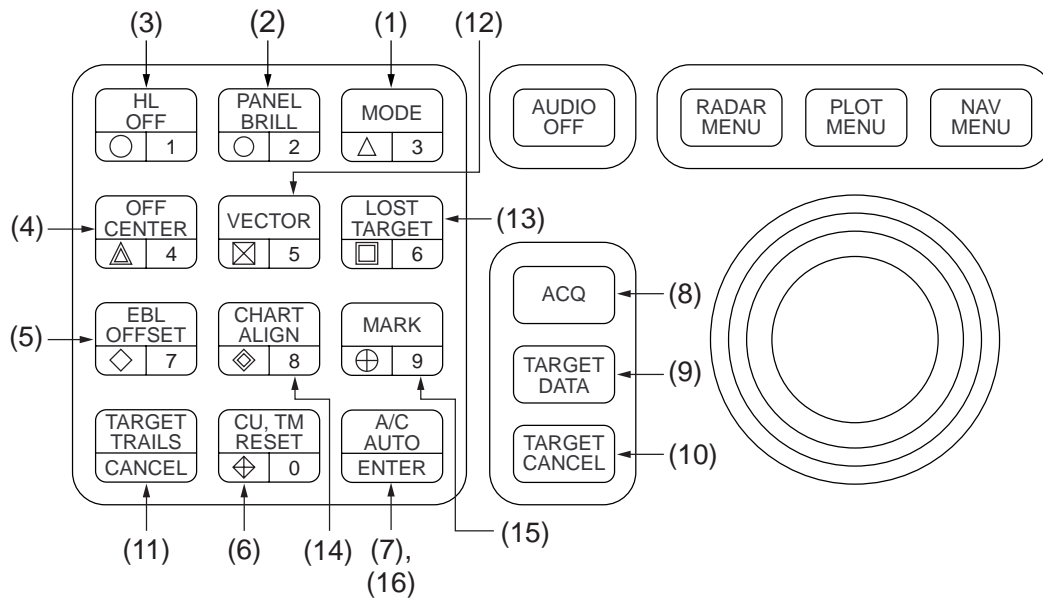


Figure 1-3 Control head, key panel

- (1) **MODE:** Selects presentation modes: Head-up, Head-up TB, North-up, Course-up and True Motion.
- (2) **PANEL BRILL:** Adjusts brightness of the control head panel.
- (3) **HL OFF:** Temporarily erases the heading line.
- (4) **OFF-CENTER:** Activates and deactivates off-centering of the own ship position.
- (5) **EBL OFFSET:** Activates and deactivates off-centering of the EBL origin.
- (6) **CU, TM RESET:** Resets the heading line to 000° in course-up mode; moves own ship position to 50% (75% for NM-type radar) radius in stern direction in the True Motion mode.
- (7) **A/C AUTO:** Reduces sea clutter at preset level. Permits manual override by A/C SEA and A/C RAIN controls.
- (11) **TARGET TRAILS/CANCEL:** Erases target trails.

Keys for EPA or ARPA (optional)

- (8) **ACQ:** Acquires a target after selecting it by trackball.
- (9) **TARGET DATA:** Displays acquired target data.
- (10) **TARGET CANCEL:** Terminates plotting of a specified target or all tracked targets.
- (12) **VECTOR:** Selects vector mode; true or relative.
- (13) **LOST TARGET:** Silences the lost target audible alarm and erases the lost target symbol.
- (14) **CHART ALIGN:** Aligns chart with the radar display. Used with radar map/video plotter.
- (15) **MARK:** Enters/erases mark. Used with radar map/video plotter.
- (16) **ENTER:** Used to save settings on menu screen.

Keys 0-9: Select video plotting symbols. Also used for entering numeric data in any mode as applicable.

1.4 CRT Brilliance

The [BRILLIANCE] control on the control head of the display unit adjusts the entire screen brightness. Note that the optimum point of adjustment varies with ambient light conditions, especially between daytime and nighttime.

Note: The CRT brilliance should be adjusted before adjusting relative brilliance levels on the BRILLIANCE menus to be explained later.

1.5 Tuning the Receiver

Tuning method can be selected at the RADAR 3 menu; auto or manual.

1. Press the [RADAR MENU] key.
2. Press [0], [0], [2], [0] and [0] in sequence to display the RADAR 3 menu.
3. Press the [9] key twice to select AUTO or MAN(ual).
4. Press the [ENTER] key to confirm your selection.
5. Press the [RADAR MENU] key to close the menu.

1.5.1 Automatic tuning

The radar receiver is tuned automatically each time the power is turned on; thus, there is no front panel control for tuning. The tuning indicator and the label AUTO TUNE at the top right corner of the display unit show the tuning circuit is working.

1.5.2 Manual tuning

If you are not satisfied with the current tune setting, follow these steps to fine-tune the receiver:

1. Set the tuning method to manual as described above.
2. While observing the picture on the 48 mile scale, slowly adjust the [TUNE] control in the tuning compartment and find the best tuning point.

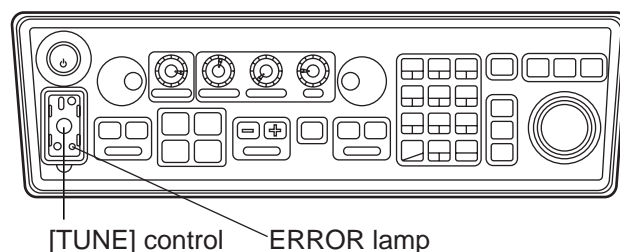


Figure 1-4 Control head, showing tuning compartment

3. Make sure that the radar has been set to the best tuning point. This condition is where the tuning indicator lights to about 80% of its total length. Note that the tuning indicator will never extend to full length.

1.6 On-screen Legends and Markers

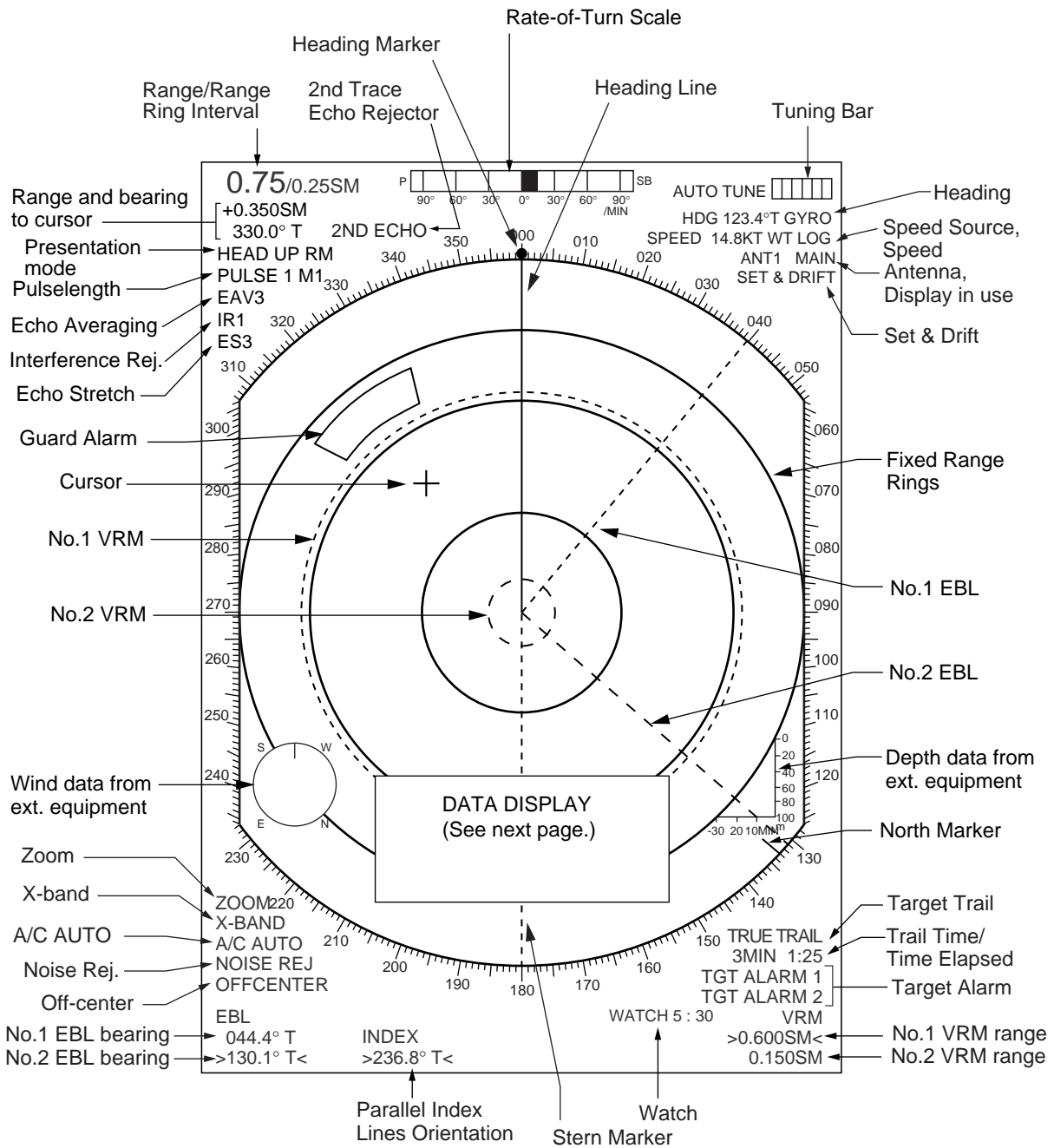


Figure 1-5 On-screen legends and markers

Note: With the serial speed inputs and SOG selection, if the type of data is changed from SOG to STW, the label SOG appears in red at the upper right corner on the screen.

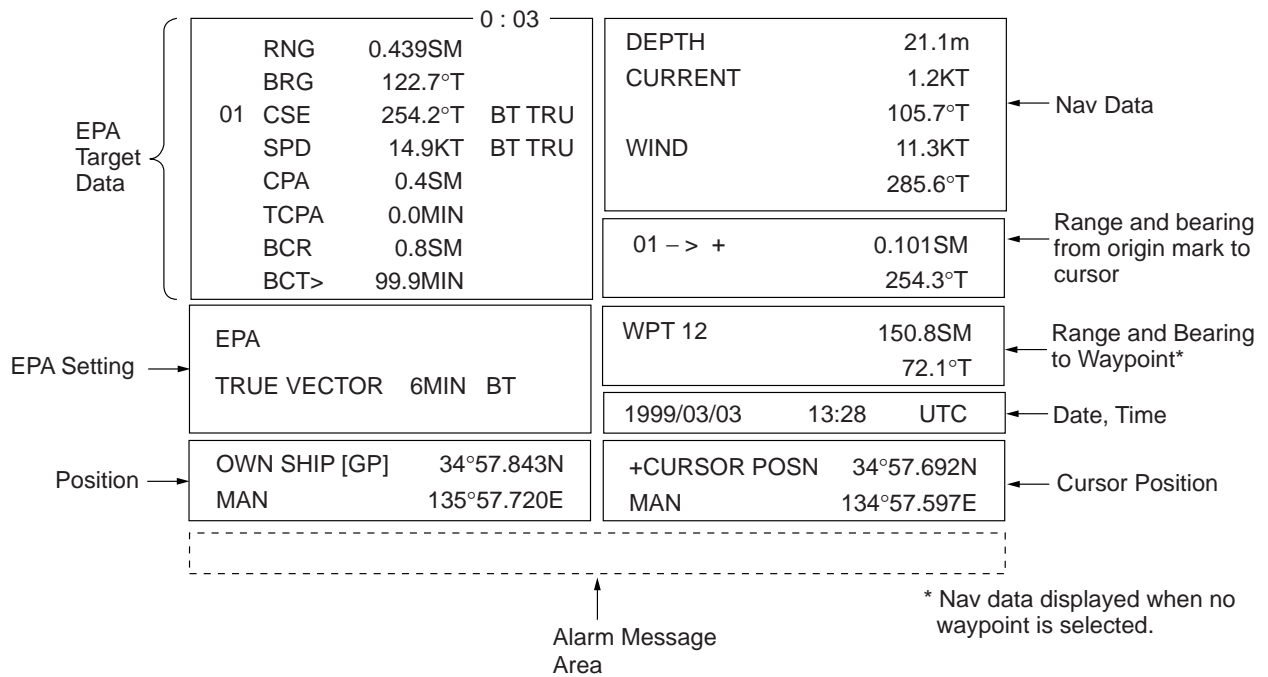


Figure 1-6 Data display

1.7 Degaussing the CRT Screen

Each time the radar is turned on, the degaussing circuit automatically demagnetizes the CRT screen to eliminate color contamination caused by earth's magnetism or magnetized ship structure.

The screen is also degaussed automatically at certain time intervals. While being degaussed, the screen may be disturbed momentarily with vertical lines. If you wish to degauss by manual operation, open the tuning compartment and press the [DEGAUSS] switch.

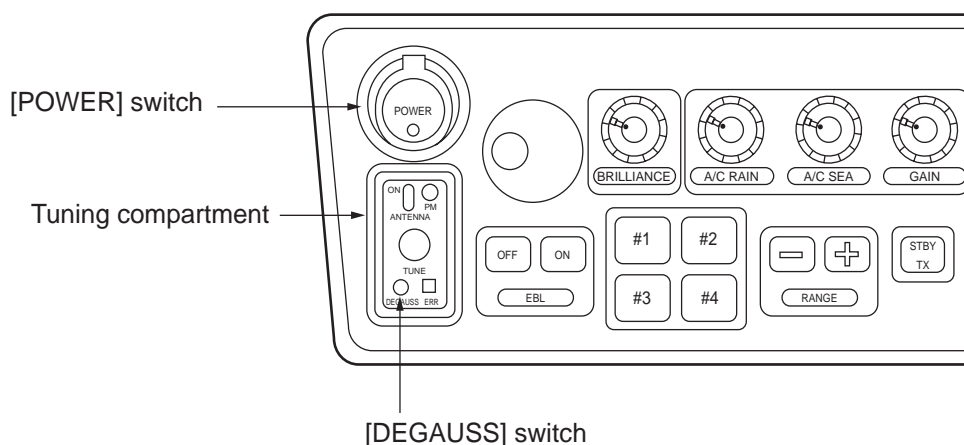


Figure 1-7 Control head, showing tuning compartment

1.8 Initializing the Gyro Readout

When a gyrocompass is interfaced with the radar, ship's heading is displayed at the top right-hand corner of the screen. Upon turning on the radar, align the on-screen HDG readout with the gyrocompass reading by the procedure shown below. Once you have set the initial heading correctly, resetting is not usually required. However, if the HDG readout goes wrong for some reason, repeat the procedure to correct it.

1. Press the [RADAR MENU] key to display the FUNCTIONS 1 menu.

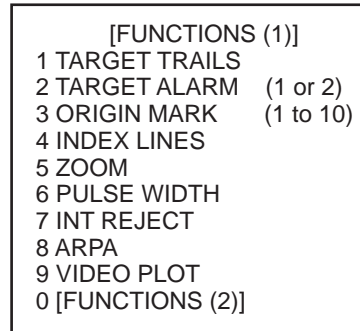


Figure 1-8 FUNCTIONS 1 menu

2. Press the [0] key twice to display the FUNCTIONS 3 menu.

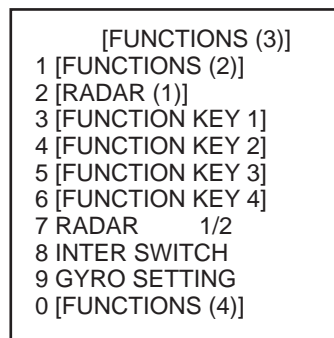


Figure 1-9 FUNCTIONS 3 menu

3. Press the [9] key to select the option GYRO SETTING.
4. Rotate the EBL control to adjust the gyrocompass (heading) reading.
5. Press the [ENTER] key to confirm the setting.

1.9 Entering Own Ship's Speed

EPA and any azimuth stabilized presentation modes require speed input and gyrocompass signal. The speed can be entered from a speed log (automatic) or through the plotting keypad (manual).

1.9.1 Automatic speed input

1. Press the [RADAR MENU] key and the [0] key to show the FUNCTIONS 2 menu.

[FUNCTIONS (2)]	
1 [FUNCTIONS (1)]	
2 BKGD COLOR	BLK(GRN CHAR)/ BLK(RED CHAR)/ BLU (ECHO AREA) BLU/ BRT BLU
3 ECHO STRETCH	OFF/1/2/3
4 ECHO AVERAGE	OFF/1/2/3
5 ECHO COLOR	YEL/GRN/COLOR
6 SHIP SPEED	LOG/NAV/MAN MAN = 00.0KT (STW/SOG)
7 SET, DRIFT	OFF/MAN SET = 000.0° DRIFT = 00.0KT
8 INDEX LINES	NO. 2 VRM/MAN MAN = 00.00SM
9 [BRILLIANCE (1)]	
0 [FUNCTIONS (3)]	

SOG (Speed-over-the-ground) is the Speed Made Good over the ground determined by EPFS, Echo Reference or Dual-axis speed log. It is obtained by a distance between points over the ground divided by the time spent for traveling between these two points.

Figure 1-10 FUNCTIONS 2 menu

2. Press the [6] key to select menu item 6 SHIP SPEED.
3. Press the [6] key to select LOG or NAV.
4. When the serial speed data is selected at the installation menu, select the speed mode, STW (speed through the water) or SOG (speed over the ground). If pulse speed data is selected, the STB/SOG does not appear.
5. Press the [ENTER] key to confirm your selection followed by the [RADAR MENU] key to close the FUNCTIONS menu. The ship's speed readout at the screen top shows own ship's speed fed from the speed log followed by the label "LOG."

Notes on automatic speed input

- 1) IMO Resolution A.823(19) for ARPA recommends that a speed log to be interfaced with an ARPA should be capable of providing through-the-water speed.
- 2) Be sure not to select LOG when a speed log is not connected. If the log signal is not provided, the ship's speed readout at the top right-hand corner will be blank.
- 3) SPD **. * and SIGNAL MISSING LOG appears if no log signal is present for 30 seconds while the ship's speed has been more than 5.0 kt.
- 4) With the serial speed inputs and SOG selection, if the type of data is changed from SOG to STW, the label SOG appears in red at the upper right corner on the screen.

1.9.2 Manual speed input

1. Press [RADAR MENU], [0] to show the FUNCTIONS 2 menu.
2. Press the [6] key to select menu 6 SHIP SPEED.
3. Press the [6] key to select (or highlight) MAN.
4. Press the [ENTER] key to confirm selection. At this point, "MAN = 00.0KT" appears on the FUNCTIONS 2 menu.
5. Enter the ship speed by hitting corresponding numeric keys followed by the [ENTER] key without omitting leading zeros, if any. For example, if the ship speed is 8 knots, press [0], [8], [ENTER].
6. Press the [RADAR MENU] key to close the FUNCTIONS 2 menu. The ship speed readout at the top right-hand corner shows own ship speed entered followed by the label "MAN."

1.10 Presentation Modes

This radar has the following presentation modes:

Relative Motion (RM)

Head-up: Unstabilised

Head-up TB: Head-up with gyrocompass-stabilized bearing scale (True Bearing) where the bearing scale rotates with the gyrocompass reading.

Course-up: Gyrocompass-stabilized relative to ship's intended course

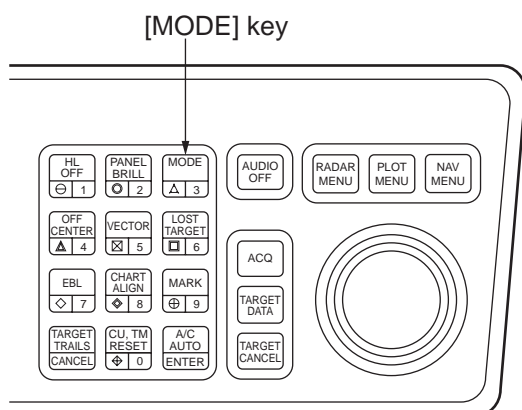
North-up: Gyrocompass-stabilized with reference to north

True Motion (TM)

North-up: Ground or sea stabilized with gyrocompass and speed inputs

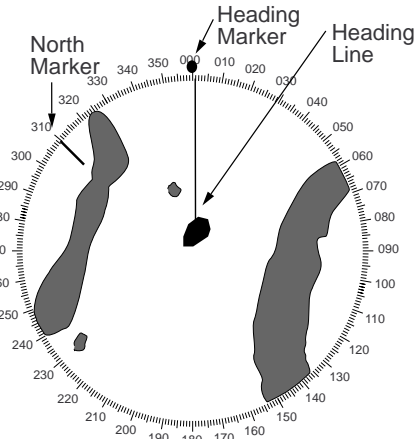
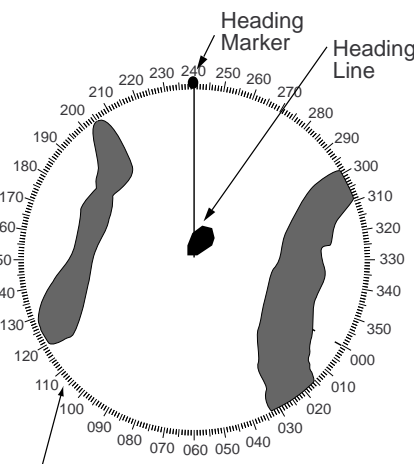
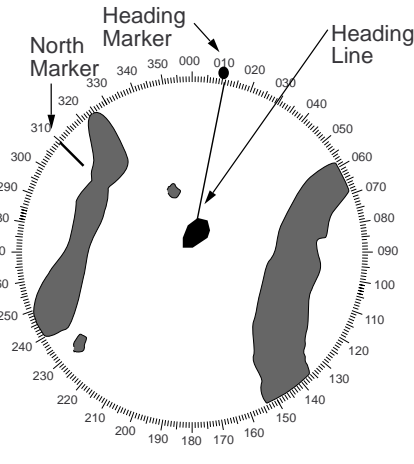
1.10.1 Selecting presentation mode

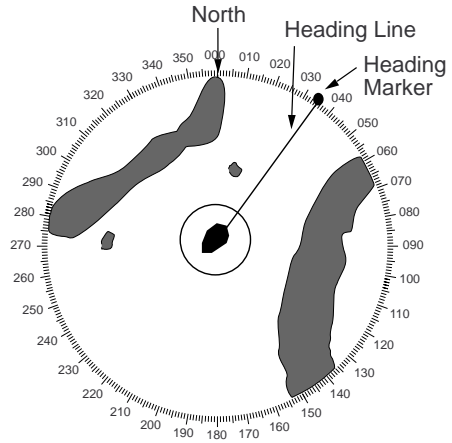
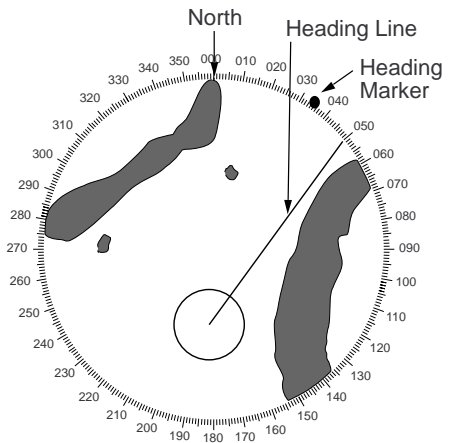
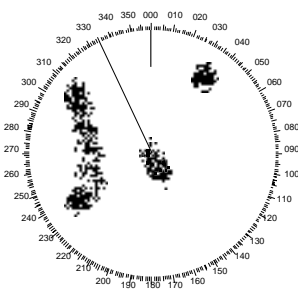
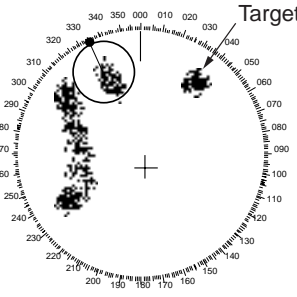
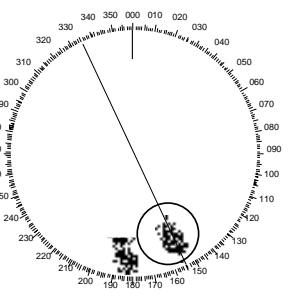
Press the [MODE] key on the control head. Each time the [MODE] key is pressed, the presentation mode and mode indication at the upper left-hand corner of the screen change cyclically.



! Loss of Gyrocompass Signal

When the gyro compass signal is lost, the presentation mode automatically becomes head-up and the HDG (heading) readout at the top right-hand corner shows ***.*. When the gyrocompass signal is restored, the indication SET HDG appears at the upper-right corner on the screen. Press the [MODE] key, and the asterisks go off. Align the HDG readout with the gyrocompass reading, referring to the paragraph 1.8. Finally, press the CANCEL key to erase the message SET HDG.

Presentation mode, representative display	Description
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">HEAD UP</p> 	<p>A display without azimuth stabilization in which the line connecting the center with the top of the display indicates own ship's heading.</p> <p>The target pips are painted at their measured distances and in their directions relative to own ship's heading.</p> <p>A short line on the bearing scale is the north marker indicating gyrocompass north. A failure of the gyrocompass input will cause the north marker to disappear and the readout to show asterisks (**.*).</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">HEAD UP TRUE BEARING</p>  <p>Bearing scale rotates with gyrocompass signal.</p>	<p>Radar echoes are shown in the same way as in the head-up mode. The difference from normal head-up presentation lies in the orientation of the bearing scale. The bearing scale is gyrocompass stabilized. That is, it rotates in accordance with the gyrocompass signal, enabling you to know own ship's heading at a glance.</p> <p>This mode is available only when the radar is interfaced with a gyrocompass.</p> <p>If the gyrocompass fails, the bearing scale returns to the state of head-up mode.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">COURSE UP</p> 	<p>An azimuth stabilized display in which a line connecting the center with the top of the display indicates own ship's intended course (namely, own ship's previous heading just before this mode has been selected).</p> <p>Target pips are painted at their measured distances and in their directions relative to the intended course which is maintained at the 0-degree position while the heading line moves in accordance with ship's yawing and course change. This mode is useful to avoid smearing of picture during course change. After a course change, press the [CU, TM RESET] key to reset the picture orientation if you wish to continue using the course-up mode. The heading line gets back to scale zero.</p>

Presentation mode, representative display	Description
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">NORTH UP</p>  <p>The diagram shows a circular radar display with a heading scale from 010 to 350. A 'North' marker is at the top (000). A 'Heading Line' is drawn from the center to the 030 mark, with a 'Heading Marker' at its end. Landmasses are shown as dark grey shapes. A small circle around the center represents the own ship's position.</p>	<p>In the north-up mode, target pips are painted at their measured distances and in their true (compass) directions from own ship, north bearing maintained up of the screen. The heading line changes its direction according to the ship's heading.</p> <p>If the gyrocompass fails, the presentation mode changes to head-up and the north marker disappears. Also, the HDG readout shows asterisks (**.*).</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">TRUE MOTION</p>  <p>The diagram is identical to the North-up mode, but the heading line is oriented vertically (000), indicating that the own ship's heading is 000 degrees.</p>	<p>Own ship and other moving objects move in accordance with their true courses and speed. In ground stabilized TM, all fixed targets, such as landmasses, appear as stationary echoes. In the sea stabilized TM without set and drift inputs, the landmass can move on the screen.</p> <p>When own ship reaches a point corresponding to 50%* of the radius of the display, it is automatically reset to a point of 50%* radius opposite to the extension of the heading line passing through the display center. Resetting can be made at any moment before the ship reaches the limit by pressing the [CU, TM RESET] key. Automatic resetting is preceded by a beep sound.</p> <p>If the gyrocompass fails, the mode is changed to the head-up and the north marker disappears. The HDG readout shows asterisks (**.*).</p>
<div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>(a) True motion selected</p> </div> <div style="text-align: center;">  <p>(b) Own ship has reached a point 50%* of display radius</p> </div> <div style="text-align: center;">  <p>(c) Own ship is automatically reset to 50%* of radius</p> </div> </div> <p>* 75% in case of NM-type radar.</p>	

1.11 Selecting the Range Scale

The display range scale is changed by pressing the [+] and [-] keys. The selected range scale and range ring interval are shown at the upper left corner on the screen. When a target of interest comes closer, reduce the range scale so that it appears in 50–90% of the display radius. The range scales are:

0.25–0.5–0.75–1–1.5–2–3–4–6–8–12–16–24–32–48–96 SM

1.12 Selecting the Pulsewidth

The pulsewidth in use is displayed at the upper left-hand position of the screen using the abbreviations shown in the table below.

Appropriate pulsewidths are preset to individual range scales and function keys. Therefore, you are not usually required to select them. If you are not satisfied with the current pulsewidth settings, however, it is possible to change them on the RADAR 1 menu as shown in paragraph 1.12.2.

You can choose the pulsewidth 1 or 2 on the scales 0.5 to 24 SM ranges.

1.12.1 Selecting pulsewidth 1 or 2

1. Press the [RADAR MENU] key to display the FUNCTIONS 1 menu.
2. Press the [6] key to select PULSE WIDTH 1 or 2 as appropriate.
3. Press the [RADAR MENU] key to close the FUNCTIONS 1 menu.

Table 1-1 Available pulsewidths

Label	Pulsewidth
S1 (Short pulse 1)	0.07 μ s
S2 (Short pulse 2)	0.15 μ s
M1 (Medium pulse 1)	0.3 μ s
M2 (Medium pulse 2)	0.5 μ s
M3 (Medium pulse 3)	0.7 μ s
L (Long pulse)	1.2 μ s

1.12.2 Presetting pulsewidth 1 and 2

Pulsewidth 1 and 2 can be preset on the PULSE WD 1 and 2 menus. Shown below are examples of the pulsewidth setup procedure.

1. To enable selection of S1 (0.07 μ s) and S2 (0.15 μ s) pulsewidth on the 0.5 SM range, select S1 at 0.5 SM on the PULSE WD 1 menu and S2 at 0.5 SM on the PULSEWIDTH 2 menu.

- To enable selection of S2 (0.15 ms) and M1 (0.3 ms) pulsewidth on the 3 SM range, select S2 at 3 SM in the PULSE WD 1 menu and M1 at 3 SM in the PULSE WD 2 menu.

A longer pulse provides an increased detection range, but with reduced discrimination. If you need discrimination in preference to detection, choose a shorter pulse.

Example: To select S1 (0.07 ms) as Pulsewidth 1 for the 0.5 SM range, display the PULSE WIDTH 1 menu following the steps shown above and hit the [2] key to choose "0.5 SM." Further hit the [2] key until the menu option "S1" is highlighted to the right of "0.5 SM."

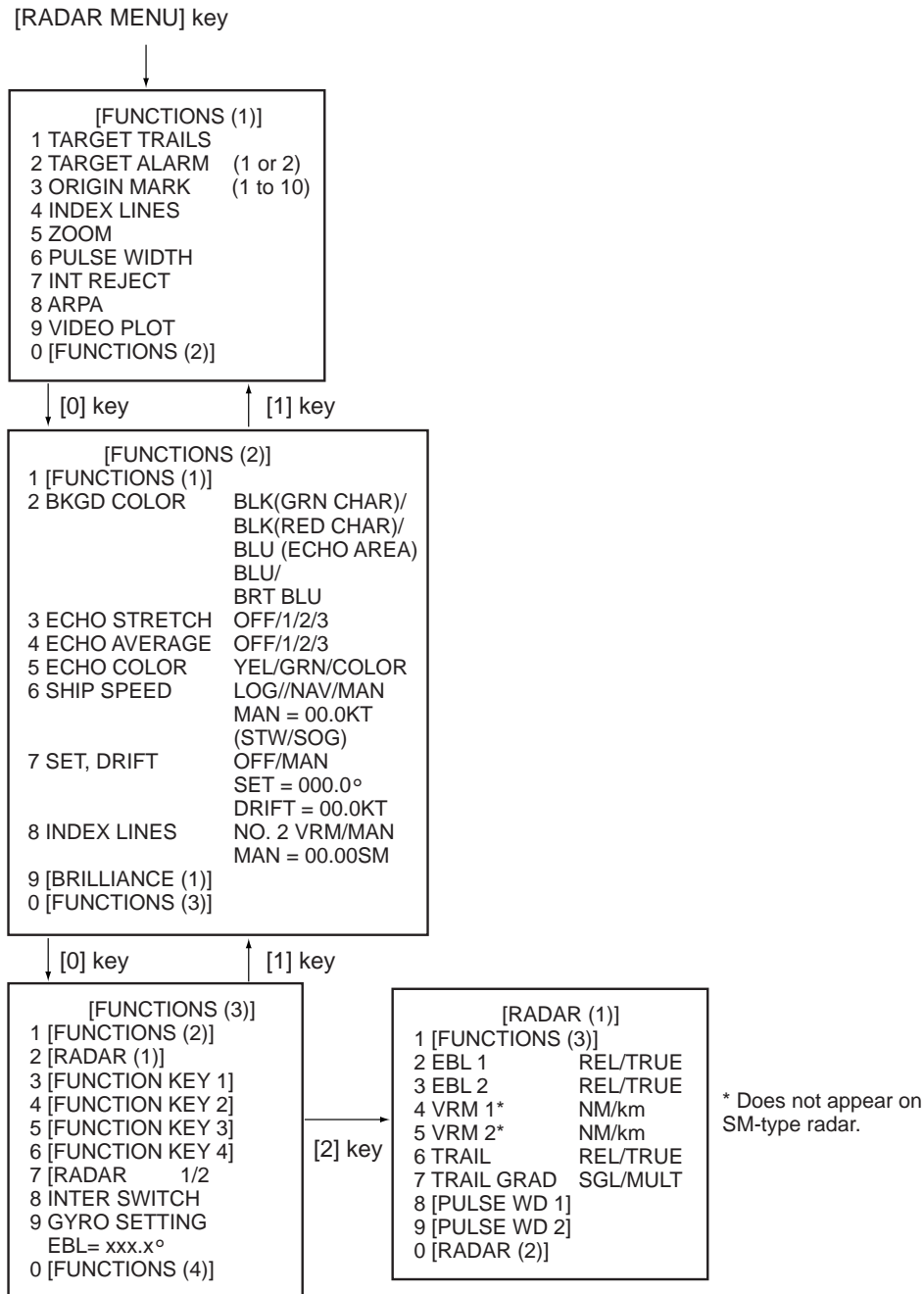


Figure 1-12 Sequence for selecting pulsewidth

In the RADAR 1 menu, select 8 for pulsewidth 1, or 9 for pulsewidth 2.

0.5 SM range	S1/S2	0.75 SM range	S1/S2/M1
1.5 SM range	S1/S2/M1	3 SM range	S2/M1/M2/M3
6 SM range	M1/M2/M3/L	12-24 SM range	M2/M3/L

1.13 Adjusting the Sensitivity

The [GAIN] control is used to adjust the sensitivity of the receiver, and thus the intensity of echoes as they appear on the screen. It should be adjusted so that the speckled background noise is just visible on the screen.

To become acquainted with the way the [GAIN] control works, try rotating it between fully counterclockwise and clockwise positions while observing the radar picture. You will notice that clockwise rotation increases the echo intensity level. A low gain setting results in the loss of weak echoes and a reduced detection range. If you turn the [GAIN] control too far clockwise for an excessive gain setting, desired echoes will be masked in the strong background noise.

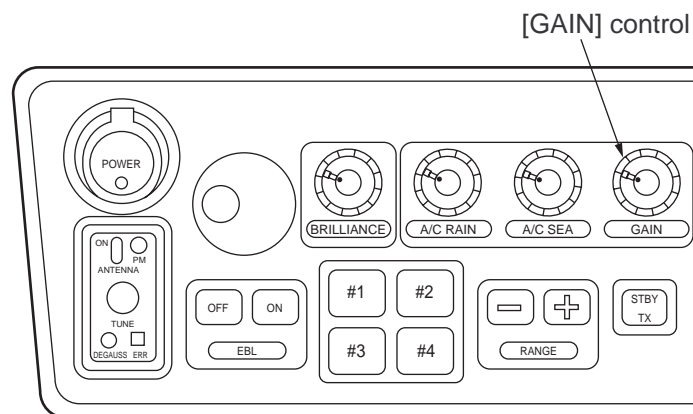


Figure 1-13 Control head

1.14 Suppressing Sea Clutter

In rough weather conditions returns from the sea surface are received over several miles around own ship and mask close targets. This situation can be improved by properly adjusting the [A/C SEA] (Anti-Clutter Sea) control.

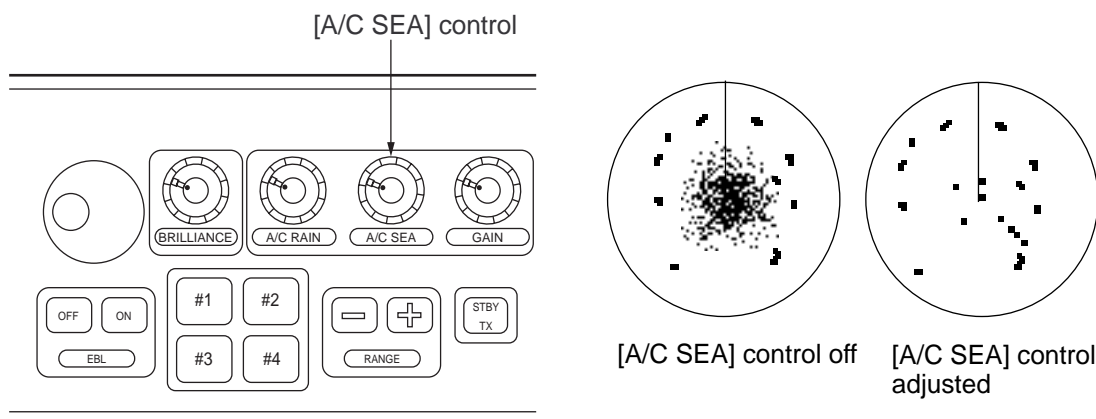


Figure 1-14 Control head, A/C SEA effect

1.14.1 Automatic anti-clutter control

The easiest way to suppress the surface clutter is to use the automatic anti-clutter control. Press the [A/C AUTO] key to turn the A/C AUTO circuit on or off. A/C AUTO appears at the bottom left-hand corner of the screen when the A/C AUTO circuit is on.

Use of a function key is also a good method for reducing sea clutter. For this purpose, presetting is required. Consult a FURUNO representative.

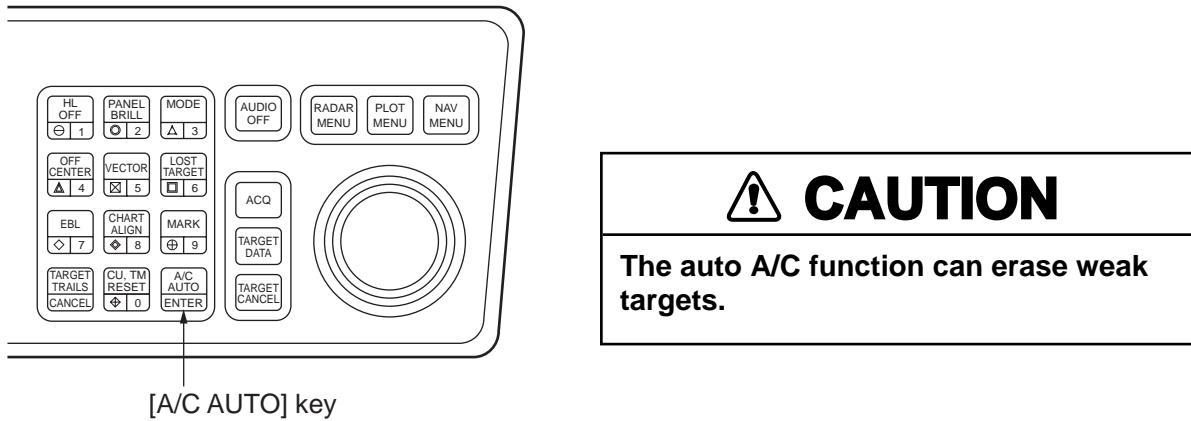


Figure 1-15 Control head

1.14.2 Manual anti-clutter control

From the fully counterclockwise position, slowly turn the [A/C SEA] control clockwise. For optimum target detection, you should leave speckles of the surface return slightly visible.

The anti-clutter sea control is often referred to as STC (Sensitivity Time Control) which decreases the amplification of the receiver immediately after a radar pulse is transmitted, and progressively increases the sensitivity as the range increases.

A common mistake is to over-adjust the [A/C SEA] control so that the surface clutter is completely removed. By rotating the control fully clockwise, you will see how dangerous this can be; a dark zone is created near the center of the screen and close-in targets can be lost. This dark zone is even more dangerous if the gain has not been properly adjusted. Always leave a little surface clutter visible on the screen. If no surface clutter is observed (on very calm waters), set the control at the fully counterclockwise position.

1.15 Suppressing Precipitation Clutter

In adverse weather conditions, clouds, rain or snow produce a lot of spray-like spurious echoes and impairs target detection over a long distance. This situation can be improved by using a function key provided that it is so programmed. If the function key fails to offer a favorable suppression of the rain clutter, adjust the [A/C RAIN] control on the control head.

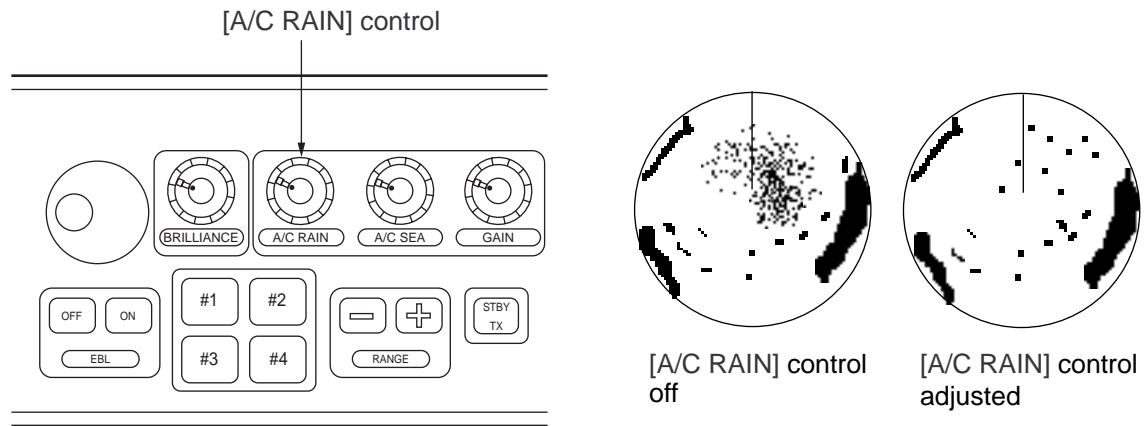


Figure 1-16 Control head, A/C RAIN effect

The [A/C RAIN] control adjusts the receiver sensitivity as the [A/C SEA] control does but rather in a longer time period (longer range). Clockwise rotation of this control increases the anti-clutter effect.

1.16 Interference Rejector

Mutual radar interference may occur in the vicinity of another shipborne radar operating in the same frequency band. It is seen on the screen as a number of bright spikes either in irregular patterns or in the form of usually curved spoke-like dotted lines extending from the center to the edge of the picture. This type of interference can be reduced by activating the interference rejector circuit.

The interference rejector is a kind of signal correlation circuit. It compares the received signals over successive transmissions and suppresses randomly occurring signals. There are three levels of interference rejection depending on the number of transmissions that are correlated. These are indicated by the legends IR1, IR2 and IR3 at the upper left-hand position of the screen.

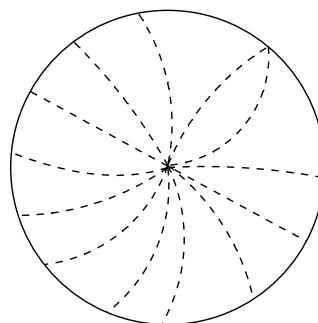


Figure 1-17 Interference

To activate the interference rejector;

1. Press the [RADAR MENU] key. The following appears.

```
[FUNCTIONS (1)]
1 TARGET TRAILS
2 TARGET ALARM (1 or 2)
3 ORIGIN MARK (1 to 10)
4 INDEX LINES
5 ZOOM
6 PULSE WIDTH
7 INT REJECT
8 ARPA
9 VIDEO PLOT
0 [FUNCTIONS (2)]
```

Figure 1-18 RADAR menu

2. Press the [7] key to select INT REJECT.
3. Successive presses of the key increase the effect of interference rejection, up to level 3. A fourth press deactivates the interference rejector. Switch off the interference rejector when no interference exists; otherwise weak targets may be lost.

Note: For stable reception of certain types of radar beacons (Racons) or SART (Search and Rescue Radar Transponder) as required by SOLAS 1974 as amended 1988 (GMDSS), it is recommended to turn the interference rejector off.

1.17 Measuring the Range

Use the fixed range rings to obtain a rough estimate of the range to a target. They are the concentric solid circles about own ship, or the sweep origin. The number of rings is automatically determined by the selected range scale and their interval is displayed at the upper-left position of the screen.

1.17.1 Adjusting range ring brilliance

1. Press the [RADAR MENU] key to display the FUNCTIONS 1 menu.
2. Press the [0] key to display the FUNCTIONS 2 menu.
3. Press the [9] key to display the BRILLIANCE 1 menu.

```
[BRILLIANCE (1)]
1 [FUNCTIONS (2)]
2 RINGS BRILL OFF/DIM/M1/M2/BRT
3 EBL BRILL DIM/M1/M2/BRT
4 VRM BRILL DIM/M1/M2/BRT
5 +CURSOR BRILL OFF/DIM/M1/M2/BRT
6 CHAR BRILL DIM/M1/M2/BRT
7 MARK BRILL DIM/M1/M2/BRT
8 TRAIL BRILL DIM/M1/M2/BRT
9 HL BRILL DIM/M/BRT
0 [BRILLIANCE (2)]
```

Figure 1-19 BRILLIANCE 1 menu

4. Press the [2] key to select RINGS BRILL.
5. Press the [2] key again. Each pressing gradually increases the brightness of the rings in 4 steps and the fifth pressing erases them.
6. Press the [ENTER] key to confirm you selection.
7. Press the [RADAR MENU] key to close the menu.

1.17.2 Measuring the range with the VRM

Use the Variable Range Markers (VRMs) for more accurate measurement of the range to a target. There are two VRMs, No. 1 and No. 2, which appear as dashed rings so that you can discriminate them from the fixed range rings. The two VRMs can be distinguished from each other by different lengths of dashes.

1. Press the [VRM ON] key to display either of the VRMs. Successive presses of the [VRM ON] key toggle the active VRM between No. 1 and No. 2 and the currently active VRM readout is marked with >.....<.
2. Turning the VRM control, align the active variable range marker with the inner edge of the target of interest and read its distance at the lower-right corner of the screen. Each VRM remains at the same geographical distance when you operate the RANGE+ or RANGE- key. This means that the apparent radius of the VRM ring changes in proportion to the selected range scale.
3. Press the [VRM OFF] key to key to erase each VRM.

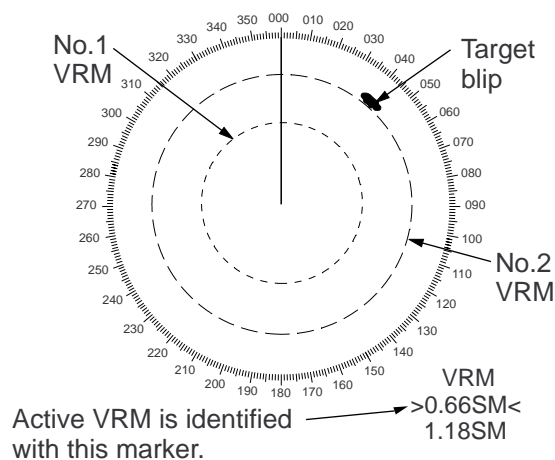


Figure 1-20 How to measure range with VRM

1.18 Measuring the Bearing

Use the Electronic Bearing Lines (EBLs) to take bearings of a target. There are two EBLs, No. 1 and No. 2, which are toggled by successive presses of the [EBL ON] key. Each EBL is a straight dashed line extending out from the own ship position up to the circumference of the radar picture. The fine dashed line is the No. 1 EBL and the coarse dashed one is the No. 2 EBL.

1. Press the [EBL ON] key to display either of the EBLs. Successive presses of the [EBL ON] key toggle the active EBL between No. 1 and No. 2 and the currently active EBL readout is marked with >... <.
2. Rotate the EBL rotary control clockwise or counterclockwise until the active EBL bisects the target of interest, and read its bearing at the lower-left corner of the screen.
3. Press the [EBL OFF] key to erase each EBL.

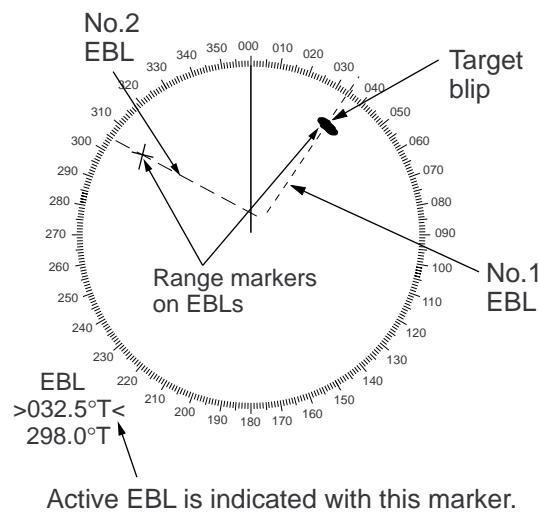


Figure 1-21 How to measure bearing with EBL

The EBL readout is affixed by "R" (relative) if it is relative to own ship's heading, "T" (true) if it is referenced to the north, as determined by the RADAR 1 menu settings.

Each EBL carries a range marker, or a short line crossing the EBL at right angles. Its distance from the EBL origin is indicated at the VRM readout whether or not the corresponding VRM is displayed. The range marker changes its position along the EBL with the rotation of the VRM control.

1.19 Collision Assessment by Offset EBL

The origin of the EBL can be placed anywhere with the trackball to enable measurement of range and bearing between any two targets. This function is also useful for assessment of the potential risk of collision. To assess possibility of collision:

1. Press the [EBL ON] key to display or activate an EBL (No. 1 or 2).
2. Place the cursor (+) on a target appearing as threatening (A in the illustrated example) by operating the trackball.
3. Press the [EBL OFFSET] key on the mode panel, and the origin of the active EBL shifts to the cursor position. Press the [EBL OFFSET] key again to anchor the EBL origin.
4. After waiting for a few minutes (at least 3 minutes), operate the EBL control until the EBL bisects the target at the new position (A¹). The EBL readout shows the target ship's course, which may be true or relative depending on the settings on the RADAR 1 menu.

If relative motion is selected, it is also possible to read CPA (Closest Point of Approach) by using a VRM as shown below (Figure (a)). If the EBL passes through the sweep origin (own ship) as illustrated (Figure (b)), the target ship is on a collision course.

5. To return the EBL origin to the own ship's position, press the [EBL OFFSET] key again.

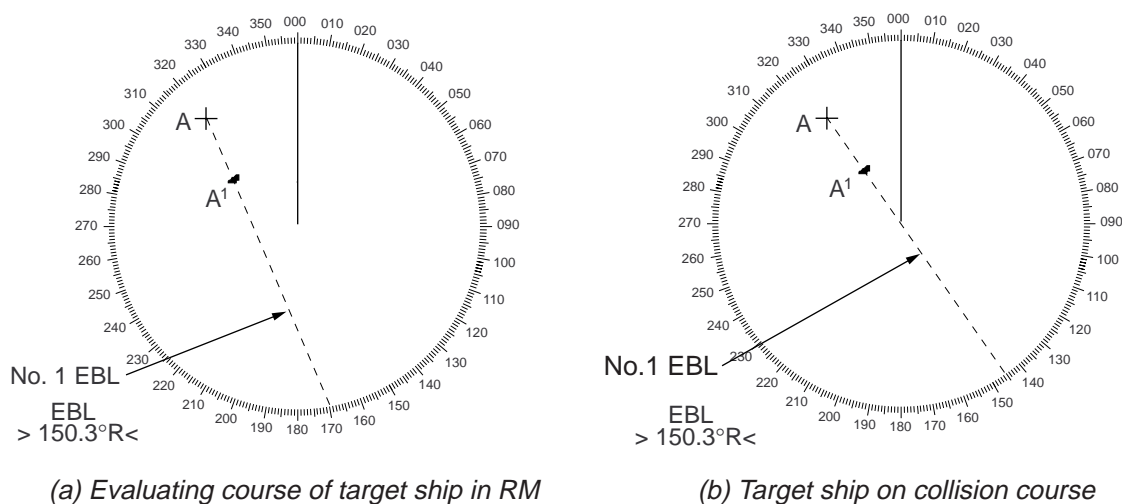


Figure 1-22 Collision assessment with the offset EBL

1.20 Measuring Range and Bearing Between Two Targets

1. Press the [EBL OFFSET] key, and place the origin of the No. 1 EBL, for example, on a target of interest (target 1 in the illustrated example), by operating the trackball.
2. Turn the EBL control until the EBL passes through another target of interest (target 2).
3. Turn the VRM control until the range marker aligns with target 2. The active VRM readout at the lower-right corner of the screen indicates the distance between the two targets.

You can repeat the same procedure on third and fourth targets by using the No. 2 EBL and No. 2 VRM.

Bearing is shown relative to own ship with suffix "R" or as a true bearing with the suffix "T" depending on EBL relative/true settings on the RADAR 1 menu.

5. To return the EBL origin to the own ship position, press the [EBL OFFSET] key again.

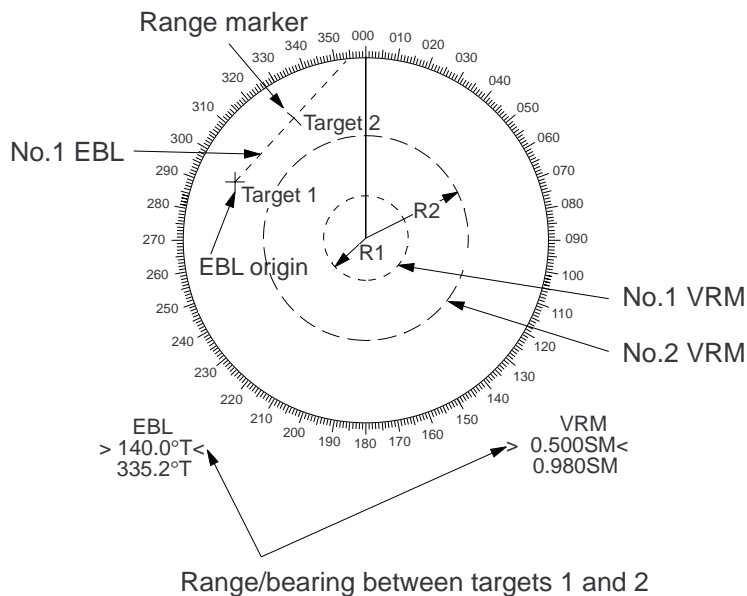


Figure 1-23 Measuring range and bearing between two targets

1.21 Setting a Target Alarm Zone



CAUTION

The target alarm should not be relied upon as the sole means for detecting possible collision situations. The operator of a ship is not relieved of the responsibility to keep lookout for possible collisions, whether or not the radar is in use.



CAUTION

The target alarm is given to targets having a certain level of echo strength. This level does not always imply a landmass, reef, ships or other surface objects but can mean returns from the sea surface or precipitation. Properly adjust the [GAIN], [A/C SEA], and [A/C RAIN] controls to reduce noise to avoid generation of an alarm against a false target.

The target alarm serves to alert the navigator to targets (ships, landmasses, etc.) entering a certain area with visual and audible alarms.

The outer and inner boundaries can be set at any distance. The sector of the zone can be set anywhere between 0 and 360 degrees in any direction.

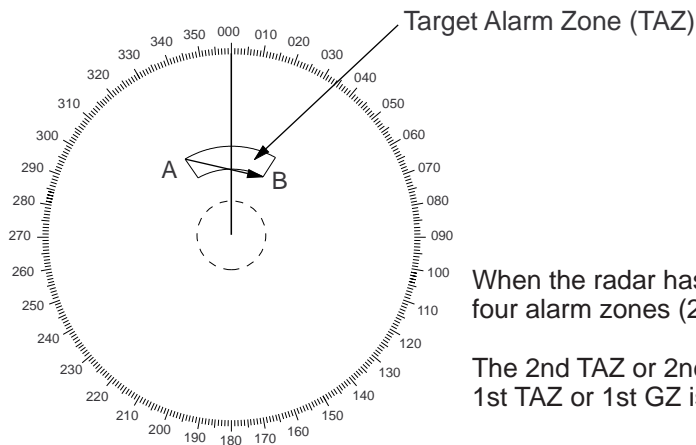
1.21.1 Setting a target alarm zone

1. Referring to Figure 1-24, use the trackball to place the cursor (+) at point "A".
2. Press the [RADAR MENU] key to show the FUNCTIONS 1 menu.
3. Press the [2] key to set start point (point "A") of the alarm zone. The message TGT ALARM1 (or 2) SET appears at the bottom-right corner of the screen.
4. Move the cursor (+) to point "B" and press the [2] key again. Then, the target alarm zone as illustrated is created and the label TGT ALARM1 (or 2) appears instead of TGT ALARM1 (or 2) SET at the lower-right corner of the screen.

Note 1: If you wish to create a target alarm zone having a 360-degree coverage around own ship, set point "B" in almost the same direction (approx. ± 3) as point "A" and press the [2] key.

Note 2: If you change the range scale to less than half of the TAZ, the warning TGT ALARM1 (or 2) OUT appears instead of TGT ALARM1 (or 2).

5. Two alarm zones can be set as described above. Press [ENTER] and [2] keys in that order while displaying the FUNCTIONS 1 menu and repeat the above steps.



When the radar has an ARPA board ARP-26, a total of four alarm zones (2 each TAZ and GZ) may be set.

The 2nd TAZ or 2nd GZ is available only when the 1st TAZ or 1st GZ is valid.

Figure 1-24 How to set target alarm zone

1.21.2 Acknowledging alarm

A target entering the watch zone produces both visual (flashing) and audible (beeping) alarms. To silence the audible alarm, press the [2] key shortly on the FUNCTIONS 1 menu and the label TGT ALARM1 ACK replaces TGT ALARM1 on the display.

This will deactivate the audible alarm but will not stop the flashing of the target in the target alarm zone. To reactivate the audible alarm, press the [2] key again on the FUNCTIONS 1 menu.

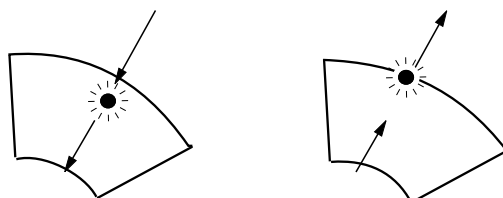
When an external buzzer is connected, the audible alarm does not stop until the target alarm is deactivated.

1.21.3 Deactivating target alarm

Hold the [2] key depressed for at least five seconds on the FUNCTIONS 1 menu.

1.21.4 Inward and outward target alarms

An inward or outward target alarm can be selected on the RADAR 2 menu. The inward target alarm generates visual and audible warnings when a target enters the guard zone from any direction. The outward target alarm is produced when a target leaves the target alarm zone.



(a) Inward target alarm (b) Outward target alarm

Figure 1-25 Inward and outward target alarm zones

1.22 Off-Centering

Own ship position, or sweep origin, can be displaced to expand the view field without switching to a larger range scale. The sweep origin can be off-centered to the cursor position, but not more than 75% of the range in use; if the cursor is set beyond 75% of the range scale, the sweep origin will be off-centered to the point of 75% of the limit.

This feature is not available on the longest range scale or in the true motion mode. The number of range rings increases, keeping the original range intervals unchanged.

To off-center the radar picture:

1. Place the cursor at a position where you wish to move the sweep origin by operating the trackball.
2. Press the [OFF CENTER] key. Then, the sweep origin is off-centered to the cursor position.
3. To cancel off-centering, press the [OFF CENTER] key again.

1.23 Echo Stretch

On long ranges target echoes tend to shrink in the bearing direction, making them difficult to see. On short and medium ranges such as 1.5, 3 and 6 SM scales, the same size targets get smaller on screen as they approach own ship. These are due to the inherent property of the radiation pattern of the antenna. To enhance target video, use the echo stretch function. There are 3 settings: echo stretch 1 (ES1) to enlarge in bearing direction for long range detection, echo stretch 2 (ES2) to enlarge in range direction and echo stretch 3 (ES3) to enlarge in both bearing and range directions.

To activate the echo stretch:

1. Press the [RADAR MENU] key to show the FUNCTIONS 1 menu.
2. Press the [0] key to display the FUNCTIONS 2 menu.

[FUNCTIONS (2)]	
1 [FUNCTIONS (1)]	
2 BKGD COLOR	BLK(GRN CHAR)/ BLK(RED CHAR)/ BLU (ECHO AREA) BLU/ BRT BLU
3 ECHO STRETCH	OFF/1/2/3
4 ECHO AVERAGE	OFF/1/2/3
5 ECHO COLOR	YEL/GRN/COLOR
6 SHIP SPEED	LOG/NAV/MAN MAN = 00.0KT (STW/SOG)
7 SET, DRIFT	OFF/MAN SET = 000.0° DRIFT = 00.0KT
8 INDEX LINES	NO. 2 VRM/MAN MAN = 00.00SM
9 [BRILLIANCE (1)]	
0 [FUNCTIONS (3)]	

Figure 1-26 FUNCTIONS 2 menu

3. Press the [3] key to select ECHO STRETCH.
4. Press the [3] key until Echo Stretch option 1, 2, 3 or OFF as desired is highlighted.
5. Press the [ENTER] key to conclude your selection followed by the [RADAR MENU] key to close the FUNCTIONS menu. Selected setting is indicated on the left side of the radar display.

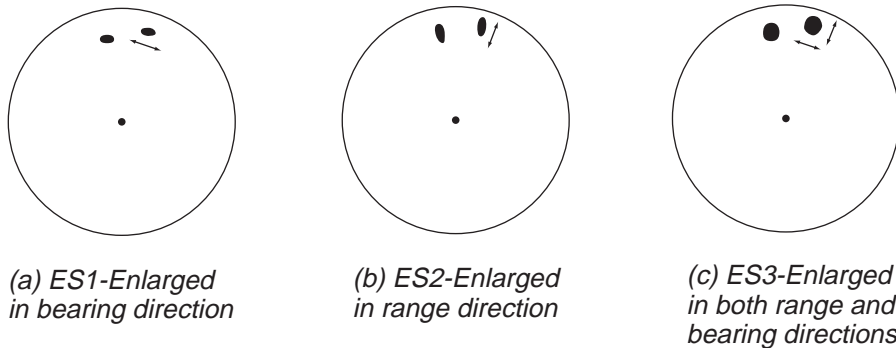


Figure 1-27 Echo stretch

Notes on use of echo stretch

- 1) If the 1.5 SM range is preset with a pulsewidth of S1 or S2, and the 3 SM scale with S2, the echo stretch is not available on these range scales.
- 2) The echo stretch magnifies not only small target pips but also returns (clutter) from sea surface, rain and radar interference. For this reason make sure these types of interference have been sufficiently suppressed before activating this function.

1.24 Echo Averaging

The echo average feature effectively suppresses sea clutter. Echoes received from stable targets such as ships appear on the screen at almost the same position every rotation of the antenna. On the other hand, unstable echoes such as sea clutter appear at random positions.

To distinguish real target echoes from sea clutter, this radar performs scan-to-scan correlation. Correlation is made by storing and averaging echo signals over successive picture frames. If an echo is solid and stable, it is presented in its normal intensity. Sea clutter is averaged over successive scans resulting in the reduced brilliance, making it easier to discriminate real targets from sea clutter.

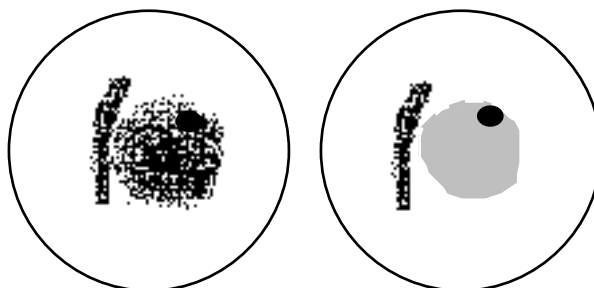
To properly use the echo average function, it is recommended to first suppress sea clutter with the [A/C SEA] control and then do the following:

1. Press the [RADAR MENU] key and the [0] key to show the FUNCTIONS 2 menu.

[FUNCTIONS (2)]	
1 [FUNCTIONS (1)]	
2 BKGD COLOR	BLK(GRN CHAR)/ BLK(RED CHAR)/ BLU (ECHO AREA) BLU/ BRT BLU
3 ECHO STRETCH	OFF/1/2/3
4 ECHO AVERAGE	OFF/1/2/3
5 ECHO COLOR	YEL/GRN/COLOR
6 SHIP SPEED	LOG/NAV/MAN MAN = 00.0KT (STW/SOG)
7 SET, DRIFT	OFF/MAN SET = 000.0° DRIFT = 00.0KT
8 INDEX LINES	NO. 2 VRM/MAN MAN = 00.00SM
9 [BRILLIANCE (1)]	
0 [FUNCTIONS (3)]	

Figure 1-28 FUNCTIONS 2 menu

2. Press the [4] key to select ECHO AVERAGE.
3. Press the [4] key until echo average option 1, 2, 3 or OFF as desired is highlighted.
OFF: No averaging effect
 - 1: Helps distinguish targets from sea clutter and suppresses brilliance of unstable echoes.
 - 2: Distinguishes small stationary targets such as navigation buoys.
 - 3: Stably displays distant targets.
4. Press the [ENTER] key to conclude your selection followed by the [RADAR MENU] key to close the FUNCTIONS menu.




(a) Echo average OFF (b) Echo average ON

Figure 1-29 Echo averaging

Echo averaging uses scan-to-scan signal correlation technique based on the true motion over the ground of each target. Thus, small stationary targets such as buoys will be shown while suppressing random echoes such as sea clutter. True echo average is not however effective for picking up small targets running at high speeds over the ground.

Echo average is inoperable when a gyrocompass signal is not available. If you wish to use this feature without a gyrocompass signal, consult a FURUNO representative.

 CAUTION
<p>Do not use the Echo Average feature under heavy pitching and rolling; loss of true targets can result.</p>

1.25 Electronic Plotting Aid (EPA)

A maximum 10 operator-selected targets can be plotted electronically to assess their motion trend. Five past positions can be displayed for each of the plotted targets. If you enter a 6th plot on a certain target, the oldest plot (past position) will be erased.

A vector appears when you enter a second plot for the target and is updated each time a new plot is entered. The vector shows the target motion trend based on its latest two plots. The vector origin will move across the screen at a rate and direction defined by the calculated true course and speed until a next manual plotting.

Target data is shown in the data display area which shows bearing, course, speed, CPA, TCPA, BCR, BCT calculated true course of targets, calculated true speed of targets.

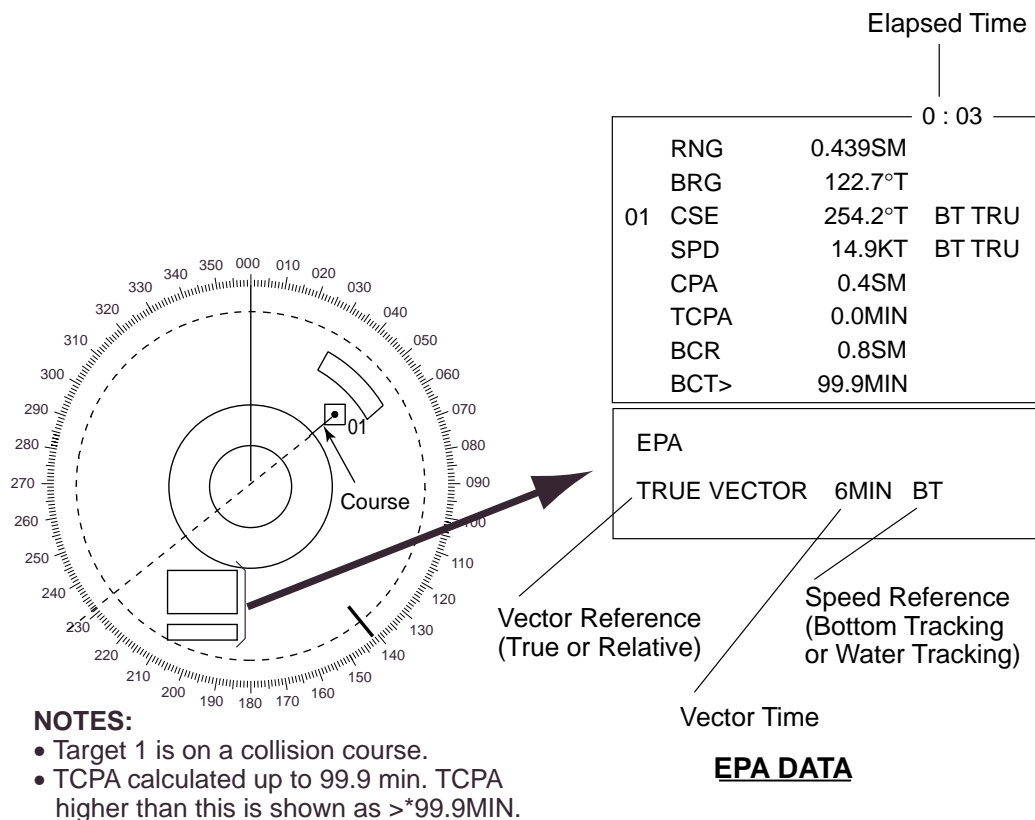


Figure 1-30 Sample EPA display

Target 01 in Figure 1-30 is on a collision course as the extension of the vector goes through the own ship position. Placing the offset EBL on the target will be a help for assessment. TCPA is counted up to 99.9 minutes and beyond this it is indicated as TCPA >* 99.9 MIN.

Note: EPA requires speed input (automatic or manual) and a heading signal. The vector and data are updated automatically every 1-2 scenes between plot entries, but do not neglect to plot a new position over a long period of time. The accuracy will be reduced. Note the plots will be lost when the gyrocompass fails; start the plotting exercise again.

1.25.1 Plotting a target

To perform electronic plotting:

1. Place the cursor(+) on a target of interest by operating the trackball.
2. Press the [ACQ] key and one of numeric keys, and the plot symbol with number appears at the cursor position.
3. Watching the EPA time shown at the screen center, wait for at least 30 seconds. Place the cursor (+) on the target at its new location, press the [ACQ] key, and the same numeric key for the target.

The plot symbol moves to the new target position and previous position is marked by a small dot.

4. To acquire other targets, repeat the above steps selecting a different plot number.

Note: If a target once plotted is not plotted again within 10 minutes, the warning "UPDATE PLOT" will appear in red on the bottom of the screen and the plot symbol of the target flashes. If you want to continue plotting this target, reacquire it within five minutes. Otherwise, the target will be regarded as a "lost target" and its plot symbol and target data will be erased. The larger the plotting interval, the less accurate the plotted target data. Plotting of each target should normally be made every three or six minutes as far as possible. You can use a Watch Alarm to warn yourself every three or six minutes or whichever you may set.

Within five seconds, you can cancel a last plot by the [TARGET CANCEL] key and make a re-entry at a different position. After five seconds, the last entry is processed to produce a vector.

1.25.2 True or relative vector

Vectors can be displayed relative to own ship's heading (Relative) or with reference to the north (True). Press the [VECTOR] key to select the required mode. This feature is available in all presentation modes (gyrocompass must be working correctly). The current vector mode is indicated at the screen center.

1.25.3 Vector time

Vector time (or the length of vectors) can be set to 30 seconds, 1, 2, 3, 6, 12, 15 or 30 minutes and the selected vector time is indicated at the screen center.

1. Press the [PLOT MENU] key followed by the [1] key several times to select vector time desired.

[EPA]	
1 VECTOR TIME	30SEC/1/2/3/6/12/15/30MIN
2 COLLISION ALARM	OFF/ON
	CPA 0.0 SM
	TCPA 00.0 MIN
3 MARK	STD/LARGE
4 PLOT NO.	OFF/ON

Figure 1-31 EPA menu

2. Press the [ENTER] key to confirm your selection.
3. Press the [PLOT MENU] key to close the menu. The vector tip shows an estimated position of the target after the selected vector time elapses. It can be valuable to extend the vector length to evaluate the risk of collision with any target.

1.25.4 Target data

The radar calculates motion trends (range, bearing, course, speed, CPA and TCPA) of all plotted targets.

In the head-up and head-up true bearing modes, target bearing, course and speed shown in the upper-right target data field become true (T) relative to north or relative (R) relative to own ship in accordance with true/relative vector setting. In the north-up, course-up, and True Motion modes, the target data field always displays true bearing, true course, and speed over the ground.

Reading the target data

Press the [ACQ] key and corresponding numeric key, and the following target data is displayed.

RNG/BRG (Range/Bearing): Range and bearing from own ship to last-plotted target with suffix "T" (True) or "R" (Relative) plot symbol.

CSE/SPD (Course/Speed): Course and speed are displayed for the last-plotted target with the suffix "T" (True) or "R" (Relative) plot symbol.

CPA/TCPA: CPA (Closest Point of Approach) is the closest range a target will approach to own ship. TCPA is the Time to CPA. Both CPA and TCPA are automatically calculated. TCPA is counted up to 99.9 minutes and beyond this it is indicated as TCPA > *99.9 MIN.

BCR/BCT: BCR (Bow Cross Range) is the range at which a target will cross own ship's bow. BCT (Bow Cross Time) is the estimated time at which a target will cross own ship's bow. If BCR is negative, BCR/BCT readout is displayed as *.*.

1.25.5 Terminating target plotting

With EPA you can plot up to 10 targets. You may wish to terminate plotting of less important targets to newly plot other threatening targets.

By Symbol: To terminate plotting of a certain target, press the [TARGET CANCEL] key and then press the corresponding plot number key.

With Trackball: Use the trackball to place the cursor (+) on a target which you do not want to be tracked any longer, and then press the [TARGET CANCEL] key.

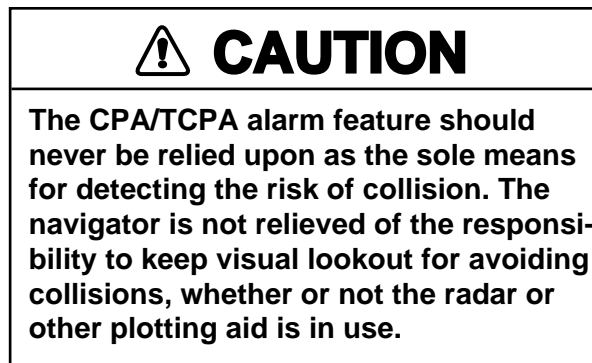
All Targets: To terminate plotting of all targets at once, press and hold the [TARGET CANCEL] key until all plot symbols and marks disappear (in about three seconds).

1.25.6 Setting CPA/TCPA alarm ranges

When the predicted CPA of any target becomes smaller than a preset CPA alarm range and its predicted TCPA less than a preset TCPA alarm limit, the EPA releases an aural alarm and displays the warning label COLLISION on the screen. In addition, the EPA symbol changes to a triangle and flashes together with its vector.

Provided that this feature is used correctly, it will help prevent the risk of collision by alerting you to threatening targets. It is important that GAIN, A/C SEA, A/C RAIN and other radar controls are properly adjusted.

CPA/TCPA alarm ranges must be set up properly taking into consideration the size, tonnage, speed, turning performance and other characteristics of own ship.



To set the CPA/TCPA alarm ranges:

1. Press the [PLOT MENU] key to show the EPA menu.
2. Press the [2] key to select COLLISION ALARM ON. At this point, a highlight cursor appears at the "CPA x.x NM" field.
3. Enter the CPA alarm range in nautical miles (0.0 to 9.9 nm) without omitting leading zeroes, if any, and press the [ENTER] key. The highlight cursor now moves to the "TCPA xx.x MIN" field.
4. Enter the TCPA alarm limit in minutes (1.0 to 99.0 minutes) without omitting leading zeroes, if any, and press the [ENTER] key.
5. Press the [PLOT MENU] key to close the menu.

1.25.7 Silencing CPA/TCPA audible alarm

Press the [AUDIO OFF] key to acknowledge and silence the CPA/TCPA audible alarm.

The warning label COLLISION and the flashing of the triangle plot symbol and vector remain on the screen until the dangerous situation is gone or you intentionally terminate tracking of the offending target by using the [TARGET CANCEL] key.

1.25.8 Changing size of the plotting symbols

You can change the size of the plotting symbols as follows:

1. Press the [PLOT MENU] key to show the EPA menu.
2. Press the [3] key two or three times until plot symbol size option STD (standard) or LARGE is highlighted.
3. Press the [ENTER] key to conclude your selection followed by the [PLOT MENU] key to close the PLOT menu.

1.26 Target Trails

It is possible to display the trails of radar echoes in the form of synthetic afterglow. The afterglow can be selected in a single tone or gradual shading as set on the RADAR 1 menu.

1.26.1 True or relative target trails

You may display target trails in true or relative motion (only true trail on TM). Relative trails show relative movements between targets and own ship. True motion trails require a gyro-compass signal and speed input to cancel out own ship's movement and present true target movements in accordance with their over-the-ground speeds and courses.

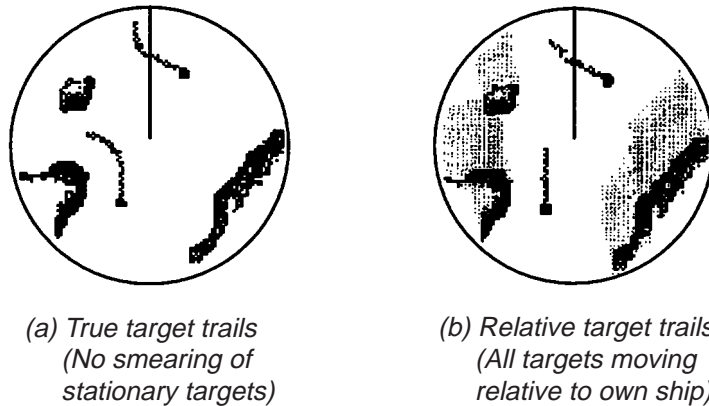


Figure 1-32 Target trails

Note: When true trail is selected on the RM mode, the legend TRUE TRAIL appears in red. The TM modes always displays True trails.

To select true or relative target trail presentation:

1. Press the [RADAR MENU] key followed by [0], [0] and [2] to display the RADAR 1 menu.

[RADAR (1)]	
1 [FUNCTIONS (3)]	
2 EBL1	REL/TRUE
3 EBL2	REL/TRUE
4 VRM1*	NM/km
5 VRM2*	NM/km
6 TRAIL	REL/TRUE
7 TRAIL GRAD	SGL/MULT
8 [PULSE WD 1]	
9 [PULSE WD 2]	
0 [RADAR (2)]	

* Does not appear on SM-type radar.

Figure 1-33 RADAR 1 menu

3. Press the [6] key to select menu item 6 TRAIL.
4. Press the [6] key to select (or highlight) REL (Relative) or TRUE option.
5. Press the [ENTER] key to confirm your selection, and then press the [RADAR MENU] key to close the menu.

1.26.2 Target trail gradation

Target trails may be shown in monotone or gradual shading. Gradual shading paints the trails getting thinner with time just like the afterglow on an analog PPI radar.



Figure 1-34 Trail gradation

1. Press the [RADAR MENU] key followed by [0], [0] and [2] to display the RADAR 1 menu.
3. Press the [7] key to select menu item 7 TRAIL GRAD.
4. Press the [7] key to select SGL (single tone) or MULT (multiple shading) option.
5. Press the [ENTER] key to confirm your selection; then [RADAR MENU] key to close the menu.

1.26.3 Displaying, erasing target trails

Press the [RADAR MENU] key followed by the [1] key to activate or deactivate the target trails feature.

[FUNCTIONS (1)]	
1 TARGET TRAILS	
2 TARGET ALARM	(1 or 2)
3 ORIGIN MARK	(1 to 10)
4 INDEX LINES	
5 ZOOM	
6 PULSE WIDTH	
7 INT REJECT	
8 ARPA	
9 VIDEO PLOT	
0 [FUNCTIONS (2)]	

Figure 1-35 FUNCTIONS 1 menu

Each press of the [1] key within five seconds cyclically changes target trail length (time) as below:

OFF - 30 s - 1 min - 3 min - 5 min - 15 min - 30 min - continuous - OFF

The current target trail setting is displayed at the lower-right corner of the screen.

Suppose that “3 MIN” has just been selected. If the [1] key is hit on the FUNCTION 1 menu more than five seconds later, target trails are removed from the display (memory still alive with target trail timer count going on). Next hitting of the key calls out the target trails on the screen. To proceed to longer plot intervals, successively push the [1] key with a hit-and-release action. The larger the target trail length, the larger the target trail plot interval.

Note: Holding the [1] key depressed for about three seconds on the FUNCTION 1 menu will cause a loss of target trail data so far stored in the memory.

1.26.3 Resetting target trails

To reset (or clear) the target trail memory, hold the [TARGET TRAILS CANCEL] key depressed for about three seconds. Target trails are cleared and the trailing process restarts from time count zero at current target trail plot interval. When the memory assigned to target trails becomes full the target trail timer at the lower-right corner of the screen freezes and the oldest trails are erased to show the latest trails.

1.27 Parallel Index Lines

Parallel index lines are useful for keeping a constant distance between own ship and a coastline or a partner ship when navigating. Index lines are drawn in parallel with the No. 2 EBL (No. 2 EBL must be active). The orientation of the index lines is controlled with the EBL control (without effecting the EBL indication) and the intervals between the lines adjusted with the VRM rotary control (provided that No. 2 VRM is active).

The maximum number of the index lines to display can be set for 2, 3 or 6 on the INITIAL SETTING 3 menu.

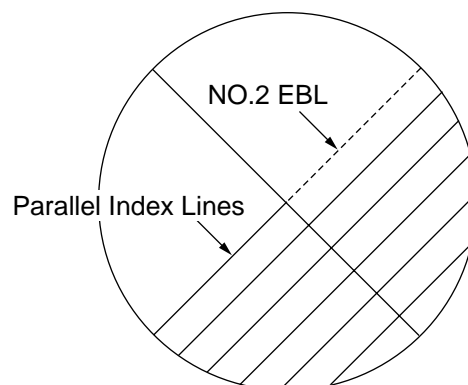


Figure 1-36 Parallel index lines

1.27.1 Displaying, erasing the index lines

1. Press [RADAR MENU], [4] key to display or erase the index lines.

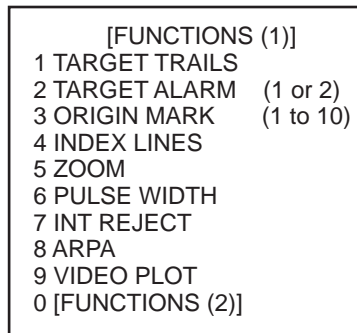


Figure 1-37 FUNCTIONS 1 menu

2. Orient the index lines in a desired direction with the EBL rotary control. The azimuth of the index lines appear at the bottom of the screen.

1.27.2 Adjusting index line intervals

1. Press [RADAR MENU], [0] to show the FUNCTIONS 2 menu.

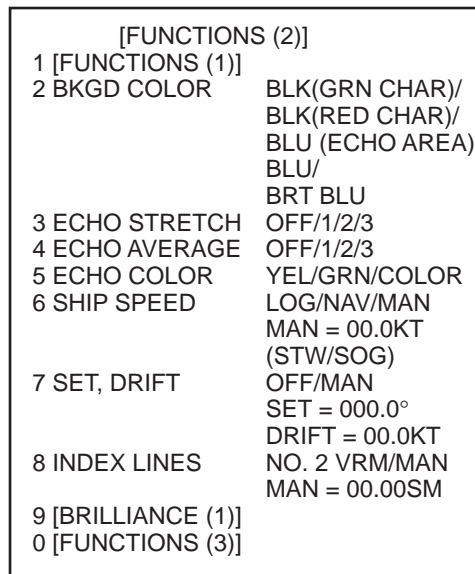


Figure 1-38 FUNCTIONS 2 menu

2. Press the [8] key to select menu item 8 INDEX LINES.
3. Press the [8] key to select (or highlight) NO. 2 VRM or MAN (manual) option.
4. Press the [ENTER] key to conclude your selection.
5. If you selected MAN in step 3 above, "MAN = 00.00NM" appears at the bottom of the FUNCTIONS 2 menu. Enter a desired line interval (without omitting leading zeroes) by hitting numeric keys and then press the [ENTER] key. There are choices of 2, 3 and 6 index lines but the number of lines visible on the screen may be less than 6 depending on the line intervals.

6. If you selected NO. 2 VRM in step 3 above, make sure that the No. 2 VRM is active and adjust the spacing between the index lines by operating the VRM control.
7. Press the [RADAR MENU] key to close the FUNCTIONS 2 menu.

1.28 Origin Mark

You can mark any reference points, prominent target or a point of particular interest using the origin mark feature. These marks (max 10) are geographically fixed, that is, ground stabilized. To display the origin marks, heading signal and position data are required.

1.28.1 Inscribing an origin mark

1. Using the trackball, place the cursor (+) at a point where you want to place a reference mark.
2. Press the [RADAR MENU] key to show the FUNCTIONS 1 menu.
3. Press the [3] key. The origin mark appears at the cursor position of which range and bearing are indicated at the screen center.
4. To measure the range and bearing to a target of interest from the origin mark, move the cursor to the target of interest. Then, the range and bearing from the origin mark to the target are shown at the screen center.
5. To enter another origin mark, press the [ENTER] key and the [3] key in the FUNCTIONS 1 menu. Place the cursor where you want to place the origin mark, then press the [3] key.
6. To erase the origin mark, select the origin mark number in the FUNCTIONS 1 menu by pressing the [ENTER] key and the [3] key repeatedly, and then press the [3] key once again.

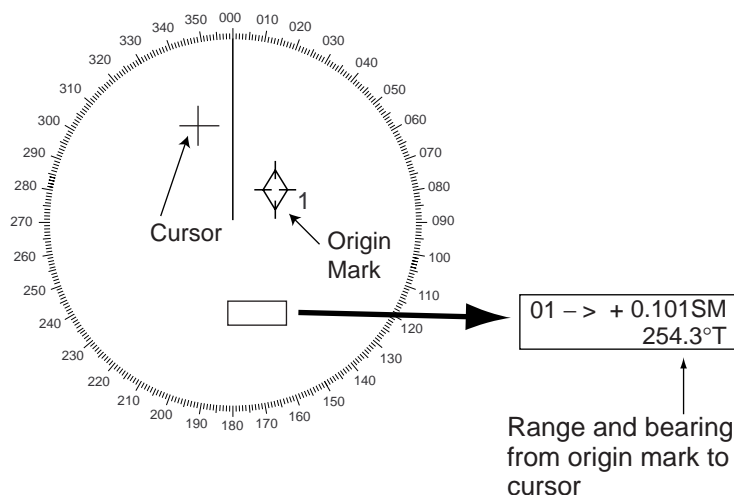


Figure 1-39 Origin mark

1.28.2 Attaching ID number or symbol to origin marks

Origin marks may be affixed with ID numbers or symbols corresponding to the keys in use.

1. Press [RADAR MENU], [0], [0], [2], [0] and [0] to show the RADAR 3 menu.
2. Press the [5] key twice to select the number or symbol.
3. Press the [ENTER] key to conclude your selection.

1.29 Zoom

The zoom function enlarges an area of interest as large as twice the normal viewing. Note that the zoom feature is inoperative when the display is off centered.

1. Place the cursor (+) close to the point of interest by operating the trackball.
2. Press the [RADAR MENU] key to show the FUNCTIONS 1 menu.
3. Press the [5] key. The area around the cursor and own ship is enlarged twice as large as the original size and the label ZOOM appears at the lower-left corner of the screen.
4. To cancel zoom, press the [5] key again on the FUNCTIONS 1 menu.

1.30 Markers

1.30.1 Heading marker and heading line

The heading marker and the heading line indicate the ship's heading in all presentation modes. The heading line is a line from the own ship position to the outer edge of the radar display area and appears at zero degrees on the bearing scale in head-up mode, and in the north-up and true motion modes it changes with ship's movement. The heading marker appears as a small circle on the bearing scale to indicate the heading when the display is off-centered or is in north-up or TM mode.

Temporarily erasing heading line

To temporarily extinguish the heading line to look at targets existing dead ahead of own ship, press the [HL OFF] key. The heading line reappears when the key is released.

1.30.2 North marker

The north marker appears as a short dashed line. In the head-up mode, the north marker moves around the bearing scale in accordance with the gyrocompass signal.

1.30.3 Stern marker

The stern marker (a dot-and-dash line) appears opposite to the heading line. This marker can be displayed provided that STERN MK ON is selected on the RADAR 2 menu.

1.30.4 Own ship symbol

The own ship symbol (⏏) can be displayed/erased on the RADAR 2 menu. The symbol is scaled to indicate the length and beam of the vessel. If the largest dimension of the symbol gets smaller than 6 mm, the symbol will disappear and own ship will be represented with a small dot or circle depending on the range in use. Details should be entered during installation.

1.31 Menu Keys

Three menu keys are provided on the right hand corner of the control head: [RADAR MENU], [PLOT MENU] and [NAV MENU].

RADAR MENU: Permits setting of basic radar parameters.

PLOT MENU: Permits setting of Electronic Plotting Aid (EPA) parameters or the optional ARPA ARP-26.

NAV MENU: Provides a choice of navigation data for on-screen display. Also selects display data for the optional Video Plotter.

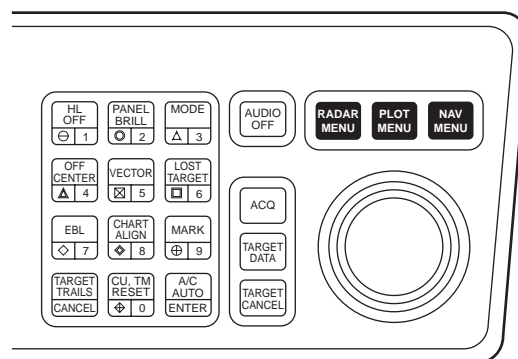


Figure 1-40 Control head, menu keys

Note: Menu automatically goes off in 30 seconds if you do not press a key.

1.32 RADAR 1, 2 and 3 Menu Settings

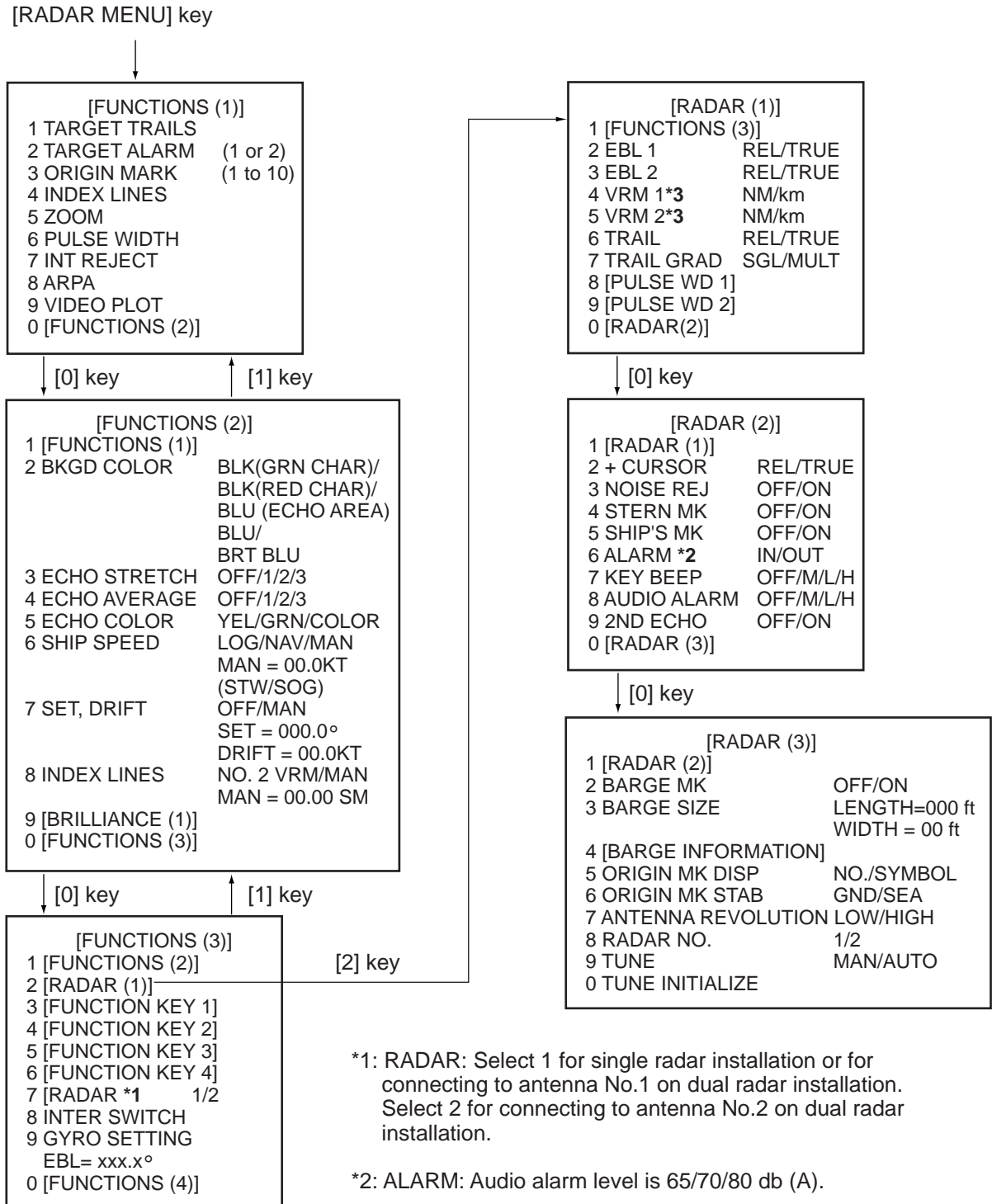


Figure 1-41 RADAR menus

1.33 Function Keys

The four function keys (#1-4) on the control head serve for a macro function to instantly select a combination of assigned functions or settings. The function keys provide optimum radar settings for a specific purpose with a single key operation.

Each function key can be assigned a combination of particular radar settings that will be most suited to your specific navigating purpose, and an adhesive label (such as BUOY, HARBOR, COAST or the like) is usually attached to the key top for easy identification of the assigned purpose.

The individual function keys are preset, or programmed, for the following purposes by qualified service personnel at the time of installation using the procedures described in the succeeding paragraphs:

Function keys #1, #2 and #3: Picture setup and specific operation

Function key #4: Specific operation or watch alarm

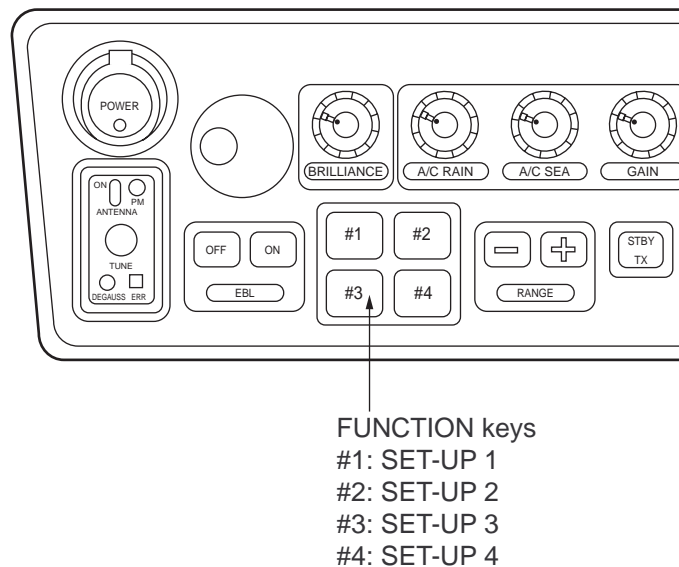


Figure 1-42 Control head, function keys

1.33.1 Picture setup

Suppose that you have been navigating along a coast for hours and now you are approaching a harbor, your final destination. You will have to adjust your radar to change from the settings for coastal navigation to those for harbor approach. Every time your navigating environment or task changes, you must adjust the radar, which can be a nuisance in a busy situation. Instead of changing radar settings case by case, it is possible to assign the function keys to provide optimum settings for often encountered situations.

The radar's internal computer offers several picture setup options to be assigned to each function key for your specific navigating requirements. For instance, one of the function keys may be assigned the buoy detecting function and labeled BUOY on the key top. If you press this key, the radar will be instantly set for optimum detection of navigation buoys and similar objects and the label BUOY is shown at the left margin of the screen. If you repress the same key, the radar returns to the previous settings.

The picture setup options assignable to any of the function keys are as shown in the table below.

Table 1-2 Picture setup options

Label	Description	Label	Description
BUOY	Optimum setting for detecting navigation buoys, small vessels and other small surface objects	SHIP	Optimum setting for detecting vessels
SHORT	Optimum setting for short range detection using a range scale of 3 SM or less	LONG	Optimum setting for long range scale of 6 SM or larger
CRUISING	For cruising using a range scale of 1.5 SM or larger	HARBOR	Optimum setting for short range navigation in a harbor area using a range scale of 1.5 SM or less
COAST	For coastal navigation using a range scale of 12 SM or less	SEA	Transoceanic voyage using a range scale of 12 SM or longer
ROUGH SEA	Optimum setting for rough weather or heavy rain	RIVER	Optimum setting for navigation on a river

Each picture setup option defines a combination of several radar settings for achieving optimum setup for a particular navigating situation. Those involved are interference rejector, echo stretch, echo average, automatic anti-clutter, pulselength and noise rejector settings.

Adjusting these features on a function key menu changes the original function key settings. To restore the original settings for a particular function key, it is necessary to display the relevant function key menu and select appropriate menu options.

Note: Function key presetting requires a good knowledge of optimum radar settings. If you want to change the original function key settings, consult your nearest FURUNO representative or dealer.

1.33.2 Specific operation

Most often used controls are placed on the center panel while less often used controls are provided in the menu. To avoid opening the menus to set up the radar for a particular situation, function keys #1, #2, #3 and #4 may be assigned a combination of the following settings at the time of installation.

- Target trails (See paragraph 1.26.)
- Echo stretch 1,2 or 3 (See paragraph 1.23.)
- Pulselength 1 or 2 (See paragraph 1.12.)
- Echo averaging 1, 2 or 3 (See paragraph 1.24.)
- Echo color (See paragraph 1.32.)
- Panel illumination
- Marks brilliance
- Noise rejection

Provided that the function key is assigned the specific operation feature, press the key to instantly set the radar for the preset purpose. The corresponding label will be displayed at the left margin of the screen. If you re-press the function key, the radar returns to the previous settings.

1.33.3 Watch alarm

The watch alarm sounds an external buzzer at selected time intervals to help you keep regular watch of the radar picture for safety or other purposes. This feature can be assigned to function key #4 with a choice of alarm intervals of 6, 10, 12, 15 and 20 minutes. (See the flowchart on page 1-45 for sequence.)

Provided that function key #4 is assigned the watch alarm feature, just press function key #4 to activate the feature. The label WATCH appears at the lower-right corner of the screen associated with a watch alarm timer counts down from the initial value (for example, "12:00").

When a preset time interval has elapsed, an audible watch alarm is released and the label WATCH turns red and the watch alarm timer freezes at "0:00."

To silence the alarm, press the [AUDIO OFF] key. The label WATCH turns to normal color and the watch alarm timer is reset to the initial value and starts the count-down sequence again.

If you press the [AUDIO OFF] key before the selected time interval is reached, the watch alarm timer is reset to the initial value and starts the count-down sequence again.

1.33.4 Setting for function keys #1/#2/#3

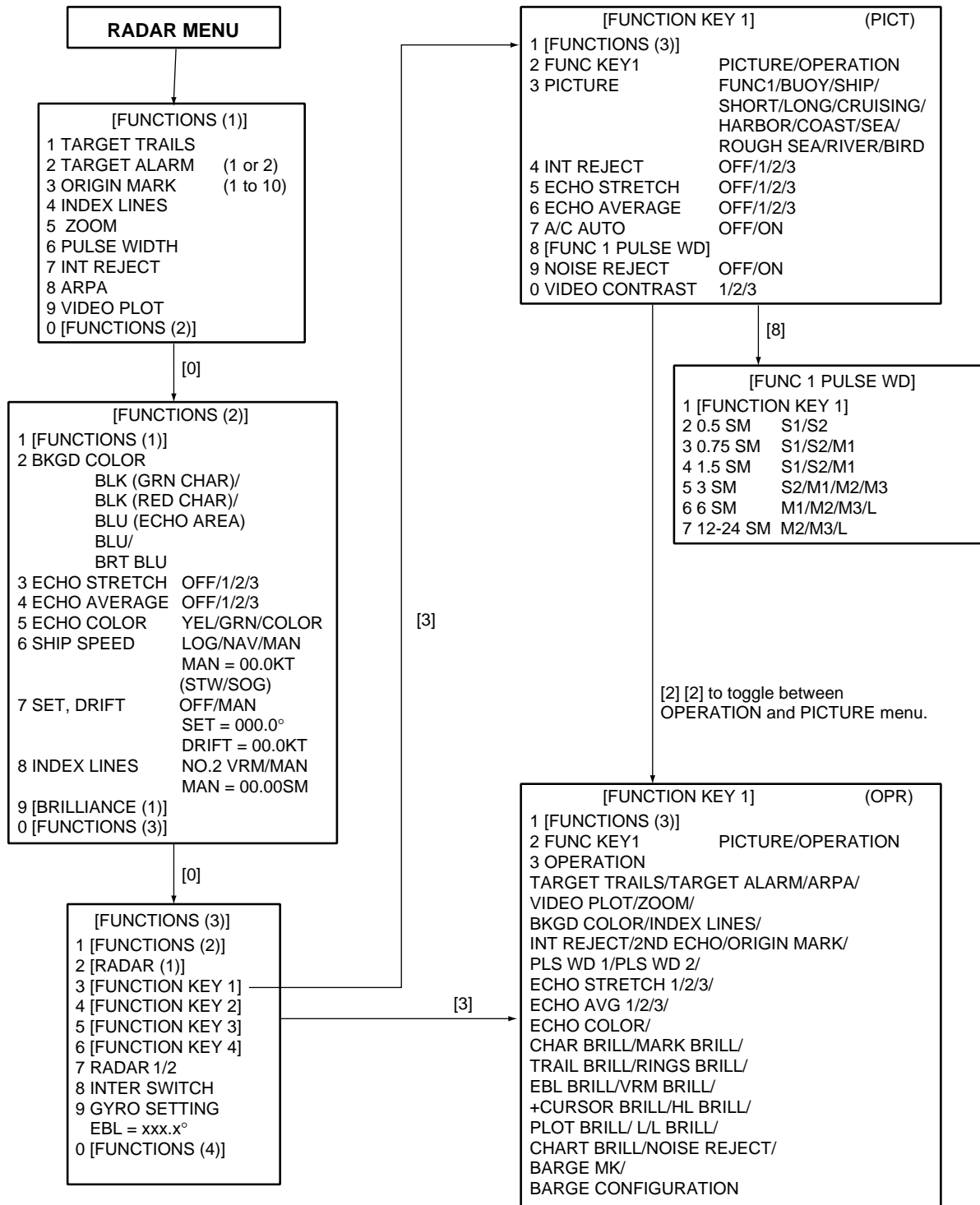


Figure 1-43 Keying sequence for setting functions keys #1/#2/#3

Picture setup default for function keys 1, 2 and 3

Table 1-3 Picture setup default for Function Keys 1, 2 and 3

	4. INT REJECT	5. ES	6. EAV	7. A/C AUTO	9. NOISE REJ.	P/L on 0.5 SM	P/L on 0.75 SM	P/L on 1.5 SM	P/L on 3 SM	P/L on 6 SM	P/L on 12-24 SM
RIVER	2	1	OFF	OFF	OFF	S	S1	S1	S2	M1	M2
BUOY	3	2	3	OFF	ON	S1	S2	S2	M1	M2	L
SHIP	3	2	3	OFF	ON	S1	S2	S2	M1	M2	L
SHORT	2	OFF	OFF	OFF	OFF	S1	S1	S1	S2	M1	M2
LONG	3	2	3	OFF	ON	S1	S1	S1	S2	M1	M2
CRUISING	3	OFF	3	OFF	ON	S2	S2	S2	M2	L	L
HARBOR	3	OFF	OFF	OFF	OFF	S1	S1	S1	S2	M1	M2
COAST	3	OFF	OFF	OFF	OFF	S1	S1	S2	M1	L	L
OCEAN	2	OFF	3	OFF	OFF	S1	S2	S2	M1	M2	L
ROUGH SEA	2	OFF	2	OFF	OFF	S1	S1	S2	M1	M2	L

1.33.5 Setting for function key #4

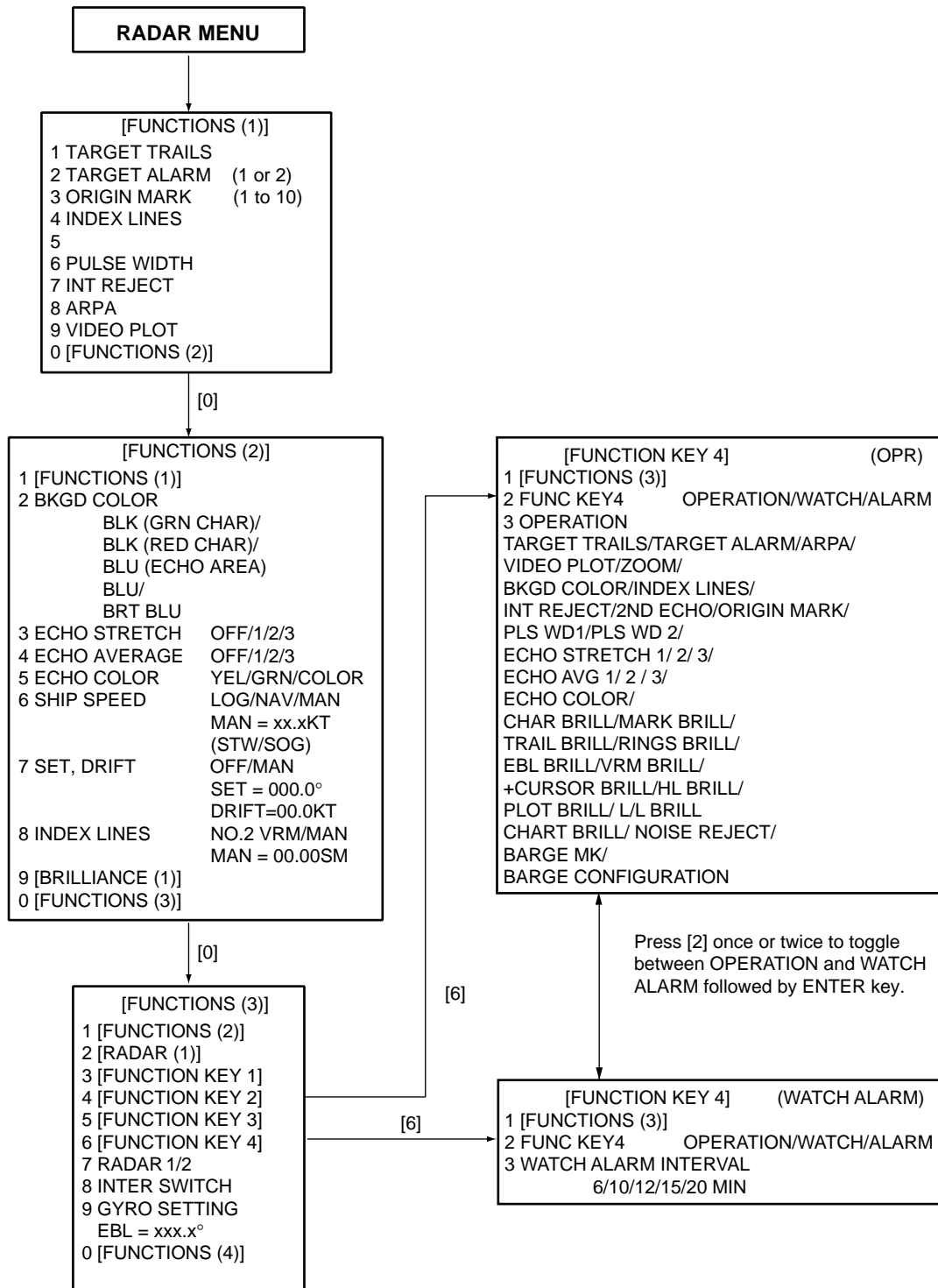


Figure 1-44 Keying sequence for setting functions keys #4

1.34 Barge Information

Do the following to display the barge information.

1. Press [RADAR MENU], [0], [0], [2], [0] and [0] to display the RADAR 3 menu.
2. Press the [2] key twice to select BARGE MK ON, followed by the [ENTER] key.
3. Press the [3] key to select BARGE SIZE and enter length and width of a barge, followed by the [ENTER] key.
4. Press the [4] key to display the BARGE INFORMATION menu.
5. Enter number of barges in first row, followed by the [ENTER] key.
6. Enter the number of barges for 2nd, 3rd, 4th and/or 5th row followed by the [ENTER] key. The barge information appears on the radar display.

1.35 Radar Map

A radar map is a combination of map lines and symbols whereby the user can define and input the navigation, route planning and monitoring data on the radar equipment. Map lines are a navigational facility whereby the observer can define lines to indicate channels or traffic separation schemes. Also called nav lines, these lines can be ground stabilized to stop them drifting. (Definition in Annex C of IEC 60936-1 and IEC 60872-1)

In this series of radar, a radar map may contain 150 points of mark and line data on one map. 10 maps can be memorized to facilitate the repeated use on the routine navigation area.

The user can create a radar map on a real-time basis while using the radar for navigation or at leisure time at anchor or while the radar is not being used. Place of a map can be made for any waterways apart from the actual own ship location. The map data is stored on the EEROM card which is mounted on the main processor board socket. When the optional Video Plotter board RP-26 and RAM card are installed in the display unit, much more data can be created and copied to another card.

1.35.1 General operation procedure

1. Press the [NAV MENU] key to show the NAV INFORMATION 1 menu.
2. Press the [2] key to select the SELECT NAVAID operation.
3. Press the [2] key again to select navigation data input device, followed by the [ENTER] key.
4. Also, set other nav data parameters as appropriate.
5. Press the [NAV MENU] key to close the NAV INFORMATION menu.

Notes on radar map operation

- 1) Own ship position display requires an input from radionavigational equipment such as a GPS receiver in accordance with the data format as defined by IEC 61162-1.
- 2) Wind, water current, depth, water temperature are not displayed when relevant sensors are not fitted.

1.35.2 Making a radar map

1. Press the [NAV MENU] key to display the NAV INFORMATION 1 menu.
2. Press the [1] key to display the RADAR MAP menu.
3. Press the [2] key twice to set MAP ON, then press the [ENTER] key.
4. Press the [8] key to select the MAP DISP SELECT menu.

[MAP DISP SELECT]	
1 [RADAR MAP]	
2 DANGER HIGHLIGHT	OFF/ON
3 COAST LINE	OFF/ON
4 MARK	OFF/ON
5 NAV LINE	OFF/ON
6 PROHIBITED AREAS	OFF/ON
7 BUOY	OFF/ON
8 CONTOUR LINE	OFF/ON

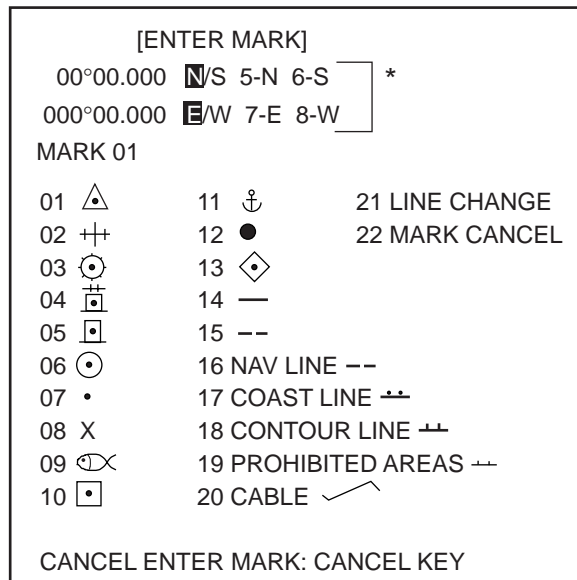
Figure 1-45 MAP DISP SELECT menu

5. Press appropriate numeric key twice to select ON, then press the [ENTER] key.
6. Press the [NAV MENU] key to close the menu.

Mark entry mode

Marks can be entered by cursor position, L/L position (manual entry), or own ship position.

1. Press the [NAV MENU] key to display the NAV INFORMATION 1 menu.
2. Press the [1] key to display the RADAR MAP menu.
3. Press the [6] key and further press the [6] key to select the entry mode; cursor, L/L or own ship position.
4. Press the [ENTER] key followed by the [NAV MENU] key.
5. Press the [MARK] key to read the following legends.



* Appears when L/L mode is selected (step 3).

Figure 1-46 Marks for radar map

6. Select a wanted position, followed by the [ENTER] key. Positions can be selected either by the Trackball, lat/lon values, or at own ship.
7. Select a desired mark by the corresponding number followed by the [ENTER] key.
8. Repeat steps 6-7. To enter the same mark selected, simply repeat step 6.
9. To erase a mark entered, enter 22, place the cursor to the mark you want to erase and then press the [CANCEL] key.
10. To escape the mark entry mode, press the [CANCEL] key.

Example: How to draw a coastline

1. Press the [MARK] key.
2. Enter 17 to select COAST LINE and press the [ENTER] key.
3. Place the cursor mark on a required position and press the [ENTER] key.
4. Place the cursor at a next position and press the [ENTER] key. One line appears connecting designated two points.
5. Repeat step 4 to establish the coastline.
6. To enter more than one of the same type of line, after entering one line, enter 21 and press the [ENTER] key. Then, repeat steps 2 to 5.
7. To draw other lines, enter line number (for example, 18 for contour line), followed by the [ENTER] key. Repeat step 3.
8. To erase a line segment entered, enter 22, place the cursor to the point to erase and then press the [CANCEL] key. For example, if point 4 is erased on the figure below, line segment 3-4 is erased.

1.35.3 Storing the map data

When you have made a map, store it with a map number as follows:

1. Press [NAV MENU], [1] to display the RADAR MAP menu.
2. Press the [7] key to show the ENTRY MAP menu.
3. Press the [2] key and enter map number by numeral key, followed by the [ENTER] key.
4. Press the [NAV MENU] key to leave this menu.

1.35.4 Displaying a radar map

1. Press [NAV MENU], [1] to display the RADAR MAP.
2. Press the [3] key and enter the map number you want to display.
3. Press the [ENTER] key.

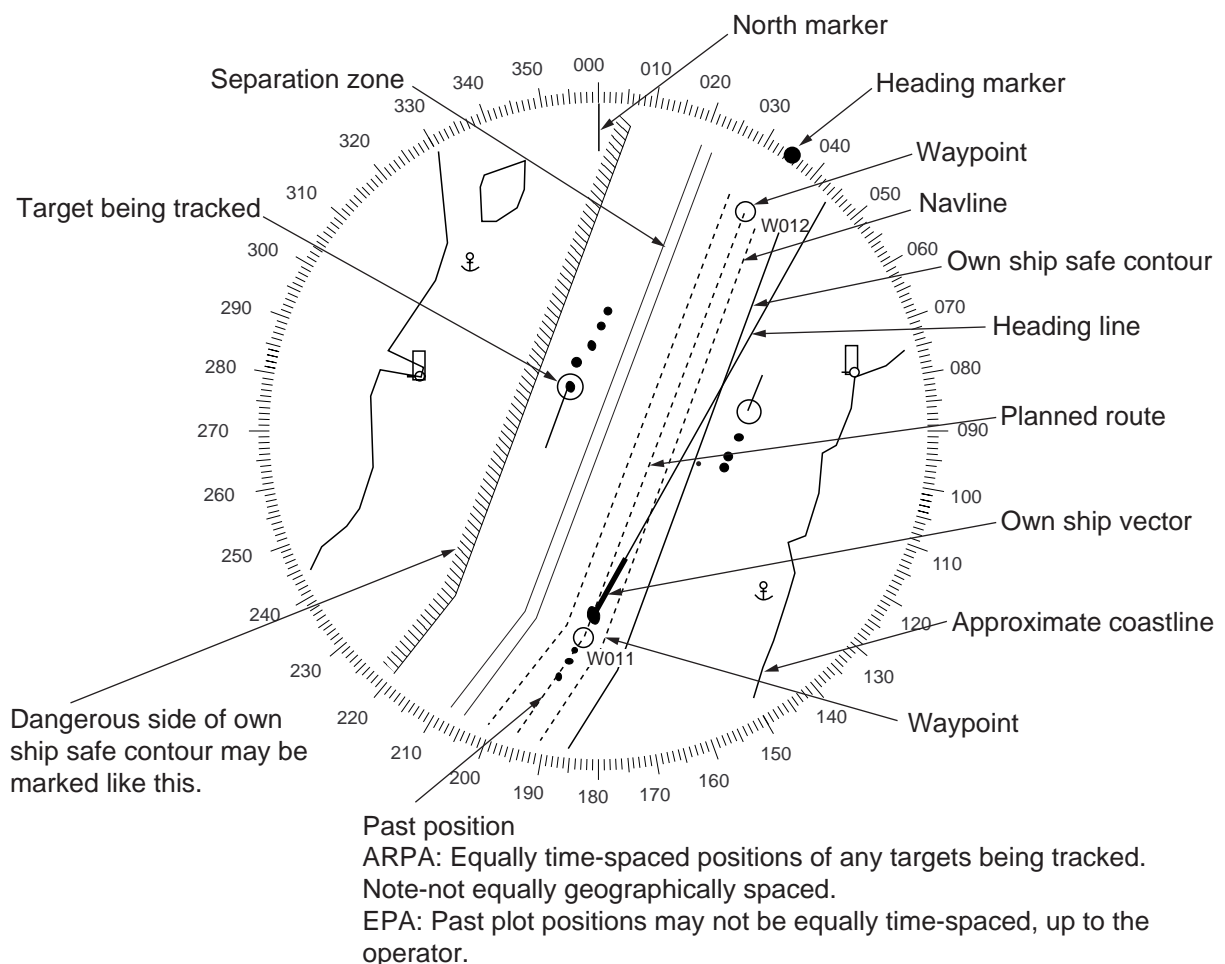


Figure 1-47 Sample radar map

4. Press [1], [7] in that order to display the NAV LINE menu.
5. Press the [4] key twice to select NAV WIDTH ON and enter navigation width in nautical mile.
6. Press the [ENTER] key followed by the [NAV MENU] key.

1.35.5 Erasing contents of a radar map

1. Press [NAV MENU], [1] and [9] to display MAP ERASE menu.

[MAP ERASE]	
1 [RADAR MAP]	
2 DANGER HIGHLIGHT	OFF/ALL
3 COAST LINE	OFF/ALL
4 MARK	OFF/ALL
5 NAV LINE	OFF/ALL
6 PROHIBITED AREAS	OFF/ALL
7 BUOY	OFF/ALL
8 CONTOUR LINE	OFF/ALL

Figure 1-48 MAP ERASE menu

2. Press a wanted number key twice to select ON or ALL, followed by the [ENTER] key.
3. Press the [NAV MENU] key to leave the menu.

1.36 Suppressing Second-trace Echoes

In certain situations, echoes from very distant targets may appear as false echoes (second-trace echoes) on the screen. This occurs when the return echo is received one transmission cycle later, that is, after a next radar pulse has been transmitted.

To activate or deactivate the second-trace echo rejector:

1. Press [RADAR MENU], [0], [0], [2] and [0] to show the RADAR 2 menu.
2. Press the [9] key to select 2ND ECHO.
3. Further press the [9] key to activate (ON) or deactivate (OFF) the second-trace echo rejector.
4. Press the [ENTER] key to register your selection followed by the [RADAR MENU] key to close the RADAR menu.

1.37 Displaying External Waypoint and Navigation Line

Waypoint or navigation line defined on another navaid can be displayed by setting WAYPOINT and NAV LINE menus as follows.

1. Press the [NAV MENU] key.
2. Press [8], [2] for waypoint or [7], [2] for navigation line if video plotter is not provided.

Note: When the waypoint is more than 5000 nm away from own ship, the data shows ">*5000 nm".

1.38 Adjusting Brilliance of Screen Data

You can adjust relative brilliance levels of various marks and alphanumeric readouts displayed on the screen by the steps below:

1. Press the [RADAR MENU] key to show the FUNCTIONS 1 menu.
2. Press the [0] and [9] keys to show the BRILLIANCE 1 menu. To display the BRILLIANCE 2 menu, further press the [0] key.
3. Select a desired menu item by pressing the corresponding numeric key. As an example, press [8] in the BRILLIANCE 1 menu if you want to change the brilliance of target trails.
4. Further press the same numeric key as you pressed in step 3 above to select or highlight a desired brilliance level.
5. Press the [ENTER] key to conclude your selection followed by the [RADAR MENU] key to close the menu.

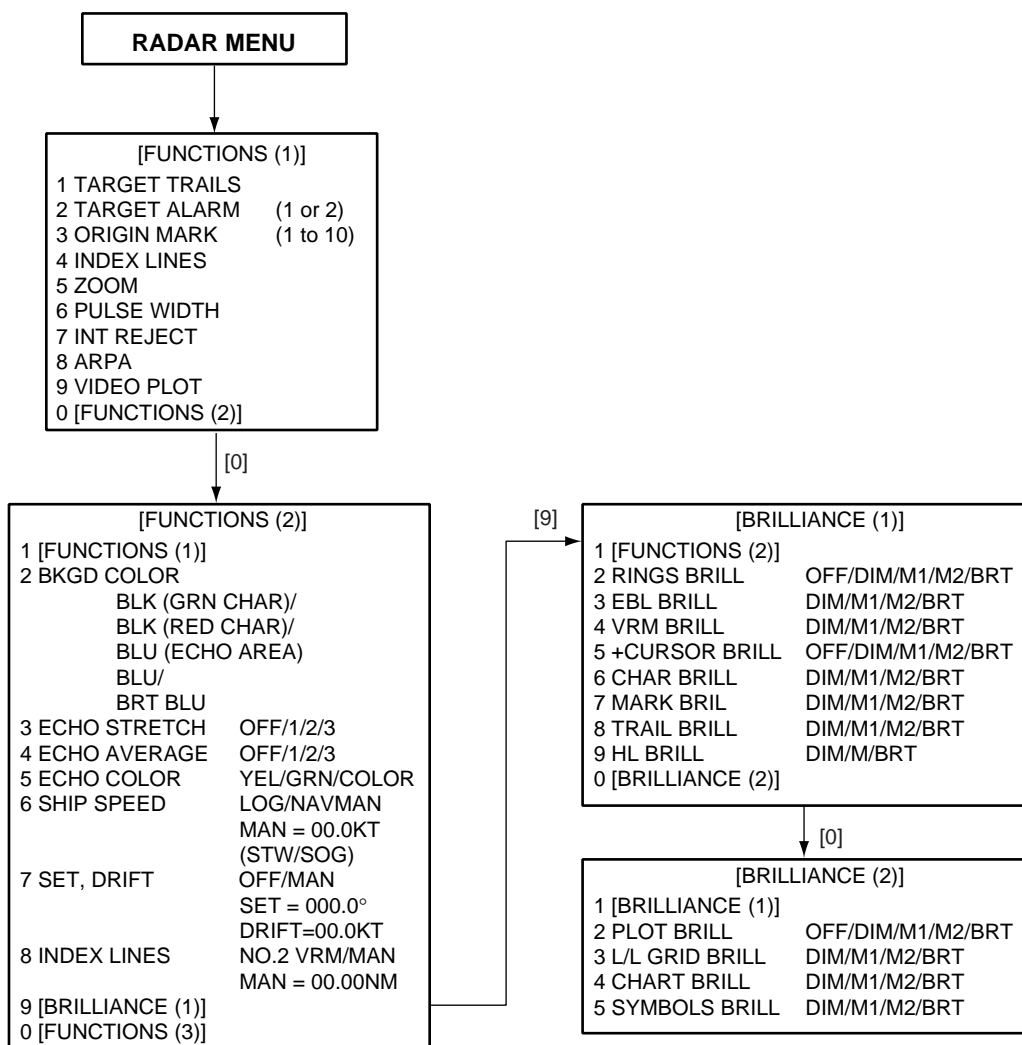


Figure 1-49 Sequence for selection of brilliance options

The table below describes which menu item adjusts the brilliance of which picture element.

Table 1-4 Brilliance menu option and function adjusted

Menu Item	Functions adjusted	Menu Item	Functions adjusted
RINGS	Fixed range rings	EBL	Electronic bearing lines No.1 and No.2
VRM	Variable range markers No.1 and No.2	+CURSOR	Trackball-controlled cursor
CHAR	Alphanumeric readouts	MARK	Bearing scale
TRAIL	Target trails	HL	Heading line and stern marker
PLOT	Plots for EPA and ARP-26	L/L	Latitude and longitude grid lines
CHART	Charts	SYMBOLS	Plot symbols

Note: You should adjust the entire CRT brilliance by operating the [BRILLIANCE] control before adjusting the respective brilliance levels on the BRILLIANCE 1 and 2 menu.

1.39 Display of Wind/Tide/Depth/Time

Wind

Wind, ocean current and depth sounding data can be displayed as follows:

1. Press the [NAV MENU] key to show the NAV INFORMATION 1 menu.
2. Press the [9] key twice to set WIND DATA ON and press the [ENTER] key.
3. Press the [0] key to show NAV INFORMATION 2 menu.
4. Press the [2] key twice to set WIND GRAPH ON and press the [ENTER] key.

Echo sounding depth and tide

1. Do the same to indicate ocean current graph and echo-sounding chart. Depth scales can be selected among 10, 20, 50, 100, 200 and 500 m. The echogram shows the last 30 minutes of depths along the ship's track.
2. Press the [NAV MENU] key followed by the [0] key to display the NAV INFORMATION 1 menu.
3. Press the [2] key to display WIND DATA ON and press the [ENTER] key.
4. Press the [5] key to display CURRENT GRAPH ON and press the [ENTER] key.
5. Press the [NAV MENU] key to close the NAV MENU.

Note: Wind data and current data require appropriate sensors. The depth data requires an adequate echo-sounding equipment. The echogram shows the last 30 minutes of depths along the ship's track. Wind vector shows a direction from which the wind blows in, relative to own ship heading, and labeled T*. Wind velocity is a true wind speed as a result of compensating for own ship's speed and orientation. Ocean current (tide) is the direction to which the current is flowing away from os position, relative to north.

* T in this case means a true value while T denotes "relative to True North" in the case of EBLs and target ship vectors.

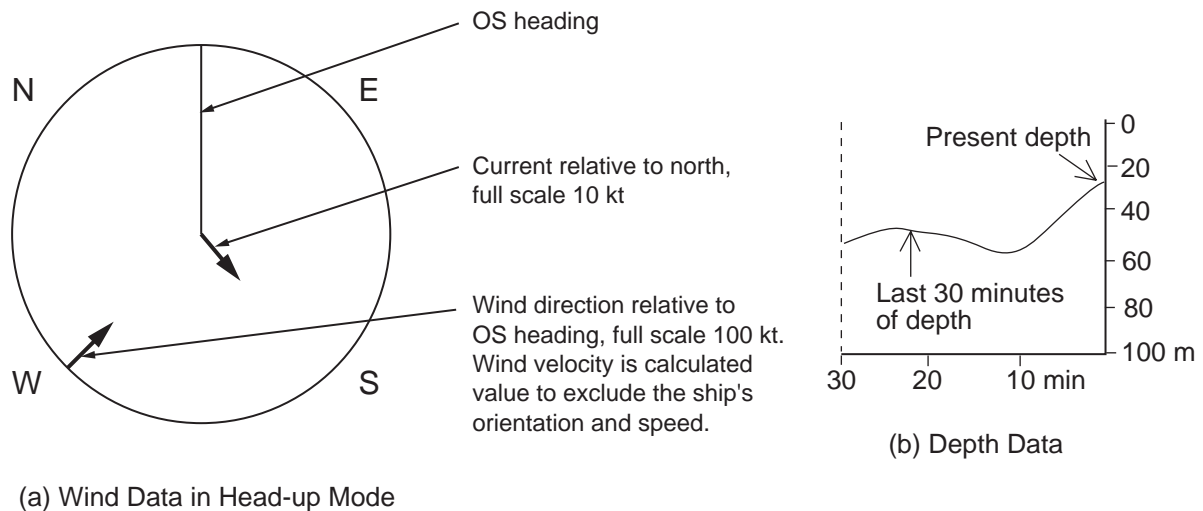


Figure 1-50 Depth and wind data displays

1.40 Displaying the Rate-of-Turn Scale

If a rate-of-turn meter is connected to this radar, the rate-of-turn scale can be displayed at the top of the radar screen.

1. Press the [NAV MENU] key.
2. Press the [0] key twice to display the NAV INFORMATION 3 menu.
3. Press the [8] key to select ROT SCALE.
4. Further press the [8] key to turn the rate-of-turn display on or off and select display range (in degrees).

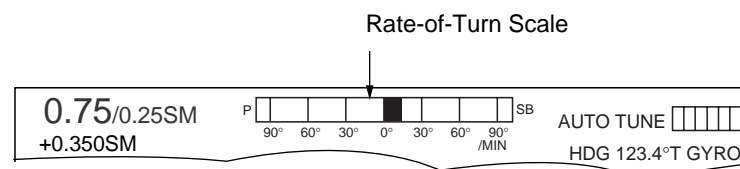


Figure 1-51 Rate-of-turn scale

1.41 Alarms

The table below summarizes alarms which may occur at various warning conditions.

Table 1-5 Alarms

Fault	Audible alarm	Visual alarm	To quit alarm status
Target alarm (TAZ)	Beeps	Target flashes.	Press [2] key on FUNCTION 1 menu. (Paragraph 1.21)
Watch alarm	Beeps	WATCH 0:00 (The label "WATCH" turns red and time count freezes at "0:00.").	Press the [AUDIO OFF] key. The label WATCH turns to normal video and the timer is reset (Paragraph 1.33.3).
Own ship lat/lon Cursor lat/lon	None	"***.*)" in own ship position field "***.*)" in cursor position field	Make sure that own ship position data is fed from external radionav equipment.
System failure	None	Message "BRG SIGNAL MISSING" appears at screeb bottom. No radar echoes. SYSTEM FAILURE in red at bottom of screen during test.	Make sure the antenna switch in the tuning compartment is on.
Incorrect keystroke	Double beep tone	None	Correct keystroke is responded by a single beep provided that KEY BEEP ON is selected at the RADAR 2 menu.
Log failure	2 beeps	"LOG *.*)." appears in red, if no log signal is input for 30 sec while the ship speed has been more than 5.0 kt.	If the log has failed, use the Manual Speed mode, or other appropriate sensor.
EPFS failure	Continuous beep	EPFS in red in the warning and indication cell. The indication also appears when the GPS mode is switched between GPS and DGPS.	To silence the beep, press the [AUDIO OFF] key.

Table 1-5 Alarms (con't.)

Fault	Audible alarm	Visual alarm	To quit alarm status
SOG indication COLLISION	None Continuous beep	The label SOG (Speed Made Good) turns red when SOG option is selected on the menu and the associated SDME (Speed and Distance Measuring Equipment = speed log) fails to detect a bottom tracking speed, resulting in the "Speed through water" (STW) mode automatically.	The radar does not automatically reset itself to receive an SOG data even if the SDME regains a bottom tracking speed. To erase SOG indication, press keys [RADAR MENU], [0], [6].
TRUE VECTOR indication	None	The label TRUE VECTOR turns red at the screen center when the True Vector is selected in the RM mode, and returns to the normal text color in the North-up TM mode.	
UPDATE PLOT	None	If you have failed to enter a next EPA plot within 10 min, this indication flashes. Plot symbol of target also flashes.	Re-acquire the flashing target within 5 min. Leave it if it is not important.
COLLISION	Continuous beep	COLLISION comes on (in red) when EPA- or ATA-tracked target is on collision course.	Take evasive action or terminated tracking of target. Then, visual indications goes off.
Guard Zone Alarm	Continuous beep	The label GZ appears in red if a target enters a guard zone. Target is masked by a flashing inverted triangle.	Press the [AUDIO OFF] key to acknowledge offending target.
GZ OUT Alarm	None	If the range scale has been reduced to make one of the GZs position more than 1.5 times of the range scale, the label GZ OUT appears in red.	Change the range scale of GZ.

2. RADAR OBSERVATION

2.1 General

2.1.1 Minimum and maximum ranges

Minimum range

The minimum range is defined by the shortest distance at which, using a scale of 1.5 or 0.75 nm, a target having an echoing area of 10 m² is still shown separate from the point representing the antenna position.

It is mainly dependent on the pulselength, antenna height, and signal processing such as main bang suppression and digital quantization. It is a good practice to use a shorter range scale as far as it gives favorable definition or clarity of picture. The IMO Resolution A. 477 (XII) and IEC 936 require the minimum range to be less than 50 m. All FURUNO radars satisfy this requirement.

Maximum range

The maximum detecting range of the radar, R_{max}, varies considerably depending on several factors such as the height of the antenna above the waterline, the height of the target above the sea, the size, shape and material of the target, and the atmospheric conditions.

Under normal atmospheric conditions, the maximum range is equal to the radar horizon or a little shorter. The radar horizon is longer than the optical one by about 6% because of the diffraction property of the radar signal. The R_{max} is given in the following equation.

$$R_{\max} = 2.2 \times (\sqrt{h_1} + \sqrt{h_2})$$

where R_{max}: radar horizon (nautical miles)
h₁: antenna height (m)
h₂: target height (m)

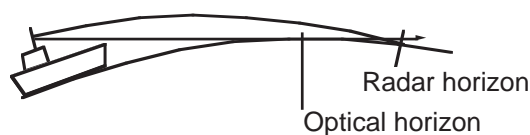


Figure 2-1 Radar horizon

For example, if the height of the antenna above the waterline is 9 meters and the height of the target is 16 meters, the maximum radar range is;

$$R_{\max} = 2.2 \times (\sqrt{9} + \sqrt{16}) = 2.2 \times (3 + 4) = 15.4 \text{ nm}$$

It should be noted that the detection range is reduced by precipitation (which absorbs the radar signal).

X-band and S-band

In fair weather, the above equation does not give a significant difference between X- and S-band radars. However, in heavy precipitation condition, an S-band radar would have better detection than an X-band radar.

2.1.2 Radar resolution

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

Bearing resolution

Bearing resolution is the ability of the radar to display as separate pips the echoes received from two targets which are at the same range and close together. It is proportional to the antenna length and reciprocally proportional to the wavelength. The length of the antenna radiator should be chosen for a bearing resolution better than 2.5° (IMO Resolution). This condition is normally satisfied with a radiator of 1.2 m (4 ft) or longer in the X-band. The S-band radar requires a radiator of about 12 feet (3.6 m) or longer.

Range resolution

Range resolution is the ability to display as separate pips the echoes received from two targets which are on the same bearing and close to each other. This is determined by pulselength only. Practically, a 0.08 microsecond pulse offers the discrimination better than 35 m as do so with all FURUNO radars.

Test targets for determining the range and bearing resolution are radar reflectors having an echoing area of 10 m^2 .

2.1.3 Bearing accuracy

One of the most important features of the radar is how accurately the bearing of a target can be measured. The accuracy of bearing measurement basically depends on the narrowness of the radar beam. However, the bearing is usually taken relative to the ship's heading, and thus, proper adjustment of the heading line at installation is an important factor in ensuring bearing accuracy. To minimize error when measuring the bearing of a target, put the target echo at the extreme position on the screen by selecting a suitable range.

2.1.4 Range measurement

Measurement of the range to a target is also a very important function of the radar. Generally, there are two means of measuring range: the fixed range rings and the variable range marker (VRM). The fixed range rings appear on the screen with a predetermined interval and provide a rough estimate of the range to a target. The variable range marker's diameter is increased or decreased so that the marker touches the inner edge of the target, allowing the operator to obtain more accurate range measurements.

2.2 False Echoes

Occasionally echo signals appear on the screen at positions where there is no target or disappear even if there are targets. They are, however, recognized if you understand the reason why they are displayed. Typical false echoes are shown below.

2.2.1 Multiple echoes

Multiple echoes occur when a transmitted pulse returns from a solid object like a large ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown below. Multiple reflection echoes can be reduced and often removed by decreasing the gain (sensitivity) or properly adjusting the [A/C SEA] control.

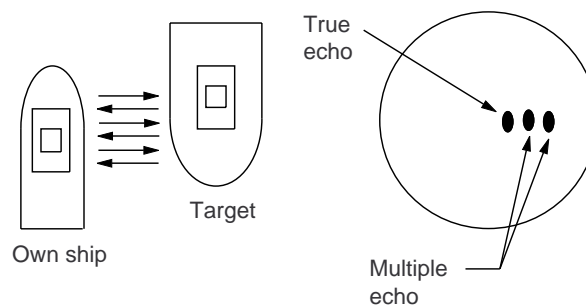


Figure 2-2 Multiple echoes

2.2.2 Sidelobe echoes

Every time the radar pulse is transmitted, some radiation escapes on each side of the beam, called "sidelobes." If a target exists where it can be detected by the side lobes as well as the main lobe, the side echoes may be represented on both sides of the true echo at the same range. Sidelobes show usually only on short ranges and from strong targets. They can be reduced through careful reduction of the gain or proper adjustment of the A/C SEA control.

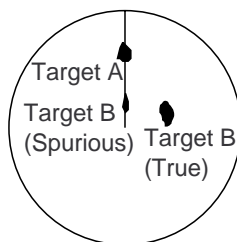


Figure 2-3 Sidelobe echoes

2.2.3 Virtual image

A relatively large target close to your ship may be represented at two positions on the screen. One of them is the true 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 your ship as shown in the figure below. If your ship comes close to a large metal bridge, for example, such a false echo may temporarily be seen on the screen.

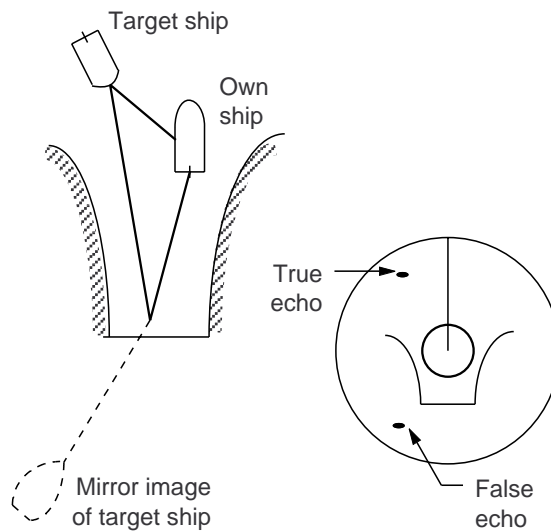


Figure 2-4 Virtual image

2.2.4 Shadow sectors

Funnels, stacks, masts, or derricks in the path of the antenna block the radar beam. If the angle subtended at the antenna is more than a few degrees, a non-detecting sector may be produced. Within this sector targets can not be detected.

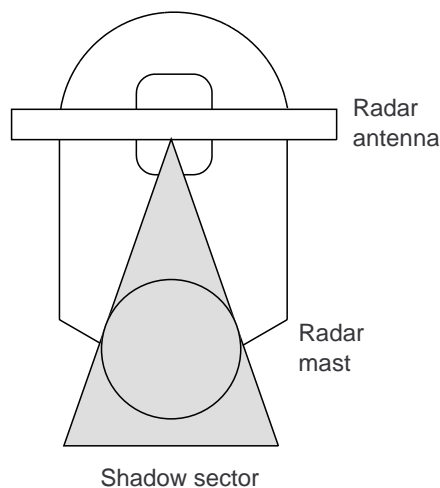


Figure 2-5 Shadow sectors

2.3 SART (Search and Rescue Transponder)

A Search and Rescue Transponder (SART) may be triggered by any X-Band (3 cm) radar within a range of approximately 8 nm. Each radar pulse received causes it to transmit a response which is swept repetitively across the complete radar frequency band. When interrogated, it first sweeps rapidly ($0.4 \mu\text{s}$) through the band before beginning a relatively slow sweep ($7.5 \mu\text{s}$) through the band back to the starting frequency. This process is repeated for a total of twelve complete cycles. At some point in each sweep, the SART frequency will match that of the interrogating radar and be within the pass band of the radar receiver. If the SART is within range, the frequency match during each of the 12 slow sweeps will produce a response on the radar display, thus a line of 12 dots equally spaced by about 0.64 nautical miles will be shown.

When the range to the SART is reduced to about 1 nm, the radar display may show also the 12 responses generated during the fast sweeps. These additional dot responses, which also are equally spaced by 0.64 nm, will be interspersed with the original line of 12 dots. They will appear slightly weaker and smaller than the original dots.

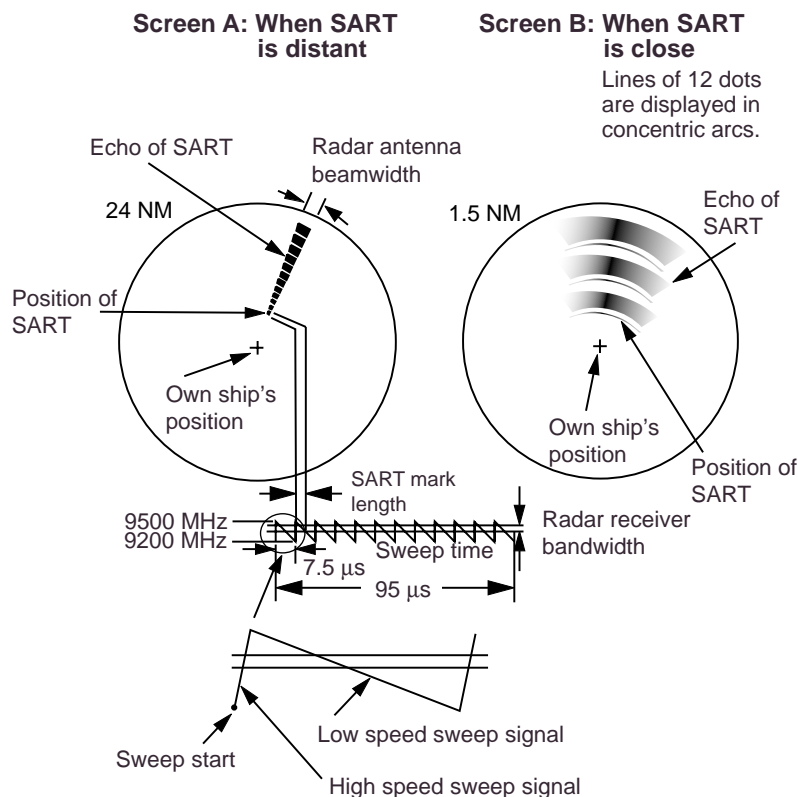


Figure 2-6 Appearance of SART signal on the radar display

2.3.1 General procedure for detecting SART response

1. Use the range scale of 6 or 12 nm as the spacing between the SART responses is about 0.6 nm (1125 m) to distinguish the SART.
2. Turn off the automatic clutter suppression.
3. Turn off the Interference Rejector.
4. Turn off the Echo Average.

2.3.2 General remarks on receiving SART

SART range errors

When responses from only the 12 low frequency sweeps are visible (when the SART is at a range greater than about 1 nm), the position at which the first dot is displayed may be as much as 0.64 nm beyond the true position of the SART. When the range closes so that the fast sweep responses are seen also, the first of these will be no more than 150 meters beyond the true position.

Radar bandwidth

This is normally matched to the radar pulselength and is usually switched with the range scale and the associated pulselength. Narrow bandwidths of 3-5 MHz are used with long pulses on long range and wide bandwidths of 10-25 MHz with short pulses on short ranges.

Any radar bandwidth of less than 5 MHz will attenuate the SART signal slightly, so it is preferable to use a medium bandwidth to ensure optimum detection of the SART.

Radar side lobes

As the SART is approached, sidelobes from the radar antenna may show the SART responses as a series of arcs or concentric rings. These can be removed by the use of the anti-clutter sea control although it may be operationally useful to observe the sidelobes as they may be easier to detect in clutter conditions and also they will confirm that the SART is near to the ship.

Gain

For maximum range SART detection the normal gain setting for long range detection should be used, that is, with background noise speckle visible.

A/C SEA control

For optimum range SART detection, this control should be set to the minimum. Care should be exercised as wanted target in sea clutter may be obscured. Note also that in clutter conditions the first few dots of the SART response may not be detectable, irrespective of the setting of the anti-clutter sea control. In this case, the position of the SART may be estimated by measuring 9.5 nm miles from the furthest dot back towards own ship.

Some sets have automatic/manual anti-clutter sea control facilities in which case the operator should switch to manual.

A/C RAIN control

This should be used normally (to break up areas of rain) when trying to detect a SART response which, being a series of dots, is not affected by the action of the anti-clutter rain circuitry. Note that Racon responses, which are often in the form of a long flash, will be affected by the use of this control.

Some sets have automatic/manual anti-clutter rain control facilities in which case the operator should switch to manual.

Note: This SART information is excerpted from IMO SN/Circ 197 Operation of Marine Radar for SART Detection.

2.4 RACON (Radar Beacon)

A racon is a radar transponder which emits a characteristic signal when triggered by a ship's radar (usually only the 3 centimeter band). The signal may be emitted on the same frequency as that of the triggering radar, in which case it is superimposed on the ship's radar display automatically.

The racon signal appears on the PPI as a radial line originating at a point just beyond the position of the radar beacon or as a Morse code signal (figure below) displayed radially from just beyond the beacon.

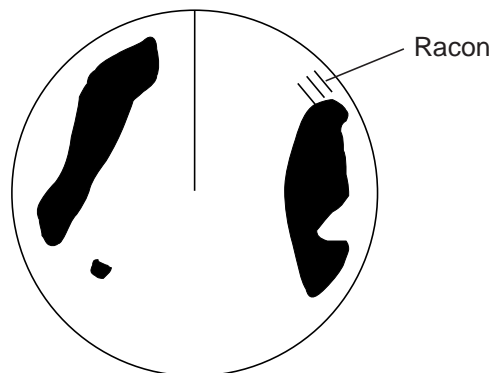





Figure 2-9 Appearance of RACON signal on the radar display

3. MAINTENANCE

Periodic checks and maintenance are important for proper operation of any electronic systems. This chapter contains maintenance instructions to be followed to obtain optimum performance and the longest possible life of the equipment.

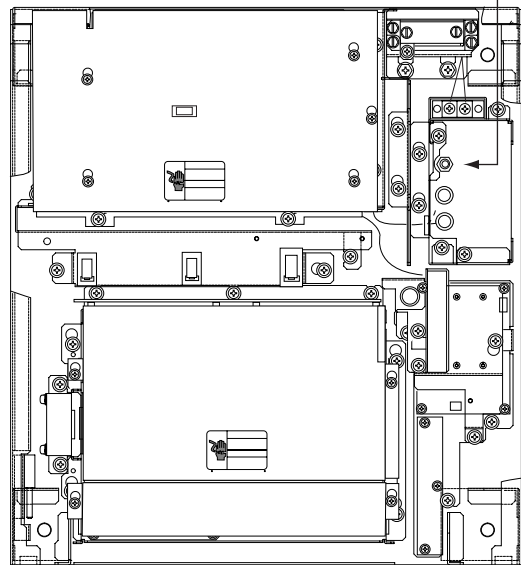
⚠ WARNING	
	Do not open the equipment. Hazardous voltage which can cause electrical shock exists inside the equipment. Only qualified personnel should work inside the equipment.
	Turn off the radar power switch before servicing the antenna unit. Post a warning sign near the switch indicating it should not be turned on while the antenna unit is being serviced. Prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazard.
	Wear a safety belt and hard hat when working on the antenna unit. Serious injury or death can result if someone falls from the radar antenna mast.

POWER Switch in AC Powered Display Unit

FOR TECHNICIANS

The display unit designed to run on AC power has a power switch inside its base which cuts off 100/200 VAC power to the display unit. Pull the display unit forward several centimeters to access the switch. **TURN THE SWITCH OFF (as well as the main POWER switch) WHENEVER ACCESSING INSIDE THE DISPLAY UNIT.**

POWER Switch



Display unit, inside view

3.1 Periodic Maintenance Schedule

Table 3-1 Periodic maintenance schedule

Interval	Check point	Check and measures	Remarks
3 to 6 months (for qualified technicians only)	Exposed nuts and bolts on antenna unit	Check for corroded or loosened nuts and bolts. If necessary, clean and repaint them thickly. Replace them if heavily corroded.	Sealing compound may be used instead of paint. Apply a small amount of grease between nuts and bolts for easy removal in future.
	Antenna radiator	Check for dirt and cracks on radiator surface. Thick dirt should be wiped off with soft cloth dampened with fresh water. If a crack is found, apply a slight amount of sealing compound or adhesive as a temporary remedy, then call for repair.	Do not use plastic solvent (acetone) for cleaning. If you need to remove ice from antenna unit, use a wooden hammer or plastic head hammer. Crack on the unit may cause water ingress, causing serious damages to internal circuits.
3 to 6 months (for qualified technicians only)	Terminal strips and plugs in antenna unit	Open antenna cover to check terminal strip and plug connections inside. Also check the rubber gasket of antenna covers for deterioration.	When closing antenna covers in position, be careful not to catch loose wires between covers and unit.
6 months to one year (for qualified technicians only)	CRT and surrounding components	High voltage at CRT and surrounding components attract dust in environment which will cause poor insulation. Ask a FURUNO representative or dealer to clean internal high-voltage components.	If CRT anode rubber cap or wire sheath is cracked, replace it. For service technician: Wait at least 3 minutes until high voltage components (CRT and HV capacitors) discharge their residual charges before accessing them.
	Terminal strips, sockets, earth terminal	Check for loose connections. Check contacts and plugs for proper seating, etc.	

3.2 Life Expectancy of Major Parts

The hours shown in the table below are the average usage times for ocean-going ships. When the radar is mainly used for detection of small targets on long ranges the usage times will be lower than shown.

Table 3-2 Life expectancy of major parts

Part	Type	Life Expectancy
Antenna motor	D8G-571, 48 rpm D8G-571, 24 rpm	Gears more than 10,000 hours
Magnetron	MG-5436, 25 kW	2,000 to 3,000 hours

3.3 Replacement of Battery

A battery installed on the RP Board or GYRO CONVERTER Board inside the display unit helps preserve the data when the power is turned off. The life of the battery is about five years.

When the battery voltage is low, NG appears at diagnostic test for RP board. Contact your dealer for replacement.

Table 3-3 Battery ordering information

PCB Name	Battery Type	Code number
RP Board	ER3S	000-127-759
GC Board	CR 1/2 8.L	000-103-769

4. TROUBLESHOOTING

WARNING



Do not open the equipment.

Hazardous voltage which can cause electrical shock exists inside the equipment. Only qualified personnel should work inside the equipment.



Turn off the radar power switch before servicing the antenna unit. Post a warning sign near the switch indicating it should not be turned on while the antenna unit is being serviced.

Prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazard.



Wear a safety belt and hard hat when working on the antenna unit.

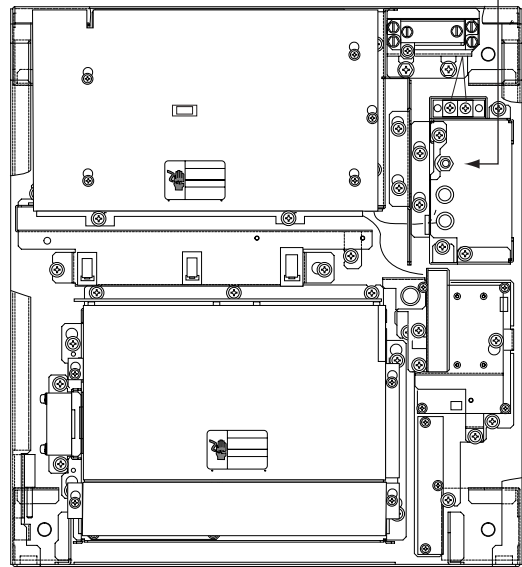
Serious injury or death can result if someone falls from the radar antenna mast.

POWER Switch in AC Powered Display Unit

FOR TECHNICIANS

The display unit designed to run on AC power has a power switch inside its base which cuts off 100/200 VAC power to the display unit. Pull the display unit forward several centimeters to access the switch. **TURN THE SWITCH OFF (as well as the main POWER switch) WHENEVER ACCESSING INSIDE THE DISPLAY UNIT.**

POWER Switch



Display unit, inside view

4.1 Easy Troubleshooting

This section provides easy troubleshooting for the user.

Table 4-1 Easy troubleshooting

Problem	Remedy
No own ship marker	Check that OS MARK ON is selected at the MARK/LINE submenu in the OTHER menu. Also, own ship information (length, width, etc.) should have been entered in initial settings. Consult a FURUNO representative or dealer for details.

4.2 Advanced-level Troubleshooting

This paragraph provides information for the service technician to cure hardware and software problems. (This radar equipment contains complex modules in which fault diagnosis and repair down to component level are not possible by users.)

Table 4-2 Advanced-level troubleshooting table

Problem	Check point and probable cause	Remedy
Power turned on but radar does not operate at all. Control panel is not illuminated either.	<ol style="list-style-type: none"> 1. Blown fuse F1 or F2 2. Mains voltage/polarity 3. Power Supply Board 4. Illumination lamps 	<ol style="list-style-type: none"> 1. Replace blown fuse. 2. Correct wirings and input voltage. 3. Replace Power Supply Board. 4. Replace defective lamps.
CRT brilliance adjusted but no picture	<ol style="list-style-type: none"> 1. RADAR 1//2/3 menu settings 2. CRT voltage 3. SPU Board 	<ol style="list-style-type: none"> 1. In case of single display installation (without radar inter-switching), make sure RADAR 1 is selected on FUNCTIONS 3 menu. 2. Check high voltage supply with utmost care. 3. Replace SPU Board.
Antenna not rotating	<ol style="list-style-type: none"> 1. Antenna drive mechanism (note that the message BRG SIG MISSING appears in ST-BY) 2. Defective antenna drive motor relay (thermal relay K2, 200/220/380, 440/100 VAC) 3. INT-9170 Board 	<ol style="list-style-type: none"> 1. Check scanner drive mechanism. 2. Press relay reset button. 3. Check that antenna switch is on.

Table 4-2 Advanced-level troubleshooting table (con't.)

Problem	Check point and probable cause	Remedy
Alphanumeric data and marks are not displayed in Transmit status.	1. SPU Board	1. Replace SPU Board.
Adjust [GAIN] control with [A/C SEA] control set at minimum. Marks, legends and noise appear but no echo. (Transmission leak, representing own ship position, is absent.)	1. Magnetron 2. Modulator Board 3. SPU Board	1. Check magnetron current. 2. Replace Modulator Board. 3. Replace SPU Board.
Picture not updated	1. Bearing Signal Generator Board (antenna unit) 2. SPU Board 3. Video lockup	1. Check the connection of signal cable. 2. Replace SPU Board. 3. Turn off and on radar.
Incorrect orientation of picture	1. SPU Board 2. Gyro Interface	1. The message "HDG SIGNAL MISSING" appears when the heading pulse is not received during stand-by. 2. Replace gyro interface.
Tuning manually adjusted but poor sensitivity	1. Deteriorated magnetron 2. Detuned MIC 3. Dirt on radiator face 4. Second trace rejection is ON.	1. Transmitting on the 48 nm range, check magnetron current. If current is below normal value, magnetron may be defective. Replace magnetron. 2. Check MIC detecting current. If it is below normal value, MIC may have become detuned. MIC must be tuned. 3. Clean radiator surface. 4. Disable the second-trace rejector referring to paragraph 1.36.
Range changed but radar picture does not change	1. Defective RANGE key 2. SPU Board 3. Mother Board 4. Video lockup	1. Try to hit [+] and [-] RANGE keys several times. If unsuccessful, replacement of keypad may be required. 2. Replace SPU Board. 3. Replace Mother Board. 4. Turn off and on radar.
Interference rejector inoperable (interference rejection level not displayed)	1. SPU Board 2. Mother Board	1. Replace SPU Board. 2. Replace Mother Board.
Echo stretch ineffective (Neither "ES1" nor "ES2" is displayed.)	1. SPU Board	1. Replace SPU Board.
Only 2 parallel index lines (6 lines wanted)	1. Incorrect setting of index line interval	1. Set parallel index line interval referring to paragraph 1.27.

Table 4-2 Advanced-level troubleshooting table (con't.)

Problem	Check point and probable cause	Remedy
Range rings are not displayed.	<ol style="list-style-type: none"> 1. Adjust the brilliance of range rings on BRILL1 menu. 2. SPU Board 	<ol style="list-style-type: none"> 1. Replace associated circuit board if unsuccessful. 2. Replace SPU Board.
Poor discrimination at range	<ol style="list-style-type: none"> 1. Sea clutter control not functioning properly. 	<ol style="list-style-type: none"> 1. Improper setting of [A/C SEA] control. If sea clutter is seen only at very close range, suspect inaccurate frequency of crystal oscillator.
True motion presentation not working correctly.	<ol style="list-style-type: none"> 1. Poor contact of [MODE] key. 2. Selection is not accessed. 3. Speed entry is incorrect. 4. TM display inaccurate 	<ol style="list-style-type: none"> 1. Try to press the [MODE] key a little harder. 2. Press the [MODE] key until "TM" appears. 3. Enter correct own ship speed referring to paragraph 1.9. 4. Make sure that speed and compass inputs are accurate.
Target not tracked correctly	<ol style="list-style-type: none"> 1. Poor definition of targets in sea clutter 	<ol style="list-style-type: none"> 1. Adjust [A/C SEA] and [A/C RAIN] controls referring to paragraphs 1.14 and 1.15.

4.3 Diagnostic Test

A diagnostic test program is provided to enable testing of major circuit boards in the radar display unit. Note that the normal radar picture is lost during this test.

Proceed as follows to execute the diagnostic test:

1. Press the [RADAR MENU] key to show the FUNCTIONS 1 menu.
2. Press the [0] key three times to show the FUNCTIONS 4 menu.
3. Press the [3] key to select menu item TEST. Then, press the [ENTER] key.

Program numbers appear. The diagnostic test is executed and the screen shows test results as shown on the next page. OKs appear for normal operation. If NG (No good) appears, corresponding components may be defective. Consult your dealer.

4. Small squares displayed at the right bottom of the test result screen are for testing the control and keys on the control head. As you operate these controls and keys, corresponding squares are highlighted, indicating that your control/key operations are properly recognized.
5. To terminate the diagnostic test, press [STBY/TX] key once or twice.

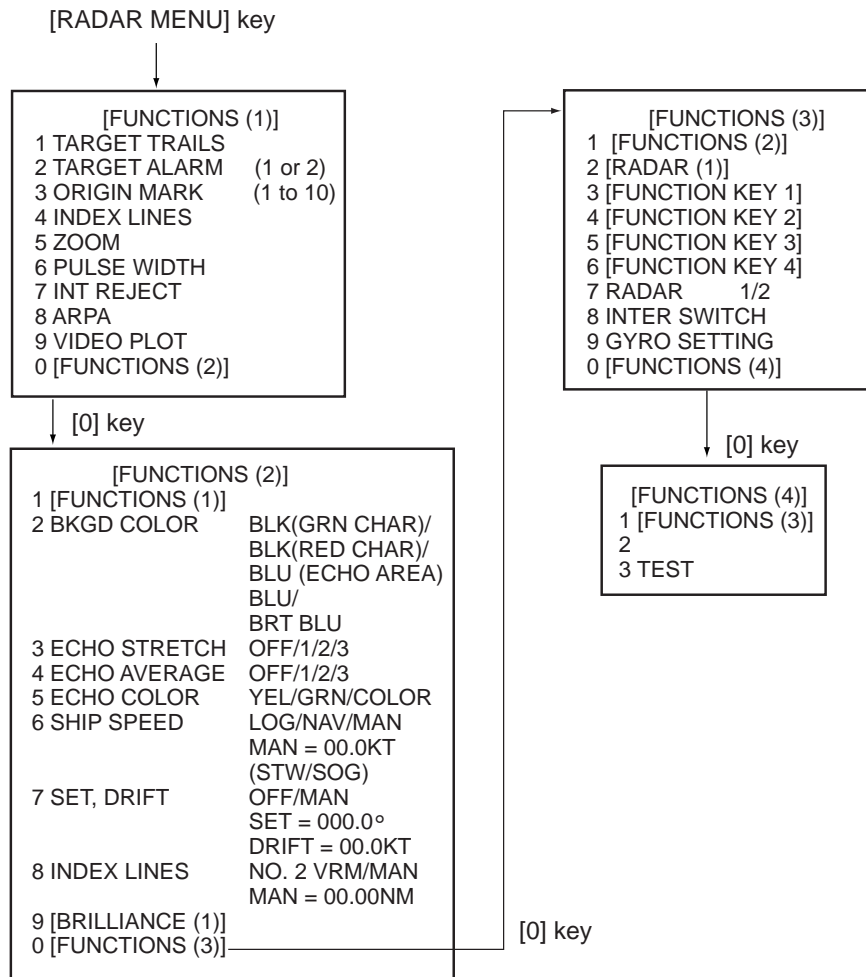


Figure 4-1 Keying sequence for diagnostic test

The test program checks the logic boards and the keyboard. The squares represent the corresponding keypads. Numerals indicate the position of the controls under check.

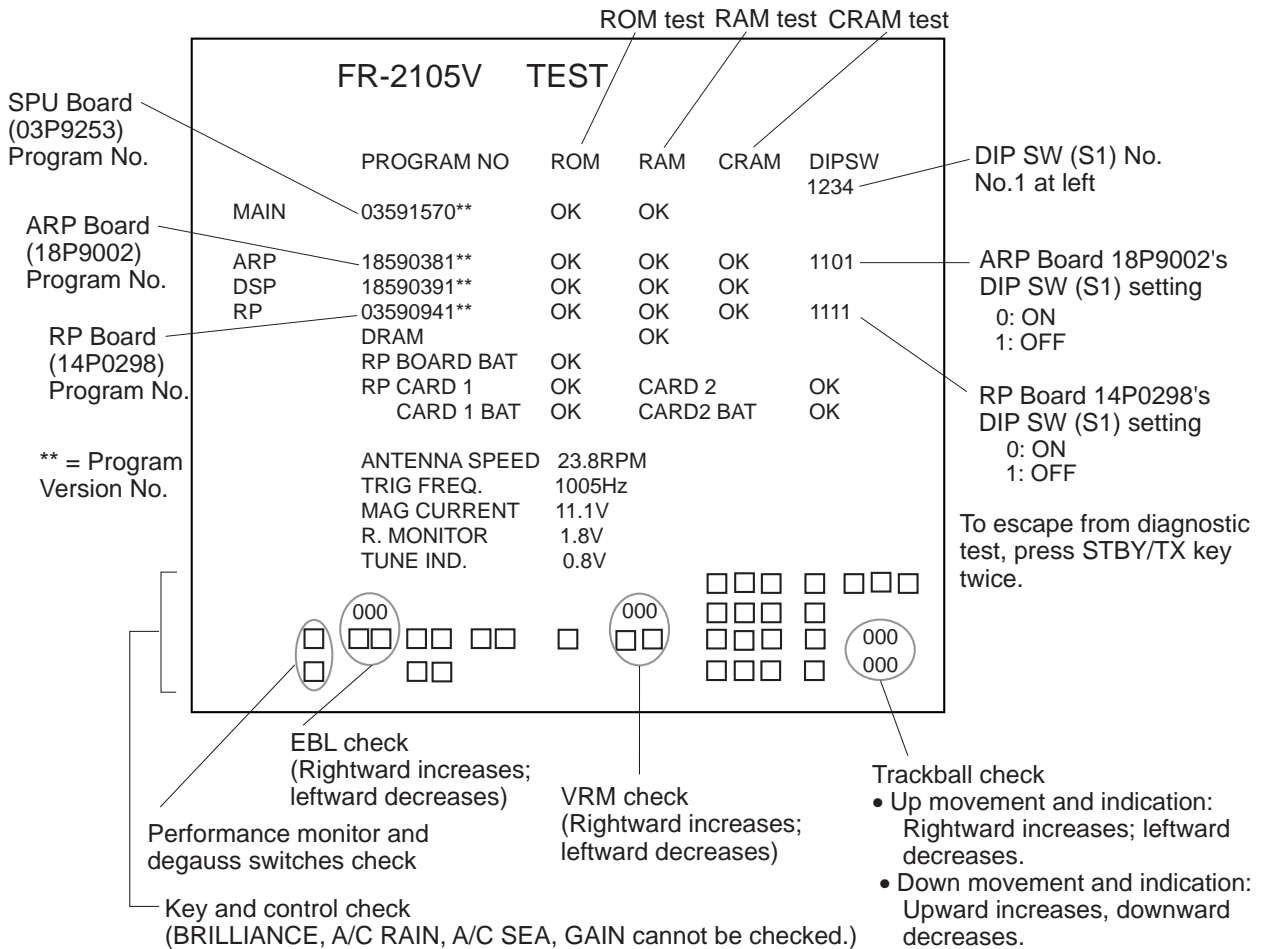


Figure 4-2 Diagnostic test results

Test pattern

A test pattern may be overlaid on the test results display by pressing the [STBY/TX] key once at the test results display.

5. ARPA ARP-26 (Option for NM-type radar)

5.1 General

This radar can accommodate an ARPA (Automatic Radar Plotting Aid) module ARP-26 complying with IMO A.823 and IEC 60987-1. This chapter describes the operation of the ARPA. For operation of normal radar, refer to Chapter 1.

Note: ARP-26 is not available with statute mile (SM)-type radar.

5.1.2 Principal specifications

Acquisition and tracking

- Automatic acquisition of up to 20 targets plus manual acquisition of 10 targets, or fully manual acquisition of 30 targets between 0.2 and 32 nm. Manual acquisition has priority over automatic acquisition. Therefore, if 20 targets have been manually acquired, the capacity for automatic acquisition is 10 targets.
- The ARPA automatically tracks all acquired targets, whether manually or automatically acquired, between 0.1 and 32 nm (0.1 and 24 nm depending on initial setting). Manually acquired targets are indicated in bold symbols and the automatically acquired targets, in thinner symbols.

Vector length: 0.5, 1, 2, 3, 6, 12, 15, 30 minutes

Orientation: True velocity or relative velocity

Stabilization: Sea or Ground as selected with the [VECTOR] key.

Motion trend: Displayed within 20 scans, full accuracy within 60 scans after acquisition.

Past positions: Choice of 5, 10 or 20 past positions at intervals of 30 seconds, 1, 2, 3 or 6 minutes.

Alarms: Visual and audible alarms against targets violating CPA/TCPA limits, lost targets, targets crossing guard zone, system failure and target full status.

Trial maneuver: Predicted situation appears after selected delay (1-60 minutes).

5.2 Controls for ARPA

The ARPA uses the keys on the plotting keyboard on the right side of the control head.

PLOT MENU: Shows/hides ARPA menus.

Plot Symbol keys: Select specific plot symbols for manually acquired targets.

TARGET CANCEL: Terminates tracking of a single target specified by the trackball if the key is pressed with a hit-and-release action. If the key is held depressed for about 3 seconds, tracking of all targets is terminated.

ENTER: Registers menu options selected.

VECTOR: Selects true or relative presentation of target vectors.

TARGET DATA: Displays data on one of tracked targets selected by the trackball.

LOST TARGET: Silences the lost target aural alarm and erases the lost target symbol.

ACQ: Manually acquires a target.

AUDIO OFF: Silences aural alarm.

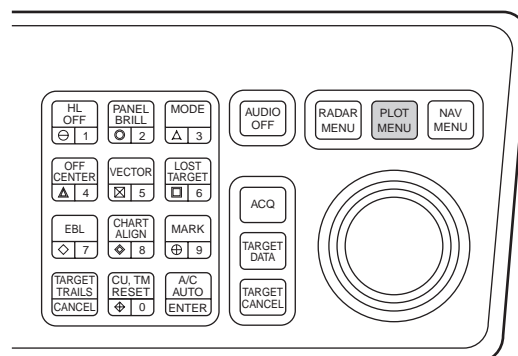


Figure 5-1 Plotting keypad

5.3 ARPA Menu Operation

5.3.1 Activating the ARPA function

1. Press the [RADAR MENU] key.
2. Press the [8] key to select ARPA, instead of EPA. (The label ARPA appears at the screen center.)

5.3.2 Setting ARPA parameters

Various parameters for the ARPA are set on the ARPA 1 and ARPA 2 menus. To do this, follow the steps shown below:

1. Press the [PLOT MENU] key to show the ARPA 1 menu.
2. Press the [0] key once if you wish to go to the ARPA 2 menu.
3. Select a desired menu item by pressing the corresponding numeric key.
4. Select a menu option by pressing the same numeric key as pressed in step 3 above. If there is more than one option on the current menu item, you may need to press the numeric key several times. Press it until the desired option is highlighted. (Note that certain menu items will prompt you to enter numeric data or to define points on the radar screen with the trackball.)
5. Press the [ENTER] key to register settings.
6. Press the [PLOT MENU] key to close the menu.

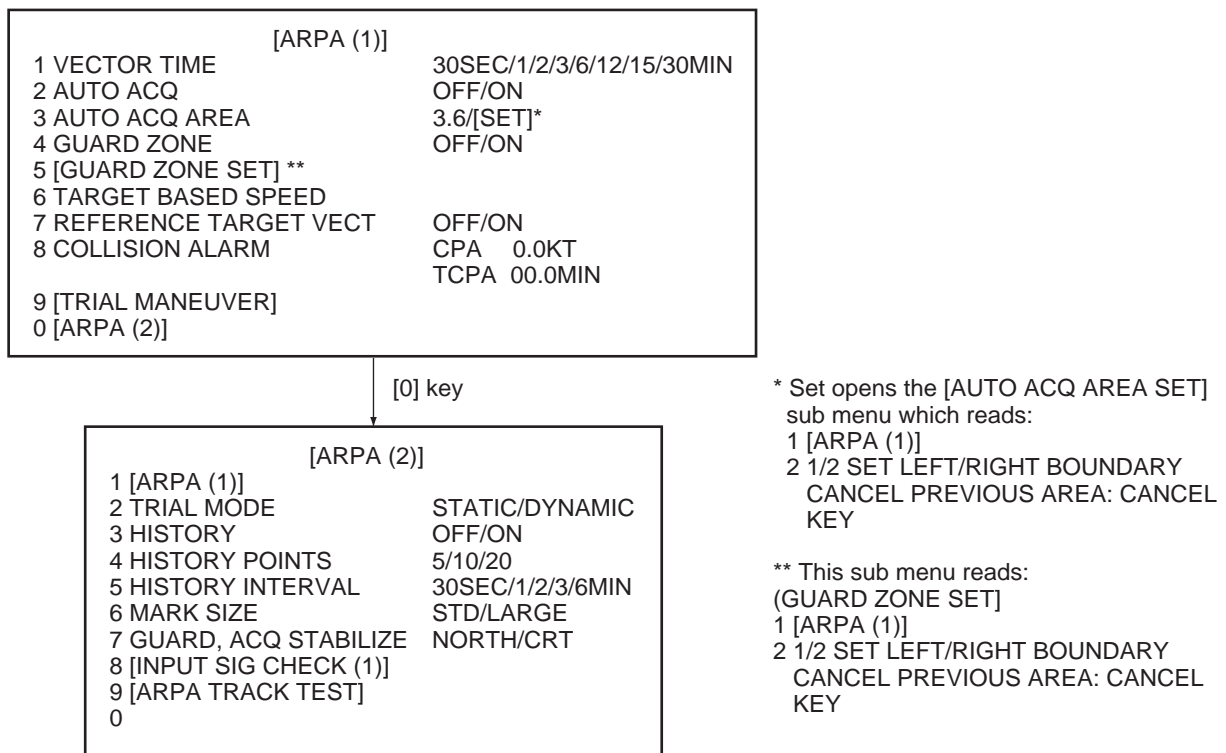


Figure 5-2 Sequence for setting up ARPA

5.4 Start-up Procedure

The ARPA requires own ship's speed input and heading data. The speed can be entered automatically from a speed log (SDME, Speed and Distance Measuring Equipment), navaid, or by referencing to a target-based speed (based on three max. stationary objects). Manual input is also possible.

5.4.1 Automatic speed input

For speed log input:

1. Press the [RADAR MENU] key and the [0] key to show the FUNCTIONS 2 menu.

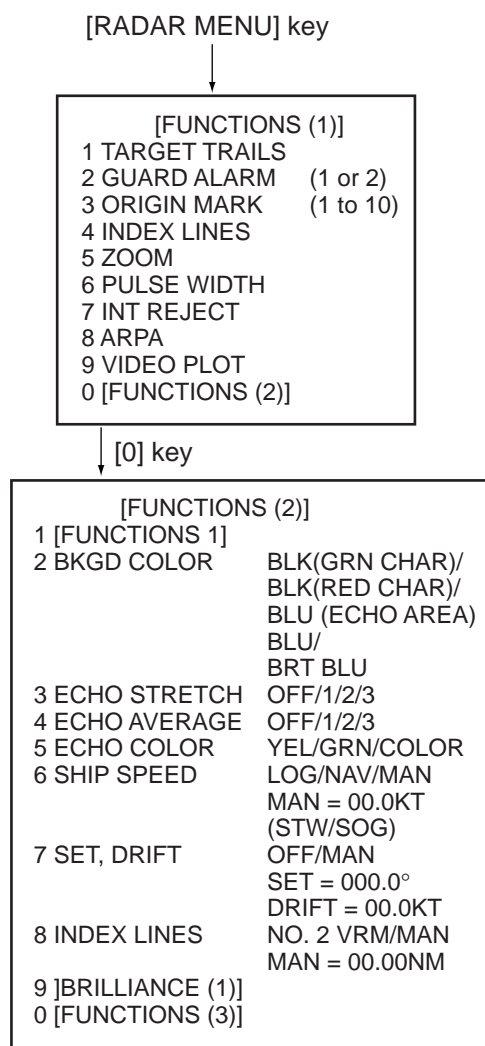


Figure 5-3 Keying sequence for entering ship's speed

2. Press the [6] key to select SHIP SPEED.
3. Press the [6] key to select LOG (or NAV) option.

4. Press the [ENTER] key to conclude your selection followed by the [RADAR MENU] key to close the FUNCTIONS 2 menu. The ship's speed readout at the top of the screen shows own ship's speed fed from the speed log preceded by the label "LOG."

Notes on automatic speed input

- 1) IMO Resolution A.823(19) for ARPA recommends that a speed log to be interfaced with an ARPA should be capable of providing through-the-water speed data (forward speed).
- 2) Be sure not to select LOG when a speed log is not connected. If the log signal is not provided, the ship speed readout at the top of the screen will be blank. In the event of a log error, you can continue plotting by entering a manual speed.
- 3) If a log signal interval becomes more than 30 seconds with the ship's speed five knots or more, the radar regards the speed log is defective and LOG FAIL appears, reading **. * KT.

5.4.2 Manual speed input

To manually enter the ship's speed with the numeric keys:

1. Press the [RADAR MENU] key and the [0] key to show the FUNCTIONS 2 menu.
2. Press the key [6] to select SHIP SPEED.
3. Press the key [6] to select (or highlight) MAN.
4. Press the [ENTER] key to conclude your selection. At this point, "MAN = 00.0KT" appears at the bottom of the FUNCTIONS 2 menu.
5. Enter the ship speed by hitting corresponding numeric keys followed by the [ENTER] key without omitting leading zeroes, if any. As an example, if the ship speed is 8 knots, press [0], [8], [ENTER]. For 4.5 knots, [0], [4], [5], [ENTER].
6. Press the [RADAR MENU] key to close the FUNCTIONS 2 menu. The ship speed readout at the screen top shows own ship's speed you entered preceded by the label "MAN."

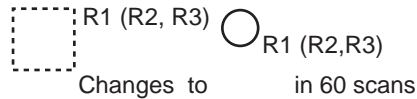
5.4.3 Target-based speed

The use of target-based speed is recommended when:

- The speed log is not operating properly or not connected to the radar.
 - The vessel has no device which can measure ship's leeward movement (Doppler sonar, speed log, etc.) when leeward movement can not be disregarded. If you select target-based speed, the ARP-26 calculates own ship's speed relative to a fixed reference target. The number of targets may be 1, 2 or 3. They appear as tracked targets, each shown in a small circle, but without a vector. When a plural of objects are selected, the mean value is used for stabilization and speed. Select the number in the PLOT MENU, referring to paragraph 5.3.2.
1. Select a small fixed island or any radar prominent point located at 0.2 to 24 nm from own ship.
 2. Place the cursor (+) on the target by operating the trackball.

3. Press the [PLOT MENU] key and the [6] key followed by the [ENTER] key.

The reference target mark (see below) appears at the cursor position and the own ship data label changes from "LOG," "NAV" or "MAN" to "REF." Note that it takes 60 scans or approximately one minute before a new speed is displayed. If tracking has failed for a reference target, the target is marked with a lost target mark (symbol formed with two triangles).



Notes on target-based speed

- 1) When the reference target is lost or goes out of the acquisition range, the reference target mark blinks and the speed reads "xx.x." Select a different reference target in this case.
- 2) When all targets are deleted, the reference target mark is also deleted and the target-based speed becomes invalid.
- 3) The vector of the reference target can be displayed by menu operation (ARPA 1 menu, [7]).

Canceling target-based speed

Target-based speed may be cancelled through the menu or by the cursor. For menu, press [PLOT MENU], [6]. For cursor, place the cursor on reference target and press the [CANCEL] key. The speed is shown by LOG, NAV selected previously.

5.4.4 Deactivating the ARPA

To deactivate the ARPA, press the [RADAR MENU] key followed by the [8] key until the ARPA is deactivated. Target plotting symbols and the on-screen label ARPA will disappear. The label EPA appears.

5.5 Automatic Acquisition

The ARPA can acquire up to 30 targets (20 automatically and 10 manually or all 30 manually). If AUTO ACQ is selected after more than 20 targets have been manually acquired, only the remaining capacity of targets can be automatically acquired. For example, when 20 targets have been acquired manually, then the ARPA is switched to AUTO ACQ. Only 10 targets can be acquired automatically.

A target just acquired automatically is marked with a broken square and a vector appears within 20 scans of the antenna to indicate the target's motion trend. Within 60 scans, the initial tracking stage is finished and the target becomes ready for stable tracking. At this point, the broken square mark changes to a solid circle. (Targets automatically acquired are distinguished from those acquired manually. The targets which are acquired manually are displayed by bold symbols.)

5.5.1 Enabling and disabling auto acquisition

1. Press [RADAR MENU], [8] twice, [ENTER] and [RADAR MENU] if the ARPA is not yet activated. Note that the label ARPA appears at the screen center.
2. Press the [PLOT MENU] key to show the ARPA 1 menu.

[ARPA (1)]	
1 VECTOR TIME	30SEC/1/2/3/6/12/15/30MIN
2 AUTO ACQ	OFF/ON
3 AUTO ACQ AREA	3, 6NM[SET]
4 GUARD ZONE	OFF/ON
5 [GUARD ZONE SET]	
6 TARGET BASED SPEED	
7 REFERENCE TARGET VECT	OFF/ON
8 COLLISION ALARM	CPA 0.0KT TCPA 00.0MIN
9 [TRIAL MANEUVER]	
0 [ARPA (2)]	

Figure 5-4 ARPA 1 menu

3. Press the [2] key to select AUTO ACQ.
4. Further press the [2] key to select (or highlight) ON (enable auto acquisition) or OFF (disable auto acquisition) as appropriate.
5. Press the [ENTER] key to conclude your selection followed by the [PLOT MENU] key to close the ARPA 1 menu. Note that the label AUTO+MAN is displayed at the screen center when auto acquisition is enabled; MAN when auto acquisition is disabled.

Note: When the ARPA has acquired 20 targets automatically, the message AUTO TARGET FULL is displayed at the screen bottom.

5.5.2 Auto acquisition areas

Automatic acquisition is performed within 1 or 2 zones. Outside these zones are the auto acquisition suppressed zones. The zones can be set at 3.0-4.0 nm and/or 5.0-6.0 nm, or anywhere within 0.2 - 32 nm.

Predefined auto acquisition areas (Menu item: 3, 6NM)

1. Press the [PLOT MENU] key to show the ARPA 1 menu.
2. Press the [3] key to select AUTO ACQ AREA.
3. Further press the [3] key to select (or highlight) menu option "3, 6NM."
4. Press the [ENTER] key to confirm your selection followed the [PLOT MENU] key to close the ARPA 1 menu.

Figure 5-5 on the next page shows how the auto acquisition areas are displayed on the screen. Up to 20* targets within the auto acquisition areas are acquired automatically. There is no priority in acquisition. It is recommended to use two zones on high speed craft.

* If 30 targets have already been acquired manually in the MAN ACQ mode (AUTO ACQ OFF on ARPA 1 menu), no more targets can be acquired.

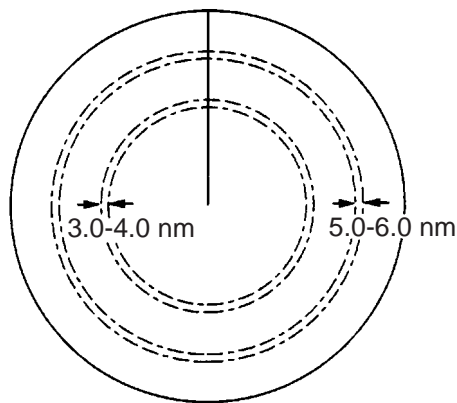


Figure 5-5 Predefined auto acquisition areas

Free selection of acquisition zones (Menu item: SET)

To set auto acquisition areas with trackball:

1. Press the [PLOT MENU] key to show the ARPA 1 menu.
2. Press the [3] key to select AUTO ACQ AREA.
3. Further press the [3] key to select (or highlight) SET.
4. Press the [ENTER] key to conclude your selection. At this point the AUTO ACQ SETTING menu is displayed.

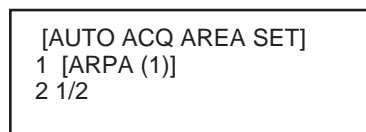


Figure 5-6 AUTO ACQ AREA SET menu

5. Press the [2] key to select menu item "1/2" and press the [ENTER] key. Then, you will see the message as shown below:

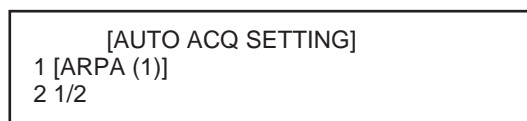
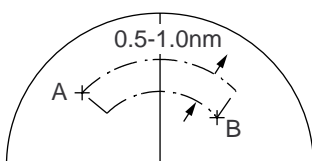


Figure 5-7 AUTO ACQ SETTING menu

6. Place the cursor at the outer counterclockwise corner of the area (point A) and press the [ENTER] key.
7. Place the cursor at the clockwise edge of the area (point B) and press the [ENTER] key.



Note: If you wish to create an auto acquisition area having a 360-degree coverage around own ship, set point B in almost the same direction (approx. $\pm 5^\circ$) as point A and press the [ENTER] key.

8. Repeat steps 5 to 7 above if you want to set another auto acquisition area with the trackball.
9. Press the [1] key followed by the [PLOT MENU] key to close the ARPA 1 menu.

An auto acquisition area like the example shown in Figure 5-5 appears on the display. Note that each auto acquisition area has a fixed radial extension (width) of 0.5-1.0 nm.

Note that the auto acquisition areas are preserved in an internal memory of the ARPA even when auto acquisition is disabled or the ARPA is turned off.

5.5.3 Terminating tracking of targets

When the ARPA has acquired 20 targets automatically, the message AUTO TARGET FULL is displayed at the screen center and no more auto acquisition occurs unless targets are lost. You may find this message before you set an auto acquisition area. Should this happen, cancel tracking of less important targets or perform manual acquisition.

Canceling individual targets

Use the trackball to place the cursor (+) on a target to cancel tracking. Press the [TARGET CANCEL] key.

Canceling all targets at a time

Press and hold the [TARGET CANCEL] key down more than 3 seconds. In the automatic acquisition mode, acquisition begins again.




5.6 Manual Acquisition

In the auto acquisition mode (AUTO ACQ ON), up to 20 targets can be manually acquired in addition to 10 auto acquired targets. When auto acquisition is disabled (AUTO ACQ OFF), up to 30 targets can be manually acquired and automatically tracked.

To manually acquire a target:


1. Place the cursor (+) on a target of interest by operating the trackball.
2. Press the [ACQ] key on the control head. The selected plot symbol is marked at the cursor position.


Note that the plot symbol is drawn by broken lines during the initial tracking stage. A vector appears in about one minute after acquisition indicating the target's motion trend. If the target is consistently detected for three minutes, the plot symbol changes to a solid mark. If acquisition fails, the target plot symbol blinks. It blinks until the [LOST TARGET] is pressed (to acknowledge it as a lost target).

-  (a) Immediately after acquisition, this plot symbol is shown in broken lines.
-  (b) Within 20 scans (or 1 min) of the antenna after acquisition, a vector appears to show a trend of movement.
-  (c) Within 60 scans (or 3 min) of the antenna after acquisition, the plot symbol changes to a small circle indicating steady-state tracking condition.

Notes on manual acquisition

- 1) For successful acquisition, the target to be acquired should be within 0.2 to 32 nm from own ship and not obscured by sea or rain clutter.
- 2) When you have acquired 30 targets manually, the message MAN TARGET FULL is displayed at the screen bottom. Cancel tracking of non-threatening targets if you wish to acquire additional targets manually. (See "5.5.3 Terminating tracking of acquired targets" on page 5-9.)

 CAUTION
TARGET SWAP When a target being tracked nears another target being tracked, the targets may be "swapped". When two targets acquired either automatically or manually come close to each other, one of the two may become a Lost Target. Should this happen, manual re-acquisition of the Lost Target may be required after the two have separated.

 Criteria of Tracking
A target measuring 800 m or more in the radial or circumferential direction is regarded as a landmass and not acquired or tracked. Echoes smaller than 800 m are regarded as targets to be tracked.

5.7 Changing Plot Symbol Size, Plot Symbols


















5.7.1 Changing plot symbol size

To choose a large or standard size for all plot symbols:

1. Press the [PLOT MENU] key followed by the [0] key to show the ARPA 2 menu.
2. Press the [6] key to select MARK SIZE.
3. Further press the [6] key to select (or highlight) STANDARD or LARGE as appropriate.
4. Press the [ENTER] key to conclude your selection followed by the [PLOT MENU] key to close the ARPA 2 menu.

5.7.2 ARPA symbols


The symbols used in this equipment comply with IEC 60872-1.

Item	Symbol	Status	Remarks
Automatically acquired targets		Initial stage epvs symbol no.3	Broken square around an echo to indicate the target under acquisition and initial stage of tracking.
		epvs symbol no.3	Broken square around an echo to indicate the target under acquisition and initial stage of tracking, before steady-state tracking.
		Steady tracking epvs symbol no. 4a	Solid circle with vector indicating steady state tracking (60 scans after acquisition).
	 (flashing)	CPA alarm epvs symbol no. 8	Plot symbol changes to an equilateral triangle flashing to indicate the target is predicted to come into CPA or TCPA.
		CPA alarm acknowledge epvs symbol no. 8	Flashing stops after CPA/TCPA alarm is acknowledged.
		Lost target epvs symbol no. 9	Lost target is indicated by flashing diamond symbol. The diamond is formed from two equal triangles.
Manually acquired targets		Initial stage epvs symbol no. 3	Plot symbol selected for a target acquired manually is shown in bold broken lines.
		epvs symbol no. 3	Bold broken square for 20 - 60 scans of antenna after acquisition.
		Steady tracking epvs symbol no. 4a	Manual plot symbol in a bold solid circle (60 scans after acquisition).
	 (flashing)	CPA alarm (collision course) epvs symbol no.8	Plot symbol changes to an equilateral triangle flashing if a target is predicted to come into the preset CPA or TCPA.
		epvs symbol no. 8	Flashing stops after CPA/TCPA alarm is acknowledged.
	 (flashing)	Lost target epvs symbol no. 9	Lost target is indicated by flashing diamond symbol. The diamond is formed from two equal triangles (one apex up and the other apex down).
Guard zone alarm		On target passing thru operator-set guard zone epvs symbol no. 7	Plot symbol changes to an equilateral triangle, apex down, flashing together with vector if target entering guard zone.
Automatic acquisition area		5.0-6.0 nm, 3.0-4.0 nm or anywhere epvs symbol no. 2	Sector of full circle as selected by the operator.
Target selected for data readout		On selected target epvs symbol no. 8	Target data (range, bearing, course, speed, CPA and TCPA)
Reference target	 In 60 scans, changes to 	On reference target	Used to calculate own ship's over-the-ground speed (target-based speed) for ground stabilization.

ARPA symbols (con't.)

Item	Symbol	Status	Remarks
Trial maneuver	T (flashing)	Bottom center epvs symbol no. 10	Appears during execution of a trial maneuver.
Performance test	X X (flashing)	Bottom center epvs symbol no. 11a	Appears during execution of a performance test.

5.7.3 ARPA, EPA symbols shown on fishing vessel specification radar

Item	Symbol	Status	Remarks
ARPA, EPA symbols			ARPA, EPA symbols available in fishing vessel specification radar

5.8 Adjusting Brilliance of Plot Marks

1. Press [RADAR MENU], [0] to show the FUNCTIONS 2 menu.
2. Press the [9] and [0] keys to show the BRILLIANCE 2 menu.
3. Press the [2] key to select PLOT BRILL.
4. Further press the [2] key to select (or highlight) a desired brilliance level.
5. Press the [ENTER] key to confirm your selection followed by the [RADAR MENU] key to close the BRILLIANCE 2 menu.

Note: Refer to paragraph 1.38 for the BRILLIANCE menu screen.

5.9 Displaying Target Data

The ARPA mode (with built-in ARP-26 optional board) provides the full functionality of ARPA as required by the IMO Resolution A.823(19) and IEC 60872-1, including display of range, bearing, course, speed, CPA and TCPA of all plotted targets. Data on one target may be displayed.

In the head-up and head-up true bearing modes, target bearing, course and speed shown at the center of the display become true (suffix "T") or relative (suffix "R") to own ship in accordance with the true/relative vector setting. In north-up, course-up and true motion modes, the target data field always displays true bearing, true course and speed over-the-ground or thru-the-water.

Place the cursor on a desired target and press the [TARGET DATA] key. Target data is displayed as below.

RNG/BRG (Range/Bearing): Range and bearing from own ship to the selected target with suffix "T" (True) or "R" (Relative).

CSE/SPD (Course/Speed): Course and speed are displayed for the selected target with suffix "T" (True) or "R" (relative).

CPA/TCPA: CPA (Closest Point of Approach) is the closest range a target will approach to own ship. TCPA is the time to CPA. Both CPA and TCPA are automatically calculated.

When the CPA has passed clear of own ship, it is indicated by a TCPA with a negative (-) sign. TCPA is counted to 99.9 minutes and beyond this it is indicated as TCPA> -99.9MIN.

BCR (Bow Cross Range): Range at which target is to cross own ship's bow.

BCT (Bow Cross Time): Time of BCR

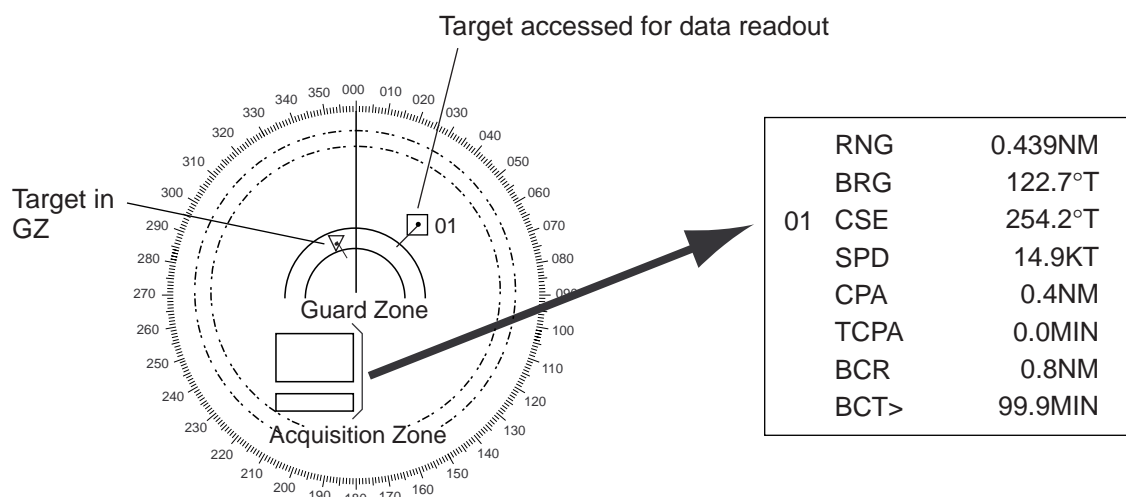


Figure 5-8 ARPA plot

5.10 Vector Modes

Target vectors can be displayed relative to own ship's heading (Relative) or north (True).

5.10.1 Ground stabilization and sea stabilization

Target vectors can be ground stabilized or sea stabilized. Sea stabilization is a mode where own ship and all targets are referenced to the sea using gyro heading and single axis log water speed inputs in the True Motion mode. Ground stabilization is a mode where own ship and all targets are referenced to the ground using the ground track or set and drift inputs. If the accuracy seems unsatisfactory, enter the set and drift correction (paragraph 5.12).

5.10.2 True vector

Vector mode, True or Relative, is selected with the [VECTOR] key. True vectors are the predicted true motion of a target as a result of own ship's direction and speed input. With true vectors the radar display will look like the one in (a) in the figure below.

In the true motion mode, all fixed targets, such as land, navigational marks and ships at anchor, remain stationary on the radar screen with vector length zero. But in the presence of wind and/or current, vectors appear on fixed targets representing the reciprocal of set and drift affecting own ship unless set and drift values are properly entered.

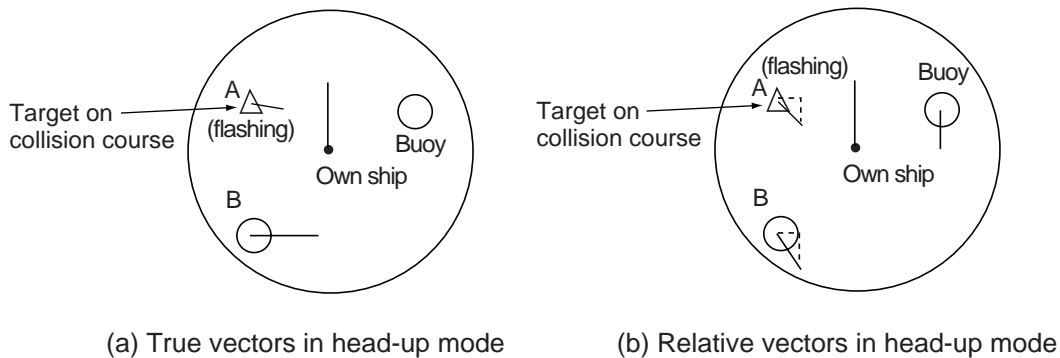


Figure 5-9 True and relative vectors in the head-up mode

5.10.3 Relative vector

True vectors are the predicted movement of a target relative to own ship. With relative vectors the radar display will look like (b) in the figure above.

Relative vectors on targets which are not moving over the ground, such as land, navigational marks and ships at anchor, will represent the reciprocal of own ship's ground track. A target of which vector extension passes through own ship is on the collision course. (Dashed lines in the figure are for explanation only.)

5.10.4 Vector time

Vector time (or the length of vectors) can be set to 30 seconds, 1, 2, 3, 6, 12, 15 or 30 minutes and the selected vector time is indicated at the screen center.

1. Press the [PLOT MENU] key to display the ARPA 1 menu.
2. Press the [1] key to select VECTOR TIME.
3. Further press the [1] key to select (or highlight) a desired vector time.
4. Press the [ENTER] key to conclude your selection.
5. Press the [PLOT MENU] key to close the menu.

The vector tip shows an estimated position of the target after the selected vector time elapses. It can be valuable to extend the vector length to evaluate the risk of collision with any target.

5.11 Past Position Display

The ARPA displays equally time-spaced dots marking the past positions of any targets being tracked.

A new dot is added every minute (or at preset time intervals) until the preset number is reached. If a target changes its speed, the spacing will be uneven. If it changes course, its plotted course will not be a straight line.

5.11.1 Displaying and erasing past positions

To display past positions;

1. Press [PLOT MENU], [0] to display the ARPA 2 menu.

[ARPA (2)]	
1 [ARPA (1)]	
2 TRIAL MODE	STATIC/DYNAMIC
3 HISTORY	OFF/ON
4 HISTORY POINTS	5/10/20
5 HISTORY INTERVAL	30SEC/1/2/3/6MIN
6 MARK SIZE	STD/LARGE
7 GUARD, ACQ STABILIZE	NORTH/CRT
8 [INPUT SIG CHECK (1)]	
9 [ARPA TRACK TEST]	
0	

Figure 5-10 ARPA 2 menu

2. Press the [3] key twice to select HISTORY ON.
3. Press the [ENTER] key followed by the [PLOT MENU] key. The label HISTORY appears on the display.

To erase past positions, press the [3] key at step 2 in the above to procedure to display HISTORY OFF.

5.11.2 Selecting the number of dots and past position plot intervals

1. Press [PLOT MENU], [0] to show the ARPA 2 menu.
2. Press the [4] key to select HISTORY POINTS.
3. Further press the [4] key to select a desired number of past positions (5, 10 or 20).
4. Press the [ENTER] key to confirm your selection.
5. Press the [5] key to select HISTORY INTERVAL.
6. Further press the [5] key to select a desired past position plot interval (0.5, 1, 2, 3 or 6 minutes).
7. Press the [ENTER] key to conclude your selection.
8. Press the [PLOT MENU] key to close the menu.

5.12 Set and Drift (Set and Rate)

Set, the direction in which a water current flows, can be manually entered in 0.1-degree steps. Drift, in another word Rate, the speed of tide, can also be entered manually, in 0.1 knot steps. Set and drift corrections are beneficial for increasing the accuracy of vectors and target data. The correction is best made in the head-up mode with true vectors, watching landmasses, or other stationary targets. Thus, the speed and course of own ship over the ground are reciprocally calculated and compared with the relative bearing and range to the reference target to produce a Set and Drift. These values are automatically applied to all targets. If stationary targets have vectors, set and drift values should be adjusted until they lose their vectors.

To enter set and drift (rate):

1. Press the [RADAR MENU] key to show the FUNCTIONS 1 menu.
2. Press the [0] key to show the FUNCTIONS 2 menu.
3. Press the [7] key to select SET, DRIFT.
4. Further press the [7] key to select OFF or MAN.
OFF: No correction against set and drift.
MAN: Manual entry of set and drift data.
5. If OFF is selected at step 4 above, press the [ENTER] key.
6. If you selected MAN in step 4 above, the highlight cursor will advance to the right requesting you to enter SET 000.0°. Enter the value of set in degrees by hitting numeric keys without omitting leading zeroes, if any, and press the [ENTER] key.

The highlight cursor will then advance to the next line DRIFT 00.0KT. Enter the value of drift in knots by hitting numeric keys without omitting leading zeroes, if any, and press the ENTER key. Set and drift have the same effect on own ship and all targets.

7. Press the [RADAR MENU] key to close the menu. The label LOG (or NAV) changes to WT (Water Tracking) or BT (Bottom Tracking). Set and drift data can also be used in the basic radar without ARPA function.


5.13 Setting CPA/TCPA Alarm Ranges

The ARPA continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each tracked target to own ship.

When the predicted CPA of any target becomes smaller than the preset CPA alarm range and its predicted TCPA less than a preset TCPA alarm limit, the ARPA releases an aural alarm and displays the warning label COLLISION on the screen. In addition, the ARPA symbol changes to a triangle and flashes together with its vector.

Provided that this feature is used correctly, it will help avoid collision by alerting you to threatening targets. It is important that GAIN, A/C SEA, A/C RAIN and other radar controls are properly adjusted.

CPA/TCPA alarm ranges must be set up properly taking into consideration the size, tonnage, speed, turning performance and other characteristics of own ship.

 CAUTION
<p>The CPA/TCPA alarm feature should never be relied upon as the sole means for detecting the risk of collision. The navigator is not relieved of the responsibility to keep visual lookout for avoiding collisions, whether or not the radar or other plotting aid is in use.</p>

5.13.1 Setting CPA/TCPA alarm ranges

To set the CPA/TCPA alarm ranges:

1. Press the [PLOT MENU] key to show the ARPA 1 menu.
2. Press the [8] key to select menu item COLLISION ALARM. At this point, a highlight cursor appears at the "CPA 0.0 NM" field.
3. Enter the CPA alarm range in nautical miles (0.0 to 9.9 nm) without omitting leading zeroes, if any, and press the [ENTER] key. The highlight cursor now moves to the "TCPA 00x.0 MIN" field.
4. Enter the TCPA alarm limit in minutes (1.0 to 99.9 min) without omitting leading zeroes, if any, and press the [ENTER] key.
5. Press the [PLOT MENU] key to close the menu.


5.13.2 Acknowledging CPA/TCPA audible alarm

Press the [AUDIO OFF] key to acknowledge and silence the CPA/TCPA aural alarm.

The warning label COLLISION and the flashing of the triangle plot symbol and vector remain on the screen until the dangerous situation is gone or you intentionally terminate tracking of the target by using the [TARGET CANCEL] key.

5.14 Setting a Guard Zone

When a target transits the operator-set guard zone, the buzzer sounds and the indication GUARD turns red at the screen bottom. The target causing the warning is clearly indicated with an inverted flashing triangle.

 CAUTION
Guard Zone Alarm
The guard zone alarm should not be relied upon as the sole means for detecting possible collision situations. The operator of a ship is not relieved of the responsibility to keep lookout for possible collisions, whether or not the radar is in use.

5.14.1 Activating the guard zone

One or two guard zones may be selected. The No. 1 guard zone is available between 3 and 6 nm and the No. 2 guard zone can be set anywhere when the No. 1 zone is already in use.

To set and activate the guard zone:

1. Press the [PLOT MENU] key to show the ARPA 1 menu.
2. Press the [4] key to select GUARD ZONE.
3. Further press the [4] key to select (or highlight) ON to activate the guard zone.
4. Press the [ENTER] key to conclude your selection.
5. Press the [5] key to select GUARD ZONE SET. At this point the GUARD ZONE SET menu appears.

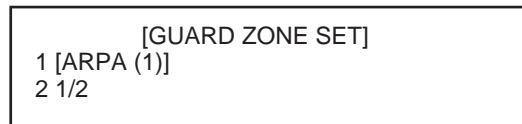


Figure 5-11 GUARD ZONE SET menu

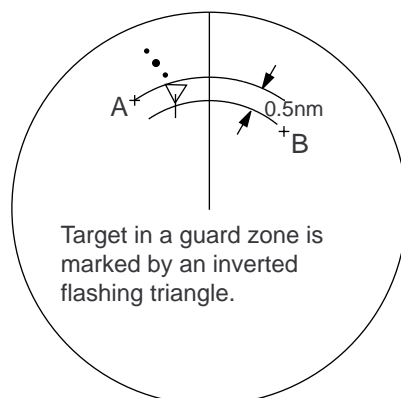
6. Press the [2] key and the [ENTER] key. ([2], [2], [ENTER] when setting the No. 2 zone.)
7. Referring to figure below, place the cursor at the outer left corner of the area (point A) and press the [ENTER] key.
8. Place the cursor at the right edge of the area (point B) and press the [ENTER] key.

Note: If you wish to create a guard zone having a 360-degree coverage around own ship, set point B in almost the same direction (approx. $\pm 3^\circ$) as point A and press the [ENTER] key.

If the range scale is changed to less than half of GZ, the label GZ OUT appears in red.

9. Press the [1] key followed by the [PLOT MENU] key to close the ARPA 1 menu.

The guard zone, like the example below, appears on the display. Note that the guard zone has a fixed radial extension (width) of 0.5 nm. The label GZ is displayed on the screen when the guard zone is enabled.



No.1 guard zone is available between 3 and 6 nm with a fixed range depth of 0.5 nm. The No.2 guard zone may be set anywhere when the No.1 guard zone is valid.

Two more alarm zones (No.1 and No.2 Target Alarm Zones) may be added. This means a maximum of four alarm zones are available at any time. ARPA symbols are not changed to inverted triangles in the TAZ - only those in the GZ do so.

Figure 5-12 Guard zone

5.14.2 Deactivating the guard zone

1. Press the [PLOT MENU] key to show the ARPA 1 menu.
2. Press the [4] key to select GUARD ZONE.
3. Further press the [4] key to select (or highlight) OFF to deactivate the guard zone.
4. Press the [ENTER] key to conclude your selection followed by the [PLOT MENU] key to close the menu.

5.14.3 Acknowledging the guard zone alarm

Press the [AUDIO OFF] key to acknowledge and silence the guard zone aural alarm.

5.15 Operational Warnings

There are six main situations which cause the ARPA to trigger visual and aural alarms:

- CPA/TCPA alarm
- Guard zone alarm
- Lost target alarm
- Target full alarm for manual acquisition
- Target full alarm for automatic acquisition
- System failures

5.15.1 CPA/TCPA alarm

Visual and aural alarms are generated when the predicted CPA and TCPA of any target become less than their preset limits. Press the [AUDIO OFF] key to acknowledge and silence the CPA/TCPA aural alarm.

5.15.2 Guard zone alarm

Visual and aural alarms are generated when a target transits the operator-set guard zone. Press the [AUDIO OFF] key to acknowledge and silence the guard zone aural alarm. (Refer to paragraph 5.14 Setting a Guard Zone for further information.)

5.15.3 Lost target alarm

When the system detects a loss of a tracked target, the target symbol becomes a flashing diamond mark and the label "LOST" appears at the screen bottom. At the same time, an aural alarm is produced for one second.

Press the [LOST TARGET] key to acknowledge the lost target alarm. Then, the lost target mark disappears.

5.15.4 Target full alarm

When the memory becomes full, the memory full status is indicated, the relevant indication appears on the screen and a short beep sounds.

5.15.5 Manually acquired targets

The indication "MAN TARGET FULL" appears at the screen center and a short beep tone sounds when the number of manually acquired targets reaches 20 or 30 depending on whether auto acquisition is activated or not.

5.15.6 Automatically acquired targets

The indication "AUTO TARGET FULL" appears at the screen center and a short beep tone sounds when the number of automatically acquired targets reaches 20.

5.15.7 System failure alarm

When the ARP board receives no signal input from the radar or external equipment, the screen shows both "SYSTEM FAIL" associated with an indication denoting offending equipment, also releasing an aural alarm. The missing signals are denoted as shown below:

Missing Signal	Indication
*Speed log signal	LOG
*Heading signal, gyrocompass or magnetic compass	HDG T (GM)
Trigger signal from radar	TRIGGER
Video from radar	VIDEO
*Bearing signal from radar antenna	AZIMUTH
*Heading pulse from radar antenna	HEADING

*Alarm available with or without ARPA.

5.16 Trial Maneuver

Trial simulates the effect on all tracked targets against own ship's maneuver without interrupting the updating of target information.

There are two types of trial maneuvers: static and dynamic.

5.16.1 Dynamic trial maneuver

A dynamic trial maneuver displays predicted positions of the tracked targets and own ship. You enter own ship's intended speed and course with a certain "delay time." Assuming that all tracked targets maintain their present speeds and courses, the targets' and own ship's future movements are simulated in one-second increments indicating their predicted positions in one-minute intervals as illustrated in Figure 5-13.

The delay time represents the time lag from the present time to the time when own ship will actually start to change her speed and/or course. You should therefore take into consideration own ship's maneuvering characteristics such as rudder delay, turning delay and acceleration delay. This is particularly important on large vessels.

In the example shown in Figure 5-13, own ship will advance straight ahead (even after a maneuver) for a delay time of five minutes and then alters speed and course until operator-specified intended speed and course are achieved (position OS7 in this example).

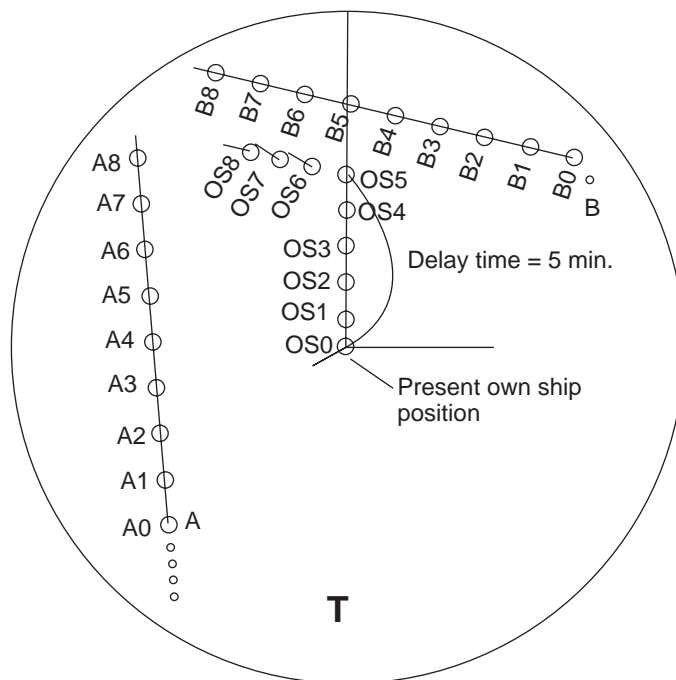


Figure 5-13 Trial maneuver

Note that once a dynamic trial maneuver is initiated, you cannot alter own ship's trial speed, course or delay time until the trial maneuver is terminated.

5.16.2 Static trial maneuver

A static trial maneuver displays only the final situation of the simulation. If you enter the same trial speed, course and delay time under the same situation as in the aforementioned example of dynamic trial maneuver, the screen will instantly show position OS7 for own ship, position A7 for target A and position B7 for target B, omitting the intermediate positions. Thus, the static trial maneuver will be convenient when you wish to know the maneuver result immediately.

Note: For accurate simulation of ship movements in a trial maneuver, own ship's characteristics such as acceleration and turning performance should be properly set in the initial settings at the time of installation.

To perform a trial maneuver:

1. Press the [PLOT MENU] key followed by the [0] key to show the ARPA 2 menu.

[ARPA (2)]	
1 [ARPA (1)]	
2 TRIAL MODE	STATIC/DYNAMIC
3 HISTORY	OFF/ON
4 HISTORY POINTS	5/10/20
5 HISTORY INTERVAL	30SEC/1/2/3/6MIN
6 MARK SIZE	STD/LARGE
7 GUARD, ACQ STABILIZE	NORTH/CRT
8 [INPUT SIG CHECK (1)]	
9 [ARPA TRACK TEST]	
0	

Figure 5-14 ARPA 2 menu

2. Press the [2] key to select TRIAL MODE.
3. Further press the [2] key to select (or highlight) STATIC or DYNAMIC as appropriate.
4. Press the [ENTER] key to conclude your selection followed by the [1] key to go back to the ARPA 1 menu.
5. Press the [9] key on the ARPA 1 menu. The TRIAL DATA SETTING menu appears at the screen bottom associated with the current own ship's speed and course readouts.

TRIAL DATA SETTING [DYNAMIC MODE]*	
SPEED (VRM)	= 15.0KT
COURSE (EBL)	= 53.6°
DELAY TIME (KEY)	= xx.xMIN
TRIAL TIME	= xx.xMIN

* STATIC MODE when static mode is selected.

Figure 5-15 TRIAL DATA SETTING menu

6. Enter own ship's intended speed, course and delay time in the following manner:
 - Speed: Set with the VRM control.
 - Course: Set with the EBL control.
 - Delay time: Enter in minutes by hitting numeric keys. This is the time after which own ship takes a new situation, not the time the simulation begins. Change the delay time according to own ship loading condition, etc.
 - Trial time: Enter in minutes by hitting numeric keys. This is the length of the trial time in minutes.
7. Press the [ENTER] key to start the trial maneuver.

Trial maneuver takes place in three minutes with the letter "T" displayed at the bottom of the screen. If any tracked target is predicted to be on a collision course with own ship (that is, the target ship comes within preset CPA/TCPA limits), the target plot symbol changes to a triangle and flashes. If this happens, change own ship's trial speed, course or delay time to obtain a safe maneuver. The trial maneuver is automatically terminated and the normal radar picture is restored three minutes later.

5.16.3 Terminating trial maneuver

Press the [PLOT MENU] key.

5.17 ARPA Performance Test

Test program is provided for assessing the ARPA overall performance. Note that normal operation is interrupted and the label “XX” is displayed at the bottom of the screen during this test. The test may be terminated at any moment.

To execute the performance test:

1. Select the north-up presentation mode on the 12 nm range.
2. Enter own ship speed of 0 knots.
3. Press the [PLOT MENU] key followed by the [0] key to show the ARPA 2 menu.
4. Press the [9] key to select ARPA TRACK TEST.
5. Press the [ENTER] key.

An alert XX flickers during the test. It takes approximately three minutes for all vectors to be displayed. The test does not need echo signals, gyro nor speed log input. Seven targets having different speeds and courses, as shown in the table below, are simulated automatically.

6. The test continues for five minutes and then repeats.

To terminate the track test, press the [STBY/TX] key. The STBY display appears.

Select any target with the cursor and check that the selected target shows the course and speed as in the table. CPA and TCPA shown below are initial values which change with time.

Target	Course	Speed (kt)	CPA (nm)	TCPA (min)
Target A	90.0° T	10.0	1.0	10.4
Target B	0.0° T	0.0	4.0	—
Target C	180.0° T	10.0	1.7	28.2
Target D	216.5° T	23.8	0.9	15.0
Target E	273.5° T	14.2	6.0	22.5
Target F	180.0° T	20.0	0.0	30.0
Target G	24.6° T	15.6	4.0	43.6

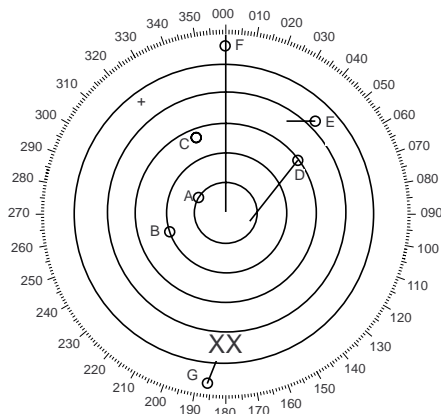


Figure 5-16 ARPA performance test values

Note: Target numbers are subject to change. If test results show any deviation from the above, consult with your service representative.

5.18 Criteria for Selecting Targets for Tracking

The FURUNO ARPA video processor detects targets in midst of noise and discriminates radar echoes on the basis of their size. Target whose echo measurements are greater than those of the largest ship in range or tangential extent are usually land and are displayed only as normal radar video. All smaller ship-sized echoes which are less than this dimension are further analyzed and regarded as ships and displayed as small circles superimposed over the video echo.

When a target is first displayed, it is shown as having zero true speed but develops a course vector as more information is collected. In accordance with the International Marine Organization Automatic Radar Plotting Aid (IMO ARPA) requirements, an indication of the motion trend should be available within 20 scans of antenna and full vector accuracy within 60 scans. The FURUNO ARPAs comply with these requirements.

5.18.1 Acquisition and tracking

A target which is hit by five consecutive radar pulses is detected as a radar echo. Manual acquisition is done by designating a detected echo with the trackball. Automatic acquisition is done in the acquisition areas when a target is detected 5-7 times continuously depending upon the congestion. Tracking is achieved when the target is clearly distinguishable on the display for 5 out of 10 consecutive scans whether acquired automatically or manually. Required tracking facilities are available within 0.1-32 nm on range scales including 3, 6, 12 nm. Full plotting information is available within one scan when the range scale has been changed.

Targets not detected in five consecutive scans become "lost targets."

5.18.2 Quantization

The entire picture is converted to a digital form called "Quantified Video." A sweep range is divided into small segments and each range element is "1" if there is radar echo return above a threshold level, or "0" if there is no return.

The digital radar signal is then analyzed by a ship-sized echo discriminator. As the antenna scans, if there are five consecutive radar pulses with 1's indicating an echo presence at the exact same range, a target "start" is initiated. Since receiver noise is random, it is not three bang correlated, and it is filtered out and not classified as an echo.

The same is true of radar interference. Electronic circuits track both the closet and most distant edges of the echo. At the end of the scanning of the echo, the discriminator indicates the measured maximum range extent and total angular extent subtended by the echo. If the echo is larger than a ship-sized echo in range extent and/or angular width, adjusted as a function of range, it is declared to be a coastline and the closet edge is put into memory as a map of the area. This land outline is used to inhibit further acquisition and tracking of ship sized echoes beyond the closest coast outline. 5 consecutive scans of coastal outline are retained in memory to allow for signal variation. All smaller echoes are declared to be ship sized and the middle of the leading edge is used to provide precise range and bearing coordinates of each echo on every scan. This range/bearing data is matched to previous data and analyzed from scan-to-scan for consistency. When it is

determined to be as consistent as a real target, automatic acquisition occurs and tracking is initiated. Continued tracking and subsequent calculation develop the relative course and speed of the target.

The true course and speed of own ship are computed from own ship's gyro and speed inputs, and the resulting course and speed of each tracked target are easily computed by vector summing of the relative motion with own ship's course and speed. The resulting true or relative vector is displayed for each of the tracked targets. This process is updated continually for each target on every scan of the radar.

5.18.3 Automatic acquisition areas and suppression lines

Performance of auto-acquisition is enhanced by controlling the limit lines (suppression line) in the former series of FURUNO ARPAs. In this new series of ARPAs, the automatic acquisition rings are used instead of the limit lines.

Auto acquisition rings work as suppression lines when viewed from the opposite direction. They should be placed clear of a landmass or shoreline. The acquisition areas may be a full 360 degree circle or sector of any angles are gyro stabilize.

5.18.4 Qualitative description of tracking error

The FURUNO ARPA accuracy complies with or exceed IMO standards.

Own ship maneuvers

For slow turns there is no effect. For very high turning rates (greater than 150°/minute, depending on gyro), there is some influence on all tracked targets which last for a minute or two and then all tracked targets revert to full accuracy.

Other ship maneuvers

Target ship courses lag 15 to 30 seconds at high relative speed, or three to six seconds at low (near 0) relative speed. It is less accurate during a turn due to lag, but accuracy recovers quickly.

5.19 Factors Affecting ARPA Functions

Sea returns

If the radar anti-clutter control is adjusted properly, there is no serious effect because distant wave clutter, not eliminated by this control, is filtered out by more than one bang correlation and scan-to-scan matching of data.

Rain and snow

Clutter can be acquired and tracked as targets. Adjust the [A/C RAIN] control. If it is heavy rain, switch to S-band if provided, or switch on the interference rejector on the radar. If heavy clutter still exists, switch to manual acquisition. Accuracy can be affected.

Low clouds

Usually no effect. If necessary, adjust the [A/C RAIN] control.

Non-synchronous emissions

No effect.

Low gain

Insufficient or low radar receiver gain will result in some targets not being acquired at long distance. The ARPA display will be missing on one or more targets that could only be visible if the radar sensitivity control (GAIN control) were increased.

The setting of the correct radar receiver gain is not critical but the target should be on the radar PPI and be clearly visible and well defined.

Manual acquisition is done if a target is positively displayed more than once. Automatic acquisition is done when the target is detected 5-7 times continuously. Tracking is achieved when the target is detected five times (not necessarily continuously) out of 10 scans. If not detected six times out of 10 scans, the target will become a "lost target." The ARPA will acquire a radar echo that is present once in every six antenna scans and continue tracking if one in 10.

Second trace echoes

When the radar beam is super refracted, strong echoes may be received at such long ranges that they appear on a different timebase sweep than the transmitted pulse. This gives an incorrect range indication. Second and third trace echoes can be tracked if they are consistent enough to meet acquisition and tracking criteria but target course and speed data will be in error.

Blind and shadow sectors

Radar shadow or blind areas caused by obstructions aboard ship, for example, funnels and masts, in the path of the radar beam can result in reduction of radar beam intensity in that particular direction. This may eliminate the detection of some targets. The ARPA system will lose track of targets shortly after they are lost on the radar picture and if they remain in a blind zone. These targets will however be acquired and tracked when they pass out of the blind zone and again present normal radar echo. The angular width and bearing of any shadow sector should be determined for their influence on the radar. In certain cases false echoes in the shadow sector cause the ARPA system to acquire, track, and vector them. Shadow sectors should be avoided.

Indirect echoes

A target at close range is usually picked up directly, but it can also be received as reflection from a large, flat surface. This will result in the radar presenting two or more echoes on the display, each at a different range. The ARPA can acquire and track the false echo if it is detected by five consecutive scans. Reduction in radar gain can eliminate the multiple echoing but care should be taken as range detection also will be reduced.

Radar interference

If interference is extreme due to another radar operating at close range, spiral “dotting” and/or false targets may appear momentarily. The interference rejector can clear the display. To receive radar beacon or SART signals, turn off the radar interference rejection and echo average which operate on the correlation technique.

6. VIDEO PLOTTER RP-26 (Option for NM-type radar)

6.1 General

The Video Plotter RP-26 is an optional circuit board which is accommodated in the display unit of the radar. It permits use of two memory cards, a memory card (RAM) for storing the operator created radar maps, and the other is a chart card (ROM) for storing FURUNO made digital charts.

The memory card enables the operator to create radar maps more precisely than the standard supplied radar map card (150 points per map). Navigation lines can have as many segments and vertexes as required (maximum 25 lines and 30 vertexes per line). The card permanently retains the data you have entered from the radar display or by Lat/Long positions. Own ship and other ship tracks may be stored at a selected interval. To display navigation lines, RTE and WPL sentences are necessary. WPL ID sentence received in figure only. The data can be copied for other ships of the same shipping company.

Charts are superimposed on the radar picture without disturbing the radar observation. The chart area is dependent on the radar range in use.

Note: RP-26 is not available with the statute mile (SM)-type radar.

The drive for the ROM card can also drive the Electronic Reference Chart (ERC). The ERC is a digital chart published by the Japanese Hydrographic Bureau. Note it is not an ENC used for ECDIS.

6.2 The Video Plotter Display

Press the [RADAR MENU] key. Press the [9] key once or twice for “Chart plus Radar” or “Radar”.

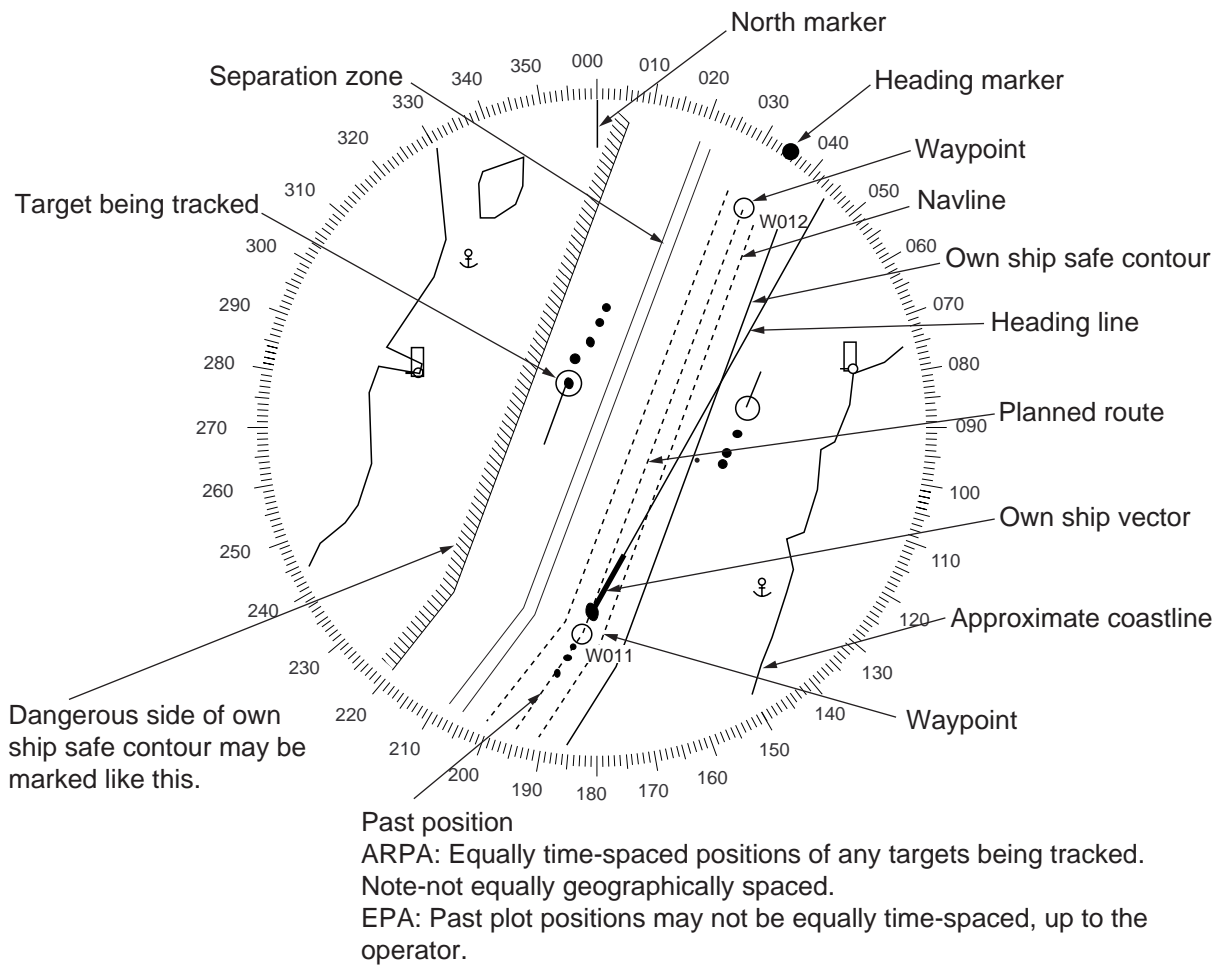


Figure 6-1 Video plotter display

6.3 Display Modes

The RP-26 has two motion displays and three presentation modes.

Motion Displays: Relative Motion (RM),
 True Motion (TM)

Presentation Modes: North-up (NU)
 Course-up (CU)
 Head-up (HU)

Note: HU is not available on the RADAR/VIDEO PLOTTER display.

When own ship mark is at a distance from the screen center $\frac{3}{4}$ the range in use it is automatically reset to a point of 50% radius.

6.3.1 Precaution for chart/memory cards

Both the chart card and memory card are susceptible to sunlight and magnetic material.

- Keep them away from direct sunlight, heat sources and active gases.
- Keep cards away from water and chemicals.
- Keep the connector free of foreign material.
- Do not drop the cards.

6.3.2 How to display charts

To display a chart;

1. Insert the chart RAM card in one of two card slots.

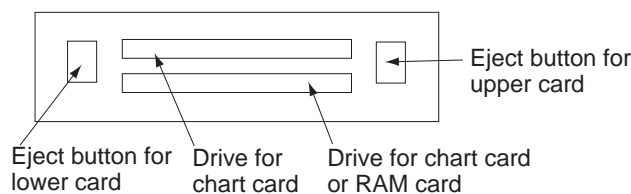


Figure 6-2 Card drives

2. Select the radar range with the RANGE keys. The chart appears. The following ranges are available: 0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 24, 48, 96 nm.

6.3.3 Chart position correction

There may be a case where the radar picture does not match the chart overlay. This is due to an error in the position fixing system (GPS, Loran, etc.) or the different coordinates between the position fixing system and the radar. You can align chart with the radar image as follows:

1. Press the [CHART ALIGN] key. CHART ALIGN appears at the top of the screen.
2. Rotate the trackball to shift the chart (or own ship) to the correct position.
3. Press the [CHART ALIGN] key again.

Canceling chart correction

1. Press [NAV MENU], [0] to display the VIDEO PLOTTER 2 menu.
2. Press the [2] key to select NAV DATA POSN.
3. Press the [ENTER] key to cancel correction. Navaid position data is restored.

The cursor position can be corrected on the "ALIGN DATA" submenu in the VIDEO PLOTTER 2 menu.

6.4 Set-up of Video Plotter Display

6.4.1 Hiding/Showing graphics

1. Press [NAV MENU], [8] to display the PLOT DISP SELECT menu. Current selections appear in reverse video. Blank items have been turned off on the VIDEO PLOTTER INITIAL SETTING menu. For further details see paragraph 6.10 Initial Settings.

[PLOT DISP SELECT]	
1 [VIDEO PLOTTER 1]	
2 DANGER HIGHLIGHT	OFF/ON
3 COAST LINE	OFF/ON
4 LAND DENSITY	OFF/ON
5 PLACE NAME	OFF/ON
6 MARK	OFF/ON
7 OWN SHIP PLOT	OFF/SEPARATE/CONTINUE
8 TARGET PLOT	OFF/ON
9 CONTOUR LINE	OFF/ON
0 GRID	OFF/ON

Figure 6-3 PLOT DISP SELECT menu

2. Press appropriate numeral key twice to hide or show graphic.
3. Press the [ENTER] key.
4. Repeat steps 2 and 3 to hide or show other graphics.
5. Press the [NAV MENU] key to close the menu.

Note: LAND DENSITY fills (ON) or hollows (OFF) land on an electronic chart. Land will be hollow when wrong card or wrong scale is used regardless of LAND DENSITY setting.

6.4.2 Hiding/Showing nav data

You may select what navigation data to display on the video plotter display as follows:

1. Press the [NAV MENU] key to display the NAV INFORMATION 1 menu.

[NAV INFORMATION 1]	
1 [VIDEO PLOTTER 1]	
2 SELECT NAVAID	GPS+LC/DEAD RECKONING
3 OWN SHIP POSN	OFF/ L/L
4 POSN	xx°xx.xxx N/S xx°xx.xxx E/S
5 +CURSOR DATA	OFF/ L/L
6 WPT DATA	OFF/REL/TRUE
7 [NAV LINE]	
8 [WAYPOINT]	
9 WIND DATA	OFF/ON
0 [NAV INFORMATION 2]	

Figure 6-4 NAV INFORMATION 1 menu

2. Press appropriate numeral key to select both item and option. Press the [ENTER] key to register selection.

For "OWN SHIP POSN" (manual input of position), do the following;

- 1) Press the [4] key.
 - 2) Enter latitude in seven digits.
 - 3) Press the [ENTER] key. (If necessary to change to coordinate, press [4], [ENTER]).
 - 4) Enter longitude in eight digits.
 - 5) Press the [ENTER] key. (If necessary to change to coordinate, press [5], [ENTER]).
3. Press the [0] key to go to next page, the NAV INFORMATION 2 menu. Select options as you did on the previous menu. To return to the previous menu, press [1].

[NAV INFORMATION 2]	
1 [NAV INFORMATION 1]	
2 WIND GRAPH	OFF/ON
3 WIND UNIT	m/s/KT
4 CURRENT DATA	OFF/ON
5 CURRENT GRAPH	OFF/ON
6 DEPTH DATA	OFF/ON
7 DEPTH GRAPH	OFF/ON
8 [DEPTH SCALE	10/20/50/100/200/500
9 DEPTH UNIT	m/ft
0 [NAV INFORMATION 3]	

Figure 6-5 NAV INFORMATION 2 menu

4. Press [0] to display the NAV INFORMATION 3 menu.

[NAV INFORMATION 3]	
1 [NAV INFORMATION 2]	
2 WATER TEMPERATURE	OFF/ON
3 DATE	OFF/GMT/LOCAL ±xx.xH
4	
5	
6	
7	

4, 5, 6: When the radar is a component of an INS.

Figure 6-6 NAV INFORMATION 3 menu

5. To set time indication, press the [3] key several times to select OFF, UTC or LOCAL and press the [ENTER] key. To use local time, select LOCAL and enter time difference between local time and GMT.

6. Press the [NAV MENU] key to close the menu.

6.5 Track

This section provides the information necessary for setting the track display conditions of both own ship and other vessels.

6.5.1 Stopping plotting of own ship's track

1. Press [NAV MENU], [5] in order to show the OWN SHIP, TARGET PLOT menu.

[OWN SHIP, TARGET PLOT]	
1 [VIDEO PLOTTER 1]	
2 RECORD OWN SHIP PLOT	OFF/ON
3 OWN SHIP PLOT INTVL	10/30SEC/1/2/3/6MIN
4 OWN SHIP PLOT COLOR	RED/MAGENTA/YEL GRN/CYAN/BLU
5 RECORD TARGET PLOT	OFF/ON
6 TARGET PLOT INTVL	10/30SEC/1/2/3/6MIN
7	
8 SMOOTHING	OFF/1/2/3/6/7/8/9

Figure 6-7 OWN SHIP, TARGET PLOT menu

2. Press the [2] key twice to select OFF.

3. Press the [ENTER] key.

Own ship's track is neither plotted nor saved to the memory. To resume plotting, select ON at step 2 and press the [ENTER] key.

6.5.2 Stopping plotting of other ship's track

1. Press [NAV MENU], [5] in order.

2. Press the [5] key twice to select OFF.

3. Press the [ENTER] key.

Other ship's tracks are neither plotted nor saved to the memory. To resume plotting, select ON at step 2 and press the [ENTER] key.

6.5.3 Track plotting interval

The memory stores ship's position in latitude and longitude at a sampling rate set on the OWN SHIP, TARGET PLOT menu. The position data so stored is used to display past own ship's track on the screen.

The plotting interval affects track reconstruction. A shorter interval provides more accurate reconstruction of track, however storage time of the track is reduced.

1. Press [NAV MENU], [5] in order.
2. To change own ship's track plotting interval, press the [3] key several times to display desired plotting interval in reverse video.
3. Press the [ENTER] key.
4. To change other ships' track plotting interval, press [6] (several times) to select plotting interval.
5. Press the [ENTER] key.

Plot interval and track storage time

Memory capacity for own ship's track and other ship's track is 6,000 points each. For other ship's track the 6,000 points is divided equally among ten targets, so there are 600 points per target. When a track memory becomes full the oldest track is deleted to make room for a new entry.

If own ship track is stored every minute, 6,000 points of memory represents 100 hours of time span; 3 minute intervals covers 16 days and 16 hours. The time span covering one other ship is 1/10 of own ship as a total of 10 other ships equal to one OS.

6.5.4 Memory used

Press [NAV MENU], [0] to display the following:

MEMORY IN USE	
OWN SHIP	= 3456
TARGET	= 1124
MARK	= 0021

Figure 6-8 MEMORY IN USE display

6.5.5 Track smoothing

Even when the vessel is sailing in a straight line the track shown on the display may not look straight. This is due to signal variation of the external navaid. You can compensate for this irregularity with smoothing.

A smoothing factor between 1 and 9 is available. OFF provides no smoothing. In most cases a smoothing setting between 1 and 5 is satisfactory.

1. Press [NAV MENU], [5] in order.

2. Press the [8] key to select smoothing factor.
3. Press the [ENTER] key.

6.5.6 Erasing track

In the busy traffic, the screen may become cluttered. You can remove all or a percentage of own ship track from the memory to clear the display. Track of other ships can also be cleared.

1. Press the [NAV MENU] key.
2. Press the [9] key to display the PLOTTER ERASE menu.

[PLOTTER ERASE]	
1 [VIDEO PLOTTER 1]	
2 OWN SHIP PLOT	30%/50%/80%/ALL
3 TARGET PLOT	30%/50%/80%/ALL
4 MARK	OFF/ALL
5 WPT	OFF/ALL
6 NAV LINE	OFF/ALL

Figure 6-9 PLOTTER ERASE menu

3. Press the [2] key several times to select OWN SHIP PLOT and the amount of track points you wish to erase.
4. Press the [ENTER] key.
5. To erase other ship's track, press the [3] key to select TARGET PLOT and the amount of track to erase.

Note: Track cannot be restored once erased.

6. Press the [ENTER] key.

6.6 Marks, Lines

6.6.1 Entering marks

You can inscribe marks on the display to note important points, for example, a buoy or a wreck. The mark capacity is 6,000 points.

Selecting method of entry

Marks can be entered by cursor position, L/L position or own ship's position.

1. Press [NAV MENU], [0], [6] in order.

2. Press the [6] key to select method of mark entry; CURSOR, L/L or OWN SHIP POSN.
3. Press the [ENTER] key.
4. Press the [NAV MENU] key.

Entering marks/lines at CURSOR or OWN SHIP POSITION

1. Select CURSOR or OWN SHIP POSITION following "Selecting method of entry" on the previous page. Press the [MARK] key to display the ENTER MARK menu.

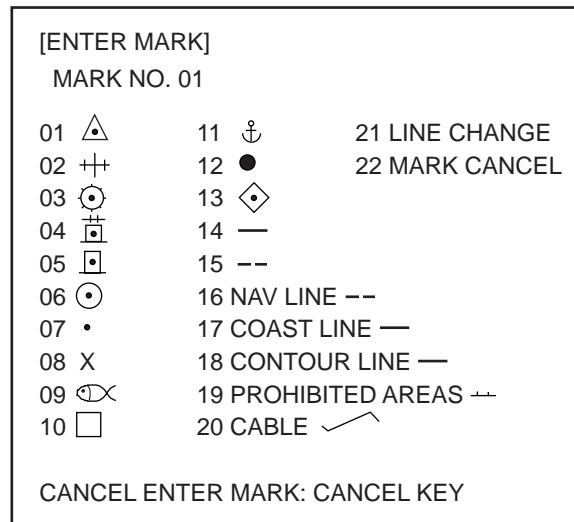


Figure 6-10 ENTER MARK menu (cursor, own ship)

2. Enter mark number to select desired mark, followed by the [ENTER] key. On the OWN SHIP POSN mode, selected mark is entered at own ship's position.
3. On the CURSOR mode, operate the trackball to place the cursor on the position desired for the mark.
4. Press the [ENTER] key.
5. To escape the mark entry mode, press the [CANCEL] key.

Entering marks by latitude and longitude

1. Select L/L POSN following "Selecting method of entry" on the previous page. Press the [MARK] key.

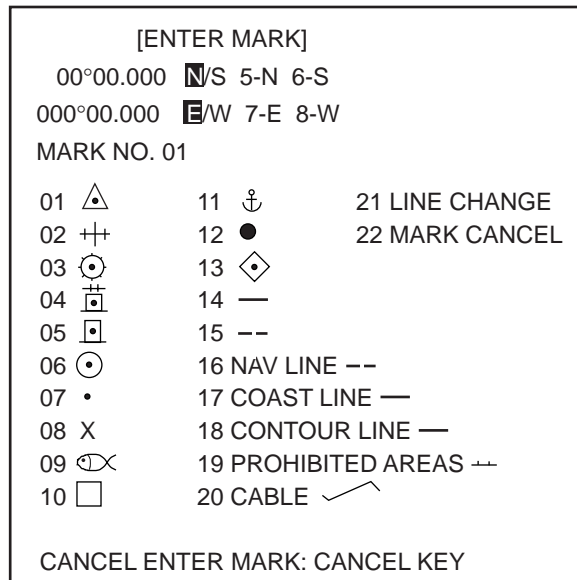


Figure 6-11 ENTER MARK menu (L/L position)

2. Enter latitude by numeric keys followed by the [ENTER] key.
3. Enter longitude followed by the [ENTER] key.
4. Enter mark number to select desired mark followed by the [ENTER] key.
5. To escape the mark entry mode, press the [CANCEL] key.

6.6.2 Erasing marks/lines

When the mark memory becomes full no marks can entered unless you erase unnecessary marks.

Erasing individual marks

1. Operate the trackball to place the cursor on the mark you want to erase.
2. Press the [CANCEL] key.

Erasing all marks and all lines

1. Press [NAV MENU], [9] in order.
2. Press the [4] key twice to select MARK OFF followed by [ENTER].

Erasing lines

1. Operate the trackball to place the cursor on the starting or end point of the line you want to erase. Selecting the intersection of two lines erases both lines.
2. Press the [CANCEL] key.

6.7 Waypoints

6.7.1 Entering waypoints

Maximum 100 waypoints, numbered 00 - 99, can be entered by the trackball, by latitude and longitude, or at own ship position.

1. Press [NAV MENU], [4] and [2] in order. The following display appears.

	[ENTER WPT]
1 [ENTER WPT, NAV LINE]	
2 ENTER WPT	CURSOR/L/L /OWN SHIP POSN
3 WPT NO.	xx
	xx°xx.xxxN/S
	xxx°xx.xxxE/W

Figure 6-12 ENTER WPT menu

2. Press the [2] key several times to select CURSOR, L/L or OWN SHIP POSN whichever is preferred, followed by the [ENTER] key.
3. Press the [3] key twice.
4. Do one of the following depending on option selected at step 2.
CURSOR: Operate the trackball to place the cursor at a location desired for waypoint.
L/L: POSN: Enter latitude followed by the [ENTER] key; enter longitude followed by the [ENTER] key.
OWN SHIP POSN: No action at his stage.
5. Enter waypoint number in two digits and press the [ENTER] key.
6. To enter another waypoint, repeat steps 4 and 5.

6.7.2 The waypoint list

To display all registered waypoints, press [NAV MENU], [4] and [3]. Waypoint 00 through 09 are shown. Empty waypoints have all asterisks. To go to next page, press [0]. Pressing [1] returns to previous page.

```

[WPT LIST]
1 [ENTER WPT, NAVLINE]
WPT
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx° xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
xx xx°xx.xxxN
xxx°xx.xxxE
9 ERASE WPTxx
0 [WPT LIST 2]

```

Figure 6-13 WPT LIST

6.7.3 Displaying a waypoint

A single waypoint may be shown on the display.

1. Press [NAV MENU], [1] and [8] to choose the WAYPOINT menu.

```

[WAYPOINT]
1 [NAV INFORMATION 1]
2 WPT MARK OFF/ON
3 WPT WPT xx
xxx°xx.xxxN/S
xxx°xx.xxxE/W
4 WPT LINE OFF/ON
5 WPT NO. OFF/ON
6 WPT DISPLAY NO. 1/ALL
7 WPT DATA VIDEO PLOTTER/NAVAID
8 ARRIVAL ALARM OFF/ON
x.xxNM
xx.xMIN

```

Figure 6-14 WAYPOINT menu

3. Press the [2] key twice to select WPT ON and then press the [ENTER] key.
4. Press the [3] key.
5. Enter waypoint number in two digits and press the [ENTER] key. The latitude and longitude position of the waypoint appear on the menu and the waypoint is displayed on the screen.

To hide the waypoint, select OFF in step 3 and press the [ENTER] key.

Showing external waypoint

You can show the external waypoint from a navaid as follows:

1. Press [NAV MENU], [8] to open WAYPOINT menu.
2. Press the [7] key to select WPT DATA.
3. If NAVAID is not in reverse video, press the [7] key again.
4. Press the [2] key.
5. If ON is not in reverse video, press the [2] key again.
6. Press the [ENTER] key.

6.7.4 Deleting waypoints

Waypoints can be deleted individually, or collectively through the waypoint list.

Deleting individual waypoints

1. Press [NAV MENU], [4], [3] to display the WPT LIST 1 menu.
2. Press the [0] key to display the page which contains the waypoint you want to delete.
3. Press the [9] key and enter waypoint number in two digits.
4. Press the [ENTER] key.

Deleting all waypoints

1. Press [NAV MENU], [9] to display the PLOTTER ERASE menu.
2. Press the [5] key twice followed by the [ENTER] key.

Note: Waypoints used for navigation lines cannot be deleted except by editing or deleting the navigation line.

6.8 Navigation Lines

30 navigation lines may be entered, and each line may have up to 30 waypoints.

6.8.1 Entering new navigation line

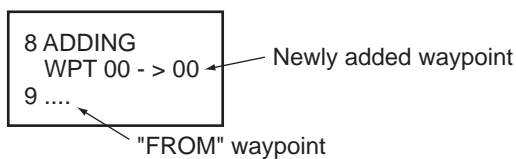
1. Press [NAV MENU], [4] and [5].
2. Press the [2] key.
3. Enter navigation line number in two digits and press the [ENTER] key.
4. Enter waypoint number in two digits and press the [ENTER] key.

5. Repeat step 4 to continue entering waypoint numbers.
6. Press the [NAV MENU] key to register navigation line.

6.8.2 Adding waypoint to navigation lines

To add waypoints to a navigation line;

1. Press [NAV MENU], [4] and [5].
2. Press the [2] key. Enter navigation line number and press the [ENTER] key.
3. Press the [8] key.
4. Enter "FROM" waypoint number to add and press the [ENTER] key.
5. Enter waypoint number to add.



6. Press the [NAV MENU] key to close the menu.

6.8.3 Removing waypoints from navigation lines

1. Press [NAV MENU], [4] and [5].
2. Press the [2] key, enter navigation line number, and press the [ENTER] key.
3. Press the [9] key, enter waypoint number, and press the [ENTER] key.

6.8.4 Displaying navigation line list

Press [NAV MENU], [4] and [6] to display the list.

6.8.5 Deleting individual navigation lines

1. Press [NAV MENU], [4], [6] and [9].
2. Enter navigation line number you want to delete. (The line in use is not deleted.)
3. Press the [ENTER] key.

6.8.6 Deleting all navigation lines

1. Press [NAV MENU], [9].
2. Press the [6] key twice to select ALL.
3. Press the [ENTER] key.

6.8.7 Displaying navigation lines

Navigation lines may be set up as follows:

1. Press [NAV MENU], [3].
2. Press the [2] key to select NAV LINE.
3. If ON is not in reverse video, press the [2] key again.
4. Press the [ENTER] key.

[NAVLINE]	
1 [NAV INFORMATION 1]	
2 NAV LINE	OFF/ON
3 NAV LINE NO.	xx/xx/xx/xx/xx
4 NAV WIDTH	OFF/ON x.xxNM
5 WPT NO.	OFF/ON
6 WPT	xx (x)→●→(xx)→ (xx)→(xx)
7 NAVLINE DATA	VIDEO PLOTTER/NAVAID
8 ARRIVAL ALARM	OFF/ON x.xxNM xx.xMIN
9 TURNING LINE	OFF/ON/REVISED

Figure 6-15 NAVLINE menu

5. Press the [7] key to choose NAV LINE DATA; VIDEO PLOTTER for internally generated navigation width data or NAV AID for external navaid generated data.
6. Press the [ENTER] key.
7. Press the [4] key to select NAV WIDTH.
8. Enter line width (in nautical miles) and then press the [ENTER] key.
9. To display waypoint number of the route on the display, press the [5] key to select ON and then press the [ENTER] key.
10. To skip a waypoint, press the [6] key, enter next waypoint to head to, and then press the [ENTER] key.
11. Press the [ENTER] key.
12. If you want to be alerted when own ship nears a waypoint, press the [8] key to select ON, press the [ENTER] key, enter arrival alarm range and press the [ENTER] key.
13. Press the [9] key to set turning line and then press the [ENTER] key.
 - OFF:** Turns turning lines off.
 - ON:** Use this setting when vessel is not to correct cross track error to return to course set, after arriving at turning line location.
 - REVISED:** Use this setting when vessel is to return to course set after correcting cross track error, after arriving at turning line location.
14. Press the [3] key.
15. Enter navigation line number and then press the [ENTER] key.

6.9 Recording, Replaying Data

6.9.1 Formatting memory cards

Before you can use a memory card (RAM card) with the RP-26, the card must be formatted. Formatting prepares the recording surface of the card for use with the system. Insert a new memory card in the right side card drive and follow the procedure below to format it.

1. Press [NAV MENU], [6] to choose CARD.
2. If RECORD is not in reverse video, press the [6] key again.
3. Press the [ENTER] key.

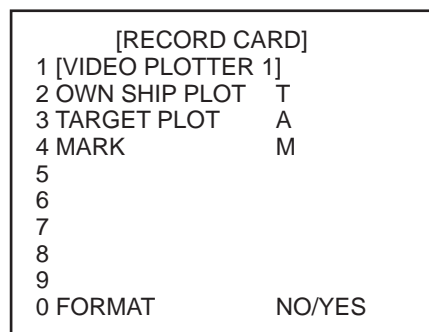


Figure 6-16 RECORD CARD menu

4. Press the [0] key twice to select YES.
5. Press the [ENTER] key.

6.9.2 Recording data

When the track memory becomes full, the oldest track is erased to make room for the latest. Further, when the mark memory becomes full you cannot enter another mark unless you erase a mark. Thus you should save important data to a memory card.

1. Insert a formatted RAM card into the card drive.
2. Press [NAV MENU] and [6] to choose CARD.
3. If RECORD is not in reverse video, press the [6] key again.
4. Press the [ENTER] key.
5. Select item to record with appropriate numeric key:
 - [2]: Own ship's track
 - [3]: Target track
 - [4]: Marks
 - [5]: Radar map
6. Enter file name. You may use ten figures.
7. Press the [ENTER] key.

6.9.3 Replaying data

1. Press [NAV MENU], [6].
2. If REPLAY is not in reverse video, press the [6] key again.
3. Press the [ENTER] key.

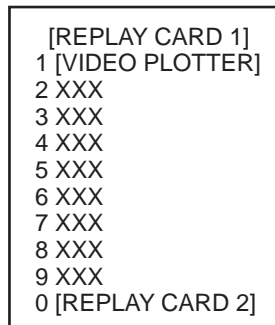


Figure 6-17 REPLAY CARD menu

4. Press numeral key to select file to replay. You can go to the next page by pressing the [0] key.
5. Press the [ENTER] key.

6.10 Initial Settings

An item on the PLOTTER DISP SELECT menu can be deleted through the VIDEO PLOTTER INITIAL SETTING menu.

1. Press the [NAV MENU] key.
2. Press the [0] key twice to display the VIDEO PLOTTER INITIAL SETTING menu.

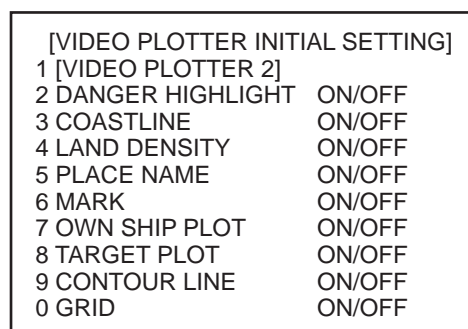
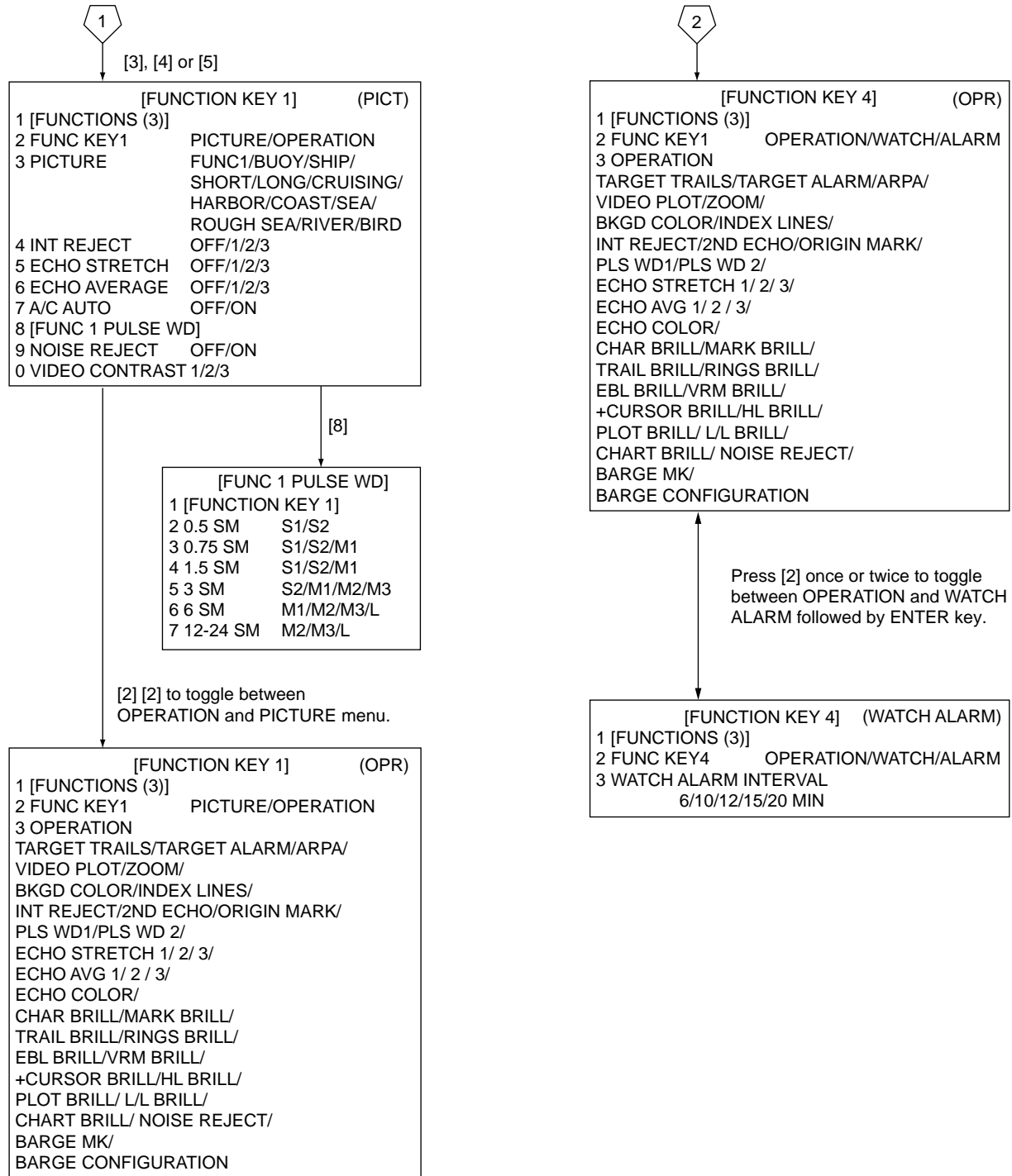


Figure 6-18 VIDEO PLOTTER INITIAL SETTING menu

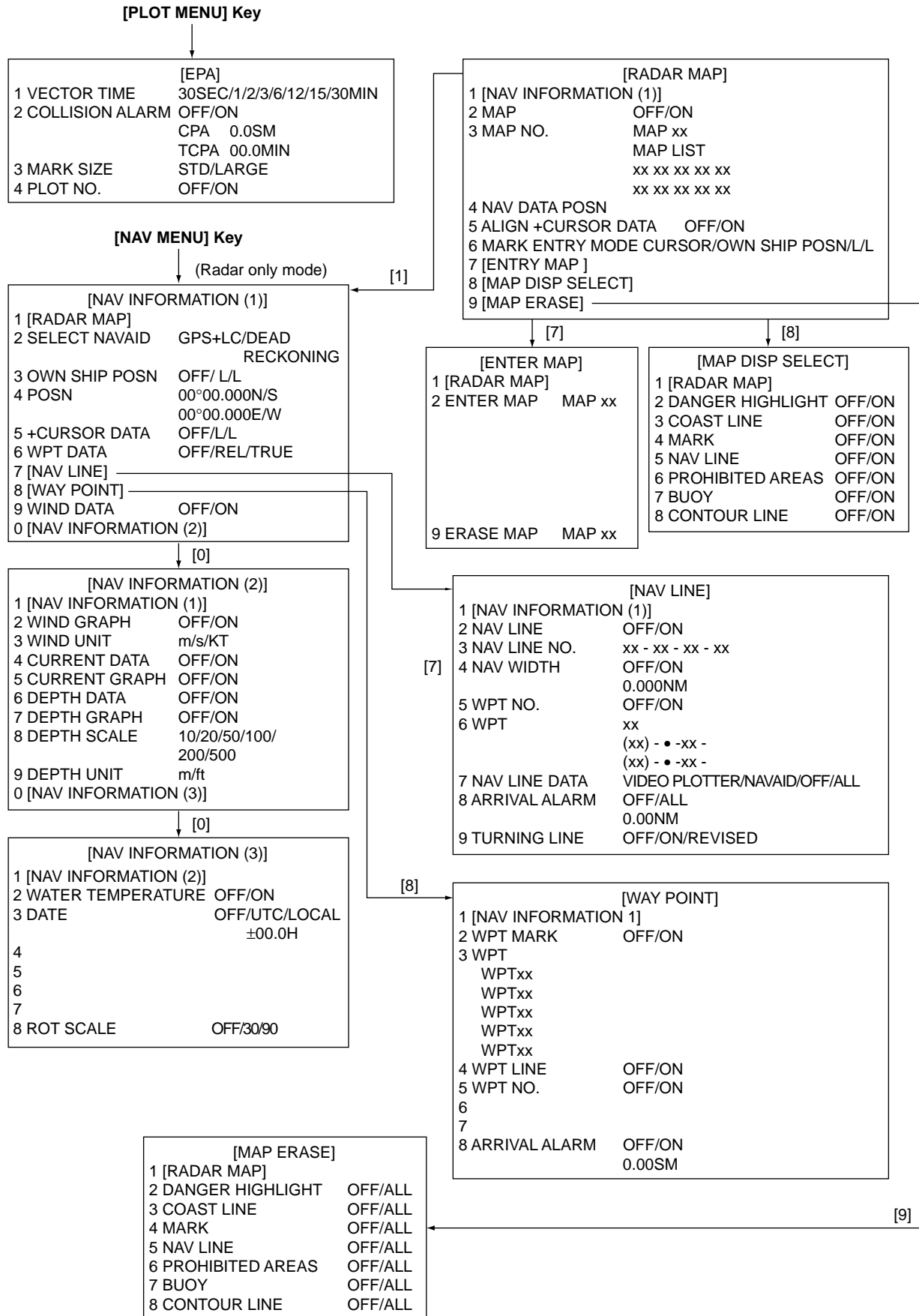
3. Press appropriate numeral key to turn item on or off.
4. Press the [ENTER] key.
5. Repeat 3 and 4.

Note: If Video Plotter fails to provide intended functions, turn ON the required functions on this menu.

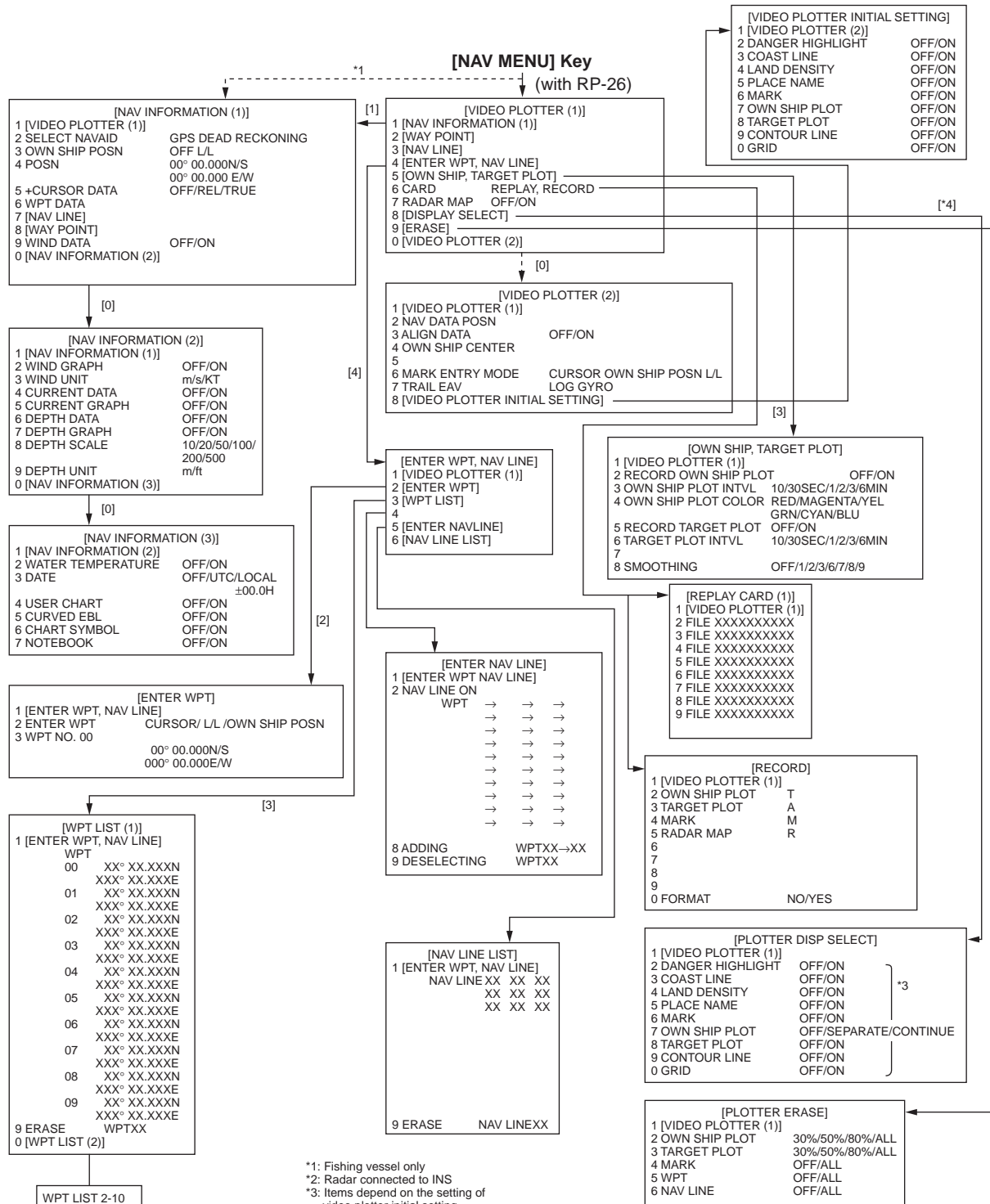
RADAR Menu (con't.)



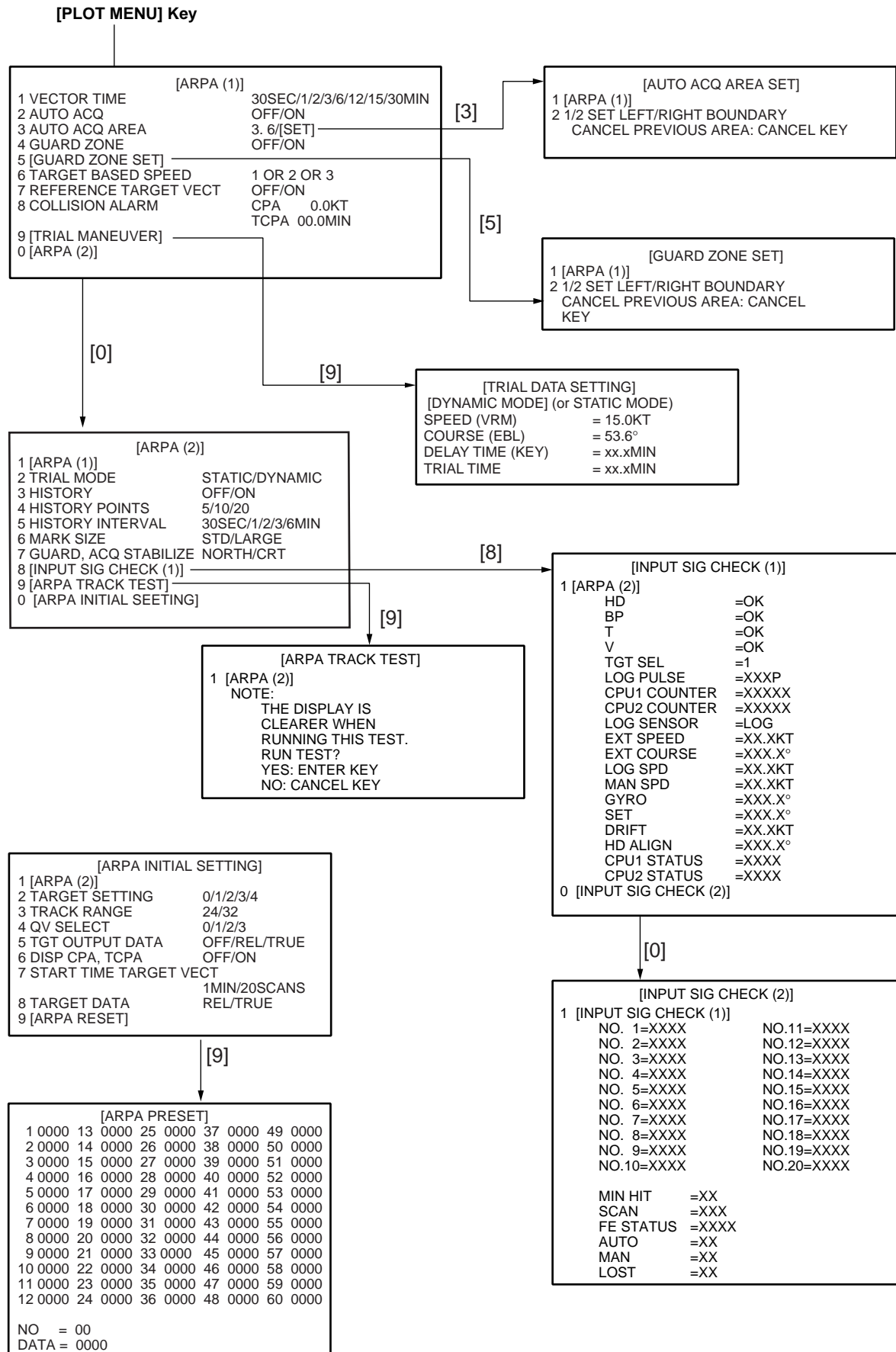
NAV Menu, PLOT Menu



NAV Menu w/RP-26



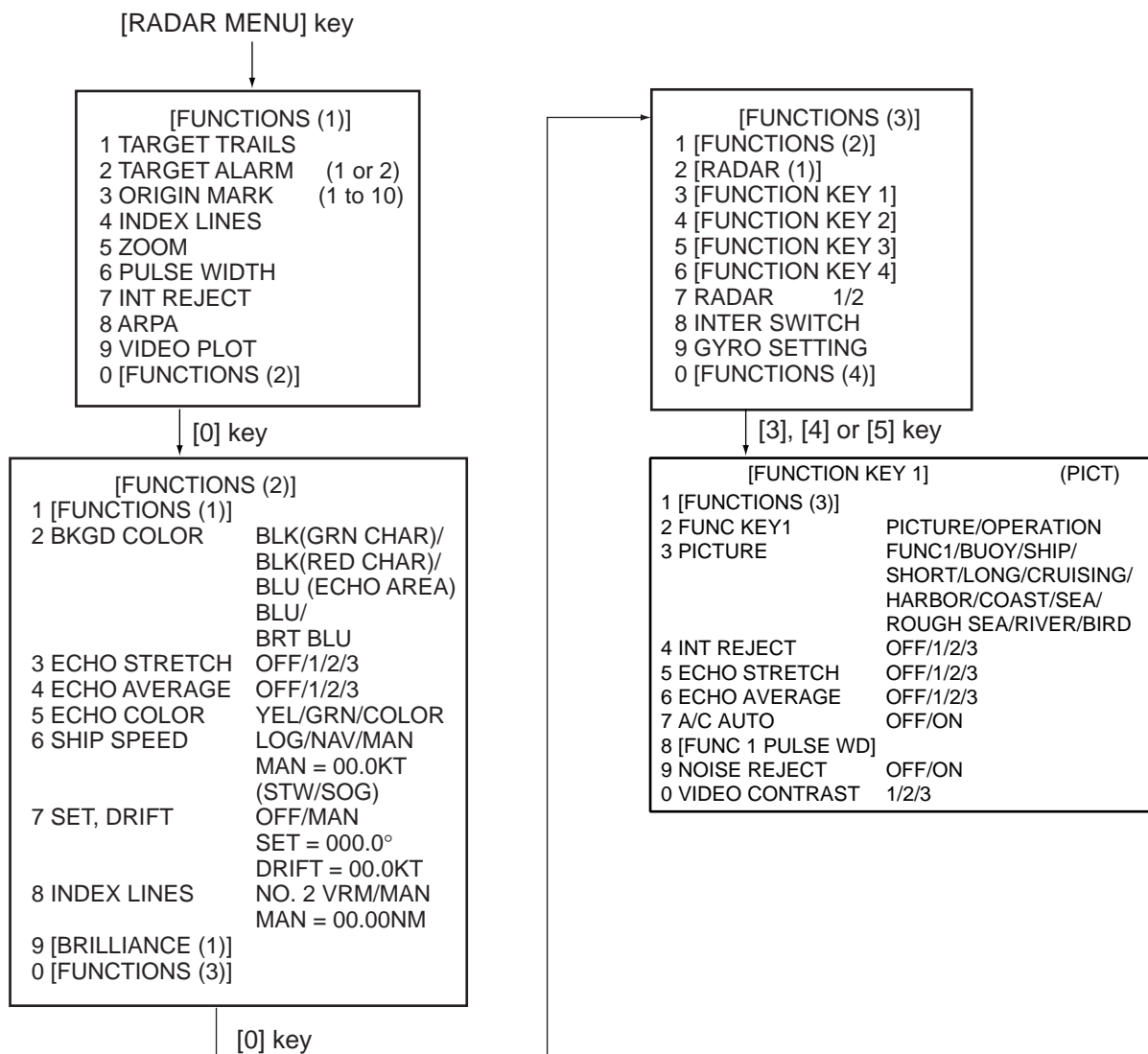
PLOT Menu w/ARP-26



Set-up for Fishing Vessel

This radar can be customized as a fishing vessel version, with an internal setting. The fishing vessel version requires an additional picture setup option "BIRD," which is assignable to one of the functions keys depending on a setting on FUNCTION KEY #1, #2 or #3 menu shown below.

When the option BIRD is menu-selected at the time of installation, the corresponding functions key is labeled "BIRD." Press the function key "BIRD" and the radar will be set up for optimum detection of sea birds between 6 and 16 nm. As is well known by professional fishermen, locating a flock of sea birds is useful for finding certain species of fish.



- (4) Range Scales and Ring Intervals
0.125, 0.25, 0.5, 0.75, 1, 1.5, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96
0.025, 0.05, 0.1, 0.25, 0.2, 0.25, 0.5, 0.5, 1, 1, 2, 2, 4, 8, 8, 12, 12
- (5) Range Accuracy 1% of range in use or 15 m whichever is the greater
- (6) Range Discrimination 25 m
- (7) Bearing Accuracy $\pm 1^\circ$
- (8) Bearing Discrimination 2.5°
- (9) Presentation modes Head-up, Head-up TB, North-up, Course-up, True Motion North-up
(Heading signal required except for HU)
- (10) Variable Range Markers Two Variable Range Markers, switched
- (11) Offcenter Sweep origin can be offcentered by 50% of range in use in any direction
(Not available for maximum range)
- (12) Guard Zone Anywhere above 0.7 SM
- (13) Electronic Plotting Aids (EPA)
10 Targets Providing Range, Bearing, Course, Speed, CPA and TCPA
Note: EPA disabled when ARPA function is used.
- (14) Parallel Index Lines 2, 3 and 6 lines (selectable on menu)

4. INTERFACE

- (1) Gyrocompass Built-in interface accepts synchronized signal (20-50 V, 50-400 Hz)
- (2) Speed Log Built-in interface accepts contact closure or DC signal at 200, 400 or 500 pulses/sm.
- (3) External Radar (option) Built-in interswitch for 2 channels provided

5. POWER SUPPLY

- (1) DC Source 24-32 VDC: 10.8-8.2 A, 260VA
- (2) AC Source 100-115/220-230 VAC: 4.1 A, 1 phase, 50-60 Hz, 410 VA

6. ENVIRONMENTAL CONDITION

- (1) Ambient Temperature (Complies with IEC60945)
Display Unit: -15°C to $+40^\circ\text{C}$
Antenna Unit: -25°C to $+70^\circ\text{C}$
- (2) Relative Humidity 95% at 40°C
- (3) Water proofing Display Unit (Panel): IPX2
Antenna Unit: IPX6
- (4) Vibration $\pm 1 \text{ mm} \pm 10\%$, 2(5) to 13.2 Hz,
Maximum acceleration 7 m/s^2 , 13.2 to 100 Hz

7. COATING COLOR

- (1) Display Unit Panel: N3.0 dark gray, Cover: 2.5GY5/1.5
(2) Antenna Unit N9.5 white

8. COMPASS SAFE DISTANCE

	Standard	Steering
Display Unit	1.40 m	1.05 m
Antenna Unit	2.15 m	1.60 m

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